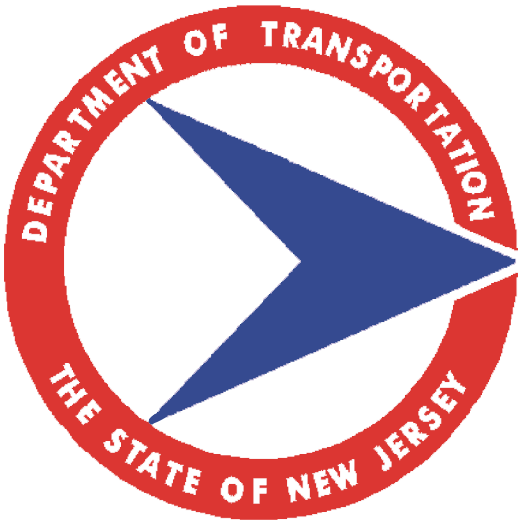
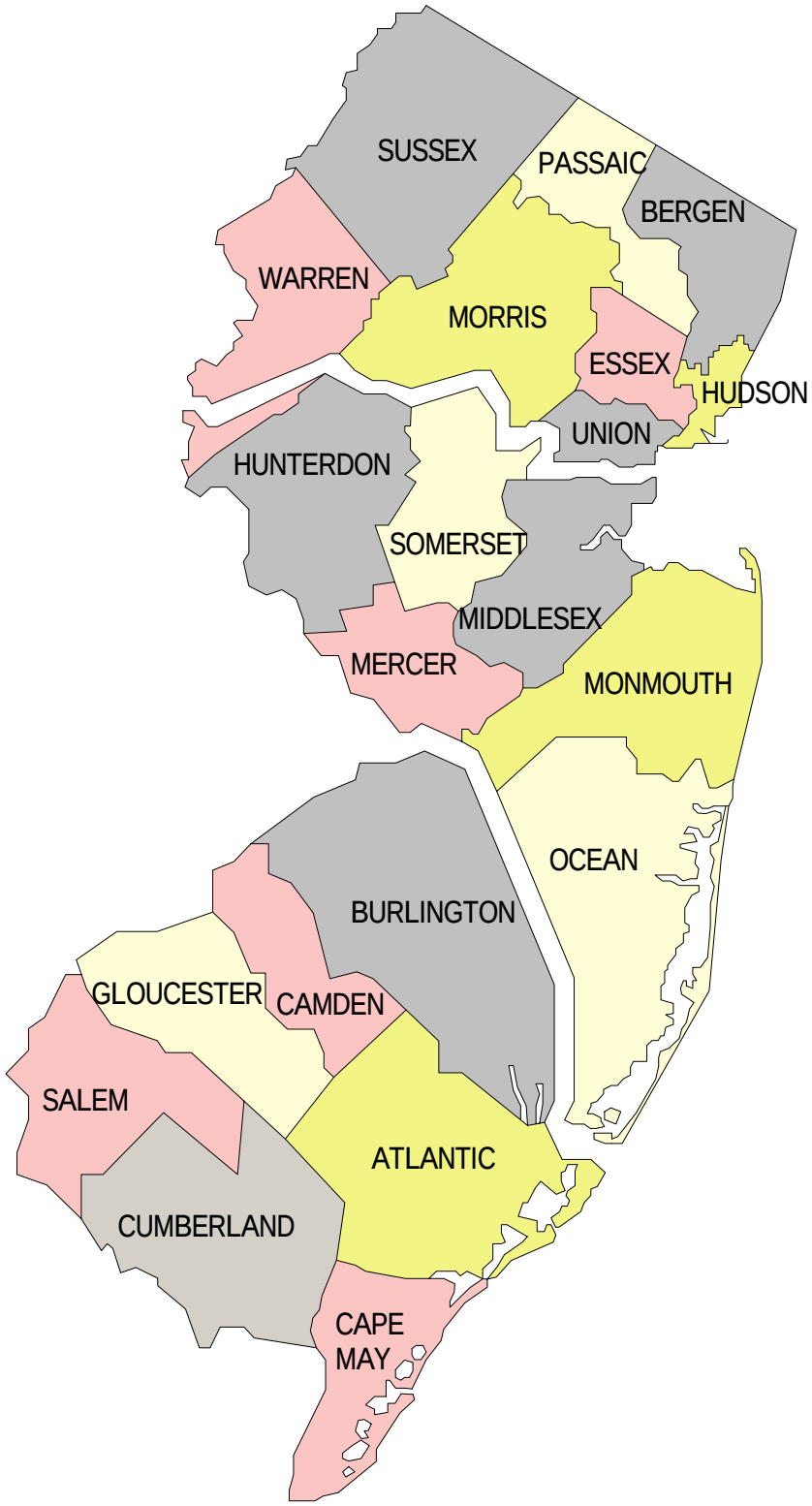
ATTACHMENT 1

New Jersey
Department of Transportation



Standard Specifications
for Road and Bridge Construction

2007


SUSSEX
PASSAIC
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OCEAN
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CENTRAL
SOUTH

TABLE OF CONTENTS

DIVISION 100 – GENERAL PROVISIONS 1

SECTION 101 – GENERAL INFORMATION 1
101.01 Introduction 1
101.02 Abbreviations 1
101.03 Terms 2
101.04 Inquiries Regarding the Project 6
SECTION 102 – BIDDING REQUIREMENTS AND CONDITIONS 8
102.01 Qualification to Bid 8
102.02 Bidder Registration and Downloading of the Proposal Documents 8
102.03 Revisions Before Submitting a Bid 8
102.04 Examination of Contract and Project Limits 8
102.05 Interpretation of Quantities in the Proposal 9
102.06 "If and Where Directed" 9
102.07 Preparation of the Bid 10
102.08 Balanced Bids 10
102.09 Proposal Bond 10
102.10 Submission of Bids 10
102.11 Withdrawal of Bids 11
102.12 Public Opening of Bids 11
102.13 Consideration of Bids 11
102.14 Irregular Bids 11
102.15 Disqualification of Bidders 11
102.16 Rejection of All Bids 12
SECTION 103 – AWARD AND EXECUTION OF CONTRACT 12
103.01 Award of Contract 12
103.02 Cancellation of Award 12
103.03 Release of Proposal Bond 12
103.04 Execution of the Contract 13
103.05 Escrow of Bid Documents 13
103.06 Failure to Execute Contract 13
103.07 Acquisition of Documents 14
SECTION 104 – SCOPE OF WORK 14
104.01 Intent 14
104.02 Value Engineering 14
104.02.01 Purpose and Scope 14
104.02.02 Conditions 14
104.02.03 Submittals 15
104.02.04 Final Documents 16
104.02.05 Payment 16
104.03 Changes to the Contract 16
104.03.01 Authority to Make Changes 16
104.03.02 Protests to Change Orders 17
104.03.03 Types of Changes 17
104.03.04 Contractual Notice 20
104.03.05 Unrecoverable Costs 21
104.03.06 Unacceptable Cost Calculation Methods 21
104.03.07 Tracking Costs 21
104.03.08 Force Account 21
104.03.09 Delay Damages 24
SECTION 105 – CONTROL OF WORK 26
105.01 Authority of the Department 26
105.01.01 RE 26
105.01.02 Inspection 27

105.02 Responsibilities of the Contractor 27
105.02.01 Labor and Equipment 27
105.02.02 Superintendent 28
105.02.03 Subcontracted Work 28
105.02.04 Fabricators and Suppliers 28
105.03 Conformity with Contract 28
105.04 Plans and Specifications 29
105.05 Working Drawings 29
105.06 Cooperation with Others 31
105.07 Cooperation with Utilities 32
105.07.01 Working in the Vicinity of Utilities 32
105.07.02 Work Performed by Utilities 33
105.08 Environmental Protection 33
105.09 Load Restrictions 34
105.10 Use of Explosives 34
SECTION 106 – CONTROL OF MATERIAL 34
106.01 Source of Supply and Quality Requirements 34
106.02 Department-Furnished Material 35
106.03 Foreign Materials 35
106.04 Materials Questionnaire 35
106.05 Materials Inspections, Tests, and Samples 36
106.06 Plant Inspection 36
106.07 Certification of Compliance 36
106.08 Unacceptable Material 37
106.09 Substitutes for Proprietary Items 37
SECTION 107 – LEGAL RELATIONS 38
107.01 Legal Jurisdiction 38
107.01.01 Applicable Law 38
107.01.02 Permits, Licenses, and Approvals 38
107.01.03 Sovereign Immunity 38
107.02 Discrimination in Employment on Public Works 38
107.03 Affirmative Action, Disadvantaged Business Enterprises, or Emerging Small Business Enterprise 39
107.04 New Jersey Contractual Liability Act 39
107.05 Limitations of Liability 39
107.06 Personal Liability of Public Officials 40
107.07 Assignment 40
107.08 Non Waiver 40
107.09 Independent Contractor 40
107.10 Non-Third Party Beneficiary Clause 40
107.11 Risks Assumed by the Contractor 40
107.12 The Contractual Claim Resolution Process 42
107.12.01 Satisfying the Notice Requirements 42
107.12.02 Steps 43
107.13 Litigation of Claims by the Contractor 45
107.14 Patented Devices, Materials, and Processes 45
107.15 Taxes 45
107.16 Recovery of Monies by the State 46
SECTION 108 – PROSECUTION AND COMPLETION 46
108.01 Subcontracting 46
108.02 Commencement of Work 48
108.03 Daily Communications 49
108.04 Work Site and Storage 49
108.05 Sanitary and Safety Provisions 49
108.05.01 Sanitary 49
108.05.02 Safety Program 50
108.06 Night Operations 52

108.07 Traffic Control 53
108.07.01 Interference 53
108.07.02 Changes to the Traffic Control Plan (TCP) 53
108.08 Lane Occupancy Charges 54
108.09 Maintenance Within the Project Limits 54
108.10 Contract Time 54
108.11 Modifications to Contract Time 55
108.11.01 Extensions to Contract Time 55
108.11.02 Reductions to Contract Time 57
108.12 Right-Of-Way Restrictions 57
108.13 Suspension of Work 57
108.14 Default and Termination of Contractor's Right to Proceed 58
108.15 Termination of Contract 59
108.15.01 For Convenience 59
108.15.02 For Cause 59
108.16 Partial Acceptance 59
108.17 Interim Completion 59
108.18 Substantial Completion 60
108.19 Completion and Acceptance 60
108.20 Liquidated Damages 60
108.21 Warranties 60
SECTION 109 – MEASUREMENT AND PAYMENT 61
109.01 Measurement of Quantities 61
109.02 Scope of Payment 61
109.03 Payment for Force Account 62
109.04 Payment for Delay Damages 62
109.05 Estimates 62
109.06 Materials Payments and Storage 63
109.07 Bonds Posted in Lieu of Retainages 64
109.08 As-Built Quantities 64
109.09 Audits 64
109.10 Contractor's Compliance with N.J.S.A. 34:11-56.25, *et seq.* 65
109.11 Final Payment and Claims 65
109.12 Ethics Standards and Conflicts of Interest 66

DIVISION 150 – CONTRACT REQUIREMENTS 68

SECTION 151 – PERFORMANCE BOND AND PAYMENT BOND 68
151.01 Description 68
151.02 Materials 68
151.03 Procedure 68
151.03.01 Performance Bond and Payment Bond 68
151.04 Measurement and Payment 68
SECTION 152 – INSURANCE 69
152.01 Description 69
152.02 Materials 69
152.03 Procedure 69
152.03.01 Owner's and Contractor's Protective Liability Insurance 69
152.03.02 Railroad Protective Liability Insurance 70
152.03.03 Pollution Liability Insurance 71
152.04 Measurement and Payment 71
SECTION 153 – PROGRESS SCHEDULE 72
153.01 Description 72
153.02 Materials 72

153.03 Procedure 72
153.03.01 CPM Progress Schedule 72
153.03.02 CPM Progress Schedule Updates 74
153.03.03 Bar Chart Progress Schedule and Updates 75
153.04 Measurement and Payment 76
SECTION 154 – MOBILIZATION 76
154.01 Description 76
154.02 Materials 76
154.03 Procedure 76
154.03.01 Mobilization 76
154.04 Measurement and Payment 77
SECTION 155 – CONSTRUCTION FIELD OFFICE 77
155.01 Description 77
155.02 Materials 77
155.03 Procedure 77
155.03.01 Field Office 77
155.03.02 Field Office Maintenance 79
155.03.03 Telephone Service 79
155.04 Measurement and Payment 79
SECTION 156 – MATERIALS FIELD LABORATORY AND CURING FACILITY 79
156.01 Description 79
156.02 Materials 79
156.03 Procedure 80
156.03.01 Materials Field Laboratory 80
156.03.02 Materials Field Laboratory Maintenance 82
156.03.03 Curing Facility 82
156.03.04 Curing Facility Maintenance 83
156.03.05 Nuclear Density Gauge 83
156.03.06 Flexural Beam Testing Equipment 83
156.03.07 Concrete Compression Testing Equipment 83
156.04 Measurement and Payment 83
SECTION 157 – CONSTRUCTION LAYOUT AND MONUMENTS 84
157.01 Description 84
157.02 Materials 84
157.03 Procedure 84
157.03.01 Construction Layout 84
157.03.02 Monument 85
157.03.03 Monument Box 85
157.04 Measurement and Payment 85
SECTION 158 – SOIL EROSION AND SEDIMENT CONTROL AND WATER QUALITY CONTROL 86
158.01 Description 86
158.02 Materials 86
158.03 Construction 87
158.03.01 Environmental Manager 87
158.03.02 SESC Measures 87
158.03.03 Erosion Control Sediment Removal 91
158.04 Measurement and Payment 91
SECTION 159 – TRAFFIC CONTROL 92
159.01 Description 92
159.02 Materials 92
159.02.01 Materials 92
159.02.02 Equipment 92
159.03 Procedure 92
159.03.01 Traffic Control Coordinator 92
159.03.02 Traffic Control Devices 93
159.03.03 Removable Black Line Masking Tape 94

159.03.04 Temporary Pavement Markers 95
159.03.05 Temporary Pavement Marking Tape 95
159.03.06 Temporary Traffic Stripes and Temporary Traffic Markings 95
159.03.07 HMA Patch 95
159.03.08 Traffic Direction 95
159.03.09 Emergency Towing Service 96
159.04 Measurement and Payment 96
SECTION 160 – PRICE ADJUSTMENTS 97
160.01 Description 97
160.02 Materials 97
160.03 Procedure 97
160.03.01 Fuel Price Adjustment 97
160.03.02 Asphalt Price Adjustment 99
160.04 Measurement and Payment 99
SECTION 161 – FINAL CLEANUP 100
161.01 Description 100
161.02 Materials 100
161.03 Procedure 100
161.03.01 Final Cleanup 100
161.04 Measurement and Payment 100

DIVISION 200 – EARTHWORK 101

SECTION 201 – CLEARING SITE 101
201.01 Description 101
201.02 Materials 101
201.03 Construction 101
201.03.01 Clearing Site 101
201.03.02 Clearing Site, Bridge and Clearing Site, Structure 102
201.03.03 Temporary Shielding 102
201.03.04 Removing Underground Storage Tanks 103
201.03.05 Monitoring Wells 104
201.03.06 Sealing Abandoned Wells 104
201.03.07 Demolition 104
201.03.08 Asbestos Removal 106
201.03.09 Disposal of Removed Materials and Debris 106
201.04 Measurement and Payment 107
SECTION 202 – EXCAVATION 107
202.01 Description 107
202.02 Materials 108
202.03 Construction 108
202.03.01 Stripping 108
202.03.02 Excavating Test Pits 108
202.03.03 Excavating Unclassified Material 108
202.03.04 Excavating Regulated Material 112
202.03.05 Excavating Acid Producing Soil (APS) 115
202.03.06 Removing Pavement 115
202.03.07 Reuse or Disposal of Excess Material 116
202.03.08 Disposal of Regulated Material 116
202.03.09 Disposal of Regulated Material, Hazardous 117
202.04 Measurement and Payment 118
SECTION 203 – EMBANKMENT 119
203.01 Description 119
203.02 Materials 119
203.02.01 Materials 119
203.02.02 Equipment 119

203.03 Construction....119
203.03.01 Constructing Embankment....119
203.03.02 Placing and Compacting Methods....121
203.04 Measurement and Payment....122

DIVISION 300 – SUBBASE AND BASE COURSES....123

SECTION 301 – SUBBASE....123
301.01 Description....123
301.02 Materials....123
301.02.01 Materials....123
301.02.02 Equipment....123
301.03 Construction....123
301.03.01 Subbase....123
301.04 Measurement and Payment....124
SECTION 302 – AGGREGATE BASE COURSE....124
302.01 Description....124
302.02 Materials....124
302.02.01 Materials....124
302.02.02 Equipment....124
302.03 Construction....124
302.03.01 Aggregate Base Course....124
302.04 Measurement and Payment....126
SECTION 303 – ASPHALT-STABILIZED DRAINAGE COURSE....126
303.01 Description....126
303.02 Materials....126
303.02.01 Materials....126
303.02.02 Equipment....126
303.03 Construction....126
303.03.01 Asphalt-Stabilized Drainage Course....126
303.04 Measurement and Payment....127
SECTION 304 – CONCRETE BASE COURSE....127
304.01 Description....127
304.02 Materials....127
304.02.01 Materials....127
304.02.02 Equipment....127
304.03 Construction....127
304.03.01 Concrete Base Course....127
304.04 Measurement and Payment....128
SECTION 305 – RUBBLIZING CONCRETE PAVEMENT....128
305.01 Description....128
305.02 Materials....128
305.02.01 Materials....128
305.02.02 Equipment....128
305.03 Construction....129
305.03.01 Rubblizing....129
305.04 Measurement and Payment....130

DIVISION 400 – PAVEMENTS....131

SECTION 401 – HOT MIX ASPHALT (HMA) COURSES....131
401.01 Description....131
401.02 Materials....131
401.02.01 Materials....131
401.02.02 Equipment....131

401.03 Construction 131
401.03.01 Preparing Existing Pavement 131
401.03.02 Tack Coat and Prime Coat 133
401.03.03 HMA Courses 134
401.03.04 Sawcutting and Sealing of Joints in HMA Overlays 142
401.03.05 Core Samples 142
401.04 Measurement and Payment 143
SECTION 402 – HMA FRICTION COURSE 144
402.01 Description 144
402.02 Materials 144
402.02.01 Materials 144
402.02.02 Equipment 144
402.03 Construction 144
402.03.01 Installing OGFC and MOGFC 144
402.04 Measurement and Payment 145
SECTION 403 – ULTRA-THIN FRICTION COURSE 145
403.01 Description 145
403.02 Materials 145
403.02.01 Materials 145
403.02.02 Equipment 146
403.03 Construction 146
403.03.01 Ultra-Thin Friction Course 146
403.04 Measurement and Payment 147
SECTION 404 – STONE MATRIX ASPHALT (SMA) 147
404.01 Description 147
404.02 Materials 147
404.02.01 Materials 147
404.02.02 Equipment 147
404.03 Construction 147
404.03.01 SMA 147
404.04 Measurement and Payment 148
SECTION 405 – CONCRETE SURFACE COURSE 148
405.01 Description 148
405.02 Materials 148
405.02.01 Materials 148
405.02.02 Equipment 149
405.03 Construction 149
405.03.01 Underlayer Preparation 149
405.03.02 Concrete Surface Course 149
405.03.03 Core Samples 152
405.03.04 Diamond Grinding 153
405.04 Measurement and Payment 153

DIVISION 450 – CONCRETE PAVEMENT REHABILITATION 154

SECTION 451 – CONCRETE SLAB STABILIZATION 154
451.01 Description 154
451.02 Materials 154
451.02.01 Materials 154
451.02.02 Equipment 154
451.03 Construction 154
451.03.01 Pozzolan Grout 154
451.03.02 High-Density Polyurethane Grout 155
451.03.03 Deflection Testing 155
451.04 Measurement and Payment 156

SECTION 452 – PARTIAL DEPTH CONCRETE PAVEMENT REPAIR 156
452.01 Description 156
452.02 Materials 156
452.02.01 Materials 156
452.02.02 Equipment 156
452.03 Construction 156
452.03.01 Partial Depth Concrete Pavement Repair 156
452.04 Measurement and Payment 157
SECTION 453 – FULL DEPTH CONCRETE PAVEMENT REPAIR 157
453.01 Description 157
453.02 Materials 157
453.02.01 Materials 157
453.02.02 Equipment 157
453.03 Construction 158
453.03.01 Full Depth Repair Using Concrete 158
453.03.02 Full Depth Repair Using HMA 160
453.04 Measurement and Payment 160
SECTION 454 – RETROFIT DOWEL BARS 160
454.01 Description 160
454.02 Materials 160
454.02.01 Materials 160
454.02.02 Equipment 160
454.03 Construction 160
454.03.01 Retrofit Dowel Bars 160
454.04 Measurement and Payment 161
SECTION 455 – DIAMOND GRINDING EXISTING CONCRETE PAVEMENT 161
455.01 Description 161
455.02 Materials 161
455.02.01 Materials 161
455.02.02 Equipment 161
455.03 Construction 161
455.03.01 Diamond Grinding Existing Concrete Pavement 161
455.04 Measurement and Payment 162
SECTION 456 – SEALING EXISTING JOINTS IN CONCRETE PAVEMENT 162
456.01 Description 162
456.02 Materials 162
456.02.01 Materials 162
456.02.02 Equipment 162
456.03 Construction 162
456.03.01 Sealing Existing Joints in Concrete Pavement 162
456.04 Measurement and Payment 163

DIVISION 500 – BRIDGES AND STRUCTURES 164

SECTION 501 – SHEETING AND COFFERDAMS 164
501.01 Description 164
501.02 Materials 164
501.03 Construction 164
501.03.01 Temporary Sheeting 164
501.03.02 Permanent Sheeting 164
501.03.03 Temporary Cofferdams 165
501.03.04 Permanent Cofferdams 165
501.04 Measurement and Payment 166

SECTION 502 – LOAD BEARING PILES 166
502.01 Description 166
502.02 Materials 166
502.02.01 Materials 166
502.02.02 Equipment 167
502.03 Construction 167
502.03.01 Furnishing Pile Driving Equipment 167
502.03.02 Preboring Holes 167
502.03.03 Driving Piles 167
502.03.04 Splicing Piles 169
502.03.05 Pile Shoes 169
502.04 Measurement and Payment 170
SECTION 503 – DRILLED SHAFT FOUNDATIONS 171
503.01 Description 171
503.02 Materials 171
503.02.01 Materials 171
503.02.02 Equipment 171
503.03 Construction 172
503.03.01 Installation Plan 172
503.03.02 Demonstration Drilled Shaft Installation 172
503.03.03 Load Tests 173
503.03.04 Crosshole Sonic Logging (CSL) 174
503.03.05 Core Drilling of Drilled Shaft Concrete 174
503.03.06 Constructing Drilled Shafts 175
503.04 Measurement and Payment 180
SECTION 504 – STRUCTURAL CONCRETE 181
504.01 Description 181
504.02 Materials 181
504.02.01 Materials 181
504.02.02 Equipment 181
504.03 Construction 182
504.03.01 Reinforcement Steel 182
504.03.02 Constructing Concrete 183
504.03.03 Epoxy Waterproofing 188
504.04 Measurement and Payment 189
SECTION 505 – PRECAST AND PRESTRESSED STRUCTURAL CONCRETE 189
505.01 Description 189
505.02 Materials 189
505.02.01 Materials 189
505.02.02 Equipment 189
505.03 Construction 190
505.03.01 Prestressed Concrete Structures 190
505.03.02 Precast Concrete Culverts 191
505.03.03 Precast Concrete Arch Structures 191
505.04 Measurement and Payment 192
SECTION 506 – STRUCTURAL STEEL 193
506.01 Description 193
506.02 Materials 193
506.03 Construction 193
506.03.01 Structural Steel 193
506.03.02 Bearings 194
506.03.03 Shear Connectors 195
506.03.04 Steel Pedestrian Bridges 196
506.03.05 Steel Grid Flooring 196
506.03.06 Repair Galvanizing 196
506.04 Measurement and Payment 196

SECTION 507 – CONCRETE BRIDGE DECK AND APPROACHES 196
507.01 Description 196
507.02 Materials 196
507.02.01 Materials 196
507.02.02 Equipment 197
507.03 Construction 197
507.03.01 Joint Assemblies 197
507.03.02 Constructing Bridge Decks 198
507.03.03 Date Panel 202
507.03.04 Concrete Bridge Sidewalk 202
507.03.05 Concrete Parapet and Barrier Curb 202
507.03.06 4-Bar Open Steel Parapet 203
507.03.07 Bridge Approach 203
507.04 Measurement and Payment 203
SECTION 508 – BRIDGE DRAINAGE 204
508.01 Description 204
508.02 Materials 204
508.03 Construction 204
508.03.01 Inlet Frames, Grates, and Scuppers 204
508.03.02 Steel Alloy Pipe 204
508.04 Measurement and Payment 204
SECTION 509 – BRIDGE RAILING AND FENCE 204
509.01 Description 204
509.02 Materials 204
509.03 Construction 205
509.03.01 Bridge Railing 205
509.03.02 Chain-Link Fence for Bridge 205
509.04 Measurement and Payment 205
SECTION 510 – TIMBER STRUCTURES 205
510.01 Description 205
510.02 Materials 205
510.03 Construction 206
510.03.01 Timber Structures 206
510.03.02 Sheeting and Wales 206
510.04 Method of Measurement 206
SECTION 511 – BULKHEAD, FENDER, AND DOLPHIN SYSTEMS 206
511.01 Description 206
511.02 Materials 206
511.02.01 Materials 206
511.02.02 Equipment 207
511.03 Construction 207
511.03.01 Bulkhead, Fender, and Dolphin Systems 207
511.04 Measurement and Payment 208
SECTION 512 – SIGN SUPPORT STRUCTURES 209
512.01 Description 209
512.02 Materials 209
512.02.01 Materials 209
512.02.02 Equipment 209
512.03 Construction 209
512.03.01 Sign Structures 209
512.04 Measurement and Payment 210
SECTION 513 – RETAINING WALLS 210
513.01 Description 210
513.02 Materials 211
513.02.01 Materials 211
513.02.02 Equipment 211

513.03 Construction 211
513.03.01 Proprietary Retaining Walls 211
513.03.02 Cast-in-Place Retaining Walls 214
513.04 Measurement and Payment 214
SECTION 514 – TEMPORARY STRUCTURES 214
514.01 Description 214
514.02 Materials 214
514.03 Construction 214
514.03.01 Temporary Structures 214
514.04 Measurement and Payment 214
DIVISION 550 – STRUCTURE REHABILITATION 215
SECTION 551 – BRIDGE DECK REHABILITATION 215
551.01 Description 215
551.02 Materials 215
551.02.01 Materials 215
551.02.02 Equipment 215
551.03 Construction 215
551.03.01 Repair of Concrete Deck 215
551.03.02 Scarification 216
551.04 Measurement and Payment 217
SECTION 552 – PRESSURE INJECTION SEALING 217
552.01 Description 217
552.02 Materials 217
552.02.01 Materials 217
552.02.02 Equipment 217
552.03 Construction 217
552.03.01 Pressure Injection Sealing 217
552.04 Measurement and Payment 218
SECTION 553 – PNEUMATICALLY APPLIED MORTAR 218
553.01 Description 218
553.02 Materials 218
553.02.01 Materials 218
553.02.02 Equipment 218
553.03 Construction 218
553.03.01 Pneumatically Applied Mortar 218
553.04 Measurement and Payment 219
SECTION 554 – PAINTING EXISTING BRIDGES 219
554.01 Description 219
554.02 Materials 219
554.02.01 Materials 219
554.02.02 Equipment 219
554.03 Construction 220
554.03.01 Pollution Control System 220
554.03.02 Cleaning and Painting 223
554.03.03 Testing, If and Where Directed 227
554.04 Measurement and Payment 227
DIVISION 600 – MISCELLANEOUS CONSTRUCTION 228
SECTION 601 – PIPE 228
601.01 Description 228
601.02 Materials 228

601.03 Construction....228
601.03.01 Installing Pipe....228
601.03.02 Installing Pipe Using Alternate Methods....230
601.03.03 Underdrains and Subbase Outlet Drains....230
601.03.04 Video Inspection of Pipe....231
601.03.05 Deflection Inspection of HDPE Pipe....231
601.03.06 Cleaning Existing Pipe....231
601.04 Measurement and Payment....231
SECTION 602 – DRAINAGE STRUCTURES....232
602.01 Description....232
602.02 Materials....232
602.02.01 Materials....232
602.02.02 Equipment....233
602.03 Construction....233
602.03.01 Culverts and Headwalls....233
602.03.02 Inlets and Manholes....233
602.03.03 Setting Castings, Resetting Castings, and Reconstructing Inlets and Manholes....233
602.03.04 Converting Inlets into Manholes....234
602.03.05 Extension Frames and Rings....234
602.03.06 Manhole Covers and Bicycle Safe Grates....234
602.03.07 Curb Pieces....234
602.03.08 Cleaning Drainage Structures....234
602.04 Measurement and Payment....235
SECTION 603 – SLOPE AND CHANNEL PROTECTION....235
603.01 Description....235
603.02 Materials....235
603.02.01 Materials....235
603.02.02 Equipment....235
603.03 Construction....236
603.03.01 Concrete Slope Gutters....236
603.03.02 Concrete Slope Protection....236
603.03.03 Riprap Stone Slope or Channel Protection....236
603.03.04 Rock Backfill....236
603.04 Measurement and Payment....237
SECTION 604 – GABION WALLS....237
604.01 Description....237
604.02 Materials....237
604.03 Construction....237
604.03.01 Gabion Walls....237
604.04 Measurement and Payment....237
SECTION 605 – FENCE....238
605.01 Description....238
605.02 Materials....238
605.02.01 Materials....238
605.02.02 Equipment....238
605.03 Construction....238
605.03.01 Chain-Link Fence....238
605.03.02 Gates....238
605.03.03 Repairing Chain-Link Fence....238
605.03.04 Temporary Chain-Link Fence....238
605.04 Measurement and Payment....239
SECTION 606 – SIDEWALKS, DRIVEWAYS, AND ISLANDS....239
606.01 Description....239
606.02 Materials....239
606.02.01 Materials....239
606.02.02 Equipment....240

606.03 Construction 240
606.03.01 HMA Sidewalks, Driveways, and Islands 240
606.03.02 Concrete Sidewalks, Driveways, and Islands 240
606.03.03 Detectable Warning Surfaces 241
606.04 Measurement and Payment 241
SECTION 607 – CURB 242
607.01 Description 242
607.02 Materials 242
607.02.01 Materials 242
607.02.02 Equipment 242
607.03 Construction 242
607.03.01 Concrete Barrier Curb 242
607.03.02 Concrete Vertical Curb and Concrete Sloping Curb 243
607.03.03 Concrete Barrier Curb, Dowelled 244
607.03.04 Concrete Vertical Curb and Concrete Sloping Curb, Dowelled 244
607.03.05 Granite Curb 244
607.03.06 Reset Granite Curb 245
607.03.07 HMA Curb 245
607.04 Measurement and Payment 245
SECTION 608 – NON-VEGETATIVE SURFACES 246
608.01 Description 246
608.02 Materials 246
608.02.01 Materials 246
608.02.02 Equipment 246
608.03 Construction 246
608.03.01 Non-Vegetative Surface, HMA 246
608.03.02 Color-Coated Non-Vegetative Surface, HMA 246
608.04 Measurement and Payment 246
SECTION 609 – BEAM GUIDE RAIL 247
609.01 Description 247
609.02 Materials 247
609.03 Construction 247
609.03.01 Beam Guide Rail 247
609.03.02 Rub Rail 248
609.03.03 Terminals and Anchorages 248
609.03.04 Beam Guide Rail Blockouts 248
609.03.05 Reset Beam Guide Rail 248
609.03.06 Removal of Beam Guide Rail 248
609.04 Measurement and Payment 249
SECTION 610 – TRAFFIC STRIPES, TRAFFIC MARKINGS, AND RUMBLE STRIPS 249
610.01 Description 249
610.02 Materials 250
610.02.01 Materials 250
610.02.02 Equipment 250
610.03 Construction 250
610.03.01 Long-Life Traffic Stripes 250
610.03.02 Thermoplastic Traffic Markings 251
610.03.03 Raised Pavement Markers (RPM) 252
610.03.04 Removal of RPMs 253
610.03.05 Removal and Replacement of RPM Lenses 253
610.03.06 Ground Mounted Flexible Delineators 253
610.03.07 Rumble Strips 253
610.03.08 Removal of Traffic Stripes and Markings 253
610.04 Measurement and Payment 253

SECTION 611 – CRASH CUSHIONS 254
611.01 Description 254
611.02 Materials 254
611.03 Construction 254
611.03.01 Inertial Barrier System 254
611.03.02 Crash Cushion 254
611.04 Measurement and Payment 254
SECTION 612 – SIGNS 255
612.01 Description 255
612.02 Materials 255
612.03 Construction 255
612.03.01 Regulatory and Warning Signs and Type GA "U" Post Support Guide Signs 255
612.03.02 Type GA Breakaway and Non-Breakaway Support Guide Signs 255
612.03.03 Type GO and Type GOX Guide Sign Panels 255
612.04 Measurement and Payment 256

DIVISION 650 – UTILITIES 257

SECTION 651 – WATER 257
651.01 Description 257
651.02 Materials 257
651.03 Construction 257
651.03.01 Water Pipe 257
651.03.02 Water Pipe, Bridge 259
651.03.03 Water Service Connection 259
651.03.04 Fire Hydrant 259
651.03.05 Relocate Fire Hydrant 260
651.03.06 Reset Fire Hydrant 260
651.03.07 Reset Water Valve Box 260
651.03.08 Water As-Built Plan 260
651.04 Measurement and payment 260
SECTION 652 – SANITARY SEWERS 261
652.01 Description 261
652.02 Materials 261
652.03 Construction 261
652.03.01 Sewer Pipe 261
652.03.02 Sanitary Sewer Pipe, Bridge 262
652.03.03 Sanitary Sewer Pipe Lining 263
652.03.04 Sanitary Sewer Service Connections 263
652.03.05 Sanitary Sewer Manhole 263
652.03.06 Reconstruct Sanitary Sewer Manhole 263
652.03.07 Reset Sanitary Sewer Manhole 263
652.03.08 Video Inspection of Sewer 264
652.03.09 Sewer As-Built Plan 264
652.04 Measurement and Payment 264
SECTION 653 – GAS 264
653.01 Description 264
653.02 Materials 264
653.03 Construction 265
653.03.01 Gas Main 265
653.03.02 Installing Gas Mains on Bridges 267
653.03.03 Gas Service Connection 267
653.03.04 Reset Gas Valve Boxes 268
653.03.05 Gas As-Built Plan 268
653.04 Measurement and Payment 268

DIVISION 700 – ELECTRICAL 269

SECTION 701 – GENERAL ITEMS 269
701.01 Description 269
701.02 Materials 269
701.02.01 Materials 269
701.02.02 Equipment 269
701.03 Construction 270
701.03.01 Existing Systems 270
701.03.02 Rigid Metallic Conduit (Earth) 270
701.03.03 Rigid Metallic Conduit (Roadway) 271
701.03.04 Rigid Metallic Conduit (Exposed) 271
701.03.05 Rigid Nonmetallic Conduit 272
701.03.06 Flexible Metallic Conduit 273
701.03.07 Flexible Nonmetallic Conduit 273
701.03.08 Junction Box 273
701.03.09 Metal Junction Boxes 274
701.03.10 Junction Box Foundation 274
701.03.11 Junction Box Frame and Cover 274
701.03.12 Foundations 274
701.03.13 Cable Rack 275
701.03.14 Meter Cabinet 275
701.03.15 Cable and Wire 275
701.04 Measurement and Payment 276
SECTION 702 – TRAFFIC SIGNALS 277
702.01 Description 277
702.02 Materials 277
702.02.01 Materials 277
702.02.02 Equipment 277
702.03 Construction 277
702.03.01 Controller 277
702.03.02 Standards 278
702.03.03 Traffic Signal Mast Arm 278
702.03.04 Traffic Signal Cable 278
702.03.05 Traffic Signal Head 279
702.03.06 Pedestrian Signal Head 279
702.03.07 Push Button 280
702.03.08 Image Detector 280
702.03.09 Loop Detector 280
702.03.10 Loop Detector Cable 280
702.03.11 Temporary and Interim Traffic Signal Systems 280
702.03.12 Controller Turn On 281
702.04 Measurement and Payment 282
SECTION 703 – HIGHWAY LIGHTING 282
703.01 Description 282
703.02 Materials 282
703.02.01 Materials 282
703.02.02 Equipment 283
703.03 Construction 283
703.03.01 Lighting Standard 283
703.03.02 Lighting Mast Arm 283
703.03.03 Luminaire 283
703.03.04 Sign Lighting 284
703.03.05 Underdeck Lighting 284
703.03.06 Tower Lighting 284
703.03.07 Temporary Highway Lighting System 285

703.04 Measurement and Payment 286
SECTION 704 – INTELLIGENT TRANSPORTATION SYSTEMS (ITS) 286
704.01 Description 286
704.02 Materials 286
704.02.01 Materials 286
704.02.02 Equipment 287
704.03 Construction 287
704.03.01 General System (GS) 287
704.03.02 Camera Surveillance System (CSS) 289
704.03.03 Fiber Optic Cable 290
704.03.04 Controlled Traffic Signal System (CTSS) 292
704.03.05 Travel Time Systems (TTS) 293
704.03.06 Road Weather Information System (RWIS) 294
704.03.07 Dynamic Message System (DMS) 295
704.03.08 Weigh in Motion System (WIMS) 296
704.03.09 Traffic Volume System (TVS) 297
704.04 Measurement and Payment 298

DIVISION 800 – LANDSCAPING 300

SECTION 801 – SELECTIVE VEGETATION REMOVAL 300
801.01 Description 300
801.02 Materials 300
801.03 Construction 300
801.03.01 Selective Thinning 300
801.03.02 Selective Clearing 300
801.04 Measurement and Payment 301
SECTION 802 – TRIMMING AND REMOVING TREES 301
802.01 Description 301
802.02 Materials 301
802.03 Construction 301
802.03.01 Trimming Existing Trees 301
802.03.02 Removing Existing Trees 301
802.04 Measurement and Payment 302
SECTION 803 – PREPARATION OF EXISTING SOIL 302
803.01 Description 302
803.02 Materials 302
803.03 Construction 302
803.03.01 Preparing Existing Soil 302
803.04 Measurement and Payment 302
SECTION 804 – TOPSOILING 303
804.01 Description 303
804.02 Materials 303
804.03 Construction 303
804.03.01 Topsoiling 303
804.04 Measurement and Payment 303
SECTION 805 – TURF REPAIR STRIP 303
805.01 Description 303
805.02 Materials 303
805.03 Construction 304
805.03.01 Turf Repair Strip 304
805.04 Measurement and Payment 304
SECTION 806 – FERTILIZING AND SEEDING 304
806.01 Description 304
806.02 Materials 304

806.03 Construction 304
806.03.01 Turf Seeding 304
806.03.02 Wildflower Seeding 305
806.04 Measurement and Payment 306
SECTION 807 – TOPSOIL STABILIZATION 306
807.01 Description 306
807.02 Materials 306
807.03 Construction 306
807.03.01 Installing Topsoil Stabilization Matting 306
807.04 Measurement and Payment 307
SECTION 808 – SODDING 307
808.01 Description 307
808.02 Materials 307
808.03 Construction 307
808.03.01 Placing Sod 307
808.04 Measurement and Payment 308
SECTION 809 – MULCHING 308
809.01 Description 308
809.02 Materials 308
809.03 Construction 308
809.03.01 Straw Mulching 308
809.03.02 Fiber Mulching 309
809.03.03 Mulching Plants 309
809.04 Measurement and Payment 309
SECTION 810 – MOWING 309
810.01 Description 309
810.02 Materials 309
810.03 Construction 309
810.03.01 Mowing Seeded Areas 309
810.03.02 Mowing Existing Turf 309
810.04 Measurement and Payment 310
SECTION 811 – PLANTING 310
811.01 Description 310
811.02 Materials 310
811.03 Construction 310
811.03.01 Planting 310
811.03.02 Plant Establishment Period 312
811.04 Measurement and Payment 313

DIVISION 900 – MATERIALS 314

SECTION 901 – AGGREGATES 314
901.01 Source 314
901.02 Stockpiles 314
901.03 Coarse Aggregate 314
901.03.01 Broken Stone 315
901.03.02 Washed Gravel 316
901.04 Blast Furnace Slag 316
901.05 Aggregates for HMA 317
901.05.01 Coarse Aggregate 317
901.05.02 Fine Aggregate 317
901.05.03 Mineral Filler 317
901.05.04 Reclaimed Asphalt Pavement (RAP) 318
901.05.05 Crushed Recycled Container Glass (CRCG) 318
901.05.06 Ground Bituminous Shingle Material (GBSM) 318
901.05.07 Remediated Petroleum Contaminated Soil Aggregate (RPCSA) 318

901.06 Aggregates for Concrete, Mortar, and Grout 319
901.06.01 Coarse Aggregate 319
901.06.02 Fine Aggregate 319
901.06.03 Lightweight Aggregate 320
901.07 Grit 320
901.08 Riprap Stones 320
901.09 Gabion Basket Stone 320
901.10 Dense-Graded Aggregate (DGA) 320
901.10.01 Virgin 320
901.10.02 Recycled Concrete Aggregate (RCA) 321
901.10.03 Virgin and RAP Mixture 321
901.11 Soil Aggregate 322
SECTION 902 – ASPHALT 324
902.01 Bituminous Materials 324
902.01.01 Asphalt Binder 325
902.01.02 Cutback Asphalts 325
902.01.03 Emulsified Asphalts 325
902.01.04 Polymer Modified Tack Coat 326
902.02 Hot Mix Asphalt (HMA) 326
902.02.01 Mix Designations 326
902.02.02 Composition of Mixtures 326
902.02.03 Mix Design 327
902.02.04 Sampling and Testing 329
902.03 Open-Graded Friction Course (OGFC) and Modified Open-Graded Friction Course (MOGFC) 330
902.03.01 Composition of Mixtures 330
902.03.02 Mix Design 331
902.03.03 Sampling and Testing 331
902.04 Ultra-Thin HMA 332
902.04.01 Composition of Mixture 332
902.04.02 Mix Design 333
902.04.03 Sampling and Testing 333
902.05 Stone Matrix Asphalt (SMA) 334
902.05.01 Composition of Mixture 334
902.05.02 Mix Design 334
902.05.03 Sampling and Testing 335
902.06 Asphalt-Stabilized Drainage Course (ASDC) 336
902.06.01 Composition 336
902.06.02 Mix Design 336
902.06.03 Sampling and Testing 336
SECTION 903 – CONCRETE 337
903.01 Cement 337
903.02 Concrete Admixtures 337
903.02.01 Air-Entraining Admixtures 337
903.02.02 Chemical Admixtures 337
903.02.03 Mineral Admixtures 338
903.02.04 Viscosity Modifying Admixture 338
903.02.05 Corrosion Inhibitor Admixture 339
903.03 Concrete 339
903.03.01 Composition 339
903.03.02 Mix Design and Verification 339
903.03.03 Mixing for Central-Plant and Transit Mixing 340
903.03.04 Mixing on the Project 342
903.03.05 Control and Acceptance Testing Requirements 343
903.03.06 Tables 347

903.04 Pavement Repair Mixes Class V and E 348
903.04.01 Composition 348
903.04.02 Mix Design and Verification 349
903.04.03 Mixing 349
903.04.04 Control and Acceptance Testing Requirements 349
903.05 High Performance Concrete (HPC) 350
903.05.01 Composition 350
903.05.02 Mix Design and Verification 350
903.05.03 Mixing 351
903.05.04 Control and Acceptance Testing Requirements 351
903.06 Self-Consolidating Concrete (SCC) 351
903.06.01 SCC for Drilled Shafts 351
903.06.02 SCC For Precast Concrete 352
903.07 Quick-Setting Patch Materials 353
903.08 Mortar and Grout 354
903.08.01 Mortar 354
903.08.02 Grout 354
903.08.03 Grout for Undersealing of Concrete Pavement 355
903.09 Controlled Low Strength Material (CLSM) 355
903.10 Curing Materials 356
903.10.01 Burlap Cloth 356
903.10.02 Liquid Membrane-Forming Compound 356
903.10.03 White Polyethylene Sheeting 356
SECTION 904 – PRECAST AND PRESTRESSED CONCRETE 356
904.01 Non-Structural Precast Concrete 356
904.01.01 Component Materials 356
904.01.02 Fabrication 357
904.01.03 Curing 357
904.01.04 Removing Forms and Finishing 357
904.01.05 Shipping and Handling 357
904.01.06 Quality Control and Acceptance Requirements 357
904.02 Precast Concrete Retaining Walls 357
904.02.01 Component Materials 357
904.02.02 Fabrication 358
904.02.03 Curing 358
904.02.04 Form Removal and Finishing 358
904.02.05 Shipping and Handling 358
904.02.06 Quality Control and Acceptance Requirements 358
904.03 Structural Precast Concrete 359
904.03.01 Component Materials 359
904.03.02 Fabrication 359
904.03.03 Curing 360
904.03.04 Removing Forms and Finishing 360
904.03.05 Shipping and Handling 360
904.03.06 Quality Control and Acceptance Requirements 360
904.04 Prestressed Concrete 360
904.04.01 Component Materials 360
904.04.02 Fabrication 361
904.04.03 Curing 362
904.04.04 Removing Forms and Finishing 363
904.04.05 Shipping and Handling 363
904.04.06 Quality Control, Quality Assurance, and Acceptance Requirements 363
SECTION 905 – REINFORCEMENT METALS 364
905.01 Reinforcement Steel 364
905.01.01 Reinforcement Bars 364
905.01.02 Spiral Reinforcement 364

905.01.03 Welded Wire Reinforcement 364
905.01.04 Structural Shapes, Plates, and Bars 364
905.01.05 Dowels 364
905.02 Prestressing and Post-Tensioning Reinforcement 364
905.02.01 High-Tensile-Strength 7-Wire Prestressing Strand 364
905.02.02 High-Tensile Strength Alloy Bars 365
905.02.03 Post-Tensioning Reinforcement 365
905.03 Reinforcement for Concrete Pavement 365
905.03.01 Tie Bars and Joint Ties 365
905.03.02 Tie Bolts 365
905.03.03 Dowel Bars 365
905.04 Rebar Coupling Devices 365
SECTION 906 – STRUCTURAL STEEL 366
906.01 Structural Steel Materials 366
906.02 Steel Piles 366
906.03 Steel Casings for Drilled Shafts 366
906.04 Structural Steel Fabrication 367
906.04.01 AISC Certification 367
906.04.02 Fabrication 367
906.04.03 Cleaning and Coating 367
906.04.04 Shipping and Handling 368
906.04.05 Quality Control and Acceptance 368
906.05 Sign Structures Fabrication 369
906.05.01 Fabrication 369
906.05.02 Shipping and Handling 369
906.05.03 Quality Control and Acceptance 369
906.06 Cleaning and Painting of Structural Steel in the Shop 369
906.06.01 Painting Materials 369
906.06.02 Surface Preparation 370
906.06.03 Conditions for Painting 370
906.06.04 Paint Application 370
906.06.05 Number of Coats and Film Thickness 371
906.06.06 Stenciling 371
906.06.07 Additional Handling Requirements for Painted Members 371
906.06.08 Quality Control and Acceptance 371
906.07 4-Bar Open Steel Parapet 371
SECTION 907 – BEARING ASSEMBLIES 372
907.01 Structural Bearing Assemblies 372
907.01.01 General Requirements 372
907.01.02 Types 372
907.01.03 Marking, Packaging, Shipping, and Handling 373
907.01.04 Quality Control and Acceptance 373
907.02 Reinforced Elastomeric Bearing Assemblies 373
907.03 Bearing Pads 373
SECTION 908 – BOLTS AND BOLTING MATERIAL 374
908.01 Steel Bolting Materials 374
908.01.01 Bolts 374
908.01.02 Nuts and Washers 374
908.01.03 Anchor Bolts 374
908.01.04 Adhesive Anchor Bolt Systems 374
908.02 High-strength Steel Bolting Materials 374
908.02.01 Material Requirements 374
908.02.02 Sampling and Testing Requirements for Bolt Assemblies 375
908.02.03 Test Reports and Certification 375
908.02.04 Shipping and Handling 376
908.03 Direct Tension Indicators (DTI) 376

908.04 Stainless Steel Bolting Materials 376
908.05 Aluminum Alloy Bolting Materials 376
SECTION 909 – DRAINAGE 376
909.01 Pipe Bedding 376
909.01.01 Class A Bedding 376
909.01.02 Class B Bedding 376
909.01.03 Class C Bedding 377
909.01.04 Class D Bedding 377
909.02 Pipe 377
909.02.01 Reinforced Concrete Pipe 377
909.02.02 HDPE Pipe 377
909.02.03 Plastic Drainage Pipe 377
909.02.04 Corrugated Aluminum Alloy Culvert Pipe and Pipe Arches 378
909.02.05 Corrugated Aluminum Alloy Underdrain Pipe 378
909.02.06 Corrugated Steel Pipe and Pipe Arches 378
909.02.07 Steel Alloy Pipe for Bridge Storm Drains 378
909.02.08 Ductile Iron Water Pipe 379
909.03 Castings and Components for Drainage Structures 379
SECTION 910 – MASONRY UNITS 379
910.01 Clay or Shale Brick 379
910.02 Concrete Block for Inlets and Manholes 380
910.03 Concrete Brick 380
910.04 Stone Curb 380
910.05 Stone Facing for Pier Shafts 381
910.06 Stone Paving Block 381
SECTION 911 – SIGNS, SIGN SUPPORTS, AND DELINEATORS 382
911.01 Signs 382
911.01.01 Materials 382
911.01.02 Fabrication 382
911.01.03 Packaging, Storing, and Shipping 383
911.01.04 Acceptance Inspection 383
911.02 Sign Supports 384
911.02.01 Steel “U” Post Sign Supports 384
911.02.02 Breakaway Sign Supports for Ground Mounted Signs 384
911.02.03 Non-Breakaway Sign Supports for Ground Mounted Signs 384
911.02.04 Timber Sign Supports 385
911.02.05 Mounting Materials for Overhead, Bridge-Mounted, and Cantilever Signs 385
911.03 Flexible Delineators 385
SECTION 912 – PAINTS, COATINGS, TRAFFIC STRIPES, AND TRAFFIC MARKINGS 386
912.01 Paints and Stains 386
912.01.01 Structural Steel Paint 386
912.01.02 Aluminum Paint 386
912.01.03 Coal Tar Epoxy Paint 386
912.01.04 Concrete Stain 386
912.02 Coatings 386
912.02.01 Galvanizing (Zinc Coating) 386
912.02.02 Epoxy Waterproofing 387
912.02.03 Asphalt Waterproofing 387
912.02.04 Coating for Non-Vegetative Surface 387
912.03 Permanent Traffic Stripes and Markings 387
912.03.01 Epoxy Traffic Stripes 387
912.03.02 Thermoplastic Traffic Markings 389
912.03.03 Raised Pavement Markers (RPM) 389
912.04 Temporary Traffic Stripes and Markings 389
912.04.01 Latex Paint 389
912.04.02 Removable Pavement Marking Tape 389

912.04.03 Temporary Pavement Markers 390
SECTION 913 – GUIDE RAIL, FENCE, AND RAILING 391
913.01 Beam Guide Rail 391
913.01.01 Rail Element 391
913.01.02 End Treatments 391
913.01.03 Posts and Blockouts 391
913.01.04 Rub Rail 391
913.01.05 Miscellaneous Hardware 391
913.02 Fence 391
913.02.01 Chain-Link Fence 391
913.02.02 Caution Fence 392
913.02.03 Snow Fence 392
913.03 Bridge Railing 392
913.03.01 Steel Railing 392
913.03.02 Aluminum Railing 392
SECTION 914 – JOINT MATERIALS 393
914.01 Preformed Joint Filler 393
914.02 Joint Sealer 393
914.03 Polymerized Joint Adhesive 393
914.04 Joint Assemblies 394
914.04.01 Preformed Elastomeric (Compression Type) 394
914.04.02 Strip Seal Expansion (Glandular Type) 394
914.04.03 Modular 395
SECTION 915 – TIMBER AND TIMBER TREATMENT 396
915.01 Sawn Timber Posts, Timber Spacers, and Routed Timber Spacers 396
915.02 Round Timber Piling 396
915.03 Dimension Lumber for Sheet Piling 396
915.04 Dimension Lumber, Timber, and Decking for Structures 396
915.05 Timber Treatment 396
915.06 Timber Connectors and Hardware 397
SECTION 916 – FIBERGLASS COMPOSITE MATERIALS 397
916.01 Fiberglass Reinforced Plastic Lumber 397
916.02 Fiberglass Reinforced Plastic Piles 399
916.03 Fiberglass-Concrete Composite Piles 401
SECTION 917 – LANDSCAPING MATERIALS 403
917.01 Topsoil 403
917.02 Soil Additives 404
917.02.01 Composted Sewerage Sludge 404
917.02.02 Compost 404
917.03 Fertilizer 404
917.04 Pulverized Limestone 405
917.05 Seed Mixtures 405
917.05.01 Grass Seed Mixtures 405
917.05.02 Wildflower Seed Mixture 406
917.05.03 Shipment and Certification 406
917.06 Mulch 407
917.06.01 Straw 407
917.06.02 Wood Cellulose Fiber 407
917.06.03 Shredded Wood and Wood Chip 407
917.06.04 Shredded Hardwood Bark 407
917.06.05 Stone 407
917.06.06 Gravel 407
917.07 Tackifiers 407
917.08 Topsoil Stabilization Matting 408
917.08.01 Type 1 Mat 408
917.08.02 Type 2 Mat – Erosion Control Mulch Blanket 408

917.08.03 Type 3 Mat – Turf Reinforcement Mat (TRM) 408
917.08.04 Type 4 Mat – Mechanically Bonded Fiber Matrix (MBFM) 408
917.09 Sod 409
917.10 Plant Materials 409
917.11 Miscellaneous Landscape Materials 414
917.11.01 Disinfectant 414
917.11.02 Antidesiccant 414
917.11.03 Herbicides 414
SECTION 918 – ELECTRICAL MATERIALS 414
918.01 Conduit and Fittings 414
918.02 Cable and Wire 415
918.02.01 Loop Detector Lead 415
918.02.02 Loop Wire 415
918.02.03 Multiple Lighting and Service Wire 415
918.02.04 Traffic Signal Cable 415
918.03 Bonding and Grounding Materials 415
918.04 Cable Connectors 416
918.05 Resin Splicing Kits 416
918.06 Electrical Tape 416
918.07 Cable Racks 416
918.08 Cast Boxes and Fittings 416
918.09 Cabinets 417
918.10 Panel Boards and Circuit Breakers 417
918.11 Photoelectric Controls 418
918.12 Pedestals, Poles, Transformer Bases, and Mast Bracket Arms 418
918.13 Tower Poles 418
918.14 Lamps 418
SECTION 919 – MISCELLANEOUS 419
919.01 Geotextiles 419
919.02 Sediment Control Bag 419
919.03 Hay and Straw 420
919.04 Gabion Wire Baskets 420
919.05 GeoMembrane Liner 420
919.06 Waterstops 420
919.07 Epoxy Bonding Compound 421
919.08 Water 421
919.09 Sodium Chloride (Rock Salt) 421
919.10 Sleeves 421
919.11 Epoxy Injection Material 421
919.12 Polyethylene Sheeting 421
919.13 Floating Turbidity Barrier 421
919.14 Detectable Warning Surface 422

DIVISION 1000 – EQUIPMENT 423

SECTION 1001 – TRAFFIC CONTROL EQUIPMENT 423
1001.01 Flashing Arrow Board 423
1001.02 Portable Variable Message Sign 423
1001.03 Traffic Control Truck with Mounted Crash Cushions 424
SECTION 1002 – COMPACTION EQUIPMENT 424
1002.01 Pneumatic-Tired Compactor 424
1002.02 Dynamic Compactor 424
1002.03 Steel-Wheel Roller 425
1002.04 Padfoot Roller 425
SECTION 1003 – HMA SITE EQUIPMENT 425
1003.01 Materials Transfer Vehicle (MTV) 425
1003.02 HMA Curb Machine 425

1003.03 HMA Paver 425
1003.04 Ultra-Thin Lift Paver 426
1003.05 HMA Compactor 426
1003.06 Vibratory Drum Compactor 427
1003.07 Bituminous Material Distributor 427
1003.08 Sealer Application System 427
SECTION 1004 – PILE DRIVING EQUIPMENT 427
1004.01 Impact Hammer 427
1004.02 Vibratory Hammer 428
1004.03 Leads and Followers 428
SECTION 1005 – CONCRETE SITE EQUIPMENT 428
1005.01 Pavement Forms 428
1005.02 Spreading and Finishing Machine 429
1005.03 Spreading and Finishing Machine for Concrete Bridge Decks 429
1005.04 Vibrator 429
1005.05 Slip-Form Paver 429
1005.06 Slip-Form (Extrusion) Machine 429
1005.07 Epoxy Resin Injection Equipment 430
SECTION 1006 – CONCRETE PAVEMENT REHABILITATION EQUIPMENT 430
1006.01 Breaker 430
1006.02 Seating Equipment 430
1006.03 Grout Pumping Unit 430
1006.04 Mixer 430
1006.05 Injection Device 431
1006.06 Lift Monitoring Equipment 431
1006.07 Deflection Testing Equipment 431
1006.08 Grinding Machine 431
1006.09 Scarification Equipment 431
SECTION 1007 – TRAFFIC STRIPING EQUIPMENT 431
1007.01 Epoxy Striping Unit 431
1007.02 Thermoplastic Applicator 432
1007.03 Traffic Stripe and Marking Removal Equipment 432
1007.04 Rumble Strip Cutting Machine 432
SECTION 1008 – MISCELLANEOUS EQUIPMENT 432
1008.01 Milling Machine 432
1008.02 Straightedge 432
1008.03 Mechanical Sweeper 433
1008.04 Pavement Saw 433
1008.05 Air Compressor 433
1008.06 Hot-Air Lance 433
SECTION 1009 – HMA PLANT EQUIPMENT 433
1009.01 HMA Plant 433
1009.02 HMA Trucks 440
SECTION 1010 – CONCRETE PLANT AND MIXING EQUIPMENT 440
1010.01 Batching Plant 440
1010.02 Concrete Trucks 442
1010.03 Mobile Mixer 443
1010.04 Small-Batch Mixer 444
SECTION 1011 – PRECAST AND PRESTRESSED CONCRETE PLANT EQUIPMENT 445
1011.01 Precast Plant 445
1011.02 Prestressed Plant 445
1011.03 ME's Office 445

NJDOT TEST METHODS 446

NJDOT A-1 – Mortar-Making Properties of Fine Aggregate 446
NJDOT A-2 – Determining Percentage of Mica in Fine Aggregate 446
NJDOT A-3 – Petrographic Analysis to Determine Lithological Composition of Coarse Aggregate 447
NJDOT A-4 – Determining Percent of Adherent Fines Present in Coarse Aggregate 448
NJDOT A-5 – Scratch Hardness Test for Coarse Aggregate Particles 449
NJDOT A-6 – Determining Gradation of Dense-Graded Aggregate Containing RAP 450
NJDOT B-1 – Falling Head Permeability Test for Asphalt-Stabilized Drainage Course 451
NJDOT B-2 – Sampling HMA Mixtures 452
NJDOT B-3 – Selecting Cores for Maximum Specific Gravity Testing in Air Voids Determination 453
NJDOT B-4 – Measuring Thickness of HMA Cores 454
NJDOT B-5 – Determining Composition of Hma Mixture Using Hot Bin Sample Analysis 454
NJDOT B-6 – Determining Percent of Air Voids in Open-Graded HMA 455
NJDOT B-7 – Determining Optimum Asphalt Content for Open-graded Friction Course (OGFC) 456
NJDOT B-8 – Determining Job Mix Formula for Modified Open-Graded Friction Course Mixes 456
NJDOT B-9 – Determining Asphalt Content for MOGFC Courses by Aggregate Surface Area 459
NJDOT C-1 – Determining Yield of Concrete Produced by Continuous-Mixing-Type Truck Mixers 460
NJDOT C-2 – Quick-Setting Patch Materials 461
NJDOT C-3 – Calcium Nitrite Presence in Plastic Concrete 462
NJDOT C-4 – Slump Flow Test and Visual Stability Index Test 463
NJDOT C-5 – Static Segregation of Hardened Self-Consolidating Concrete Cylinders 464
NJDOT R-1 – Operating Inertial Profiler Systems for Evaluating Pavement Profiles 465
NJDOT S-1 – Rotational-Capacity Test on Long Bolts in Tension Calibrator 466
NJDOT S-2 – Rotational-Capacity Test on Bolts Too Short to Fit Tension Calibrator 467
NJDOT S-3 – Veryifying Direct Tension Indicators (DTI) 468
NJDOT ST –Statistical Tables 469

DIVISION 100 – GENERAL PROVISIONS

SECTION 101 – GENERAL INFORMATION

101.01 INTRODUCTION

The 2007 Standard Specifications for Road and Bridge Construction are written to the Bidder before Award and to the Contractor after Award. Sentences that are written as commands are directed to the Contractor. For example, a requirement to construct a cofferdam would be expressed as, "Construct cofferdams to ensure the stability of the excavation and to keep the excavation free of water," rather than "The Contractor shall construct cofferdams to ensure the stability of the excavation and to keep the excavation free of water."

Titles and headings of sections and subsections are for convenience and do not bear on the meaning of the text. Whenever any Section, Subsection, Subpart, or Subheading is amended in the Special Provisions by such terms as changed to, deleted, or added, it is construed to mean that it amends that Section, Subsection, Subpart, or Subheading of the Standard Specifications.

When a publication is specified or referenced, if no issue or effective date for the publication is specified, use the issue or version of the publication that is current at the opening of bids.

101.02 ABBREVIATIONS

The following abbreviations are used in the Contract:

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AISC	American Institute of Steel Construction, Inc.
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
API	American Petroleum Institute
AREMA	American Railway Engineering and Maintenance-of-Way Association
ASCE	American Society of Civil Engineers
ASTM	ASTM (American Society for Testing and Materials) International
AWPA	American Wood Protection Association
AWS	American Welding Society
AWWA	American Water Works Association
CIAP	Construction Industry Advancement Program of New Jersey
CRSI	Concrete Reinforcing Steel Institute
DBE	Disadvantaged Business Enterprise
ESBE	Emerging Small Business Enterprise
EEI	Edison Electric Institute
EPA	United States Environmental Protection Agency
FED-STD	Federal Standard
FHWA	Federal Highway Administration
FSS	Federal Specifications and Standards, General Services Administration
HDPE	High-Density Polyethylene
HMA	Hot Mix Asphalt
HPC	High Performance Concrete
ICEA	Insulated Cable Engineers Association, Inc.
ISO	International Organization for Standardization
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
MSDS	Material Safety Data Sheet
MUTCD	Manual on Uniform Traffic Control Devices
NCHRP	National Cooperative Highway Research Program

NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NIST	National Institute of Standards and Technology
N.J.A.C.	New Jersey Administrative Code
N.J.S.A.	New Jersey Statutes Annotated
NJACI	New Jersey Chapter American Concrete Institute
NJDEP	New Jersey Department of Environmental Protection
NOAA	National Oceanic and Atmospheric Administration
NJDOT	New Jersey Department of Transportation
NPCA	National Precast Concrete Association
NTCIP	National Transportation Communications for ITS Protocol
OSHA	Occupational Safety and Health Administration
PCI	Precast/Prestressed Concrete Institute
PVC	Polyvinyl Chloride
QPL	Qualified Products List
RAP	Reclaimed Asphalt Pavement
ROW	Right-of-Way
SBE	Small Business Enterprise
SESC	Soil Erosion and Sediment Control
SI	International System of Units
SSPC	Society of Protective Coatings
UL	Underwriters Laboratories
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard

101.03 TERMS

When the following terms are used in the Contract, the meaning is as follows. If the term is capitalized, it is capitalized in the Specifications.

Acceptance. The written acceptance by the Department of the Work.

acceptance testing. Testing conducted by the Department to measure the degree of compliance to the Contract.

actual cost. The computed cost using calculations provided in 104.03.08.

addendum. A Contract revision or response to a Contractor inquiry issued after advertisement and before the opening of bids.

approval. The Department's written notification that a submission or portion of work is believed to be in conformance with the Contract.

as-built quantity. The quantity of a completed Item eligible for payment.

authorized funding amount. The amount of funds authorized by the Department for the Contract.

bridge. A structure, other than a culvert, including supports, erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads and having a length measured along the center of the structure of more than 20 feet between undercopings of abutments or extreme ends of openings for multiple boxes. Structure dimensions are defined as follows:

1. **bridge length.** The length of a bridge structure is the overall length measured along the line of survey stationing from back to back of backwalls of abutments, if present, otherwise end to end of the bridge floor; but, in no case less than the total clear opening of the structure.
2. **bridge width.** The clear width measured at right angles to the longitudinal centerline of the bridge between the bottom of curbs, or in the case of multiple height of curbs, between the bottoms of the lower risers or, if curbs are not used, between inner faces of parapet or railing.

Change Order. A written order issued by the Department to the Contractor after execution of the Contract authorizing one or more of the following:

1. Changes in the Work.
2. Modifications in the basis of payment.
3. Modifications to Contract Time.

Completion. When all of the following have occurred:

1. The Work has been satisfactorily completed in all respects according to the Contract.
2. The Project is ready for use by the Department as required by the Contract.
3. The Contractor has satisfactorily executed and delivered to the RE all documents, certificates, and proofs of compliance required by the Contract including the Notice of Completion.

construction operations. Physical construction of work done in the performance of the Contract within the Project Limits. Does not include off-site mobilization, procurement and off-site storage of materials and plants, engineering, performance bond and payment bond, surveys, working drawings, off-site field offices, schedules, certificates, forms, or documents.

Contract. The written integrated agreement between the Department and the Contractor setting forth the obligations of the parties, including, but not limited to, the performance of the Work and the basis of payment.

The Contract includes the advertisement, Proposal, Certification as to Publication and Notice of Advertisement for Proposal, bid, Appointment of Agent by Nonresident Contractors, Resolution of Award of Contract, Executed Form of Contract, performance and payment bonds, Specifications, Plans, Right-of-Way Plans, permits, boring logs, pavement core records, addenda, Change Orders, and Field Orders, all of which are to be treated as one instrument whether or not set forth at length in the form of Contract. Other information mailed or otherwise made available to the prospective bidders before the opening of bids is not part of the Contract unless specified as such.

Contract Time. The number of working days allowed to complete the work for a milestone or the date by which work must be completed, as provided in the Contract and as modified by Change Order. When Interim Completion and Completion requirements are specified as a specific date instead of the number of working days, achieve Interim Completion or Completion on or before that date.

Contractor. The individual, firm, partnership, corporation, or any acceptable combination thereof contracting with the Department for performance of the Contract. For the purpose of carrying out the Contract, it also means the Contractor's representative.

day. Every day shown on the calendar.

Department. The Department of Transportation of the State of New Jersey, as created by law, acting through duly authorized representatives, such representatives acting within the scope of the particular duties delegated to them.

Department Laboratory. The main testing laboratory of the Department at 930 Lower Ferry Road, P.O. Box 607 Trenton, New Jersey 08625, or such other laboratory as the Department may designate.

Estimate. Progress payment made to the Contractor by the Department.

Extra Work. New Work and quantity adjustments to Items that are not the result of as-built measurement or calculation.

Field Order. Written direction, signed by the RE, requiring action by the Contractor.

highway, street, or road. A general term denoting a public way for purposes of vehicular travel, including the entire area within the ROW (see Figure 101-1).

holiday. A legal holiday as defined by N.J.S.A. 36:1-1.

inspector. The Department's authorized representative assigned to inspect the Work for conformance to the Contract.

Interim Completion. A milestone other than "Completion of Work," requiring completion by a specified date or within a specified time.

Item. A specifically described portion of Work for which there is a unit or lump sum price. Items described in the Specifications are designated in all capital letters.

ME. The Department's Manager of the Bureau of Materials, or the Department's Regional Materials Engineer and their designated representatives.

land surveyor. A person who is legally authorized to practice land surveying in New Jersey according to the provisions of N.J.S.A. 45:8-27, *et seq*.

manufacturer's recommendations. Recommendations and instructions by the manufacturer including but not limited to the construction requirements, drawings, plans, and material requirements.

New Work. Work directed by the Department that is not covered under an existing Item or combination of Items in the Contract. Items established to provide payment modifications as specified in the Contract, such as damages, bonuses, and penalties, are not New Work.

Others. An individual or a legal entity other than the Contractor, the Surety, or an individual or a legal entity in a contractual relationship with the Contractor or the Surety. For example, the term "Others" may include the Department, a Utility, or another contractor on the Project.

pavement structure. The combination of pavement base courses, and when specified, a subbase course, placed on a subgrade to support the traffic load and distribute it to the roadbed (see Figure 101-1). These various courses are defined as follows:

1. **pavement.** One or more layers of specified material of designed thickness at the top of the pavement structure.
2. **base course.** One or more layers of specified material of designed thickness placed on the subgrade or subbase.
3. **subbase.** One or more layers of specified material of designed thickness placed on the subgrade.

plan. The Contractor's proposed methods of performing work including but not limited to materials, equipment, personnel, and schedules.

Plans. The advertised plans as amended by addenda and Change of Plan. This includes the version of the Standard Details specified on the key sheet.

Professional Engineer. A person licensed to practice engineering in the State of New Jersey.

Project. The specific section of highway or other public improvement constructed under the Contract. The Project may include work performed by Others.

Project Limits. The Project Limits are shown on the key sheet and modified as follows:

1. The areas of construction operations and areas used by the Contractor to perform the work. If only a portion of a lane or shoulder of a road is being constructed, the Project Limits include all lanes and shoulders of the roadway.
2. Where only one direction of a road is being constructed, and the road is divided by a median, island, or barrier curb, the Projects Limits include all of the lanes in that direction and the median. Otherwise, the Project Limits include all lanes in both directions.
3. The longitudinal Project Limits include all safety devices and signs excluding signs greater than 1600 feet outside the Project Limits shown on the key sheet.
4. Areas within the ROW provided for the Contractor's use.

Proposal. The schedule of Items and estimate of the various quantities and kinds of Work to be performed for which bid prices are invited. The Proposal also includes the location and description of the Project and the date and time of the opening of bids.

qualified products list (QPL). A list of specific qualified products maintained by the Department for use in the Work. The complete QPL is available at the following website:

http://www.state.nj.us/transportation/eng/materials/qualified

RE. The Department's field representative having direct supervision of the administration of the Contract.

Right-Of-Way (ROW). The land, property, or interest therein acquired for or devoted to transportation purposes or construction of a public improvement (see Figure 101-1).

Right-Of-Way Plans. The most current revisions of the General Property Parcel Maps and Entire Tract Maps approved for use in setting the existing and proposed ROW, including setting out or laying out the various easements within which Items are to be constructed or used to enable construction.

Specifications. The compilation of provisions and requirements for the performance of prescribed work contained in the Standard Specifications, Special Provisions, and Electrical Materials Specifications as modified by addenda.

State. The State of New Jersey.

subcontractor. An individual, firm, partnership, corporation, or any acceptable combination thereof, to which the Contractor subcontracts part of the Work pursuant to 108.01.

subgrade. The surface of the roadbed upon which the first layer of the pavement structure is constructed (see Figure 101-1).

Substantial Completion. When all work is complete, with the exception of landscaping Items listed in 811.04, removal of SESC measures, FINAL CLEANUP, and repair of unacceptable work; provided the RE has determined that:

1. The Project is safe and convenient for use by the public.
2. Failure to complete work and repairs excepted above will not result in the deterioration of other completed work.
3. The value of the remaining landscaping work, removal of SESC measures, repairs, and FINAL CLEANUP is less than 2 percent of the Total Adjusted Contract Price.

Superintendent. The Contractor's authorized representative responsible for and in charge of the Work and is authorized by the Contractor to receive all communications from the Department.

Surety. The individual, partnership, or corporation, other than the Contractor, that has provided a proposal bond, a performance bond, or a payment bond.

Testing Agency. A privately-owned facility capable of testing and evaluating component parts, or the whole, for certification of the composition or construction of the material or product. The testing agency must be an AASHTO-accredited laboratory for each field of accreditation and type of material to be tested.

Total Adjusted Contract Price. The Total Contract Price as it is adjusted through the issuance of Change Orders and the calculation of as-built quantities.

Total Contract Price. The correctly determined summation of lump sum bids and products of all quantities for Items shown in the Proposal multiplied by the unit prices bid.

traveled way. The portion of the roadway for the movement of vehicles exclusive of shoulders and auxiliary lanes (see Figure 101-1).

Utility. The company, agency, or other entity that provides services, including, but not limited to: electric, water, gas, sewer, fiber optic, communications, and railroad, and the Department with regard to its ITS and electrical facilities.

utility. The rails, lines, facilities, or systems owned by Utilities.

Work. Labor, services, materials, equipment, tools, transportation, supplies, and incidentals necessary or convenient for Completion by the Contractor of the construction described in the Contract and the carrying out of all duties and obligations imposed by the Contract wholly, or any portion thereof, on the Contractor.

work. Particular elements, Items, or portions of the Work.

working day. Any day, exclusive of:

1. Saturdays, Sundays, and holidays.
2. Days on which the Contractor is specifically required by the Contract to suspend construction operations.
3. Days on which the Contractor is prevented by any conditions beyond the control of the Contractor and adverse to the current controlling operation or operations, as determined by the RE, from proceeding with at least 75 percent of the normal labor and equipment force engaged on such operation or operations for at least 60 percent of the total daily time being currently spent on the controlling operation or operations for all shifts.

working drawings. Stress sheets, shop drawings, catalogue cuts, calculations, diagrams, illustrations, schedules, performance charts, brochures, and other supplementary plans or similar data prepared by the Contractor or subcontractors, manufacturers, suppliers, or distributors. The Contractor is required to submit working drawings, as specified in 105.05, for approval or certification.

101.04 INQUIRIES REGARDING THE PROJECT

Submit inquiries regarding discrepancies, errors, or omissions, or concerns regarding the intent or meaning of the Contract to the Department as follows:

1. **Before Award of Contract.** Submit inquiries by e-mail directly to the contact provided in the Special Provisions. Include the following with each inquiry:

    1. Name of the Bidder.
    2. Telephone number, fax number, e-mail address, and contact person.
    3. Specifics of the inquiry, including anticipated results.

    The deadline for submitting inquiries is 12:00 noon, 5 days before the opening of bids.

    The Department will investigate the information provided in the inquiry and, if the Department determines that a change or response is necessary, the Department will issue an addendum.

    Requests for postponement of bids will not receive a response. The Department will issue an addendum postponing bids if warranted.

2. **After Award of Contract.** Submit inquiries to the RE through the office specified in the Special Provisions.

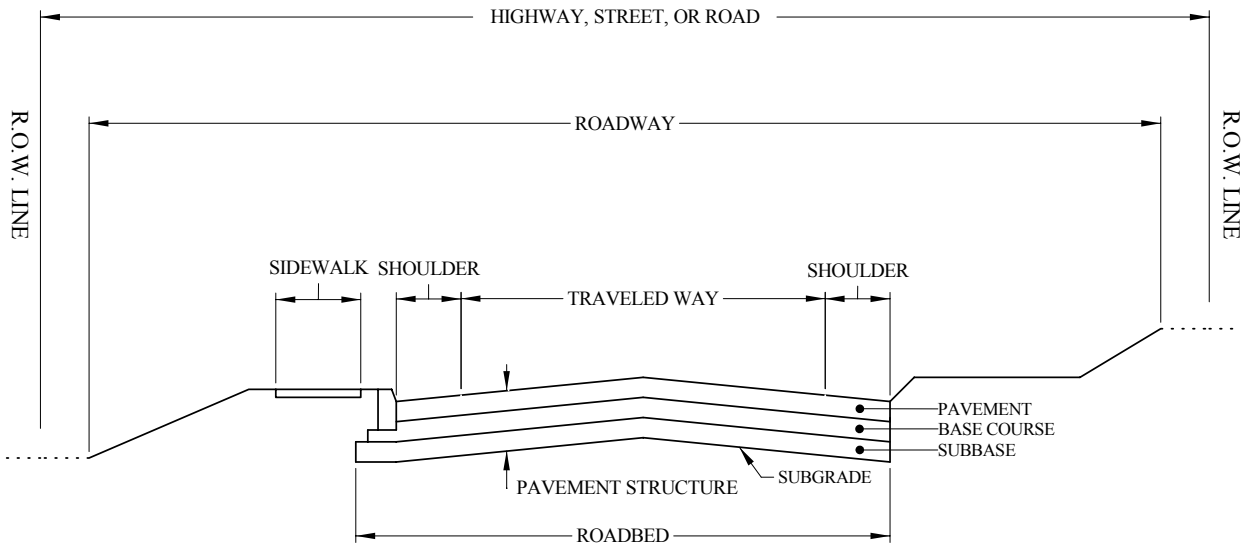
HIGHWAY, STREET, OR ROAD
R.O.W. LINE
ROADWAY
R.O.W. LINE
SIDEWALK
SHOULDER
TRAVELED WAY
SHOULDER
PAVEMENT
BASE COURSE
SUBBASE
PAVEMENT STRUCTURE
SUBGRADE
ROADBED

FIGURE 101-1

SECTION 102 – BIDDING REQUIREMENTS AND CONDITIONS

102.01 QUALIFICATION TO BID

The Bidder is an individual, firm, or corporation submitting a bid for the advertised Work. The Department will not accept bids from Bidders who fail to meet all of the following criteria:

1. The Bidder has been prequalified according to regulations covering the Classification of Prospective Bidders as required by N.J.S.A. 27:7-35.1, *et seq.*
2. Before delivery of the bid, the Bidder has disclosed ownership as required by N.J.S.A. 52:25-24.2.
3. At the time the bid is delivered, the Bidder has an effective maximum and project ratings of not less than the amount of its bid.
4. If the Bidder is a corporation not incorporated in the State, the Bidder has been authorized to do business in the State as required by N.J.S.A. 14A:15-2, *et seq*.
5. For wholly State funded projects, the Bidder is in compliance with N.J.S.A. 19:44A-20.13, *et seq.*
6. For wholly State funded projects, the Bidder has a valid business registration with the Division of Revenue in the New Jersey Department of Treasury as required by N.J.S.A. 52:32-44.
7. For wholly State funded projects, the Bidder has a valid, current registration with the New Jersey Department of Labor, Division of Wage and Hour Compliance as required by "Public Works Contractor Registration Act," N.J.S.A. 34:11-56.48, *et seq*.

102.02 BIDDER REGISTRATION AND DOWNLOADING OF THE PROPOSAL DOCUMENTS

This Contract is being bid by use of an electronic bidding process. Electronic bidding information is available on the Department's website. Registration and a subscription fee are required to access the Proposal documents. The Bidder shall download the bidding software. When installing the bid program, the Bidder enters its vendor code assigned by the Department. The Bidder shall not alter or in any way or change the software.

The Bidder shall download all Proposal documents from the Department's website. The Department assumes no responsibility for errors or omissions in the downloaded Proposal documents except as specifically provided for in the Contract. The Bidder shall direct questions or problems with downloading or using the electronic files to the contacts identified on the website.

102.03 REVISIONS BEFORE SUBMITTING A BID

The Department will only issue written, graphic, or electronic information to clarify, correct, or change the Proposal documents, Contract, or bidding notices as addenda posted on the website before the opening of bids. It is the obligation of the Bidder to check the Department's website for addenda. The Department will not post addenda less than 24 hours before the time set for the opening of bids, with the exception of addenda postponing the opening of bids.

The Bidder shall acknowledge all addenda posted through the Department's website before the opening of bids. The Department will not accept the bid if the Bidder has not acknowledged all addenda posted.

Certain addenda contain amendments. Amendments require revisions to the schedule of Items to be bid. The Bidder shall ensure that the schedule of Items to be bid submitted contains all applicable amendments. The Department has the right to reject bids that do not contain all applicable amendments to the schedule of Items to be bid.

102.04 EXAMINATION OF CONTRACT AND PROJECT LIMITS

The Bidder shall carefully examine the Contract and the Project Limits of the proposed Project before submitting a bid. The Bidder shall provide written notice to the contact specified in 101.04 of the Special Provisions, at least 24 hours in advance of any visits to the Project Limits. The Bidder shall ensure that staff visiting the Project Limits have proper identification.

If conditions of the Project Limits are inconsistent with the Contract or there are discrepancies, conflicts, errors, omissions, or ambiguities within the Contract, the Bidder shall immediately notify the Department as specified in 101.04. The Bidder shall evaluate subsurface conditions to determine how these conditions may affect the methods and cost and time of construction. The Bidder shall evaluate, with respect to possible material sources, the quality and quantity of material available, applicable regulatory requirements, and the type and extent of processing that may be required to produce material conforming to the requirements of the Contract. It is understood and agreed that the Bidder

has considered in its bid all of the permanent and temporary utilities in their present, new, or relocated positions to the extent required by the Contract and as revealed by its own investigations. It is also understood and agreed that the Bidder is aware that a Utility's service demands, field conditions, and emergencies may affect the Utility's ability to comply with the proposed schedules for utility work.

Items 1 through 3 below are not a part of the Contract and are made available for information only. The boring logs and pavement cores are part of the Contract, but any reports or interpretations of them are provided for information only. The Department makes no representation, warranty, or guarantee, expressed or implied, by making reports or interpretations available. It is the Bidder's responsibility to obtain the following information:

1. **Evaluation of Subsurface and Surface Conditions.** The Bidder may inspect the records of the Department's subsurface investigation through the Department's Engineering Documents Unit, 1035 Parkway Avenue, P.O. Box 600, Trenton, NJ 08625-0600. This investigation is not a substitute for the Bidder's own evaluation or judgment in preparing a bid. The Bidder should not rely on any estimates or quantities included in these investigations. The conditions indicated by such investigations or records thereof, and as shown by the cross-sections in the Plans may not be representative of those existing throughout such areas. The Bidder may encounter materials other than, or in proportions different from, those indicated.

   The soil and rock descriptions shown on the boring logs are determined by a visual inspection of samples from the various explorations, unless otherwise noted. The Department may make these samples available for nondestructive examination. The observed water levels and other water conditions indicated on the boring logs are as recorded at the time of the exploration. These levels and other conditions may vary considerably, with time, according to the prevailing climate, rainfall, and other factors. If a generalized soil profile is described in the text, it is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples.

   The Bidder is charged with knowledge of the State's physical geography and geology, and in performing its Project Limit evaluation is fully aware of the available publications on that subject matter.

2. **Utility Agreements.** In addition to what is specified in 105.07, the Bidder may inspect or request the Utility agreements, modifications, and orders relating to the Contract through the Department's Division of Project Management, 1035 Parkway Avenue, P.O. Box 600, Trenton, NJ 08625-0600. The Bidder shall obtain information regarding existing utilities, proposed construction of utilities, or relocation of utilities through the respective Utility.

3. **Existing Plans and As-Builts.** The Department will provide a list of existing structures within the Project on the Plans. The Department will list the existing plans and as-builts used in the development of the Contract in the Special Provisions. The Bidder may inspect as-built plans of Department-owned facilities or order copies upon written request through the Engineering Documents Unit. Contour maps may be available for some Projects. Bidders may inspect such maps, or the Bidder may obtain copies for their use upon written request to the Engineering Documents Unit. The Bidder shall obtain plans of municipality-owned or county-owned facilities through the municipality or county. The Bidder shall verify information obtained from the existing documents with regard to its application to bidding and performing the Contract.

Submission of a bid is confirmation that the Bidder has made an independent evaluation and examination and is fully aware of the requirements of the Contract, including all restrictions. Further, the Bidder warrants that the bid prices include all costs to complete the Work.

102.05 INTERPRETATION OF QUANTITIES IN THE PROPOSAL

The quantities appearing in the Proposal are estimates. The Department has a right to increase or decrease the quantities of Work, or has the right to eliminate Items in their entirety, at its sole discretion.

The Department will pay only for the quantities of work completed as specified in the Contract.

102.06 "IF AND WHERE DIRECTED"

The Proposal may include Items for which the Department has designated quantities as "if and where directed." The estimated quantities set out in the Proposal for "if and where directed" quantities are presented for the purpose of

obtaining a representative bid price, but are not indicative of the Department's intent regarding incorporation into the Project. The RE has the right to direct the Contractor to perform work using "if and where directed" quantities.

102.07 PREPARATION OF THE BID

The bid is the completed Proposal documents that are submitted by the Bidder to the Department at the time for the opening of bids. The Bidder shall submit a bid produced from the software that was downloaded from the Department's electronic bidding website. The Bidder shall include all addenda in the bid. The Bidder shall specify a price in numerals for each Item. The Bidder shall insert the price in the box provided for the lump sum Item under the column designated as "Amounts." For unit price Items, the Bidder shall insert the per unit price under the column designated "Unit Price" in the appropriate box at the location provided therefore. When the Bidder intends to bid zero ($0.00) for an Item, the Bidder shall insert a "0" in the "Unit Price" and "Amounts" columns for unit price Items or in the "Amounts" column for lump sum Items.

Where no numeral is provided by the Bidder in either the "Unit Price" or the "Amount" columns for one or more Items, or where no figure is provided in the "Amount" column for one or more lump sum Items, the Department will consider the amount bid to be zero ($0.00) for that Item.

When the Proposal contains alternate Items, the Bidder shall insert only the unit price and amount for the lowest priced alternate Item. When alternate Items in the Proposal have a lump sum pay quantity, the Bidder shall insert only the amount for the lowest priced alternate Item. The Bidder shall construct the alternate Item for which a price has been provided. When the Proposal contains groups of alternate Items, the Bidder shall insert only the unit price and amount for each Item within the lowest priced alternate group. The Bidder shall construct the alternate group of Items for which a price has been provided.

The only entries permitted in the bid are the unit or lump sum prices for Items to be bid. The software will perform all extensions of the unit or lump sum prices and calculate the total bid amounts.

The Bidder shall check the bid before submission using the software. The Bidder shall select "tools" and then select "check bid" and ensure that there are no errors before submitting the electronic bid. For bids submitted by Joint Ventures select "tools" from the software menu and mark the electronic bid as "Joint Bid." The Bidder may print a completed bid for its records after completing the bid.

102.08 BALANCED BIDS

The Bidder shall reflect in the bid price for each Item the cost the Bidder anticipates incurring for the performance of that Item, together with a proportional share of the Bidder's anticipated profit, overhead, and costs to perform work for which no Item is provided.

102.09 PROPOSAL BOND

The Proposal Bond guarantees execution of the Contract by the Bidder receiving Award.

With the bid submission, the Bidder shall complete the electronic bond form. The Proposal Bond must be satisfactory to the Department and for a sum of 50 percent of the total bid amount.

The Bidder shall ensure that the Proposal Bond is properly completed and furnished by a surety authorized to do business in the State as are listed in the current US Treasury Department Circular 570 as of the date for opening of bids for the particular Contract and are authorized to issue bonds in at least the amount of the Proposal Bond.

The Bidder shall ensure that the Proposal Bond has a power of attorney executed by the Surety. The power of attorney shall set forth the limits of authority of the attorney-in-fact who has signed the bond on behalf of the Surety to bind the company and shall further certify that such power is in full force and effect as of the date of the bond.

The Department will not accept Proposal Bonds that do not comply in all respects with the provisions of N.J.A.C. 16:44-5.1(d) and that are not substantiated by a valid power of attorney executed by the Surety.

102.10 SUBMISSION OF BIDS

Once the Bidder has completed its bid and made all desired changes, the Bidder shall submit the electronically signed bid via the internet using the appropriate software. An authorized representative of the Bidder is required to digitally sign

the bid. Information regarding digital signatures is available on the Department's website. The Department may reject internet bids that are not digitally signed by the authorized representative of the Bidder with an approved digital signature.

The Bidder shall ensure delivery of its bid with all required components and attachments, including, but not limited to the following:

1. Schedule of Items.
2. Updated Financial Statement (Form DC-74B).
3. Proposal Electronic Bidding File with Bidder's Certification.
4. For wholly State funded contracts, acknowledgement of compliance with the registrations specified in 102.01.
5. For wholly State funded contracts, acknowledgement of compliance with N.J.S.A. 19:44A-20.13, *et seq.*
6. Proposal Bond form.
7. Other related documents as specified in the Contract.

When the Bidder submits bids for 2 or more Contracts that the Department will open on the same day, the Bidder may submit a single Updated Financial Statement instead of a separate statement for each Contract.

The Bidder is solely responsible for any and all errors and for timely submission of the bid, all components thereof, and all attachments thereto, through the electronic bidding system; the Department assumes no responsibility for any claim arising from the failure of any Bidder or of the electronic delivery system to cause any bid, bid component, or attachment to not be delivered to the Department on or before the time set for the opening of bids.

102.11 WITHDRAWAL OF BIDS

A Bidder may withdraw a bid after it has been submitted to the Department, provided the request for such withdrawal is received by the Department on the Request for Withdrawal of Bids Form, in writing or by fax, before the time set for bid opening. The Bidder may obtain the Department's Request for Withdrawal of Bids Form from the electronic bidding website.

102.12 PUBLIC OPENING OF BIDS

The Department will open and read bids publicly at the time and place indicated in the advertisement or such other time and place as established by addenda. The Department invites Bidders, their authorized agents, and other interested parties to be present.

102.13 CONSIDERATION OF BIDS

The Department reviews bids for conformity with the Contract and compares bids on the basis of the correctly determined summation of the correctly determined products of all the quantities for Items shown in the bid multiplied by the unit prices bid together with the sums bid for lump sum Items. The Department will make the total bid amount for all bids available.

102.14 IRREGULAR BIDS

The Department will consider a bid irregular and will reject it if the Department determines that the bid contains a material defect.

102.15 DISQUALIFICATION OF BIDDERS

The Department will disqualify a Bidder and reject a bid submitted by that Bidder if the Bidder is determined by the Department to lack responsibility. Factors demonstrating a lack of responsibility include, but are not be limited to:

1. Evidence of collusion among Bidders.
2. Uncompleted work, which in the opinion of the Department, might hinder or prevent completion of additional work if awarded.
3. Failure to satisfy the pre-award requirements for DBE or ESBE as specified in the Special Provisions for Federally funded contracts.
4. Failure to satisfy the pre-award requirements for SBE as specified in the Special Provisions for wholly State funded contracts.

5. Submission of a materially unbalanced bid. A materially unbalanced bid is a bid where there is a reasonable doubt that award to the Bidder submitting a mathematically unbalanced bid, which is structured on the basis of nominal prices for some work and inflated prices for other work, will result in the lowest ultimate cost to the Department.
6. Lack of competency or lack of adequate machinery, plant, or other equipment.
7. Unsatisfactory performance on previous or current contracts.
8. Questionable moral integrity as determined by the Attorney General of New Jersey or the Department.
9. Any other outward actions or lack of action that demonstrates the Bidder is not responsible.
10. Disqualification, suspension, or debarment of an individual, firm, partnership, corporation, or any combination as required by N.J.S.A. 16:44-8.1.

102.16 REJECTION OF ALL BIDS

The Department has the right to reject all bids when the Department deems it advisable to do so in the best interest of the State or public.

SECTION 103 – AWARD AND EXECUTION OF CONTRACT

103.01 AWARD OF CONTRACT

The Department will award the Contract to the lowest responsible Bidder whose bid conforms in all respects to the requirements set forth in the Contract. The Department will award the Contract based on the Total Contract Price. The Department will award the Contract or reject all bids within 30 State Business Days after the bids are received. The Department may conditionally award the Contract pending the approval of the Federal Government, another State governmental body, or private party. If the Department does not award the Contract or conditionally award the Contract within 30 State Business Days, all Bidders have the right to withdraw their bids. However, the Department, with the agreement of the lowest responsible Bidder, the second lowest responsible Bidder, or both Bidders, may extend the time that the Department may make an Award or Conditional Award by mutual consent.

At the time of Award or Conditional Award, if the Bidder is not a resident of the State, such Bidder shall appoint, on the form provided by the Department, a proper agent located in the State on whom service of process can be made in the event of litigation of any type arising under the Contract or as a result of performance of the Contract. Said agency shall remain in effect during the performance of the Contract and for 6 years following Acceptance.

The Award or Conditional Award is not binding upon the Department until the Department has executed the Contract. No person shall perform any Work in furtherance of the Contract until notified that the Contract has been executed, and then only as specified in 108.02.

The term "State Business Day" as used in this Subsection is synonymous with the term "Working Day" as used in N.J.S.A. 27:7-31 and N.J.S.A. 27:7-33 and is any day exclusive of Saturdays, Sundays, State recognized legal holidays, and such other holidays or State office closings as declared by the State.

103.02 CANCELLATION OF AWARD

The Department reserves the right to cancel an Award or Conditional Award at any time before the execution of said Contract by all parties without incurring any liability of any kind.

103.03 RELEASE OF PROPOSAL BOND

The Department will release all Proposal Bonds except those of the 2 lowest Bidders within 5 days after opening of bids.

The Department will release the Proposal Bond of the lowest and next lowest Bidders when the Contract and performance bond and payment bond have been executed and delivered as specified in 103.04, or, if not executed, when other disposition of the matter has been made by the Department.

103.04 EXECUTION OF THE CONTRACT

Within 14 days of the date of Award or Conditional Award, the Bidder shall properly and duly execute the Contract and deliver to the Department the following:

1. If escrowing bid documents, the custody agreement as specified in 103.05.
2. Performance bond and payment bond as specified in 151.03.01.
3. Request for Authorization Form for the New Jersey Pollutant Discharge Elimination System 5G3 – Construction Activity Stormwater General Permit (NJG0088323) when required as shown on the Plans.
4. Proof of the registrations specified in 102.01 for the Department of Treasury and the Department of Labor.
5. For wholly State funded projects, all completed Certification/Disclosure Forms for compliance with N.J.S.A. 19:44A-20.13, *et seq.*
6. If the case of non-resident Bidders, the completed form regarding "Appointment of Agent" for compliance with N.J.S.A. 14A:15-2, *et seq*.

If the Contract is not executed by the Department within 60 days following receipt from the successful Bidder of the signed Contract and the performance bond and payment bond, the successful Bidder may withdraw its bid without penalty. Where the Bidder chooses not to withdraw its bid before the Department executes the Contract, the Bidder shall be deemed to have waived any claim for additional payment or for an extension of time. The Contract does not become effective until it has been fully executed by all parties.

103.05 ESCROW OF BID DOCUMENTS

A. Purpose. The bid documents are the supporting information, calculations, quotes, and other information used to prepare the bid. The Department may use the Contractor's bid documents to negotiate changes and claims if they are escrowed and a signed custody agreement is provided. The information contained in the bid documents does not modify the terms and conditions of the Contract. If the Contractor fails to escrow bid documents within the time specified in 103.04, the Department will not make payment for a disproportionate allocation of costs for work for which no Item is provided in the Contract, as specified in 102.08, in the renegotiation of costs of Items when there is a major decrease in quantity as specified in 104.03.03.

B. Stipulations and Acknowledgements. Escrowed bid documents are the property of the Contractor and are not public records. If a third party requests a copy of the escrowed bid documents, the Contractor, and not the Department, must take the legal steps needed to defend the confidentiality of the escrowed bid.

C. Form and Contents. The Department will consider escrowed bid documents reliable only if information is provided for all Items, and the total cost shown in the bid documents for each Item equals the bid price for the Item.

The Contractor may submit escrowed bid documents in its usual cost-estimating format. It is not the intent of the Department to cause the Contractor to expend additional effort in preparing its bid.

D. Custody. Escrow bid documents in sealed boxes with a custody agent, and provide a copy of the fully executed custody agreement provided by the Department. Include with the custody agreement a certification that the escrowed bid documents have not been modified, corrected, or otherwise revised in any manner after the opening of bids.

The Department may access the escrowed bid documents with the Contractor's written authorization.

After Acceptance and upon request from the Contractor, the Department will provide a release for the bid documents provided that there are no pending claims.

103.06 FAILURE TO EXECUTE CONTRACT

Failure on the part of the Bidder, to whom the Contract has been awarded, to execute the Contract as specified in 103.04, in the manner and within the time specified, is just cause for annulment of the Award or Conditional Award and for the exclusion of the Bidder from bidding on subsequent projects for such period as the Department deems appropriate. If the Award is annulled, the Proposal Bond, as specified in 102.09, is forfeited, and the Department has the right to recover under the terms and provisions of the Proposal Bond. The Department has the right to award the Contract to the next lowest responsible Bidder, or to readvertise and construct the Work under the Contract, or otherwise, as the Department decides in its sole discretion.

The successful Bidder may file with the Department a written notice, signed by the Bidder or the Bidder's authorized representative, stating that the Bidder refuses to execute the Contract. The filing of such notice has the same force and effect as the failure of the Bidder to execute the Contract and furnish a performance bond and payment bond within the time specified in 103.04.

103.07 ACQUISITION OF DOCUMENTS

After the Award, additional sets of the Plans or additional copies of the Special Provisions are available to subscribers through the Department's website or upon request to the Department's Engineering Documents Unit, at a charge according to the Department rate.

SECTION 104 – SCOPE OF WORK

104.01 INTENT

The intent of the Contract is for the Contractor to construct the Work to be functionally complete and aesthetically acceptable. Perform work that may be reasonably inferred from the Contract as being required to produce the intended result under the Items of the Contract. Perform the Work using the best construction practices and provide materials and workmanship of the first quality to meet the Contract requirements.

Perform the Work to ensure the least possible obstruction to traffic, while adhering to the highest safety standards, and with the least inconvenience to local residents and the general public.

104.02 VALUE ENGINEERING

104.02.01 Purpose and Scope

The intent of value engineering (VE) is to promote Contractor innovation, for which the Department will share with the Contractor 50 percent of the value of cost savings generated as a result of a Department approved VE proposal.

The Department will only consider VE proposals that produce a cost savings to the Department without, in the sole judgment of the Department, impairing essential functions or characteristics of the Project. Essential functions that cannot be adversely impacted include, but are not limited to, safety, service life, economy of operation, ease of maintenance, environmental compliance, and desired appearance. The Department will not consider VE proposals that change the Project's original design criteria; merely eliminate work; are based on an unknown factor; do not show a cost savings; or extend Contract Time.

104.02.02 Conditions

The Department will consider VE proposals only after Award of the Contract and only in accordance with the following terms and conditions:

1. In the event that the Department rejects a VE proposal during any step of the process, the Contractor is required to complete the Work as specified in the Contract. The Contractor recognizes that the Department has the right to reject VE proposals and cannot base its bid on the anticipated approval of a VE proposal.
2. All VE proposals, approved or not approved by the Department for use in the Contract, apply only to the ongoing Contract or Contracts referenced in the VE proposal. The VE proposals shall become the property of the Department and shall contain no restrictions imposed by the Contractor on their use or disclosure. The Department will have the right to use, duplicate, and disclose in whole or in part any data necessary to use the VE proposal. The Department retains the right to use any accepted VE proposal or part thereof on any other or subsequent project without any obligation to the Contractor. This provision is not intended to deny rights provided by law with respect to patented materials or processes.
3. If the Department already has under consideration certain revisions to the Contract that are subsequently incorporated in a VE proposal, the Department will reject the Contractor's VE proposal and has the right to proceed with such revisions without obligation to the Contractor.

4. The RE will determine whether a VE proposal qualifies for consideration and evaluation by the Department, including whether the savings generated by the VE proposal are sufficient to warrant review and processing. The Department may still reject a final VE proposal after approval of the initial VE proposal.
5. The RE has the right to reject all or any portion of work performed according to an approved VE proposal if the RE determines that results do not meet the requirements of the VE proposal or the Contract. The RE has the right to direct the removal of such rejected work and require the Contractor to proceed according to the original Contract. If the Contractor is directed to proceed according to the original Contract, the Department will not make payment for the rejected work performed under the VE proposal, or for its removal. The Contractor is responsible for the consequential costs arising from the rejected work to complete the work as proposed under the original Contract, including the cost to Others.
6. The Contractor may only submit VE proposals based on Items scheduled to be performed by the Contractor. The Department will not consider anticipated cost savings based on revisions to utility relocations or other work to be performed by Others. The Contractor is responsible to obtain the concurrence of Utilities, property owners, governing bodies, and agencies for any work affected by the VE proposal. The Department has the right to reject VE proposals that may increase the time or cost of work done by Others.
7. In calculating the value of cost savings, the Department has the right to disregard the Contract bid prices, if such prices do not represent the value of the work to be performed or to be deleted, and has the right to calculate the savings based on reasonable costs for such work.
8. Ensure that VE proposals are designed according to the Department design manuals and other Department standards for the proposed work.
9. If additional information is needed to evaluate VE proposals, provide this information in the Department specified time period, otherwise the Department will reject the VE proposal. Additional information may include, where design changes are proposed, results of field investigations and surveys, design computations, and field change sheets.
10. The Department will not deduct the Department's costs for review and processing of the VE proposal from the cost savings.
11. The Department will not make payment for the Contractor's costs for development and submission of the VE proposal. The Contractor waives its right to claim for costs or delays incurred due to the Department's review or rejection of a VE proposal. These costs include, but are not limited to, development costs, loss of anticipated profits, or increased material or labor costs resulting from delays in the review of such VE proposal.
12. The Department will not use the value of cost savings for: additional vehicle operating and delay costs incurred by the traveling public, compared to normal operating conditions, resulting from the establishment of construction, maintenance, or rehabilitation work zones (road user costs), or for costs to oversee the Project (construction engineering costs).
13. The Contractor may submit VE proposals for an approved Subcontractor, provided that payment is made by the Department to the Contractor and that the terms of the payment to the Subcontractor are satisfactorily negotiated and accepted before the proposal is submitted to the Department. Submit revised agreements as specified in 108.01.1. Subcontractors may only submit a VE proposal through the Contractor.

104.02.03 Submittals

The Contractor may submit VE proposals electronically. With electronic submissions, submit the appropriate attachments and a printed copy.

If the initial VE proposal is only submitted in printed form, provide at least 3 sets of documents. If the final VE proposal is only submitted in printed form, the Department will designate the required number of sets of documents.

Submit initial and final VE proposals as follows:

1. **Initial VE Proposal.** Submit to the RE an initial VE proposal outlining the general technical concepts associated with the VE proposal and the estimated savings that will result.

   The Department will review the initial VE proposal and, if found to be conceptually acceptable, will grant approval to submit a final VE proposal. A finding of conceptual acceptability of the initial proposal in no way obligates the Department to approve the final VE proposal.

2. **Final VE Proposal.** The Department will consider a final VE proposal only after the approval of the initial VE proposal. With each final VE proposal, submit, at a minimum, to the RE the following information:

    1. A statement that the final VE proposal is submitted as a VE proposal with a reference to the approval of the initial VE proposal.
    2. A description of the differences between the existing Contract requirements and the proposed change, and the comparative advantages and disadvantages of each. Document the effects on safety, service life, economy of operations, ease of maintenance, environmental requirements, and desired appearance.
    3. Complete plans, specifications, and calculations showing the proposed changes relative to the original Contract features and requirements. Ensure that plans and engineering calculations are signed and sealed by a Professional Engineer.
    4. A complete cost analysis indicating the final estimated costs and quantities to be replaced by the VE proposal, the new costs and quantities generated by the final VE proposal, and the cost effects of the proposed changes on operational, maintenance, and other considerations.
    5. An evaluation of the effect the final VE proposal has on Contract Time, including a revised schedule and a time impact evaluation as specified in 108.11.01.C.
    6. A description of any previous use or testing of the final VE proposal on another Department project or elsewhere and the conditions and results. If the final VE proposal was previously submitted on another Department project, indicate the date, the project, and the action taken by the Department.
    7. A letter of concurrence to the VE proposal from Others that are affected.
    8. The specific date that the Change Order adopting the final VE proposal must be executed to obtain the maximum cost reduction. Ensure that this date allows the Department ample time, usually a minimum of 60 days, for review and processing a Change Order. If the Department finds that there is insufficient time available for review and processing, it has the right to reject the final VE proposal solely on such basis. If the Department fails to respond to the final VE proposal by the date specified, the Contractor shall consider the final VE proposal rejected and shall make no claim against the Department as a result thereof.
    9. Additional information requested by the Department.

104.02.04 Final Documents

If the final VE proposal is approved, submit working drawings for approval. The Department will designate the number of sets to be submitted.

104.02.05 Payment

If the VE proposal is approved, the Department will issue a Change Order incorporating the VE proposal and establishing payment for the cost savings.

The Department will make payment to the Contractor for 50 percent of the cost savings from the VE proposal. It is understood that the payment includes all costs resulting as a consequence of the change, including but not limited to quantity increases to Items, and unanticipated work or expenses arising out of the change.

104.03 CHANGES TO THE CONTRACT

104.03.01 Authority to Make Changes

The Department has the right to make changes to the Work at any time, including altering the Contract, altering the requirements of an Item, increasing or decreasing the quantities of any Item, or deleting any Item. Such changes neither invalidate the Contract, nor release the Surety. The Contractor agrees to perform the Work as changed.

The Contractor may request changes to the Contract.

The Department will direct changes using a written Field Order or Change Order as follows:

1. **Field Orders.** The RE has the right to unilaterally direct Contractor performance with a written Field Order. Upon receipt of a Field Order, proceed as directed by the Field Order. A Field Order will state whether the

directions provided by the Field Order are eligible for payment or modification of Contract Time. The Department will provide such payment or modification to Contract Time in a subsequent Change Order.

2. **Change Orders.** The Department will modify the Contract with a Change Order.

   The Department has the right to unilaterally make the following changes: make minor increases or decreases in quantity; modify Contract Time as specified in 108.11; direct New Work to be performed on a force account basis; and establish payment modifications for damages, credits, bonuses, and penalties provided for in the Contract.

   For changes that require the Contractor's assent, the RE will negotiate the terms of the change and the Department will offer a Change Order. If the Contractor accepts the offer, the Contractor will sign the Change Order, whereupon the Department may approve and issue the Change Order. By signing a Change Order, the Contractor agrees that the Change Order constitutes the full extent of the agreement between the Department and the Contractor, including the full extent of payment and modified Contract Time for the work and for any effects upon all and any part of the Work, and supersedes any prior written or oral agreement between the parties. Additionally, the Contractor acknowledges the sufficiency and propriety of the consideration for the work detailed in the Change Order, and understands that the agreement is binding.

   Upon receipt of an approved Change Order, proceed as directed by the Change Order.

Do not deviate from the requirements of the Contract unless and until a Field Order is issued by the RE or a Change Order is approved by the Department.

Notwithstanding the issuance of a Field Order or Change Order, do not expend or cause to be expended any sum in excess of the Contract's current authorized funding amount. The Department will notify the Contractor when the authorized funding amount for the Contract has been modified. Any expenditure by the Contractor that exceeds the Contract's authorized funding amount is at the Contractor's risk and the Contractor waives any right to recover from the Department any sum in excess of the amount appropriated.

104.03.02 Protests to Change Orders

If the Contractor disagrees with any terms or conditions set forth in a Change Order, submit a written protest to the Department within 15 days after the date of receipt of the Change Order.

A protest is notice that the terms and conditions for proposed work are not in accordance with the Contract, quantity adjustments are incorrect, or that the modification for Contract Time is incorrect. A protest is not a substitute for notice as specified in 104.03.04. Providing a protest within 15 days after the date of the receipt of a Change Order may not meet the requirements of 104.03.04 or N.J.S.A 59:13-5 and the Department will not make payment for the costs of a claim if recovery is barred by other provisions in the Contract.

In the protest, list the points of disagreement, and, if possible, the specification references, quantities, and costs involved. Ensure that the protest is a specific, detailed statement of the points of disagreement. The Department will reject general protests. If the Department rejects a protest for being a general protest, provide a specific, detailed statement within 7 days of such rejection.

If an acceptable written protest is not submitted within 15 days after the date of receipt of the Change Order or within 7 days of the initial rejection, the Department will make payment and modify Contract Time as set forth in the Change Order. Such payment is full payment for all work included or required by the Change Order and is conclusive as to any Contract Time modifications provided for therein or in establishing that no Contract Time modification was warranted.

For Change Orders that require the Contractor's assent, if the Department processes the Change Order within 15 days of receiving the Contractor's signature, the Contractor is barred from protesting the approved Change Order.

Protest does not relieve the Contractor from the obligation to proceed with work directed by an approved Change Order.

104.03.03 Types of Changes

The Department will address all changes under one or a combination of the following types:

1. **Quantity Increases and Decreases.** The Department has the right to increase or decrease the quantities of work to be performed. If the quantity of an Item is cumulatively increased or decreased by 25 percent or less

from the Proposal quantity, the Department will consider the quantity adjustment to be a minor change in quantity. If the quantity of an Item is cumulatively increased or decreased by more than 25 percent from the Proposal quantity, the Department will consider the quantity adjustment a major change in quantity. For the purpose of this subsection, the term "Proposal quantity" is the quantity indicated in the Proposal less the quantities designated on the Plans as "if and where directed."

For minor changes in quantity, the Department will make payment for the quantity of the Item performed at the bid price for the Item.

For major increases in quantity, the Department or the Contractor may request to renegotiate the price for the quantity in excess of 125 percent of the Proposal quantity. For Items that are measured by Unit, the Department will not renegotiate a price for a fraction of a Unit, rather a Unit is eligible for renegotiation if it causes the quantity to be in excess of 125 percent of the Proposal quantity. If a mutual agreement cannot be reached on a renegotiated price, the Department will make payment by force account as specified in 104.03.08.

For major decreases in quantity, the Department or the Contractor may request to renegotiate the price for the quantity of work performed. If a mutual agreement cannot be reached on a renegotiated price, the Department will make payment by force account as specified in 104.03.08. However, the Department will not make payment in an amount that exceeds 75 percent of the value of the bid price multiplied by the Proposal quantity.

The Department will consider making payment for costs attributed to a disproportionate allocation of costs for work for which no Item is provided in the Contract if the Contractor has escrowed its bid documents as specified in 103.05. The Department will not make payment for lost anticipated profits.

If the cost (C) is less than $5000, the Department will not make a modification, and will make payment for the quantity of the Item performed at the bid price. Calculate C as follows:

$$C = Q \times (P_B - P_R)$$

Where:
C = Cost.
P_B = Bid price.
P_R = Renegotiated price.
Q = Quantity of work performed at the renegotiated price.

If a change results in a major change in quantity and results in a renegotiated price for the quantity in excess of 125 percent from the Proposal quantity, the RE will determine the locations of which work is to be performed at the renegotiated price and which locations of work is performed at the bid price. For subsequent increases in quantities, perform the work at the renegotiated price. However, if the quantities of subsequent increases exceed 25 percent of the Proposal quantity and 25 percent of the adjusted quantity for the Item at the renegotiated price, either party may request to re-renegotiate the price for the excess quantity. When the locations of the work to be performed at a renegotiated price are established, subsequent decreases in quantities of work at the bid price will not affect the quantity of work at the renegotiated price.

Deleted work is work deleted from the Contract by decreasing the quantity of an Item, except the provisions for deleted work do not apply to quantities designated as "if and where directed."

If the Department deletes work from the Contract, immediately cancel orders for materials for that Item. If the Contractor has ordered acceptable material for work deleted from the Contract before the date the RE notified the Contractor that the work was deleted and the material cannot be returned to the vendor, the Department will make payment based on the cost of the material, as evidenced by paid invoices. In that event, the Department becomes the owner of the material, and the Contractor will deliver the material to a location as directed by the RE. The Department will only make payment for material that meets the requirements of the Contract.

If the Contractor has ordered acceptable material for work deleted from the Contract before the date the RE notified the Contractor that the work was deleted, the material is returnable to the vendor, and the RE directs the material be returned, the Contractor shall return the material. The Department will make payment for actual vendor charges for returning and restocking the material.

For deleted work, the Department will make payment for material costs and vendor restocking charges as specified in 104.03.08; except that the Department will not apply profit, and the total payment may not exceed the bid price multiplied by the deleted quantity. If the Department directs the material to be delivered to a designated location, the Department will make payment for the associated handling and delivery costs. If a price for these handling and delivery costs cannot be agreed upon, the Department will make payment by force account as specified in 104.03.08.

When the entire quantity of an Item is designated "if and where directed," and is increased by more than 100 percent of the Proposal quantity, the Department or the Contractor may request to renegotiate payment for the quantity in excess of 200 percent of the Proposal quantity. If a mutual agreement for a renegotiated price cannot be achieved, the Department will make payment by force account as specified in 104.03.08.

When the entire quantity of an Item is designated "if and where directed," and is decreased by any amount, the Department will make payment for work performed at the rate of the bid price. When the entire quantity of an Item is designated "if and where directed," and is deleted, the Department will not make a modification, and will not make payment for the quantity of the Item performed at the bid price.

2. **New Work.** When requested by the RE, submit to the RE a detailed cost proposal for performance of New Work. If a price for a New Work cannot be mutually agreed upon, the Department will make payment by force account as specified in 104.03.08.

3. **Changes in the Character of Work.** A change in the character of work is a change that causes the work to substantially differ in kind or nature from the original proposed construction. The Department may make payment for a change in the character of work whether the change directly causes a change in the character of the work or causes other work to become significantly different in character. Efficiencies or inefficiencies resulting from minor increases or decreases in quantities of work are not a change in the character of work. If a change in the character of the work results in a decreased cost to perform the work, the RE will revise the price to reflect this reduced cost.

   For changes in the character of work, the Department will base the modification on the difference between what the actual cost to perform the work of the Item or portion thereof involved would have been if there were no change, and the actual cost of performing the work or portion of work as changed. The modification shall only apply to the portion of the work for an Item actually affected by the change.

   If a modification cannot be reached by agreement, the Department will make payment by force account as specified in 104.03.08.

   Specific changes in character of work have the following requirements:

   a. **Differing Site Condition.** A condition is considered to be a Type 1 Differing Site Condition when a subsurface or latent physical condition at the site differs materially from those specified in the Contract. A condition is considered to be a Type 2 Differing Site Condition when unusual conditions are encountered that differ materially from those ordinarily encountered or is generally recognized as inherent in the work that could not have been reasonably anticipated from the pre-bid examination as specified in 102.04 or from the preparation of the bid as specified in 102.07.

      The Department will make payment for increased costs resulting from a Type 1 or Type 2 Differing Site Condition as a change in the character of work; however, the Department will not consider payment for a differing site condition unless the resulting change in cost exceeds the amounts as specified in Table 104.03.03-1. If the change in cost exceeds these amounts, the Department will base the modification on the total cost of the change. The Department will not deduct the amounts shown in Table 104.03.03-1 from the cost of the change. If the same differing site condition is encountered subsequently, the Department will consider the cumulative total value towards meeting the requirements of Table 104.03.03-1.

Table 104.03.03-1

Total Contract Price	Cost of Change
Up to $2,000,000	$5000
Over $2,000,000	$25,000

b. Constructive Acceleration. The Department will make payment for costs resulting from constructive acceleration as a change in the character of work if there was an excusable compensable delay for which the Department improperly rejected the Contractor's notice requesting an extension of Contract Time, and for which the Contractor incurred additional costs. Payment for constructive acceleration may not exceed the cost of liquidated damages saved by the actions of constructive acceleration. The Department will not make payment for claims for constructive acceleration if the Contractor fails to have an approved progress schedule as specified in 153.03.

Before constructively accelerating, provide the RE with a plan detailing the methods and activities of the constructive acceleration. Include how the plan accelerates the Work relative to the current approved progress schedule. Do not deviate from the submitted plan without providing the RE with a revised plan.

c. Inefficiencies. If the source of the loss of productivity cannot be isolated and priced separately, the Department will consider making payment for inefficiency costs based on a Measured Mile analysis comparing the productivity of work impacted by a change to the productivity of similar work under unimpacted conditions.

If the source of the inefficiency is working out of the scheduled sequence, use the current approved progress schedule to show that the work was performed out-of-sequence.

d. Delays. The Department will modify Contract Time as specified in 108.11. The Department will make payment for delay damages resulting from excusable, compensable delays as specified in 104.03.09.

104.03.04 Contractual Notice

It is the responsibility of all parties to promptly provide written notice to the other party when circumstances are believed to constitute a change to the Contract.

Immediately provide written notice to the RE of any circumstances that are believed to be a change to the Contract. If notice is not provided on Contractual Notice (Form DC-161), include the following in the initial written notice:

1. A statement that this is a notice of a change.
2. The date when the circumstances believed to be a change were discovered.
3. A detailed and specific statement describing the nature and circumstances of the change.
4. If the change will or could affect costs to the Department.
5. If the change will or could affect Contract Time as specified in 108.11.01.C.

The Department will not modify the Contract for work performed or for expenses incurred due to a change before the date notification is provided to the RE. The Contractor waives its right to file a claim for costs incurred before providing notice to the RE.

Following submission of written notice, diligently continue with the unaffected work to the maximum extent possible. If a Type 1 or Type 2 Differing Site Condition is encountered, do not disturb the existing site condition until directed by the RE.

Within 5 days after receipt of each written notice, the RE will respond in writing with one of the following:

1. Reject the notice for providing insufficient information. The Department will not accept general notices. The RE may request resubmission of the notice with additional information. If the Department rejects the written notice for insufficient information, the Department will deem the Contractor to have not provided notice even if the RE issues directions based on the information provided.
2. Reject the notice because the Contractor failed to submit the notice within the specified time frames of N.J.S.A 59:13-5, or 104.03.02.
3. Acknowledge that notice has been provided, and state that the Department has not determined whether the circumstances constitute a change that may be eligible for additional payment or time or both. If necessary, the RE may direct the mode of further performance. The RE may require the Contractor to submit additional information within a specified time period.
4. Acknowledge that notice has been provided, and confirm that the circumstances constitute a change that may be eligible for additional payment or time or both. If necessary, the RE may direct the mode of further

performance. The RE may require the Contractor to submit additional information within a specified time period.

104.03.05 Unrecoverable Costs

For all changes, the Department will not make payment or modify Contract Time for the following:

1. Loss of anticipated profits.
2. Consequential damages.
3. Expense related to claim preparation and submission, including but not limited to attorney's fees and expenses, consultant's fees and expenses, and litigation expenses.
4. Interest.
5. Reimbursement for home office overhead in excess of that provided by the Contract.

104.03.06 Unacceptable Cost Calculation Methods

The Contractor has the burden of substantially proving entitlement to and quantifying its costs. The Department will not make payment for costs calculated using the following methods:

1. **Total Cost Method.** Method based on calculating costs as the difference between the Contractor's bid for the Work from the Contractor's calculation of costs for the Work.
2. **Modified Total Cost Method.** Method based on calculating damages as the difference between the Contractor's bid for a portion of the Work and the Contractor's calculation of cost for that portion of the Work.
3. **Productivity Factors.** Costs for inefficiency based on industry productivity factors such as those provided by the Mechanical Contractors Association of America (MCAA) Factors Affecting Labor Productivity.
4. **Eichleay Formula.** Eichleay and other formulas or approaches to calculating home office overhead costs due to delay other than as specified in 104.03.08.

104.03.07 Tracking Costs

For all work directed to be paid for by force account, and for all costs for which the Contractor will pursue reimbursement through a claim, track and maintain complete records to provide a clear distinction between the costs for that work and the costs of other operations. On a daily basis, submit for review by the RE a daily work report for the work involved in the force account or claim, signed by the Contractor's authorized representative. For days with multiple shifts of work, submit a separate report at the completion of each shift. Provide the following in the daily or shift work report:

1. For labor, provide the name, classification, date, daily hours, and whether the hours are straight time or overtime for each worker and foreperson.
2. For equipment, provide the description, dates, daily hours worked, daily hours idle, and whether each unit of equipment or component thereof is rented or Contractor-owned.
3. For materials, provide the description, quantities delivered and placed, and whether the materials were for temporary use or permanent construction.
4. Indicate the description of work associated with the force account or claim performed for that day or shift.

If there are separate instances of work being tracked, provide separate daily or shift reports for each instance.

Submit in writing to the RE for review before using special equipment, materials, or labor. The Department will not make payment for costs that the Contractor fails to document as required in the daily work report.

104.03.08 Force Account

Payment made for the work directed to be performed by force account represents full payment for that work. Upon request, submit to the RE a detailed cost estimate of the work to be paid by force account using the electronic format provided by the Department. Submit daily or shift reports for force account costs as specified in 104.03.07. For work directed to be paid for by force account, and when approved by the RE in the daily or shift reports, the Department will make payment for the following:

1. **Direct Labor.** The Department will make payment for all necessary direct labor and the supervising foreperson of the specific operation, whether the employer is the Contractor, or subcontractor, based on the gross rate of wage paid to the employee as shown in its certified payrolls for each and every hour that said labor and foreperson are actively engaged in such work.

   For specific extraordinary operations, the Department may allow supervising or other special types of employees, which would usually be considered as overhead, to be considered direct labor, but only for that time allowed by the RE. Submit justification in writing for the RE's approval before using such employees.

2. **Labor Fringe Benefits.** The Department will make payment for the cost of benefits paid by the Contractor on direct labor costs allowed under 104.03.08.1, to or on behalf of, workers when required by collective bargaining agreements or other employment contracts generally applicable to the classes of labor employed on the work.

3. **Indirect Labor Costs.** The Department will make payment for the cost of FICA, Workers Compensation Insurance, Federal and State unemployment insurance and other payroll taxes paid by the Contractor on direct labor costs allowed under 104.03.08.1.

4. **Insurance.** The Department will make payment for the actual increased cost of insurance, necessarily and directly resulting from the force account work, as evidenced by certified documentation of insurance rates and premiums.

5. **Materials.** The Department will make payment for the cost of materials and shipping charges as evidenced by paid invoices, except as follows:

   1. If a cash or trade discount is offered by the actual supplier or available to the purchaser, credit the Department notwithstanding the fact that such discount may not have been taken.
   2. If materials are procured by the purchaser by any method that is not a direct purchase from and a direct billing by the actual supplier to such purchaser, the cost of such materials is the price paid to the actual supplier as determined by the RE, plus the costs, if any, incurred in the handling of such materials.
   3. If in the opinion of the RE the cost of such materials is excessive, then the Department will limit the cost of such materials to the prevailing market price for such materials as are available in the quantities concerned, delivered to the Project Limits, and deducting any discounts as specified in 104.03.08.5.1.
   4. For materials not incorporated into the permanent construction, the Department will deduct the reasonable salvage value of the material after the performance of the work.

   The Department will only allow sales tax on materials that are not permanent and do not qualify for an exemption under the Sales and Use Tax Act.

   The Department reserves the right to furnish materials, and the Department will not make payment for costs and markup on such materials.

6. **Extraordinary Expenses.** The Department will make payment for permit and disposal fees, if approved before incurring the cost and evidenced by paid invoices. If the cost is, in the opinion of the RE, excessive, then the Department will limit the payment for such expenses to reasonable costs as available in the prevailing market.

7. **Equipment.** The Department will make payment for Contractor-owned or rented equipment required for the force account work. The Department will not provide payment for equipment that is determined to be unsuitable by the RE for the force account work or that is inoperable due to breakdown or during periods of repair. In the event the Contractor proposes to use equipment of a higher cost than that suitable for the work, the Department will make payment at the rate applicable to the suitable equipment. The Department will make payment for Contractor-owned or rented equipment as follows:

   a. **Contractor-Owned Equipment.** For equipment owned directly by the Contractor or by entities that are divisions, affiliates, subsidiaries, or in any other way related to the Contractor or its parent company, submit in writing to the RE for approval the type of equipment and proposed cost before starting the work. The Department will make payment for equipment rental, operating, and idle time costs based on

the calculated cost. The Department will determine the calculated cost using the Rental Rate Blue Book (Blue Book), published by Equipment Watch, as follows:

1. The Department will calculate the "rental" hourly rates by dividing the monthly rate by 220. The Department will not use weekly, daily, or hourly rates. The Department will apply rental hourly rates for every hour the equipment is in active use, except that for any 30-day period, the Department will limit the total amount paid for each piece of equipment to a maximum of 80 percent of the monthly rate.
2. The Department will apply the operating cost rate for every hour the equipment is active.
3. The Department will apply the rental and operating rates that are current on the first day that the equipment is in use for the force account work throughout the next 6 months that the force account is in progress. The Department will apply updated rates for every following 6 month period the force account is in progress. Submit to the RE documentation establishing the Blue Book rates for the equipment proposed and the age of the equipment. The Department will adjust rates for each 6-month period thereafter.
4. The Department will not permit area adjustments. The Department will adjust rental rates for equipment age adjustments according to the rate adjustment tables.
5. The Department will not make payment for idle time for equipment required for only portions of the force account work, except where the equipment has been held on the work site on a standby basis at the request of the RE and, but for this request, would have left the work site. Portions of the work include hours when the equipment is inactive within a working day. For the idle time for each piece of equipment, the Department will make payment at one-half the rate established as specified in 104.03.08.7.a.1. Idle time is limited to the Contractor's normal working hours. Idle time is further limited to a maximum of eight hours a day and a maximum of 176 hours in a 30-day period.

The payment established is full payment for all equipment costs, including the cost of fuel, oil, lubrication, supplies, attachments, repairs and maintenance of any kind, depreciation, storage, and all incidentals. Furthermore, the payment established above is also full payment for all costs (including labor and equipment) for transporting equipment to, on, and away from the work site.

If a rate is not established in the Blue Book for a particular piece of equipment, the RE will establish a rate for that piece of equipment that is consistent with its cost and use in the industry.

b. Rented Equipment. In the event that the Contractor does not own a specific type of equipment and must obtain it by rental, submit in writing to the RE for approval the need to rent the equipment and the rental rate for that equipment before using it on the work. The Department will make payment for the rental of the equipment as specified in the rental agreements and as evidenced by paid invoices for the time that the equipment is used to accomplish the work, plus the cost of moving the equipment to, on, and away from the work site.

8. Profit. The Department will make payment for profit at the rate of 10 percent applied on the following:

1. Total direct labor cost as specified in 104.03.08.1.
2. Total labor fringe benefit costs as specified in 104.03.08.2.
3. Total material cost as specified in 104.03.08.5 excluding transportation, shipping, handling, and taxes.

9. Overhead. The Department will make payment for overhead at the rate of 15 percent applied on the following:

1. Total direct labor cost as specified in 104.03.08.1, except for the direct labor cost of any extraordinary supervisory or special employees.
2. Total labor fringe benefit costs as specified in 104.03.08.2.
3. Total material cost as specified in 104.03.08.5 excluding transportation, shipping, handling, and taxes.

The above 15 percent allowance is full compensation for the Contractor's field and home office overhead including, but not limited to, the following:

1. Salaries and expenses of executive officers, supervising officers, or supervising employees, except as provided for specific extraordinary operations under 104.03.08.1.
2. Salaries and expenses of clerical and administrative employees.
3. Charges for minor equipment, such as small tools, including shovels, picks, axes, saws, bars, sledges, lanterns, jacks, cables, pails, wrenches, and other miscellaneous supplies and services; and equipment consumed during operations, such as saw blades, drill bits, and milling teeth.
4. Costs for preparing documents and records, including reproduction and mailing costs.

10. Subcontractors. The Department will make payment for work performed by subcontractors in the same manner as for the Contractor as specified in 104.03.08.

The Department will make payment for markup on subcontracted work at the rate of 5 percent applied on the total amount of all costs for subcontracted force account work. The markup on subcontracted work may not exceed $5000.

104.03.09 Delay Damages

If the Department grants an extension of Contract Time for excusable, compensable delays, as specified in 108.11.01, beyond the completion time requirements specified in 108.10, the Department will make payment for the following:

1. Non-Productive Activity. The Department will make payment for the following non-productive activities:

a. Direct Labor. For all necessary non-productive labor and supervising forepersons of specific operations who must remain on the Project during such periods of delay due to collective bargaining contracts or other reasons approved by the RE and cannot be assigned to other work not affected, the Department will make payment at the prevailing rate of wage as shown in its certified payrolls. This includes the necessary labor required for maintenance within the Project Limits, maintenance of traffic control devices, maintenance of SESC measures, and similar activities resulting from the delay and approved by the RE. This rate is inclusive of all employee contributions to taxes, insurance, and other benefits.

b. Labor Fringe Benefits. The Department will make payment for the costs for benefits paid by the Contractor on direct labor costs allowed under 104.03.09.1.a to or on behalf of, workers when required by collective bargaining agreements or other employment contracts generally applicable to the classes of labor employed on the work.

c. Indirect Labor. The Department will make payment for the costs for FICA, Workers Compensation Insurance, Federal and State Unemployment Insurance and other payroll taxes paid by the Contractor on direct labor costs allowed under 104.03.09.1.a.

d. Insurance. The Department will make payment for the actual increased cost for insurance, necessarily and directly resulting from the delay, as evidenced by certified insurance rates and premiums.

e. Equipment. If as the result of the delay, equipment cannot be used for any active work, and is directed by the RE to remain on the work site during the delay, the Department will make payment as specified in 104.03.08.7.a.6. If as the result of the delay, equipment cannot be used for any active work, and the RE determines that it is not necessary for the equipment to remain on the work site, the Department will make payment for labor and equipment costs to remove the equipment and to return it to the work site at the end of the delay period.

If equipment is required for additional maintenance within the Project Limits, maintenance of traffic control devices, maintenance of SESC measures, and similar activities resulting from the delay and approved by the RE, the Department will make payment as specified in 104.03.08.7.

f. Contractor's Field Office. If the Contractor has a field office dedicated for the Project, and if the extension of time is for more than one month, the Department will make payment for the costs to maintain the Contractor's field office, as evidenced by paid invoices. These costs may include property rent or leases, trailer rentals, utility and sanitation services, and fixed monthly telephone services required for a field office directly established for the Project.

g. Profit. The Department will not make payment for profit.

h. Overhead. The Department will make payment for overhead at a rate of 15 percent of the sum of labor and labor fringe benefits. This is full payment for all field and home office overhead and general superintendence.

2. Labor Escalation. If, as the result of the delay, an activity, which had a planned late-finish date occurring before a labor rate increase date, is required to start after the labor rate increase date, the Department will make payment for the following:

a. Increased Direct Labor. For all necessary non-salaried labor and supervising forepersons of the specific activity, the Department will make payment for the difference between the gross rate of wage paid to the employee as shown in its certified payrolls and the gross rate of wage for the planned period of performance, for each and every hour that the employee was actively engaged in such work.

b. Increased Labor Fringe Benefits. The Department will make payment for the increased costs for benefits paid by the Contractor on direct labor costs allowed in 104.03.09.2.a, to, or on behalf of, workers when required by collective bargaining agreements or other employment contracts generally applicable to the classes of labor employed on the work.

c. Increased Indirect Labor Costs. The Department will make payment for the costs for FICA, Workers Compensation Insurance, Federal and State Unemployment Insurance, and other payroll taxes paid by the Contractor on increased direct labor costs allowed under 104.03.09.2.a.

d. Profit. The Department will make payment for profit at the rate of 10 percent applied on the following:

1. Total direct labor cost as specified in 104.03.09.2.a.
2. Total labor fringe benefit costs as specified in 104.03.09.2.b.

e. Overhead. The Department will not make payment for overhead for labor escalation costs. Provide the RE with the following documentation for all labor escalation costs:

1. A breakdown of costs by Item, activity, and date detailing the labor classification and hours for each.
2. For each activity, an analysis demonstrating that the entire activity was forced to be performed when labor costs were higher than the labor rates in effect on the planned late-finish date.
3. Collective bargaining agreement information detailing the increase in direct wages and fringe benefits.

3. Material Escalation and Storage. If the delay forces the Contractor to purchase material when material costs are higher than the cost of material would have been for the planned late-finish dates of an activity using the material, or if the Contractor incurs additional storage costs as a result of the delay, provide the RE with the following documentation:

1. A breakdown of costs by Item, activity, and date the material cost was incurred.
2. Cost basis for the material at the time of an activity's late start date as evidenced from documented vendor quotes.
3. The cost of materials and transportation charges as evidenced by paid invoices.
4. An analysis demonstrating that the activity or portions of the activity were forced to be performed when material costs were higher than those that were in effect on the planned late-finish date.

For such material escalation and storage, the Department will make payment as follows:

a. Increased Material Costs. The Department will make payment for the difference between the costs of materials, as specified in 104.03.08.5, and the cost of such materials that were available for the planned late-start to late-finish dates of an activity using the material. However, the cost of unacceptable material, and cost increases for fuel and asphalt are not eligible for payment. Furthermore, the Department will not make payment for quantities in excess of the amount necessary for construction, except where lesser quantities cannot be economically purchased and the excess has no significant reuse value. If the cost basis of materials is, in the opinion of the RE, excessive, the Department will establish the cost of the materials from market prices.

b. Increased Storage Costs. Obtain the RE's approval before storing materials. The Department will make payment for additional storage costs as evidenced by certified vendor quotes detailing the terms of the storage agreement, and paid invoices.

c. Profit. The Department will make payment for profit at the rate of 10 percent applied on the following:

1. Total increased material costs as specified in 104.03.09.3.a.
2. Total increased storage costs as specified in 104.03.09.3.b.

d. Overhead. The Department will make payment for overhead at the rate of 15 percent applied on the following:

1. Total increased material costs as specified in 104.03.09.3.a.
2. Total increased storage costs as specified in 104.03.09.3.b.

From the total value of delay damages, when the Total Adjusted Contract Price cost is greater than the Total Contract Price, the Department will deduct the amount of 10 percent applied to the difference between the Total Adjusted Contract Price and the Total Contract Price. If this deduction is greater than the total value of delay damages, the Department will not deduct the difference from the Contractor.

SECTION 105 – CONTROL OF WORK

105.01 AUTHORITY OF THE DEPARTMENT

105.01.01 RE

The RE has the authority to direct work and the Contractor has an obligation to proceed as directed. The RE has the authority to reject work that is not in conformance with the Contract and direct its removal and replacement. If the Contractor fails to promptly remove or replace defective work as directed by the RE, the RE has the authority to direct Others to remove or replace the work. The Department has the right to recover costs incurred for such removal and replacement from the Contractor.

Unless otherwise specified, send correspondence with the Department to the RE. Where correspondence is specified to be directed to persons other than the RE, send a copy to the RE. Ensure that correspondence complies with the following:

1. Assign every correspondence sent to the Department a unique correspondence serial number in the subject line, numbered sequentially beginning with Contractor Correspondence No. 1.
2. If the correspondence includes a request for information or asks for an interpretation of the Contract, also assign a unique RFI serial number in the subject line numbered sequentially beginning with RFI-1.
3. If the correspondence constitutes a notice of change as specified in 104.03.04, assign a unique change notice serial number in the subject line numbered sequentially beginning with Change Notice No. 1. For subsequent correspondence referring to a change notice or to the events that are the subject of a previous change notice, refer in the subject line to the original change notice number.

The RE will decide questions that arise concerning the following:

1. Quality and acceptability of the work.
2. Progress of the Work.
3. Interpretation of the Contract.
4. Modifications to the Contract.
5. The percentage for partial payments made in Estimates, as specified in 109.05.

The RE has the authority to suspend the Work wholly or in part and to suspend Estimates, as specified in 109.05, for failure of the Contractor to correct conditions unsafe for the workers or the general public, for failure to carry out provisions of the Contract, or for failure to comply with RE direction. The RE also has the authority to suspend the Work wholly or in part for unsuitable weather, for conditions considered unsuitable for the prosecution of the Work or portion of the Work, or for any other condition or reason deemed to be in the interest of the public.

105.01.02 Inspection

Inspectors employed or contracted by the Department are authorized to inspect work. Inspection may extend to the preparation, fabrication, or manufacture of the materials to be used. The inspector is not authorized to waive the provisions of or modify the Contract. The inspector is not authorized to act as foreman or perform other duties that are the responsibility of the Contractor. The inspector has the authority to reject work subject to confirmation by the RE.

Each part or detail of the Work is subject to inspection by the Department. If the Department determines that work requires special inspection, testing, or approval not specified in the Contract, the Department will perform such inspection, testing, or approval.

If an agency or entity financially participates in the Contract or has jurisdiction over portions of the Work, the agency or entity also has the right to inspect the Work. Such financial participation or inspection does not make an agency or entity a party to the Contract.

Provide safe access for inspection to all parts of the Work. Provide the necessary assistance, including but not limited to traffic control, lighting, and scaffolding in order to allow a complete and detailed inspection. When the Department is within the Project Limits, the Department is an invitee of the Contractor.

At any time before Acceptance, the RE has the right to direct the Contractor to expose specified portions of the finished work. If the exposed work is unacceptable, correct the work and restore the exposed area. Also, if subsequent work prevents inspection of the previous work, the RE has the right to direct the Contractor to remove and replace the subsequent work. The Department will not make payment for exposing, correcting, or restoring work or removing and replacing nonconforming work and any subsequent work that was required to be removed.

The Department will make payment and may modify Contract Time for exposing the work and restoring the area as Extra Work if all of the following conditions are met:

1. The exposed work was acceptable as specified in the Contract.
2. The daily communications, as specified in 108.03, were given to the Department reasonably before the exposed work was originally performed.
3. The work was not covered by subsequent work if the RE directed that such subsequent work not be performed.

The Contractor is responsible for carrying out the provisions of the Contract at all times and for control of the quality of the Work regardless of whether an authorized inspector is present or not. Neither the observations of the RE in the administration of the Contract, nor inspections, tests, or approvals relieve the Contractor from its obligation to perform the Work in accordance with the Contract.

105.02 RESPONSIBILITIES OF THE CONTRACTOR

105.02.01 Labor and Equipment

Provide labor and equipment sufficient to prosecute the Work, as specified in the Contract, to Completion. Ensure that the labor and equipment used to prosecute the Work do not cause damage to public or private property. Provide labor and equipment as follows:

1. Labor. Employ workers that have sufficient skill and experience to properly perform the work assigned to them. Do not engage or employ current Department employees or workers that would cause the worker to be in violation of N.J.S.A. 52:13D-17.

Upon written direction by the RE, the Contractor will remove Contractor employees or subcontractor employees who, in the opinion of the RE, are not performing the Work in a proper or skillful manner, or are intemperate, disorderly, or create a hostile environment. Do not allow the removed employee to be re-employed to perform any portion of the Work without written approval by the RE.

2. Equipment. Provide equipment of sufficient size and mechanical condition to meet the requirements of the Contract. Ensure that each piece of equipment has an automatic audible warning signal when operating in reverse.

Do not provide equipment that is owned or operated by firms or individuals suspended or debarred by the Department or included in the *State of New Jersey Consolidated Debarment Report* as maintained by the

Department of the Treasury, Division of Building and Construction, Bureau of Contractor Prequalification or in the Federal Government's General Services Administration document titled "List of Parties Excluded from Federal Procurement and Nonprocurement Programs (GSA List)."

Equip construction equipment powered by an internal combustion engine with a properly maintained muffler. Fit air-powered equipment with pneumatic exhaust silencers. Ensure air compressors meet EPA noise emission standards. Do not operate stationary equipment powered by an internal combustion engine within 150 feet of noise sensitive sites without portable noise barriers placed between the equipment and the noise sensitive sites. Noise sensitive sites include but are not limited to residential buildings, motels, hotels, schools, churches, hospitals, nursing homes, libraries, and public recreation areas.

Whenever automatically-controlled equipment is specified and a breakdown or malfunction of the automatic controls occur, the Contractor may operate the equipment manually for the remainder of the day provided such operation produces results that comply with the Contract. Repair or replace the equipment so that it is controlled automatically before starting construction operations the next day.

105.02.02 Superintendent

Provide a competent, English-speaking superintendent and alternate who are experienced in the type of construction being performed and are capable of reading and understanding the Contract.

Ensure that the superintendent and alternate have the authority to represent the Contractor. Ensure that the superintendent and the alternate have the authority to execute orders or direction from the RE, without delay, and to promptly supply materials, equipment, tools, labor, and incidentals as necessary.

Ensure that the superintendent gives the Work the constant attention necessary to ensure its successful prosecution. Ensure that the superintendent cooperates with the RE, the Department inspectors, and Others. Ensure that the superintendent or the alternate is present at the work site at all times while the Work is in progress.

The RE has the right to suspend the Work if the superintendent or the alternate is not present at the work site. The Department will not modify Contract time or make payment for such suspensions.

105.02.03 Subcontracted Work

Consent of the Department to allow work to be subcontracted, as specified in 108.01, does not relieve the Contractor of its responsibility for the Work, nor does it relieve the Surety of its obligations under the bond. The Contractor is responsible for the work of subcontractors. Ensure that the work performed by subcontractors conforms to the Contract. The Department's consent to subcontract any part of the Work shall not be construed as approval of the subcontract or its terms, but only as approval of the Contractor's request to subcontract to its chosen subcontractor.

105.02.04 Fabricators and Suppliers

If the Contractor is not the owner of the place where fabrication, preparation, or manufacture is in progress, the owner thereof is deemed to be the agent of the Contractor.

105.03 CONFORMITY WITH CONTRACT

The Contract is comprised of complementary documents that together describe the requirements of the Project. Requirements occurring in one are as binding as though occurring in all. Keep one set of Plans, Special Provisions, addenda, Change of Plan, Right of Way Plans, Standard Specifications, and Standard Details within the Project Limits at all times.

In the event the Contractor discovers a discrepancy, error, omission, or ambiguity in the Contract, or if the Contractor has any doubt or question as to the intent or meaning of the Contract, the Contractor must immediately notify the RE as specified in 104.03.04. Do not take advantage of a discrepancy, error, omission, or ambiguity in the Contract. The Department will promptly make, in writing, interpretations or corrections if necessary. The Contractor is not relieved of the obligation to complete work because of a discrepancy, error, omission, or ambiguity. Do not make changes to the Work without written direction from the Department.

If the RE determines that work is not in conformance with the Contract or RE direction, remove and replace the work. The Contractor may request RE approval to perform corrective action rather than remove and replace nonconforming

work. Submit a plan detailing a proposed method of performing corrective action to the RE for approval. Approval of a corrective action plan does not relieve the Contractor from providing work that is in conformance with the Contract.

The Department will not make payment or modify Contract Time to correct or replace nonconforming work.

If the RE identifies work that, while not in full conformance with the Contract, is reasonably acceptable, the RE will determine if the work may remain in place. The RE and the Contractor will negotiate an appropriate reduction in the Contract price. If the Department loses Federal funding for the nonconforming work, on the basis of permitting nonconforming work to remain, the Department will not pay for the work permitted to remain in place. If an appropriate modification cannot be negotiated, remove and replace or otherwise correct the work. Processing an Estimate or making payment, as specified in 109.05, does not imply or establish that the work is in conformance with the Contract.

105.04 PLANS AND SPECIFICATIONS

Perform work in conformity with the lines, grades, cross-sections, dimensions, material requirements, and to the tolerances specified in the Contract. Whenever a slope is indicated in the Specifications, it is given in horizontal to vertical dimensions. The horizontal is indicated with an "H" and the vertical is indicated with a "V." In case of discrepancy, calculated dimensions will govern over scaled dimensions; Plans will govern over Specifications; Department issued documents will govern over Contractor-submitted documents, ROW Plans will govern over Plans when setting monuments; Special Provisions will govern over Standard Specifications, and Project-specific Plans will govern over Standard Details.

105.05 WORKING DRAWINGS

When working drawings are specified, submit methods of construction, material designations, design calculations, catalogue cuts, illustrations, schedules, performance charts, brochures, and other information necessary to construct the work as specified in the Contract. Do not submit working drawings that are repetitious or duplicative of Items specified or detailed within the Contract or that change the Plans or Specifications.

Ensure that working drawing submissions also conform to the Department design manuals and other Department standards for the proposed work. After Award, the Department will provide additional formatting information, the number of copies required, and the designated design unit to which the Contractor shall submit working drawings.

Submit working drawings on 22 × 36-inch sheets or 8-1/2 × 11-inch sheets. Submit design calculations required for the working drawings on 8-1/2 × 11-inch paper. Submit 7 copies of the working drawings to the designated design unit for review with a copy of the transmittal letter to the RE. For railroad-carrying structures, submit 4 additional copies to the designated design unit. Submit an additional copy for each outside testing agency or authority involved in the Project.

For 22 × 36-inch sheets, locate the title block in the lower right-hand corner of each sheet. For 8-1/2 × 11-inch sheets, provide a cover sheet with the title block. Do not include the title block on subsequent 8-1/2 × 11-inch sheets. Include in the title block the following minimum information:

1. Route and Section or Contract number.
2. Name of bridge/structure (on structural drawings only)
3. Municipality and county.
4. Contractor's name.
5. Fabricator's name (if applicable).
6. Data Processing Number and Federal Project Number (if applicable).
7. Title of drawing.
8. Sheet number.

For 22 × 36-inch sheets, include a revision block located to the left and adjacent to the title block and a block for an embossed Professional Engineer's seal on each sheet. For 8-1/2 × 11-inch sheets, include a revision block and a block for an embossed Professional Engineer's seal on the cover sheet. Do not include the revision block and the block for an embossed Professional Engineer's seal on subsequent 8-1/2 × 11-inch sheets.

For 22 × 36-inch sheets, include the structure number shown on the Plans for each structure in the upper right-hand corner of each sheet. For 8-1/2 × 11-inch sheets, include the structure number shown on the Plans for each structure on the cover sheet.

Review, sign, and submit working drawings in an orderly sequence so as not to delay the Work, or the work performed by Others. By submitting working drawings for review and approval, the Contractor certifies that it has verified all field measurements and that all dimensions shown conform to the Contract. The Contractor further certifies that catalog numbers, field construction criteria, materials, and other criteria have been coordinated with the requirements of the Contract and the Work for each submitted working drawing. Working drawing notes regarding materials do not satisfy the requirements for materials approval as specified in 106.04. The certification or approval of working drawings does not constitute an approval of any materials noted.

The Department's certification or approval of working drawings signifies only that the drawings are in general conformance with the Contract. The Department's certification or approval of working drawings does not relieve the Contractor from responsibility for errors and omissions in the working drawings and their correction.

Submit working drawings for certification or approval as specified in Table 105.05-1. This list is not all inclusive.

Table 105.05 1 – Working Drawing Submission Category

Certified	Approved
Temporary Shielding	Mechanically Stabilized Earth (MSE) Walls
Catalog Cuts	Prefabricated Modular Walls
Structural Steel Fabrication	Catalog Cuts (related to landscape Items)
Erection Plans	Precast Concrete Arch Structures
Stay-In-Place Forms	Precast Concrete Box Culverts
Elastomeric Bearings Pads	Change of Prestressed Concrete Strand Patterns
Reinforced Elastomeric Bearings	Change in Structural Steel Details
Precast Prestressed Concrete Beams and Piles Fabrication	Temporary Sheeting and Cofferdams
Expansion Deck Joint Assembly Systems	Demolition Plans
Bridge Drainage	High Load Multi-Rotational (HLMR) Bearings
Bridge Railing and Fencing Anchorage System	Isolation Bearings
Sign Legends	Modular Expansion Joint Assembly
Electrical Items Not Pre-Qualified	Composite Piles
Sign Support Structures	ITS System Drawings, including Block Diagrams
Breakaway and Non-Breakaway Tubular GA Sign Support Posts	Value Engineering Plans
	Machinery and Electrical Items for Movable Bridges
	Other work shown on the Plans as conceptual
	Temporary Structures (When removal leaves behind a permanent addition to a structure)

Submit working drawings for certification and approval as follows:

1. **Certified Working Drawings.** For working drawings requiring certification, include 2 blank blocks directly above the title block. Designate one block for design unit certification, and designate the other block for the Contractor's approval stamp. The Department will require 30 days for review and certification or rejection and return of certified working drawings.

   The designated design unit, upon receipt of working drawings submitted for certification, will review the working drawing for conformance with the Contract. The designated design unit may certify compliance, conditionally certify compliance with notation or comment, or reject working drawings as submitted. The designated design unit will sign and stamp the submitted working drawings as follows:

   1. "CERTIFIED" for certification without condition.
   2. "CERTIFIED AS NOTED" for conditional certification.
   3. "REVISE AND RESUBMIT" for rejection or non-certification.

   For submitted working drawings that are stamped "REVISE AND RESUBMIT," the designated design unit will return the submitted working drawings directly to the Contractor with a copy to the RE. Make the required revisions, corrections, and additions, and otherwise comply with the directions of the designated design unit. Ensure that revisions, corrections, additions, and other changes that were not directed are

emphasized on the working drawings. Promptly re-submit the specified number of copies to the designated design unit. Only resubmit the sheets stamped "REVISE AND RESUBMIT," and other sheets that are revised with corrections, additions, and other changes that were not directed. Do not perform work or order materials relating to the submitted working drawings before the designated design unit stamps the working drawings "CERTIFIED" or "CERTIFIED AS NOTED."

For the working drawings stamped "CERTIFIED AS NOTED," submit to the RE the revised working drawings incorporating or satisfying the conditions of the certification in the designated design unit's notes or comments. Ensure that the revised working drawings are submitted to the RE within 30 days of receipt of the conditional certification.

2. **Approved Working Drawings.** For working drawings requiring approval, include 3 blank blocks directly above the title block. Designate one block for design unit recommendation for approval, designate the second block for the Department's approval, and designate the third block for the Contractor's approval stamp. The Department will require 45 days for review and approval or rejection and return of working drawings.

   The designated design unit, upon receipt of working drawing submitted for approval, will review the working drawing for conformance with the Contract and the design concept of the Project. The designated design unit may recommend approval to the Department or may reject working drawings as submitted. The designated design unit will sign and stamp the submitted working drawings as follows:

   1. "RECOMMENDED FOR APPROVAL" for submission to the Department.
   2. "REVISE AND RESUBMIT" for rejection or non-approval.

   When the designated design unit signs and stamps the working drawings "RECOMMENDED FOR APPROVAL," the designated design unit will submit the working drawing to the Department for approval. The Department will sign and stamp the submitted working drawings as follows:

   1. "APPROVED" for approval.
   2. "REVISE AND RESUBMIT" for rejection or non-approval.

   For submitted working drawings that are stamped "REVISE AND RESUBMIT," the designated design unit or Department will return the submitted working drawings directly to the Contractor with a copy to the RE. Make the required revisions, corrections, and additions and otherwise comply with the directions of the designated design unit or Department. Ensure that revisions, corrections, additions, and other changes that were not directed are emphasized on the working drawings. Promptly re-submit the specified number of copies to the designated design unit. Only resubmit the sheets stamped "REVISE AND RESUBMIT," and other sheets that are revised with corrections, additions, and other changes that were not directed. Do not perform work or order materials relating to the submitted working drawings before the Department stamps the working drawings "APPROVED."

After the submitted working drawings have been stamped "CERTIFIED," "CERTIFIED AS NOTED," or "APPROVED," submit the final drawings on 3.15-mil minimum polyester film to the RE at least 30 days before Completion. Also, submit the specified number of copies on bond. Ensure that lines and lettering are opaque and of sufficient height and width so that legible 11 × 17-inch reductions may be made. Include the Contractor's approval stamp, containing the word "APPROVED," and the Contractor's original signature and date.

Do not deviate from the approved, certified, or conditionally certified working drawings without obtaining prior written approval from the RE.

Ensure future revisions to the original tracing have the date within the approval stamp updated with each revision to verify that the revision was reviewed and approved by the Contractor.

105.06 COOPERATION WITH OTHERS

At any time during the Contract, the Department has the right to procure, permit, and have work performed by Others on or near the Project. The Department will provide available information for work to be performed by Others.

Conduct Work so as not to interfere with or hinder the progress of the work being performed by Others. The Contractor assumes the positive obligation of cooperating with and coordinating its activities with the work done by Others. If there is a difference of opinion regarding the rights of the Contractor and Others doing work, the RE will decide the rights of the various parties involved.

105.07 COOPERATION WITH UTILITIES

105.07.01 Working in the Vicinity of Utilities

A. Initial Notice. For the Utilities specified in the Special Provisions, at least 10 days before beginning construction operations, submit notice to each Utility, with a copy to the RE, that includes the following:

1. Name and location of the Project.
2. Name and contact information of the Contractor and superintendent.
3. Portion of the approved preliminary schedule or baseline schedule that affects the Utility.

If the Work requires or causes the Contractor to enter railroad ROW, obtain the regulations from the railroad, including fouling parameters, before beginning construction operations.

B. Locating Existing Facilities. Before performing construction operations, obtain the location of utilities and Department electrical and ITS facilities as follows:

1. Notify the State's One Call System (811) to obtain the location of public utilities.
2. For the Department's fiber optic network, submit a Traffic Operations Markout Form to the Traffic Operations location specified in the Special Provisions. Obtain and complete the form as specified on the Department's website. The Department will complete the markout within 15 days after Traffic Operations receives the form. Provide the RE a copy of the form, and maintain the markout until construction operations in the vicinity of the Department's fiber optic network are completed.
3. For the Department's electrical facilities and other ITS facilities, obtain the as-built information as specified in 102.04 and contact the Department as specified in the Special Provisions.

At least 15 days before excavating test pits, as specified in 202.03.02, to determine utility locations, contact each affected Utility.

C. Protection of Utilities. If required by the Utility, provide the required advance notice before beginning the work within the vicinity of the utility. If utilities need to be supported or protected, submit a plan to the Utility for approval that includes the method of support or protection to provide for uninterrupted service. At least 20 days before beginning the work, provide a copy of the plan and the Utility's approval to the RE. Protect and support utilities according to the approved plan.

Protect and support existing Department electrical and ITS facilities and ensure that there is no interruption of service. At least 30 days before beginning the work, submit a plan to the RE for approval showing the method of support and protection.

When high voltage lines are within the Project Limits, comply with N.J.S.A. 34:6-47.1 to N.J.S.A. 34:6-47.9, 29 CFR 1926.550, and N.J.A.C. 16:25. Obtain written approval from the Department of Labor, Office of Safety Compliance, and the respective Utilities for construction operations that do not provide the minimum clearances under these regulations.

Before beginning work within the railroad ROW or on railroad facilities, obtain the railroad's written approval for access, the method of construction, and the schedule of the work. Provide a copy of the submittal and approval to the RE.

If the Contractor wants to use crossings other than those indicated in the Contract, obtain written approval from the railroad. At least 14 days before beginning the work, provide the RE with a copy of the approval.

When working in proximity of the railroad, do not interfere with the continuity of railroad operations. The Department will provide the estimated railroad train schedules in the Special Provisions. Ensure that construction operations do not affect the tracks appurtenances, and other property of the railroad.

Do not store or operate equipment or material within the fouling distance of railroad facilities without written approval from the railroad. Provide the RE a copy of the approval at least 7 days before beginning the work.

D. Access. Provide Utilities or their agents access to their facilities at all times, including the opportunity to monitor the work.

E. Damage. If the Contractor damages a utility, including service connections, the Contractor shall immediately notify the affected Utility and the RE.

105.07.02 Work Performed by Utilities

The Contractor is responsible for coordinating work performed by Utilities, and is responsible for delays and costs resulting from failure to coordinate. Provide a written request to each Utility in the time specified for the advance notice requirements specified in the Special Provisions. Include the following:

1. Name and location of the Project.
2. Name and contact information of the Contractor and superintendent.
3. Portion of the approved preliminary schedule or baseline schedule that affects the Utility.

Provide a copy of the notice and response to the RE.

Where Utilities jointly use poles or duct banks, the Utilities will perform the work sequentially.

Ensure that the work site is in a condition that allows the Utility to perform its work at the scheduled time. If the Contractor fails to provide the work site at the scheduled time, the Contractor is responsible for the resulting delays and costs to the Project. If the Contractor causes the Utility to incur additional costs, or delays the Utility without prior written approval of the RE, the Contractor is responsible for these costs and delays. The Department has the right to recover the cost of damages from the Contractor.

Immediately notify the RE of failure by the Utility to respond or complete its work as specified in the Special Provisions.

105.08 ENVIRONMENTAL PROTECTION

Perform the Work in compliance with environmental requirements of the Contract and the terms and conditions of permits, grants, licenses, authorizations, certifications, and other approvals procured for the Work. Maintain a copy of Department-obtained permits, grants, licenses, authorizations, certifications, and other approvals within the Project Limits. Keep a copy of Contractor-obtained permits, grants, licenses, authorizations, certifications, and other approvals for the Work within the Project Limits.

Obtain all permits, grants, licenses, authorizations, and other approvals, for off-site disposal, storage, and borrow locations. These may include but are not limited to wetlands, floodplains, regulated waste, threatened and endangered species, and historic properties (archeological sites, historic buildings, and historic districts). Conduct the studies required to obtain the necessary environmental clearances, permits, grants, licenses, authorizations, and other approvals for off-site disposal, storage, and borrow locations. Provide the RE a copy of all of the permits, grants, licenses, authorizations, and other approvals.

The Department's authority to certify SESC plans does not include off-Project borrow pits, disposal sites, or storage areas that the Contractor uses or establishes to accomplish the Work of the Project. If the land disturbance for off-Project work is 555 square yards or greater, provide the RE with a copy of the SESC plan certified by the soil conservation district according to N.J.S.A. 4:24-39, *et seq*.

Do not use treated timber products in shellfish areas and other environmentally sensitive areas such as, but not limited to, essential fish habitat, endangered or threatened species habitat, category one waters, trout-associated waters, and wetlands. Use non-polluting materials such as fiberglass composites in these areas. Before using treated timber products in areas other than those specified in the Contract, obtain the Department's approval.

Take the necessary precautions to prevent pollution, caused by construction operations, of land, air, waterbodies, wetlands, and groundwater within and beyond Project Limits. Employ methods and controls to minimize noise caused by construction operations. Before beginning construction operations, ensure that SESC methods are in place and functioning as specified in 158.03.02. Also, comply with the following:

1. **Historical and Archeological Sites.** Ensure that locations eligible for or listed on the State or National Registers of Historic Places are not used for disposing, storing, or obtaining borrow excavation. For information about historical places, consult the New Jersey Department of Environmental Protection Historic Preservation Office website at www.state.nj.us/dep/hpo/1identify/nrsr.htm.

   When prehistoric or historic artifacts or remains are encountered, immediately cease construction operations in that area and notify the RE. Do not resume construction operations until the Department provides direction.

2. **Forests.** When performing work within or adjacent to State or National Forests or Parks, comply with the regulations of the State Fire Warden, State Division of Parks and Forestry, or other authority having jurisdiction.

   Take reasonable precautions to prevent forest fires caused by construction operations and also other precautions requested by Forestry officials. If a wild fire occurs, immediately notify a Forestry official and the RE of the location and extent of the fire.

3. **Navigable Waters.** If work is required over, on, or adjacent to navigable waters, do not interfere with the free navigation of the waterways, and ensure that the existing navigable depths are not reduced, except as allowed by permits issued for the Project. Before beginning work in or over a navigable waterway for which a Coast Guard permit has been issued, notify the Coast Guard and other agencies specified by permit condition.

4. **Hazardous Material.** If evidence of hazardous material not specified in the Contract is discovered, immediately cease construction operations and notify the RE. Do not resume construction operations in that area until the Department provides direction.

105.09 LOAD RESTRICTIONS

Do not haul equipment or loads whose weight may damage structures, roadways, or construction. The RE may limit hauling of materials over the pavement structure. When hauling outside of the Project Limits, do not exceed legal load limits unless a permit is obtained from the New Jersey Motor Vehicle Commission.

If the Contractor is provided a certified weigh ticket by the material supplier, submit a copy of the certified weigh ticket to the RE.

If a certified weigh ticket is not provided by the material supplier, and when the Contractor will haul more than 5000 cubic yards of material for that Item to or from the Project Limits, submit to the RE a list of the trucks to be used for the operation. Include the certified tare weight of the truck, license plate number, and the motor vehicle classification. At least 5 days before starting hauling, provide the RE notice when hauling will begin. Provide to the RE a certified weigh ticket indicating the gross weight for the first load for each truck.

If the RE finds that trucks are in violation of the legal weight limits under N.J.S.A. 39:3-84, the RE has the right to reject that load of material. The RE has the right to suspend the Work for repeated violations until the condition is corrected.

105.10 USE OF EXPLOSIVES

When using explosives, conform to N.J.S.A. 21:1A-128, *et seq*. and N.J.A.C. 12:190. When storing explosives within the Project Limits, store safely under lock and key at a location approved by the RE. Clearly mark the storage places as DANGEROUS EXPLOSIVES. Ensure that the storing and handling of explosives and highly inflammable materials conform to the regulations of the New Jersey Department of Labor and Workforce Development Safety Compliance Unit and local regulations.

Submit a blasting plan as specified in 202.03.03.A.3.a. Attend a pre-blasting meeting scheduled by the RE with the New Jersey Department of Labor and Workforce Development Safety Compliance Unit. Do not blast before the pre-blasting meeting and obtaining RE approval.

When using explosives for the prosecution of the Work, exercise the utmost care not to endanger life or property, including work completed under the Contract.

SECTION 106 – CONTROL OF MATERIAL

106.01 SOURCE OF SUPPLY AND QUALITY REQUIREMENTS

Ensure that materials furnished for the Project are new, unless otherwise specified in the Contract. Use materials that conform to the requirements of the Contract. When required by the Contract, use only products and suppliers listed on the QPL. Use sources of materials that have been approved by the Department on a Materials Questionnaire as specified in 106.04.

Within 12 hours of receiving a shipment of material, notify the RE of the type, size, quantity, and location of the material. Within 2 days of the receipt of material, provide the RE with the delivery ticket indicating the Project, Contractor, material supplier, date shipped, material description, quantity, Item, and Item number.

Do not change the source, brand, or type of material from that which has been approved for use, without the consent of the Department as specified in 106.04.

106.02 DEPARTMENT-FURNISHED MATERIAL

If the Department furnishes materials, the Department will deliver or make the materials available at the points specified in the Special Provisions. After the Contractor picks up or takes possession of Department-furnished material, submit written notice to the Department certifying that the material was received, inspected, and accepted by the Contractor. After the notice is submitted, the Contractor is responsible for the material. The Department has the right to recover costs from the Contractor for losses, deficiencies, or damage to materials that occur after receipt by the Contractor. The Department may require the Contractor to replace, at no cost to the Department, the lost, deficient, or damaged material with material that is acceptable to the Department.

106.03 FOREIGN MATERIALS

Comply with the appropriate statutes and regulations concerning the use of foreign materials as follows:

1. **Wholly State-Funded Projects.** Comply with N.J.S.A. 52:32-1 and N.J.S.A. 52:33-1, *et seq.*, which prohibits the use by the Contractor or subcontractors of farm products or materials produced or manufactured outside of the United States on public work. The Department may allow exceptions if its enforcement would be inconsistent with the public interest, where the cost of enforcing the prohibition would be unreasonable, or where the material in question is not of a class or kind mined, produced, or manufactured in the United States.

2. **Federal Aid Projects.** Comply with the Federal statutes and regulations that establish the "Buy America" requirements applicable to the Project. These Federal requirements, which are contained in 23 CFR 635.409 and 23 CFR 635.410, mandate among other things that manufacturing processes for iron and steel materials and all iron and steel coatings must be performed in the United States.

If the use of foreign materials is allowed, the Department may require the Contractor to deliver the material to a Department-approved site for sampling, inspection, and testing. Do not use or incorporate the foreign material into the Work before the Department approves the material.

If the Department finds the Contractor failed to comply with the Federal or State provisions regarding foreign materials, the Department may require the unapproved foreign material be removed and replaced with acceptable material. If the Department decides not to remove the unapproved foreign material, the Department will not make payment for the Item incorporating unapproved foreign material, and will make the findings, including the Contractor's name, public.

106.04 MATERIALS QUESTIONNAIRE

At least 30 days before shipment of a material, and at least 30 days before fabrication of structural steel, precast concrete, and prestressed concrete Items, notify the RE of the proposed source of materials using the Materials Questionnaire form provided by the Department. For soil aggregate and dense graded aggregate (DGA) material, submit a copy of recently performed test results for washed gradation test, proctor test, and other tests, as specified in 901.11, for the source with the Materials Questionnaire. For ITS systems as specified in Section 704, obtain approval of system working drawings before submitting the materials on the Materials Questionnaire.

The Department will approve the source of material based on conformance of the source or material with the requirements of the Contract. If the material is required by the Contract to be listed on the QPL, the Department will base approval on the QPL. A material is not approved for use solely because the product is on the QPL; the Contractor must submit the material for approval. Do not order, fabricate, or procure materials before obtaining material source approval by the Department.

Approval by the ME of a proposed source of aggregate materials does not constitute approval of materials delivered to the Project Limits from that source, but is permission to select and use materials from that source only so long as they conform to the Specifications. As the work progresses, ensure that materials selected from approved sources continue to conform to the Specifications.

The Department will not approve material from firms and individuals suspended or debarred by the Department, included in the *State of New Jersey Consolidated Debarment Report* as maintained by the Department of the Treasury, Division of Building and Construction, Bureau of Contractor Prequalification, or in the Federal Government's General Services Administration document titled "List of Parties Excluded from Federal Procurement and Nonprocurement Programs (GSA List)."

106.05 MATERIALS INSPECTIONS, TESTS, AND SAMPLES

All materials being used are subject to inspection and testing at any time before Acceptance. For materials that are stored, locate the materials so that the Department may promptly and conveniently inspect them. The Department's test results are the official test results for acceptance or rejection of materials. The Department will base acceptance or rejection on acceptance testing results or Certifications of Compliance for the various materials as specified in the respective methods of test or in the Subsections applicable to that particular material or work. After inspection, store materials to ensure the preservation of their quality. The Department has the right to re-inspect or retest materials regardless of previous approvals.

The Department may require additional samples to determine the quality and suitability of materials for their intended uses. The provisions in Section 106 do not limit the rights of the Department to order special inspections or tests as specified in 105.01.02.

Submit to the RE a request for HMA plant and field inspection, concrete plant and field inspection, and in-place testing for soil aggregate by 1:00 p.m. of the day before the requested inspection, or by 1:00 p.m. of the previous Friday for inspections requested for a Monday. With the request, provide the RE with the locations, estimated quantities, and estimated start times for each type of material. If the start time for a material delivery is delayed by more than 2 hours, the Department has the right to cancel the request, and require the Contractor to submit a new request.

The Department will not pay for unapproved materials, and the Contractor shall remove and replace unapproved materials at no cost to the Department.

When the Department performs testing on materials, the Department will bear the expense of the testing except as otherwise specified.

For aggregates that do not meet the requirements of the Contract for gradation or density or are not used in the Work, the Department has the right to charge the Contractor for the cost of sampling and testing at Departmental rates. The Department will charge $300.00 per failing sample tested for gradation and $200.00 per failing lot or sub-lot tested for density.

106.06 PLANT INSPECTION

The ME has the right to inspect the materials at the source and has the right to inspect manufacturing plants periodically for compliance with specified manufacturing methods. The ME may obtain material samples for laboratory testing for compliance with materials quality requirements at the plant or may use plant inspection as the basis for the acceptability of manufactured materials.

In the event plant inspection is undertaken, meet the following conditions:

1. Ensure that the ME has the cooperation and assistance of the Contractor and the producer.
2. Ensure that the ME has full access at all times to such parts of the plant as may concern the manufacture or production of the materials being furnished.
3. If required for the use of the ME, provide office space located conveniently in or near the plant.
4. Ensure that adequate safety measures for the ME are provided and maintained.

The Department reserves the right to retest or re-inspect materials that have been approved at the source of supply after they have been delivered and to reject materials which, when retested or re-inspected, do not meet the requirements of the Contract.

106.07 CERTIFICATION OF COMPLIANCE

The Department will accept materials, as specified, on the basis of Certificates of Compliance stating that the materials or assemblies fully comply with the requirements of the Contract.

The Department has the right to sample and test materials or assemblies accepted on the basis of Certificates of Compliance at any time. The Department will reject materials or assemblies, whether in place or not, if found not to be in conformance with the Contract requirements.

Ensure that 4 copies of the manufacturer's Certificates of Compliance are provided with each delivery of materials, components, and manufactured items that are accepted by certification. Retain 1 copy and submit 3 copies to the RE. With the Certificate of Compliance, provide a transmittal identifying the Item for which it is submitted. Ensure that Certificates of Compliance contain the following information:

1. Project Name.
2. Name of the Prime Contractor.
3. Material description.
4. Quantity of material represented by the certificate.
5. Means of identifying the consignment, such as label marking and seal number.
6. Date and method of shipment.
7. A statement that the material conforms to the Contract material requirements and that representative samples have been sampled and tested.
8. If the submission is for an assembly of materials, a statement that the assembly conforms to the Contract.
9. Signature of a person having legal authority to bind the supplier.
10. Signature attested to by a notary public or other properly authorized person.

The Department will not make payment for work for which material is accepted on the basis of a Certificate of Compliance until the RE has received the required Certificate of Compliance and inspected and accepted the material or assembly.

106.08 UNACCEPTABLE MATERIAL

Materials, whether in place or not, that do not conform to the requirements of the Contract, are considered unacceptable. The Department will reject unacceptable materials. Immediately remove rejected materials, unless approved by the RE as specified in 105.03. Do not use rejected material, for which the defects have been corrected, until approval has been given by the RE.

106.09 SUBSTITUTES FOR PROPRIETARY ITEMS

If material or equipment is specified in the Contract by using the name of a proprietary item or the name of a particular supplier, the Contractor may propose a substitute except when the Special Provisions state that no substitution is permitted. To request approval for using a substitute item of material or equipment, submit a written request to the RE including the following:

1. Certification that the proposed substitute performs the functions and achieves the results called for by the design, is similar and of equal substance to that specified, and is suited to the same use as that specified.
2. Details or catalogue cut sheets on the material properties of the substitute.
3. A statement that the evaluation and approval of the proposed substitute does not hinder the Contractor's ability to complete the Contract as specified in 108.10.
4. A statement that the proposed substitute for use in the Work does not change or modify the Contract.
5. Difference between the proposed substitute from that specified.
6. Manufacturer's recommendations, maintenance requirements, and repair or replacement requirements for the substitute.

Submit additional information as requested by the Department to assist the Department's evaluation. The Department will evaluate the request and notify the Contractor in writing of approval or rejection of the proposed substitute. The Department has the right to require the Contractor to provide, at no cost to the Department, a special performance guarantee or other bond with respect to a substitute.

If, during the use of the substitute material or equipment, the RE determines that the work produced is not in conformance with the Contract, immediately discontinue the use of the substitute and complete the remaining work with the specified material or equipment. Remove the deficient work and replace it, or take corrective action as directed by the RE. The Department will not make payment or modify Contract Time to remove and replace work resulting from an authorized substitution.

SECTION 107 – LEGAL RELATIONS

107.01 LEGAL JURISDICTION

107.01.01 Applicable Law

This Contract shall be construed and governed by the Constitution and laws of the State. It is the Contractor's responsibility to be aware of and comply with Federal, State, and local laws, ordinances, rules, and regulations, and orders and decrees of bodies or tribunals having jurisdiction or authority that affect those engaged or employed on the Work, or that affect the conduct of the Work. The Contractor shall observe and comply with, and ensure the Contractor's agents and employees observe and comply with, laws, ordinances, rules, regulations, orders, and decrees. Defend and indemnify the State and its representatives against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree, whether by the Contractor or the Contractor's agents or employees, subcontractors of any tier, or suppliers. If discrepancies or inconsistencies are discovered between any document of the Contract and any law, ordinance, regulation, order, or decree, immediately notify the RE in writing.

107.01.02 Permits, Licenses, and Approvals

Procure permits, grants, licenses, authorizations, certifications, and other approvals for the prosecution of the Work, except where the Department has procured such permits, grants, licenses, authorizations, certifications, and other approvals.

For existing permits previously obtained by the Department, submit proposed modifications to the permits to the Department for approval before submitting them to the regulatory agencies having jurisdiction and interest. After receiving the Department's approval, obtain the necessary approvals from the appropriate regulatory agencies. Do not begin work covered by the proposed permit modification until the necessary approvals are obtained from the designated regulatory agencies. Before beginning the work affected by the modification, provide a copy of the approval, authorization, or modification to the RE.

Keep copies of current permits, grants, licenses, authorizations, certifications, other approvals, and modifications within the Project Limits. Clearly post a copy of each so that it is publicly available for inspection. Before beginning work that requires Contractor-procured permits, grants, licenses, authorizations, certifications, or other approvals, provide a copy to the RE.

If the Contractor is not in compliance with required permits, grants, licenses, authorizations, certifications, or other approvals, the Contractor shall take corrective actions immediately. The RE has the right to suspend the Work as specified in 108.13, until the Contractor is in full compliance. Provide to the RE, whenever requested, documentation pertaining to the noncompliance and related corrective actions taken. The Department will not make payment for or modify Contract Time for performing corrective and remedial work required to bring the Contractor into compliance.

The Contractor is responsible to pay fines levied against the Contractor, its agents, employees, and subcontractors that arise out of or are alleged to arise out of noncompliance with permits, grants, licenses, authorizations, certifications, or other approvals. The Department will recover from the Contractor costs due to fines levied against the Department that arise out of, or are alleged to arise out of, noncompliance by the Contractor, its agents, employees, and subcontractors with permits, grants, licenses, authorizations, certifications, or other approvals. The Department may hold the Contractor responsible for all engineering, inspection, and administration costs (including overhead) incurred as a result of the Contractor's noncompliance.

107.01.03 Sovereign Immunity

The Department, by entering into this Contract, does not waive its Sovereign Immunity, except as provided under N.J.S.A. 59:13-1, *et seq.* The rights or benefits provided the Contractor in this Contract that exceed those provided under N.J.S.A. 59:13-1, *et seq.,* are contractual in nature, and do not expand the waiver of Sovereign Immunity provided under N.J.S.A. 59:13-1, *et seq.*

107.02 DISCRIMINATION IN EMPLOYMENT ON PUBLIC WORKS

Pursuant to N.J.S.A. 10:2-1, the Contractor agrees that in the hiring of persons for the performance of work under the Contract or any subcontract, or for the procurement, manufacture, assembling, or furnishing of materials, equipment,

supplies, or services to be acquired under the Contract, the Contractor, subcontractor, or any person acting on their behalf shall not discriminate against any person who is qualified and available to perform the work to which the employment relates by reason of race, creed, color, national origin, age, ancestry, marital status, gender, or affectional or sexual orientation.

The Contractor, subcontractor, or any person acting on their behalf shall not, in any manner, discriminate against or intimidate any employee engaged in the performance of the Work under the Contract or any subcontract hereunder, or engaged in the procurement, manufacture, assembling, or furnishing of any such materials, equipment, supplies, or services to be acquired under such Contract, by reason of race, creed, color, national origin, age, ancestry, marital status, gender, or affectional or sexual orientation.

The Department has the right to deduct a penalty of $50.00 for each person for each day that the person is discriminated against or intimidated in violation of the provisions of the Contract pursuant to N.J.S.A. 10:2-1. The Department has the right to terminate the Contract, and any monies due the Contractor under the Contract may be forfeited, for any violation of this Subsection occurring after notice to the Contractor from the Department of any prior violation of this Subsection.

107.03 AFFIRMATIVE ACTION, DISADVANTAGED BUSINESS ENTERPRISES, OR EMERGING SMALL BUSINESS ENTERPRISE

It is the public policy of the State and of the United States that no individual, group, firm, or corporation working on or seeking to work on a Public Works Project should be discriminated against on the basis of race, creed, color, national origin, age, ancestry, nationality, marital or domestic partnership status, gender, disability, liability for military service, affectional or sexual orientation, atypical cellular or blood trait, or genetic information (including the refusal to submit to genetic testing). The Department has developed Affirmative Action, Disadvantaged Business Enterprise, or Emerging Small Business Enterprise Programs to implement this policy, and the regulations and requirements applicable to the Contract are contained in the Special Provisions. The Department will resolve conflicts between these regulations and requirements and the other provisions of the Contract to further the above stated public policy.

107.04 NEW JERSEY CONTRACTUAL LIABILITY ACT

The Contractor agrees to be responsible for compliance with N.J.S.A. 59:13-1, *et seq*. The Contract does not in any way waive or amend the Contractor's duties under N.J.S.A. 59:13-1, *et seq*.

The various notice provisions specified in the Contract are contractual obligations that are in addition to the Contractor's notice obligations under N.J.S.A. 59:13-1, *et seq*. The Contractor must submit a fully completed Contractual Notice Form in order to comply with the notice requirements of N.J.S.A. 59:13-5, *et seq*.

The Contractor acknowledges that it will be forever barred from recovering against the State if it fails to give timely notice in accordance with N.J.S.A. 59:13-1, *et seq.,* on the Contractual Notice Form, of any happening of an event, thing, or occurrence or of an act or failure to act, by the Department, and that the Contractor is solely responsible for complying with the various notice requirements and the timeliness of a claim as set forth under N.J.S.A. 59:13-1, *et seq*.

For purposes of determining the date of "completion of the contract" pursuant to N.J.S.A. 59:13-5, "completion of the contract" occurs on the date that the Contractor provides written notice to the Department of Acceptance or conditional Acceptance of the Proposed Final Certificate or the 30th day after the Department issues the Proposed Final Certificate, whichever event occur first.

Subcontractors, suppliers, manufacturers, and fabricators are barred from making claims against the Department as a matter of law by N.J.S.A. 59:13-1, *et seq*.

107.05 LIMITATIONS OF LIABILITY

Regarding any claim arising from a breach of Contract, tort (including negligence), or otherwise, the State will not be liable to the Contractor for any special, consequential, incidental, or penal damages, including, but not limited to, loss of profit or revenues, loss of rental value for contractor-owned equipment, damages to associated equipment, cost of capital, or interest, except as permitted by N.J.S.A. 59:13-8.

107.06 PERSONAL LIABILITY OF PUBLIC OFFICIALS

There shall be no liability upon the Department or authorized representatives of the Department, either personally or as officials of the State, in carrying out any of the provisions of the Contract or in exercising any power or authority granted to them by or within the scope of the Contract, it being understood that in all such matters they act solely as agents and representatives of the State. Similarly, for projects on county or local roads, there shall be no liability, either personally or in an official capacity, upon the Board of Chosen Freeholders of the county or counties, or upon the governing body of the municipality or municipalities within the Project Limits.

107.07 ASSIGNMENT

Do not assign the performance of the Contract.

Do not transfer or assign to any party any Contract funds, due or to become due, or claims of any nature the Contractor has against the Department, without obtaining the written approval of the Department. The Department, by sole discretion, may grant or deny such approval.

107.08 NON WAIVER

Provisions of the Contract do not waive other provisions of the Contract unless specifically stated.

If the Department waives a provision of the Contract for a particular occurrence, this waiver does not constitute a continued waiver by the Department of that provision or any other provision of the Contract.

107.09 INDEPENDENT CONTRACTOR

The relationship of the Contractor to the State is that of an independent contractor, and the Contractor, shall conduct itself consistent with such status. It shall neither hold itself out, as nor claim to be, an officer or employee of the Department by reason hereof. Do not make a claim, demand, or application to or for the rights or privileges applicable to an officer or employee of the Department, including, but not limited to, Workers Compensation Insurance, unemployment insurance benefits, social security coverage, or retirement membership or credit.

107.10 NON-THIRD PARTY BENEFICIARY CLAUSE

No provision of the Contract is intended to make the public or any member thereof a third party beneficiary, or to authorize anyone not a party to the Contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of the Contract.

It is the further intent of the Department and the Contractor in executing the Contract that no individual, firm, corporation, or any combination thereof, that supplies materials, labor, services, or equipment to the Contractor for the performance of the Work becomes thereby a third party beneficiary of the Contract. The Department and the Contractor understand that such individual, firm, corporation, or combination thereof, has no right to bring an action in the courts of this State against the Department, by virtue of this lack of standing, and also by virtue of the provisions of N.J.S.A. 59:13-1, *et seq.*, which allows suit against the State in Contract only on the basis of express contracts or contracts implied in fact.

107.11 RISKS ASSUMED BY THE CONTRACTOR

The Contractor shall take every precaution, as allowed by the Contract, against injury or damage to any part of the Project by the action of the elements, the traveling public, vandalism, or from any other cause, whether arising from the execution or the non-execution of the work.

The Contractor cannot impute the negligence of consultants, other contractors, Utilities (other than the Department), other public entities, persons or entities to the Department.

The Contractor assumes the following distinct and several risks, whether they arise from acts or omissions, whether negligent or not, and whether such risks are within or beyond the control of the Contractor, as specified in 107.11.1 to 107.11.4. Excepted from this assumption of risks are only those risks that arise from solely affirmative acts by the State subsequent to the execution of the Contract with actual and willful intent to cause loss, damage, or injury. The risks are assumed by the Contractor as follows:

1. **Damage Caused by the Contractor.** The Contractor bears the risk of all loss or damage caused by the Contractor, the Contractor's agents or employees, subcontractors of any tier, suppliers, or agents making deliveries. Protect and preserve public and private property from damage or loss in the prosecution of the Work. Promptly repair or replace such damage or loss as directed by the RE. The Department will not make payment or modify Contract Time for such repair or replacement.

   If the Contractor damages the Department's fiber optic network, the Contractor shall immediately notify the RE and the Traffic Operations Center. The Contractor shall include in the notification if the Contractor shall perform the repairs or if it is necessary for the Department to perform the repairs. If the Contractor can not complete the repairs in the time specified by the RE, the Department has the right to repair the damage and recover the cost for the repair from the Contractor. The Department will assess liquidated damages for lost services at the rate of $1000 per hour.

2. **Risks of Loss or Damage to the Construction.** Until Acceptance, the Contractor bears the risk of all loss or damage to materials and to construction performed under the Contract. Promptly repair or replace such damage or loss. The Department will not make payment or modify Contract Time for repairing or replacing loss or damage.

   The Contractor shall not bear such risk of loss or damage for the repair or replacement of any permanent element of work if the element of the work damaged is completed and is serving its intended function, is subsequently damaged by a public traffic accident, and the Contractor provides the RE satisfactory evidence that such damage was caused by a public traffic accident. Satisfactory evidence is limited to:

   1. Accident reports filed with the New Jersey Motor Vehicle Commission.
   2. Documents supporting the damage issued by police agencies or insurance companies.
   3. Statements by reliable, unbiased eye witnesses.
   4. Identification of the vehicle involved in the accident.

   The Contractor shall not bear the risk of loss or damage that arises from acts of war, floods, tidal waves, earthquakes, cyclones, tornadoes, hurricanes, or other cataclysmic natural phenomenon, unless such loss or damage is covered by the Contractor's insurance.

3. **Risks of Claims on Account of Injury, Loss, or Damage.** The Contractor bears the risk of claims, just or unjust, by third persons made against the Contractor or the State, on account of injuries (including wrongful death), loss, or damage of any kind whatsoever arising or alleged to arise out of or in connection with the performance of the Work. The risk of claims, whether or not actually caused by or resulting from the performance of the Work or out of or in connection with the Contractor's operations or presence at or within the Project Limits, whether such claims are made and whether such injuries, loss, and damages are sustained, applies at any time both before and after Acceptance.

4. **Risks of Loss to Property of Those Performing the Work.** The Contractor bears the risk of loss or damage to any property of the Contractor, and of claims made against the Contractor or the State for loss or damage to any property of subcontractors, workers, and others performing the Work, and to lessors. Said risk occurs at any time before removal of such property from the Project Limits, the State's ROW, or any other property procured by the Contractor for the Project.

Defend and indemnify the State from any and all claims or alleged claims described in 107.11.3 and 107.11.4, and for all expense incurred by the State in the defense, including legal and related costs, settlement, or satisfaction thereof. If so directed by the State, the Contractor shall at its own expense defend against such claims, in which event it shall not, without obtaining express advance permission from the State, raise any defense involving in any way jurisdiction of the tribunal, immunity of the State, governmental nature of the State, or the provisions of any statutes respecting suits against the State.

The provisions of this Subsection are also for the benefit of the State, its agents, officers, and employees so that they have all the rights that they would have under this Subsection if they were named at each place above at which the State is named, including a direct right of action against the Contractor to enforce the foregoing indemnity except, however, that the State may at any time in its sole discretion and without liability on its part cancel the benefit conferred on any of them by this Subsection, whether or not the occasion for invoking such benefit has already arisen at the time of such cancellation.

Except as specified in 107.11.2, Acceptance, the Final Certificate, or Termination does not release the Contractor from its obligations under this Subsection.

The enumeration in this Subsection or elsewhere in this Contract of particular risks assumed by the Contractor or of particular claims for which it is responsible shall not be deemed:

1. To limit the effect of the provisions of this Subsection or of any other provision of the Contract relating to such risks or claims; or
2. To imply that the Contractor assumes or is responsible for risks or claims only of the type enumerated in this Subsection; or
3. To limit the risks that the Contractor would assume or the claims for which the Contractor would be responsible in the absence of such enumerations.

The Contractor expressly understands and agrees that any insurance protection required by the Contract, or otherwise provided by the Contractor, in no way limits the Contractor's responsibility to defend and indemnify the State. Such insurance requirements are designed to provide greater assurance to the State that the Contractor is financially able to discharge its obligations under this Subsection and as to the risks assumed elsewhere in the Contract, and are not in any way construed as a limitation on the nature and extent of such obligations.

107.12 THE CONTRACTUAL CLAIM RESOLUTION PROCESS

107.12.01 Satisfying the Notice Requirements

If the Contractor has provided the RE notice of change as specified in 104.03.04, the RE and the Contractor may negotiate a resolution, even if the full impact has not been determined. If a notice of change has not been resolved, the Contractor may initiate the contractual claims resolution process.

To initiate the contractual claims resolution process, submit to the RE a Contractual Notice Form for the claim. At a minimum, include the following information with the Contractual Notice Form:

1. A detailed factual statement of the claim providing all necessary dates, locations, and Items affected by the claim.
2. The date on which facts arose that gave rise to the claim.
3. A copy of notice given to the Department pursuant to any other Subsection of the Contract that relates to the matter giving rise to the claim.
4. The name, function, and activity of each individual involved in or knowledgeable about the claim.
5. The specific provisions of the Contract that support the claim and a statement of the reasons why the provisions support the claim.
6. A detailed factual statement of the actions taken by the Contractor to mitigate the claim.
7. If the claim relates to a decision of the Department that the Contract leaves to the Department's discretion or as to which the Contract provides that the Department's decision is final, the Contractor shall set out in detail the facts supporting its contention that the decision of the Department was fraudulent, arbitrary, or capricious.
8. The identification of documents and the substance of communications relating to such claim.
9. If an extension of Contract Time is sought, the specific days sought and the basis for the claim, supported by the Contractor's approved baseline progress schedule and updates, as well as relevant fragnets. Include a time impact evaluation of the delay as specified in 108.11.01.C.
10. If additional payment is sought, provide a breakdown of the amount sought in the manner specified in 104.03.08, or other calculations and basis of the amount sought.
11. If additional payment is sought, the Contractor may provide the bid documents when escrowed with an escrow custody agent, as specified in 103.05.
12. The Contractor must state in writing that all documentation in support of the claim has been provided to the Department and that the Contractor has requested that the review process begin.

If the Department determines that the submitted Contractual Notice Form does not provide sufficient information, the Department will consider the Contractual Notice Form incomplete for the purpose of processing the claim under the Contractual Claim Resolution Process, and the Department will notify the Contractor of the missing components required to start the process. The Department will not initiate formal discussions or meetings concerning a claim submitted on an incomplete Contractual Notice Form.

The Department will review alleged liability and damages at the same time.

107.12.02 Steps

The Department will not process or review claims submitted by a subcontractor or supplier at any tier. Claims submitted by the Contractor are eligible only for payment when there is an obligation or liability on the part of the Contractor and shall not be a pass through of a claim by a subcontractor or by a supplier.

A Contractor may initiate the Contractual Claims Resolution Process up to 30 days after the issuance of the proposed Final Certificate.

The Contractual Claims Resolution Process may continue beyond the "completion of the contract" as defined in 107.04; however, the Contractual Claims Resolution Process will not extend any statute of limitation that may apply to a claim.

The Contractual Claims Resolution Process is sequential in nature and is composed of the following steps:

1. Step I – Review by the RE.
2. Step II – Review by the Dispute Review Board.
3. Step III – Review by the Claims Committee.
4. Step IV – Non-Binding Mediation.

The Department will not allow a claim to proceed to the next level of review unless and until the claim has been reviewed at the preceding step. Additionally, the Department will not allow the claim to proceed to the next level until the Contractor indicates in writing that the decision of the previous step is unacceptable and requests that the claim be forwarded to the next step within the specified timeframe. If during any step in the process, a claim is resolved, the Contractor must sign an unconditional release, provided by the Department, as to all matters arising from the claim.

The Contractor is limited to the documentation provided to the Department at the beginning of Step I throughout all steps of the Contractual Claims Resolution Process. Submission of additional information by the Contractor at any subsequent step is cause for the claim to be returned by the Department to Step I for review. The Department will inform the Contractor in writing if the claim is returned to Step I. If a claim is returned, it must proceed through all completed steps in the process again.

The Department will not pay interest on the amount of any payment made in resolution or settlement of a claim resolved through the Contractual Claims Resolution Process.

When the value of the claim submitted by the Contractor is $20,000 or less, the Step II review will be the final step in the Contractual Claims Resolution Process. For such claims, the decision of the Dispute Review Board is final and terminates the Contractual Claims Resolution Process.

Where there has been a determination at Step I or Step II that the Contract does not provide a basis for the claim or that the Contractor has failed to timely submit a notice of claim pursuant to N.J.S.A. 59:13-1, *et seq*., the Department reserves the right to terminate the Contractual Claims Resolution Process at the end of Step II. For such claims, the Secretary of the Department Claims Committee will provide the Contractor with the reasons for the termination of the Contractual Claims Resolution Process and the rejection of the claim. The review of a claim at any step does not constitute a waiver by the Department of its defenses that the Contract does not provide a basis for the claim or that the Contractor failed to timely submit a notice of claim pursuant to N.J.S.A. 59:13-1, *et seq*.

When the Contractual Claims Resolution Process is terminated for a claim as a result of the Contractor's act or failure to act, the Contractor waives its rights to further participation in the Contractual Claims Resolution Process for that claim.

The Contractual Claims Resolution Process is as follows:

1. **Step I, RE.** The RE will render a written decision regarding the claim presented by the Contractor within 20 days after the RE has determined that sufficient information was provided by the Contractor on the Contractual Notice Form as specified in 107.12.01. This time limit may be extended by mutual agreement of the parties.

   Within 10 days of the receipt of the decision by the RE, the Contractor shall either accept or reject the decision in writing; or upon failure to accept or reject the decision in writing, the Department will terminate the Contractual Claims Resolution Process. If the Contractor rejects the decision and intends to proceed to a Step II review, the Contractor must request a Step II review within 10 days of receipt of the RE's decision.

2. **Step II, Dispute Review Board (DRB).** The DRB is comprised of 3 delegated members of the Department.

If the Contractor provides a timely written rejection of the RE's decision and a timely request to forward the claim to Step II, the RE will forward the claim and supporting information previously submitted by the Contractor to the DRB within 7 days of receipt of the Contractor's request to forward the claim to the next step. The DRB will schedule and hold a meeting to review the claim with the Contractor within 30 days of receipt of the claim information from the RE. This time limit may be extended by mutual agreement of the parties. The DRB will issue a written decision regarding the claim within 20 days of the meeting.

Within 15 days of the receipt of the decision by the DRB, the Contractor shall either accept or reject the decision in writing; or upon failure to accept or reject the decision in writing, the Department will terminate the Contractual Claims Resolution Process. If the Contractor rejects the decision and intends to proceed to a Step III review, the Contractor must request a Step III review within 15 days of receipt of the DRB's decision. Submit the request to the Secretary of the Department Claims Committee, P.O. Box 600, Trenton, New Jersey 08625-0600.

3. **Step III, Claims Committee**. The Claims Committee is comprised of 3 delegated voting members of the Department's management. Additional non-voting members may include a Deputy Attorney General, the Secretary of the Claims Committee, and a member of the FHWA. For issues involving the Claims Committee or Mediation, contact the Secretary of the Claims Committee.

   The Claims Committee will not review a claim or combination of claims valued less than $250,000 until after the receipt of conditional release as specified in 109.11. The Claims Committee will review a claim or combination of claims valued more than $250,000, the Claims Committee will review the claim or claims, unless the Contract is 75 percent complete as measured by Contract Time or Adjusted Total Contract Price, which ever occurs first. If the Claims Committee does not review a claim or combination of claims before Completion, the Claims Committee will review the claim or combination of claims at a single session of the Claims Committee after the receipt of the conditional release as specified in 109.11 and all claims have been reviewed at Steps I and II of the Claims Resolution Process. When reviewing a combination of claims, the Claims Committee will not review any individual claim valued less than $20,000.

   Regarding a request for a Step III review that meets the applicable requirements, the Secretary of the Claims Committee will schedule a Claims Committee review to be held within 60 days of the receipt of the request from the Contractor. This time limit may be extended by mutual agreement of the parties. The Claims Committee will notify the Contractor in writing of its decision on the claim within 60 days of the review. Within 20 days of the receipt of the decision by the Claims Committee, the Contractor shall either accept or reject the decision in writing, or upon failure to accept or reject the decision in writing, the Department will terminate the Contractual Claims Resolution Process. If the Contractor rejects the decision and intends to proceed to a Step IV Non-Binding Mediation, the Contractor must request a Step IV Non-Binding Mediation within 60 days of receipt of the Claims Committee's decision. Submit the request to the Secretary of the Claims Committee.

4. **Step IV, Non-Binding Mediation.**

   a. **Conditions**. If the Contractor submits a timely request for a Step IV Non-Binding Mediation, and the Department tentatively agrees to participate in non-binding mediation, the Contractor must satisfy the following conditions to proceed:

      1. The Contractor has entered into the Department's standard Step IV Non-Binding Mediation Agreement (Step IV Agreement), a copy of which is available on the Department's website.
      2. The Contractor has submitted the names of 6 proposed mediators. Include the fee schedule and the biographical background listing the experience and qualifications of each candidate. If a candidate was previously engaged by the Department or Contractor, identify the project and when the candidate served. If a candidate was employed by the Department or Contractor, identify when the candidate was employed and the candidate's job duties. The Contractor may propose candidates that have been used for mediation purposes for this Project or another project.

   b. **Mediator.** The Department will select the mediator for the Non-Binding Mediation from the list of candidates submitted by the Contractor. If the Department rejects the proposed candidates, the Department will request the Contractor to submit 4 additional candidates that meet the original criteria. Submit this additional list within 15 days of the receipt of a written request from the Department. The

mediator must be acceptable to both the Contractor and to the Department for the Non-Binding Mediation to proceed. Upon mutual agreement, the mediator can be an individual proposed by the Department.

c. Meeting. Upon selection of the mediator and the return of the executed Step IV Agreement, the Secretary of the Claims Committee will schedule a meeting for the Non-Binding Mediation.

d. Decision. If an agreement is reached at non-binding mediation, it will be forwarded for Department approval.

107.13 LITIGATION OF CLAIMS BY THE CONTRACTOR

The Contractual Claims Resolution Process is not an administrative procedure but is contractual in nature, intended to review properly filed and documented claims. The exhaustion of the Claims Resolution Process is not a prerequisite to the filing of a legal action against the Department. The Contractor, however, must fully comply with all of the terms and conditions of N.J.S.A. 59:13-1, *et seq*. before commencing a legal action. Therefore, where a Contractor brings a legal action, arising out of a Contract, against the Department, its agents, officers, or employees, arising out of or related, directly or indirectly, to a claim pending against the Department, the Contractual Claims Resolution Process, at any step, shall terminate as to that claim(s) or related claims being litigated, no matter which level of review the claim may be at when the legal action is filed. The Department will, thereafter, resolve such claim(s) under the legal action, subject to the provisions of N.J.S.A. 59:13-1, *et seq*. The Contractor may submit claims to the Department for processing through the Contractual Claims Resolution Process that are unrelated to pending litigation, subject to the terms of the Contract and N.J.S.A. 59:13-1, *et seq*.

In a legal action, the Contractor's remedy for additional payment or an extension of Contract Time shall not exceed the actual additional costs incurred by the Contractor resulting directly from the change. In addition, the damages sought by the Contractor shall not exceed the amount allowed by force account as specified in 104.03.08. The Contractor bears the burden of proving compliance with the requirements of the Contract, and must maintain all records required under the Contract.

107.14 PATENTED DEVICES, MATERIALS, AND PROCESSES

Observe patent and copyright laws. If a design, device, material, or process covered by letters of patent or copyright is used in the Work, obtain permission for such use by suitable legal agreement with the patentee or owner. Pay the costs for the use of patented materials, equipment, devices, or processes used on or incorporated in the Work. Defend and indemnify the State and the Department, affected third parties, or political subdivision from any and all claims filed against the State or Department for infringement of patented designs, devices, materials, or processes, or any trademark or copyright. The Contractor is responsible for all costs, expenses, and damages that the Contractor may be obliged to pay by reason of an infringement during the performance of the Work or after Acceptance.

107.15 TAXES

N.J.S.A. 54:32B-9 provides that any sale or service to the State, or any of its agencies, instrumentalities, public authorities, public corporations (including a public corporation created pursuant to agreement or compact with another state), or political subdivisions where the State is the purchaser, user, or consumer, is not subject to the sales and use taxes imposed under the Sales and Use Tax Act. N.J.S.A. 54:32B-8 provides that sales of materials, supplies, or services made to contractors, subcontractors, or repairmen for exclusive use in erecting structures, or building on, or otherwise improving, altering, or repairing real property of the above listed bodies are exempt from the tax on retail sales imposed by the Sales and Use Tax Act. The sales tax exemption does not apply to equipment used for Contract work or for force account work whether the equipment is to be purchased or rented. The Contractor may obtain the required Contractor's Exemption Purchase Certificate (Form No. ST-13) to apply for the exemption, by writing or calling the New Jersey Division of Taxation, Tax Information Services, P.O. Box 269, Trenton, New Jersey 08625, or any New Jersey Division of Taxation Regional Office.

Pursuant to N.J.S.A. 54:49-19, *et seq*., and notwithstanding any provisions of the law to the contrary, whenever a taxpayer, partnership, or S-corporation under contract to provide goods, services, or construction projects to the State or its agencies or instrumentalities, including the legislative and judicial branches of the State government, is entitled to payment for those goods or services at the same time a taxpayer, partner, or shareholder of that entity is indebted for any State tax, the Director of the Division of Taxation will seek to set off the necessary payment to satisfy the indebtedness.

The amount set off shall not allow for the deduction of any expense or other deductions that might be attributable to the taxpayer, partner, or shareholder subject to set-off under this act.

The Director of the Division of Taxation will give notice of the set-off to the taxpayer, partner, or shareholder and will provide an opportunity for a hearing within 90 days of the notice under the procedures for protests established under N.J.S.A. 54:49-18. No request for conference, protest, or subsequent appeal to the tax court from any protest, shall stay the collection of the indebtedness. The Department will stay interest that may be payable by the State to the taxpayer, pursuant to N.J.S.A. 52:32-32, *et seq*.

107.16 RECOVERY OF MONIES BY THE STATE

Whenever the Contract provides that:

1. the State or Department is entitled to withhold, deduct, or recover money from any monies due or that may become due the Contractor;
2. the Contractor is to pay or return monies for any reason; and
3. the State or Department is entitled to payment from the Contractor for costs, assessments, or fines

the State or Department has the right to recover any monies due or that may become due the Contractor under the Contract or any other contracts with the Department (including joint ventures in which the Contractor is a participant but only to the extent of its participation), including but not limited to deducting the amount from Estimates, retainage, or the sale of bonds held in lieu of retainage for any contract with the Department, even when such recovery is being contested by the Contractor.

SECTION 108 – PROSECUTION AND COMPLETION

108.01 SUBCONTRACTING

The Department will not permit subcontracting without Department approval. The Contractor is responsible for the work performed by subcontractors. Ensure that no work is performed by a subcontractor before receiving written approval for each subcontractor from the Department. Ensure that work reserved for a subcontractor designated as a DBE, ESBE, or SBE, is not performed by any other firm, including the Contractor's own organization. Submit requests for approval to subcontract on Department forms to the Department at least 20 days before the anticipated start of the work with the following:

1. A certified copy of the executed subcontract agreement between the Contractor and the subcontractor.
2. Proof of the subcontractor's valid business registration with the Department of Treasury, Division of Revenue according to N.J.S.A. 52:32-44.
3. Proof of the subcontractor's valid Public Works Contractor Registration with the Department of Labor, Division of Wage and Hour Compliance according to N.J.S.A. 34:11-56.18.

If requesting approval for a third tier subcontract, submit a letter from the subcontractor permitting subcontracting to a third tier, and submit the request for approval to subcontract, completed by the second tier subcontractor.

The Department will allow the Contractor to subcontract work as follows:

1. Values and Quantities. The total value of the work subcontracted may not exceed 50 percent of the Total Contract Price, except as follows:

1. The Contractor may deduct the value of work for Items designated as Specialty Items as specified in the Special Provisions from the value of the Total Contract Price.
2. The Contractor may deduct the value of work subcontracted to certified DBE, ESBE, and SBE firms indicated on the original DBE/ESBE/SBE Form A approved by the Department from the value of work subcontracted.

The total value of the work subcontracted may not exceed 70 percent of the Total Contract Price less the value of Specialty Items as noted above.

If the entire quantity or a portion of the quantity of a unit price Item is subcontracted, the Department will determine the value of the work subcontracted by multiplying the price of the Item by the quantity to be performed by the subcontractor.

If a portion of the work for a unit price Item is subcontracted, the Department will consider the entire unit subcontracted. The Department will determine the value of the work subcontracted by multiplying the price of the Item by the quantity of units to be performed by the subcontractor.

If a portion of a lump sum Item, an Item that includes specialty work, or a sign support structure is subcontracted, the Department will determine the value of work subcontracted based on the value of the work subcontracted as indicated in the subcontract agreement and as shown in a breakdown of cost submitted by the Contractor.

2. Limits and Restrictions. The Department will permit subcontracting of work with the following restrictions:

1. The Contractor is barred from subcontracting MOBILIZATION.
2. The Contractor may only subcontract electrical, blasting, asbestos removal, landscaping, and lead paint abatement work to subcontractors having the required certificates and licenses. Submit copies of required certificates and licenses with the request for approval to subcontract.
3. The Contractor is barred from subcontracting to firms and individuals suspended or debarred by the Department or included in the *State of New Jersey Consolidated Debarment Report* maintained by the Department of the Treasury, Division of Building and Construction, Bureau of Contractor Prequalification. The Contractor must certify that neither the individual, partnership, corporation, or limited liability corporation applying to do subcontract work nor any of its corporate officers, stockholders, partners, or members are collectively or individually suspended, debarred, proposed for debarment, disqualified, declared ineligible, or voluntarily excluded from doing business by this or any other State or sub-division thereof or listed in the Federal Government's General Services Administration document, *List of Parties Excluded from Federal Procurement and Nonprocurement Programs (GSA List)*.
4. Subcontractors are barred from making claims against the Department, its agents, officers, or employees.

3. Subcontract Requirements. Ensure that subcontract agreements include the following Contract provisions:

a. Federal Aid Projects. When subcontracting work on a Federal Aid project, ensure the following are included in the subcontract agreement.

1. Required Contract Provisions, Federal Aid Construction Contracts (Form FHWA 1273).
2. Standard Federal Equal Employment Opportunity Construction Contract Specifications (Executive Order 11246).
3. Notice of Requirement for Affirmative Action to Ensure Equal Opportunity (Executive Order 11246).
4. State of New Jersey Equal Employment Opportunity Specifications for Contracts Funded by FHWA.
5. Disadvantaged Business Enterprise Utilization Attachment, FHWA Funded Contracts or Emerging Small Business Enterprise Utilization Attachment, FHWA Funded Contracts.
6. Incentive Program, Disadvantaged Business Enterprise Utilization Attachment for FHWA Funded Contracts.
7. Equal Employment Opportunity Special Provisions.
8. Special Contract Provisions for Investigating, Reporting, and Resolving Employment Discrimination and Sexual Harassment Complaints.
9. Training Special Provisions.
10. General Wage Determinations Issued Under the Davis-Bacon and Related Acts.
11. New Jersey Department of Labor Prevailing Wage Rate Determination.
12. New Jersey Department of Transportation Code of Ethics for Vendors.
13. Subsection 107.04 as amended or supplemented.

b. Wholly State Funded Projects. When subcontracting work on a wholly State funded project, ensure the following are included in the subcontract agreement.

1. State of New Jersey Equal Employment Opportunity for Contracts Funded by Wholly State Funds.
2. Payroll Requirements for 100 Percent State Projects.
3. Americans with Disabilities Act for 100 percent State Funded Contracts.
4. Equal Employment Opportunity Special Provisions Construction Contracts Funded by Wholly State Funds.
5. Small Business Enterprise Utilization Attachment for 100 Percent State Funded Contracts.
6. Minority/Female Outreach and Training Program for Wholly State Funded Projects.
7. Training Reimbursement.
8. New Jersey Department of Labor Prevailing Wage Rate Determination.
9. New Jersey Department of Transportation Code of Ethics for Vendors.
10. Subsection 107.04 as amended or supplemented.

108.02 COMMENCEMENT OF WORK

Within 15 days from the date of the execution of the Contract and before beginning construction operations, submit to the RE the following:

1. Insurance certificates as specified in 152.03.
2. The designated superintendent, environmental manager, TCC, and safety officer contact information.
3. Safety program as specified in 108.05.02.
4. Progress schedule as specified in 153.03.02.

Provide written notice to the contact provided in 101.04.2 of the date when construction operations will begin. Provide the notice at least 21 days in advance of starting construction operations. Do not begin construction operations before the date provided.

Do not perform CONSTRUCTION LAYOUT and FIELD OFFICE TYPE ___ SET UP until the Department has approved the insurance certificates and the safety program. Do not begin other construction operations until after the following actions:

1. A preconstruction conference with the Department has been held.
2. Approval of the progress schedule as specified in 153.03.02.
3. The field office has been established.
4. The ROW limits, limits of construction, and environmentally restricted areas have been laid out.

When a Request for Authorization Form for the New Jersey Pollutant Discharge Elimination System 5G3 – Construction Activity Stormwater General Permit (NJG0088323) is specified as a Contract requirement, do not perform land disturbance activity, including clearing, grading, or excavation, until 35 days after submission of the Request for Authorization Form to the Department as specified in 103.04.

Begin construction operations within 25 days of the date the Contract is executed by the Department. For contracts with a completion date as specified in 108.10, the Contract start date is the 25th day after execution of the Contract. For Working Day contracts, the Contract start date is the earlier of: the 25th day after execution of the Contract or the first day that the Contractor begins construction operations.

If the Contractor begins Work before the execution of the Contract, the Work is at the Contractor's own risk and as a volunteer. In the event the Department decides not to execute the Contract, the Contractor shall at its expense perform whatever work is necessary to leave the Project Limits in an approved condition. If any work performed before the Department's decision not to execute the Contract affects any existing road or highway, the Contractor shall at its expense restore it to its former condition or the equivalent thereof, as approved. However, all work done according to the Contract before its execution by the Department will, if the Department executes the Contract, be considered authorized work and the Department will make payment for this work as provided in the Contract.

The Contractor is not entitled to payment or an extension of Contract Time for any delay, hindrance, or interference before the first day of Contract Time following execution of the Contract by the Department.

108.03 DAILY COMMUNICATIONS

By 9:00 A.M. every Friday, submit a written proposed work schedule for the following week (Monday through Sunday). Include at a minimum the following:

1. Items to be performed.
2. Location of the Item to be performed.
3. Hours to be worked.

Confirm with the RE the proposed work schedule before beginning each day's operation. Do not perform any work operation without providing notice to the RE.

If weather restricts the controlling activity on the critical path, provide written notice identifying the date of occurrence and activities restricted to the RE.

Provide the RE with written notice 72 hours in advance of changes in work shifts, and before restarting work after shutdowns of more than 72 hours.

108.04 WORK SITE AND STORAGE

With the approval of the RE, the Contractor may use areas within the Project Limits for storage. With the approval of the Department, the Contractor may use portions of ROW outside of the Project Limits for storage and for work.

Store and handle materials to maintain their conformance with the Contract. Comply with manufacturers', suppliers', and fabricators' storing and handling recommendations.

Do not store flammable or explosive materials near bridge structures. The Department will not allow the decks of bridges or the area under bridges, including the slopes, to be used as work sites or storage areas. Do not store equipment or material within 30 feet of the traveled way unless protected by construction barrier. If construction barrier is requested to protect a work site or storage area, submit a plan detailing the proposed installation, including required impact attenuators, to the RE for approval. The Department will not make payment for traffic control devices placed to protect a work site or storage area.

Restore storage areas and work sites to their original condition or restore as directed by the RE.

If the Contractor is in default, as specified in 108.14, the Department has the right to take over and occupy leased or rented areas used for work sites and storage, or cause it to be occupied, for the purpose of completing the Project. If the procured space is leased, the lease shall contain a provision that in event that the Contractor is in default, the lease may be assigned to the Department or its nominee.

108.05 SANITARY AND SAFETY PROVISIONS

108.05.01 Sanitary

Provide sanitary facilities that comply with the requirements of the Federal, State, and local health departments for the use of anyone authorized to be within the Project Limits. Ensure that the sanitary facilities are in compliance with 29 CFR 1926.51(c). Provide separate sanitary facilities for male and female employees clearly marked MEN and WOMEN. Ensure that the maximum distance between same gender sanitary facilities is not more than one-half mile and the maximum distance between sanitary facilities and workers is not more than one-half mile. Provide the number of facilities at each facility site as specified in Table 108.05.01-1.

Table 108.05.01-1 Number of Facilities			
Number of Male Employees	**Minimum No. of Facilities for Male Use**	**Number of Female Employees**	**Minimum No. of Facilities for Female Use**
1 - 15	1	1 - 15	1
16 - 35	2	16 - 35	2
36 - 55	3	36 - 55	3
56 - 80	4	56 - 80	4
81 - 110	5	81 - 110	5
111 - 150	6	111 - 150	6
Over 150	6[1]	Over 150	6[1]

1. Provide one additional facility for each additional 40 employees of each sex.

From October through April, clean and sanitize sanitary facilities at least once per week. From May through September, clean and sanitize sanitary facilities at least twice per week.

108.05.02 Safety Program

Observe all rules and regulations of the Federal, State, and local health officials, including regulations concerning construction safety and health standards.

At the preconstruction meeting, submit to the RE for approval a written safety program that meets or exceeds the minimum requirements of the Contract and applicable State or Federal regulations. Include at a minimum the following:

1. **Description.** Describe in detail how the safety program is implemented and monitored. Provide guidelines for protecting personnel from hazards associated with Project operations and activities. Establish the policies and procedures for safety practices that are necessary for the Work to be in compliance with the requirements of OSHA and other State and Federal regulatory agencies with jurisdiction, rules, regulations, standards, or guidelines in effect at the time the Work is in progress.

2. **Certification, Responsibility, and Identification of Personnel.** Identify the qualified safety professional responsible for developing the safety program and provide that person's qualifications for developing the safety program including, but not be limited to, education, training, certifications, and experience in developing this type of safety program.

   Provide a certification, executed by the qualified safety professional that developed the safety program, stating that the safety program complies with the rules, regulations, standards, and guidelines in effect at the time the Work is in progress, of OSHA, and other applicable Federal, State, and local regulatory agencies having jurisdiction.

   Identify a safety officer and designate the on-site supervisory-level personnel responsible for implementing and monitoring the safety program until Acceptance and having the authority to take prompt corrective measures to eliminate hazards, including the authority to stop work. Include documentation of training provided to the on-site supervisory-level personnel.

   For work that requires a competent person as defined by OSHA, ensure that the person is capable of identifying existing and predictable hazards and has the authority to take prompt corrective measures to eliminate the hazards, including the authority to stop work. Include documentation of the qualifications of such competent persons identified, including certifications received.

3. **Elements of the Program.** Include information and procedures for the following elements:

   a. **Chain of Command.** Include the responsibilities of the management, supervisor, safety officer, and employees.

   b. **Traffic Control Coordinator.** Include the name and contact information. Ensure that the traffic control coordinator meets the requirements specified in 159.03.01.

   c. **Environmental Manager.** Include the name and contact information. Ensure that the environmental manager meets the requirements specified in 158.03.01.

d. Local Emergency Telephone Numbers. Include police, fire, medical, and, NJDEP hot line 1-877-WARN DEP (1-877-927-6337).

e. Procedures for Handling Emergencies. Provide guidelines for handling emergencies, including emergency action plans for accidents involving death or serious injury, property damage, fires, explosions, and severe weather. Include the emergency contact information of the Contractor's personnel responsible for handling emergencies.

f. Training Topics. Include regulatory and jobsite toolbox meetings. Include the documentation from the training and an attendance sheet for each.

g. Contractor's Safety Rules. Include housekeeping procedures and personal protective equipment requirements.

h. Employee Disciplinary Policy. Include the violation forms.

i. Safety Checklists. Include project safety-planning, emergency plans and procedures, documentation, and protective materials and equipment.

j. Forms. Include OSHA 300 Log and New Jersey Department of Labor L&I-1.

k. Security Policy Guidelines. Provide a copy for the office and for the Project Limits.

l. Hazard Communication Program. Provide the following:

1. The location of and instructions for understanding the MSDS. Ensure that the location and instruction are available to anyone within the Project Limits.
2. The person responsible for the hazard communication program and the method of informing personnel of the hazardous communication program. Include attendance sheets of hazard communication meetings.
3. When performing work that generates airborne crystalline silica, include engineering and work practice controls to limit exposure levels to at or below the permissible exposure limit according to 29 CFR 1910.1000 Table Z-3. Ensure that the program includes employee training and respiratory protection measures according to 29 CFR 1910.134 and control of the area when the permissible exposure limit is exceeded. Provide a trained and competent person, according to 29 CFR 1926.30, within the Project Limits at all times when performing work that produces airborne crystalline silica.

m. Additional Requirements. Provide additional procedures for Project specific topics including:

1. Compressed gas cylinders.
2. Confined spaces.
3. Cranes.
4. Electrical.
5. Equipment operators.
6. Fall protection.
7. Hand and power tools.
8. Hearing conservation.
9. Highway safety.
10. Lead.
11. Lock out/tag out.
12. Materials handling, storage, use, and disposal.
13. Night work.
14. Personal protective equipment.
15. Project entry and exit.
16. Respiratory protection.
17. Sanitation.
18. Signs, signals, and barricades.
19. Subcontractors.
20. Trenching.

Within 15 days of receiving the safety program, the Department will determine if the safety program meets the requirements of the Contract. If the safety program does not meet the requirements, the Department will return the safety program for revision. Do not begin work within the Project Limits until the Department has approved the safety program.

The Contractor is responsible for implementing, monitoring, updating, and revising the safety program until Acceptance. Submit updates and revisions to the safety program to the RE for approval when new information, new practices or procedures, or changing site and environmental conditions necessitate modifications to protect site personnel.

Maintain a copy of the updated safety program, including the appropriate documentation associated with each element, within the Project Limits so that it is available to workers and other authorized persons entering the Project Limits. Provide copies of updates to the safety program to the RE.

If an incident occurs that requires a New Jersey Department of Labor Form (L&I-1) to be submitted, send a copy to the Office of Capital Project Safety, New Jersey Department of Transportation, 1035 Parkway Avenue, P.O. Box 600, Trenton, NJ 08625-0600.

108.06 NIGHT OPERATIONS

Night operations comprises work performed from 30 minutes before sunset to 30 minutes after sunrise. Before beginning night operations, demonstrate to the RE the method of meeting the specified illuminance levels and visibility requirements for workers and equipment for each planned operation. The Department will determine illuminance levels by taking light meter readings horizontally to the road surface facing the light source. Do not begin night operations until the RE approves the method of meeting the specified illuminance levels and visibility requirements.

1. **Lighting Requirements and Illuminance Levels.** Maintain the minimum illuminance level throughout the required lighting area as specified in Table 108.06-1. Provide lighting for all areas of the Work.

Table 108.06-1 Minimum Illuminance Levels for Night Operations

Work Description	Minimum Level (Foot Candles)	Minimum Lighting Area
Embankment Excavation Landscaping (seeding and sodding) Mechanical sweeping and cleaning Subgrade	5	General lighting throughout area of operation
Traffic Control setup and removal (excluding barrier curb)	5	Lighting on task
Traffic Director	5	Lighting on task plus minimum of 50 feet ahead and 50 feet behind employee
Milling[1] HMA paving operation[1] HMA roller operation[1]	10	Lighting on task and around equipment plus minimum of 25 feet ahead and 25 feet behind equipment plus 10 feet to each side of equipment
Crack Sealing Sawcutting and Sealing Joints Electrical work Intelligent Transportation System work	20	Lighting on task
All work not listed in this table[1]	10	Lighting on task

1. Provide 5 foot-candles for the indicated lighting area outside the limits for 10 foot-candles to a minimum of 100 feet ahead and 100 feet behind equipment

Ensure that lighting equipment is in good operating condition, and in compliance with applicable NEC and NEMA codes. Use freestanding portable or trailer-mounted towers capable of being moved as needed to keep pace with construction operations.

For moving operations, ensure that lighting and illuminance requirements are maintained where the work is in progress and that lighting keeps pace with the operation. Provide sufficient fuel, spare lamps, generators, and qualified personnel to ensure that required illuminance levels are maintained continuously during night

operations. If at any time minimum illuminance levels are not met, cease night operations until the required illuminance levels are attained.

2. **Visibility Requirements for Workers and Equipment.** Ensure that workers wear a 360° high-visibility retroreflective orange safety garment meeting ANSI/ISEA Class 3, Level 2 standards.

   Uniformly light the hopper, auger, and screed areas of pavers as well as the operator's controls on all machines.

   Conventional vehicle headlights do not meet illuminance requirements. Ensure that moving lighting equipment used for night operations has lights directed ahead and behind the equipment.

   Equip moving equipment with 2-inch wide, alternating red and white, conspicuity tape meeting the National Highway Transportation Safety Administration standards. Equip off-road equipment with conspicuity tape along the full length of all 4 sides. Equip on-road vehicles, including trailers and trailer-mounted devices, with conspicuity tape along the full length of both sides, excluding the cab, and across the rear of the vehicle.

Prevent or minimize glare that may interfere with traffic or disturb local residents. Perform glare control to the RE's satisfaction. Glare control may require relocating, aiming, or adjusting lights or providing screens, shields, visors or louvers on lights.

108.07 TRAFFIC CONTROL

108.07.01 Interference

Do not occupy a lane, shoulder, median, or sidewalk area adjacent to traffic with equipment, material, personnel, or employee vehicles without the RE's approval.

Schedule and perform the Work so that successive construction operations and lane or roadway openings follow preceding operations as closely as possible. Confine construction operations adjacent to traffic to one side of the roadway at a time unless otherwise specified by the Contract. Where the Work is performed in stages adjacent to traffic, ensure that the road opened to traffic adequately accommodates traffic. Do not interfere with existing traffic access, except when required to perform the Work or as approved by the RE.

Do not work above vehicular or pedestrian traffic, except as specified in the Contract. Where construction interferes with existing pedestrian access, provide temporary pedestrian access as directed by the RE. Where necessary, install and maintain temporary sidewalks and curb ramps. Remove temporary access measures when no longer required.

Provide temporary approaches to maintain traffic access to private and public property as directed by the RE. When the work interferes with property owners' normal passage, provide written notice to the RE and the property owners at least 3 days before beginning work.

The RE has the right to reject or rescind approval of lane or shoulder closures because of the following:

1. Weather conditions.
2. The closure is unnecessary to perform the work.
3. Emergency conditions either on or off the Project that result in an unacceptable impact to the traveling public.

The Department will only make payment for delays or costs arising from the RE's rejecting or rescinding of lane or shoulder closure resulting from emergency conditions.

If the Work is stopped for more than 7 days or if the Work is suspended, restore excavated areas within or adjacent to the traveled way as directed by the RE.

108.07.02 Changes to the Traffic Control Plan (TCP)

Submit requests for changes to the TCP to the RE for approval at least 40 days before the change is needed. Include a written description of the requested TCP change and detailed plan sheets signed and sealed by a Professional Engineer. When proposing detours, include a copy of the signed agreement with the local government authority having jurisdiction. The signed agreement shall document the local government authority's approval of the proposed detour and indicate that the Contractor is solely responsible for the maintenance and restoration of the roadway.

The Department will not make payment for furnishing, installing, or maintaining additional traffic control devices. Remove traffic control devices when no longer required. If detours were used, restore the roadway to its original condition or as required by the agreement with the local government. The Department will not make payment for costs to restore the roadway.

108.08 LANE OCCUPANCY CHARGES

The lane closure schedule is the time period for allowable lane closures as specified in the Contract. If the Contractor's lane closures exceed these time periods, the Department will deduct from the monthly estimate a lane occupancy charge for the use and occupancy of each such lane or lanes beyond the permitted lane closure schedule until such time that the lane or lanes are reopened to traffic or until such time that the lane closure is allowed to take place again under the lane closure schedule.

The RE will keep record of each occurrence as well as the cumulative amount of time that a lane is kept closed beyond the lane closure schedule and provide the record to the Contractor. The Department will calculate the lane occupancy charge by multiplying the length of time of the delayed opening, in minutes, by the rate of $10 per minute per lane. The total amount per day for the lane occupancy charge that the Department will collect will not exceed $10,000.00.

The Department will waive the lane occupancy charge where a lane or lanes are not re-opened as specified in the lane closure schedule directly and solely by reason of extraordinary, exigent circumstances not under the control of or reasonably foreseeable by the Contractor. Equipment breakdowns, supplier deliveries, and weather related hindrances are not extraordinary, exigent circumstances. However, the Department has the right to assess a lane occupancy charge for any period of time that a lane or lanes are closed beyond the reasonable period of time needed by the Contractor to open the lane or lanes closed due to an extraordinary, exigent circumstance.

108.09 MAINTENANCE WITHIN THE PROJECT LIMITS

Continuously perform maintenance requirements within the Project Limits until Acceptance. The Project Limits to be maintained include the limits of all temporary and permanent construction, excluding those sections of highways, streets, and roads where only signs are placed. Maintenance includes but is not limited to the following:

1. Picking up and disposing of trash and debris, including trash and debris not generated by the Contractor. However, the Contractor is not responsible for the disposal of dead animals.
2. Keeping the roadway clear of dust, soil, and cleaning up non-hazardous spills.
3. Maintaining a safe and unobstructed passageway through the construction area for public traffic, including but not limited to constructing escape ramps at the edges of pavement.
4. Maintaining surface drainage, including the removal of debris, ice, and snow around inlets, to ensure that it is functioning as intended.
5 Removal of ice and snow from bridge sidewalks open to pedestrian access.

Provide for maintenance and repairs beyond the Project Limits for reasonable continuance to restore the required functional operation of any systems that are impacted within the Project Limits such as drainage, utilities, and electrical.

The Contractor is not responsible for removal of ice and snow from sections of the roadway opened to traffic. For critical safety repairs, the Department has the right to complete the necessary repairs if the Contractor has not responded to the RE's notice to complete the repairs in the time frames given in the notice. The Department will recover costs incurred for having to make such repairs from the Contractor.

If the Contractor at any time fails to fully perform maintenance, the RE will immediately notify the Contractor of the noncompliance, and direct a time by which the Contractor must perform the maintenance. If the Contractor fails to remediate unsatisfactory maintenance within the time directed by the RE after receipt of such notice, the Department has the right to proceed to maintain the Project and recover costs incurred for this maintenance from the Contractor.

108.10 CONTRACT TIME

Time is of the essence as to all time frames stated in the Contract. Complete the work required for Interim Completion and Completion requirement as specified in the Special Provisions.

When Contract Time is specified in working days, the RE will provide the Contractor with a weekly statement showing the number of days charged to the Contract for the preceding week and the number of days of Contract Time remaining. If the Contractor has dismissed its crew due to unfavorable conditions that affect the controlling operations on a day

where the contractor was prepared to begin work at the regular starting time of a scheduled shift, the Department will not charge a Working Day to the Contract.

108.11 MODIFICATIONS TO CONTRACT TIME

108.11.01 Extensions to Contract Time

A. Qualifications for Extensions. The Department will only extend Contract Time if an excusable delay, as specified in 108.11.01.B.2 or 108.11.01.B.3, delays work on the critical path beyond the Contract Time as specified in 108.10 using the approved progress schedule that is current at the time the delay occurred.

The Department will not extend Contract Time due to Extra Work or other type of delay unless an approved progress schedule and updates are current as specified in 153.03. The Department will not make payment for delay damages, as specified in 104.03.09, unless an approved progress schedule and updates are current as specified in 153.03.

The Department will not extend Contract Time for failure of the RE to furnish interpretations of the Contract unless such request for an interpretation of the Contract is reasonable and made in good faith, and was provided more than 5 days after the written request was received by the RE and the failure to respond within this 5-day period was unwarranted.

The Department will not extend Contract Time for a delay that was or should have been anticipated by the Contractor at the time the Contract was awarded.

B. Types of Delays. The Department recognizes the following types of delays:

1. Non-Excusable Delays. Non-excusable delays are delays that are the Contractor's fault or responsibility. The Department will not extend Contract Time or make payment for delay costs incurred due to non-excusable delays.

2. Excusable, Non-Compensable Delays. Excusable, non-compensable delays are delays that are not the Contractor's or the Department's fault or responsibility. The Department will extend Contract Time but will not make payment for the delay costs incurred by the Contractor for the following excusable, non-compensable delays:

a. Others. Delays caused by work done by Others, excluding the Department.

b. Utilities. Delays caused by Utilities, excluding the Department, when the actual duration to complete the utility work is more than 30 percent greater than the estimated duration specified in 105.07.02. The duration includes both the advance notice and the completion of the work by the Utility.

c. Extreme Weather. The Department will only extend Contract Time for weather if the Contractor cannot perform work on the controlling activity on the critical path due to weather and the cumulative delay due to weather each month exceeds the number of days specified in Table 108.11.01-1. The work on the controlling activity on the critical path is considered delayed if the Contractor is prevented from proceeding on such activity for at least 60 percent of the total daily time planned for the activity for all shifts scheduled for that day. Submit daily documentation, as specified in 108.03, for activities that are delayed by weather.

Table 108.11.01-1 Anticipated Number of Days Lost per Month for Weather Sensitive Activities	
Month	**Number of Days Lost**
January	31[1]
February	28[1,2]
March	20
April	15
May	10
June	10
July	10
August	10
September	10
October	15
November	15
December	20

1. For concrete placements Items, as specified in Division 500, other than approach slabs, the number of days restricted is 20 days.
2. For leap years, the number of days restricted is 29.

d. Cataclysmic Natural Phenomena. Delays caused by lightning strikes, wild fires, floods, tidal waves, earthquakes, tornadoes, hurricanes, or other cataclysmic phenomena.

e. Sovereign Acts of the State. Delays caused by the State in its sovereign capacity, including but not limited to epidemic or quarantine restrictions, states of emergency, and State shutdowns.

f. War and Unrest. Delays due to war or civil disturbances.

g. Labor Disputes. Delays due to strikes or labor disputes beyond the control of the Contractor.

h. Shortage of Materials. Extraordinary delays in material deliveries that the Contractor or suppliers cannot foresee or forestall resulting from freight embargos, government acts, or area wide material shortages. Shortage of materials applies only to raw and fabricated materials, articles, parts, or equipment that are standard and does not apply to materials, parts, articles, or equipment that are processed, made, constructed, fabricated, or manufactured to meet the specific requirements of the Contract. The Department will only consider the physical unavailability of the material as constituting a shortage, and shall not consider cost factors as constituting a shortage. Provide documented proof that every effort to obtain the materials from all known sources within a reasonable distance from the Project Limits was made. Also provide proof that the inability to obtain such materials when originally planned, could not be remedied by revising the sequence of the construction operations.

If approved excusable, non-compensable delays exceed a total of 180 days, the time in excess of 180 days will become excusable and compensable as specified in 108.11.01.B.3.

3. Excusable, Compensable Delays. Excusable, compensable delays are delays that are the Department's fault or responsibility. For excusable, compensable delays, the Department will grant an extension of Contract Time and will make payment for delay damages as specified in 104.03.09.

4. Concurrent Delays. Concurrent delays are separate delays on the critical path that occur at the same time. When an excusable, non-compensable delay is concurrent with an excusable, compensable delay, the Department will grant an extension of Contract Time but will not make payment for delay damages as specified in 104.03.09. When a non-excusable delay is concurrent with an excusable delay, the Department will not grant an extension of Contract Time or make payment for delay damages.

C. Submitting Time Impact Evaluation. If an excusable delay occurs, notify the RE, as specified in 104.03.04, detailing how the event or cause is affecting the approved progress schedule that is current at the time the delay occurred. When the full extent of the impact on the approved progress schedule can be determined, submit a request for an extension of Contract Time to the RE with a Time Impact Evaluation Form and a CPM fragnet diagram including all additional work, and the fragnet's relationship to the approved progress schedule that is

current at the time the delay occurred. Clearly identify how each change or delay is represented by an activity or group of activities. Ensure that the fragnet shows logic revisions, duration changes, and new activities, including the predecessor and successor relationships.

The Contractor is considered to have waived its rights to claim an extension of Contract Time, if the Contractor fails to provide written notice as specified in 104.03.04 or fails to provide the time impact evaluation.

The RE will evaluate the time impact evaluation. The Department will only extend Contract Time when delay causes the work to be extended beyond the scheduled Contract Time as specified in 108.10. If the Contractor is already behind schedule and an excusable delay delays the work beyond the Contract Time as specified in 108.10, the Department will only extend Contract Time for the amount of time that directly results from the excusable delay. If the Department determines that an extension of Contract Time is warranted, the Department will extend Contract Time by a Change Order.

For excusable, compensable delays, submit a request for and documentation supporting the entitlement to compensable delay damages associated with the delay as specified in and limited by 104.03.09.

108.11.02 Reductions to Contract Time

If the Work required is reduced or altered such that less time is needed to meet Contract Time, the Department has the right to reduce Contract Time by analyzing the current approved progress schedule.

108.12 RIGHT-OF-WAY RESTRICTIONS

The Special Provisions will indicate ROW that has not been secured and the anticipated dates of availability. Review the ROW Plans and obtain from the RE all other information regarding ROW parcels, easements, temporary easements, and temporary access to parcels acquired for the Project as well as the nature and type of title acquired.

Temporary easements and temporary access to parcels will in most cases contain a limitation as to the length of time that they are in force and effect. Schedule the Work, as specified in 153.03, to accommodate the time limitations associated with each parcel.

Provide written notice to the RE at least 30 days before entering a parcel with a temporary easement or entering a parcel with temporary access. Do not enter a parcel until the RE provides written notice to the property owner.

If the Contractor needs to occupy a temporary easement or parcel beyond the time period provided by the temporary easement or access, provide a written request to the RE at least 15 days before the time period expires. Do not enter or continue to occupy the easement or parcel unless approved by the RE.

108.13 SUSPENSION OF WORK

The RE has the right to suspend the Work, wholly or in part, for such period as deemed necessary for the following:

1. **Contractor Fault.** Contractor fault includes but is not limited to: failure to carry out Contract requirements; failure to correct unsafe conditions; or, failure to carry out the directions of the RE.
2. **Unsuitable Weather.** Unsuitable weather is a weather condition that prevents the Contractor from performing work as specified in the Contract. The RE also has the right to suspend work for a potential weather condition.
3. **Convenience of the Department.** For the convenience of the Department, the RE may direct, in writing, the Contractor to suspend all or any portion of the Work for the period of time that the RE determines to be appropriate.

If the RE suspends a portion of the Work, Contract requirements governing work on continuing portions of the Project remain in effect. When the RE suspends the Work or portions of the Work, the Contractor is still responsible for the following:

1. Maintaining the Project Limits as specified in 108.09.
2. Maintaining SESC measures as specified in 158.03.02.
3. Maintaining traffic control devices as specified in 159.03.
4. Protecting the work already performed, and preventing damage and deterioration.

5. Protecting stored materials.
6. Complying with additional direction by the RE to secure the Project Limits and safeguard the public.

If, during suspension, the Contractor at any time fails to comply with items 1 to 6 above, the RE will immediately notify the Contractor of the noncompliance. If the Contractor fails to remediate unsatisfactory conditions within 24 hours after receipt of such notice or within the time otherwise specified, the Department has the right to remediate the unsatisfactory conditions and recover the cost of this remediation from the Contractor.

Resume work when directed by the RE. Within 7 days of receiving notice to resume work, provide the RE a written request for payment for the costs and for a modification of Contract Time for the number of days sought resulting from the suspension.

108.14 DEFAULT AND TERMINATION OF CONTRACTOR'S RIGHT TO PROCEED

The Department will provide written notice to the Contractor and the Surety of the cause for default, and demand elimination of such cause for default, if the Contractor does any of the following:

1. Fails to begin construction operations within 40 days of execution of the Contract.
2. Fails to perform the Work with sufficient workers and equipment or with sufficient materials to ensure its completion within the Contract Time specified, or any modification thereof.
3. Fails to complete the Contract within the Contract Time specified, as modified.
4. Performs the Work unsuitably or neglects or refuses to remove materials or to again perform such Work as may be rejected as unacceptable and unsuitable.
5. Discontinues the prosecution of the Work.
6. Fails to resume Work which has been discontinued within a reasonable time after notice to do so.
7. Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency.
8. Allows any final judgment to stand against it unsatisfied for a period of 10 days.
9. Makes an assignment for the benefit of creditors.
10. Fails to acquire or maintain the required insurance.
11. Fails to comply with Contract requirements regarding minimum wage payments, DBEs, or equal employment opportunity requirements.
12. Is a party to fraud.
13. For any other cause whatsoever, fails to carry out the Work in an acceptable manner.

If the Contractor or Surety, within a period of 10 days after such notice, does not proceed as specified in the notice, then the Department has full power and authority, without violating the Contract, to declare the Contractor in default and notify the Contractor to discontinue the Work. The Department will provide, in writing, the declaration of default to the Contractor and Surety. The Department has the right to appropriate any or all materials and equipment within the Project Limits to complete the Contract. The Department has the right to direct the Surety to complete the Contract or may enter into an agreement for the completion of the Contract with the Surety or another contractor, or use such other methods required for the completion of the Contract, including completion of the Work by the Department.

The Contractor and Surety are not relieved of the assessment of liquidated damages, as specified in 108.20, because of the Contractor's default.

The Department will recover the costs and charges incurred by the Department, together with the cost of completing the Work from the Contractor or Surety.

The rights and remedies of the Department are in addition to any other rights and remedies provided by law or under the Contract and the bonds.

If, after declaration of default, the Department determines for any reason that the Contractor was not in default or that the delay was excusable, the rights and obligations of the parties are the same as if the Department had issued an order of termination for convenience as specified in 108.15.01.

If, after declaration of default, a court determines for any reason that the Department's default of the Contract was legally improper, the rights and obligations of the parties are the same as if the Department had issued an order of termination for convenience as specified in 108.15.01.

108.15 TERMINATION OF CONTRACT

108.15.01 For Convenience

The Department has the right to, by written order, terminate the Contract for convenience.

Upon receipt of an order of termination for convenience, only perform the work required in the order of termination. The Department may add work in order to secure the Project. Perform the work required in the order of termination as specified in the Contract. The Department has the right to declare the Contractor in default, as specified in 108.14, if the Contractor fails to carry out the conditions set forth in an order of termination for convenience.

When the Department orders termination for convenience, the Department will make payment for the Items completed as of the date of termination at the Contract price. The Department will make payment for the work in the order of termination, including work that was not in the Contract.

108.15.02 For Cause

The Department has the right to, by written order, terminate the Contract for cause after determining the Contractor has been declared in default as specified in 108.14.

Upon receipt of an order of termination for cause, only perform the work required in of the order of termination. The Department may add work in order to secure the Project. Perform the work required in the order of termination as specified in the Contract. If the Contractor fails to carry out the conditions set forth in an order of termination for cause, the Department will recover the costs and charges incurred by the Department, together with the cost of completing the Work from the Contractor or Surety.

The rights and remedies of the Department are in addition to any other rights and remedies provided by law or under the Contract and the bonds.

When the Department orders termination for cause, the Department will make payment for the Items completed as of the date of termination at the Contract price. The Department will make payment for the work in the order of termination including work that was not in the original Contract.

The Department will not make payment for profit and overhead not included in the Contract price for Items for work completed or partially completed except that the Department may make payment for profit and overhead on force account work as specified in 104.03.08.

If the Department's termination for cause is found by a court to be legally improper, the Department will rescind the termination for cause and order a termination for convenience. The Department will then make payment as if the termination for cause had been a termination for convenience as specified in 108.15.01.

108.16 PARTIAL ACCEPTANCE

If the Contractor completes a portion of the Work, the Contractor may request that the RE inspect that portion. If the RE finds that the portion has been completed, as specified in the Contract, the Department may accept that portion as being completed. If the portion is accepted, the Department may relieve the Contractor of the responsibility of maintaining that portion of the Work as specified in 108.09. The RE may reject the request made by the Contractor if the RE determines that the portion of the Project should not be subject to partial acceptance.

108.17 INTERIM COMPLETION

When an Interim Completion requirement is specified, notify the RE in writing when the work for the milestone is complete. If the RE determines that the work for the milestone appears to be complete, the RE will notify the Contractor. If the RE determines that the work for the milestone has not been completed, the RE will give the Contractor the necessary instructions to correct or complete the Work to meet the Interim Completion requirement. Notify the RE upon compliance with the RE's instructions. Repeat this procedure until the RE determines that the work for a milestone has been completed.

108.18 SUBSTANTIAL COMPLETION

Notify the RE, in writing, when the Work is substantially complete. When the RE receives written notice, the Department will perform an inspection. If the inspection indicates that the Work is not substantially completed to the Department's satisfaction, the RE will respond within 14 days and provide the Contractor the necessary instructions for completion and correction. Upon completion and correction of the Work, the Contractor shall renotify the RE that the Work is substantially complete, and the RE will perform another inspection. Repeat this procedure until the Department determines that the Work is substantially complete.

The date of the Contractor's acceptable notice is the date of Substantial Completion.

108.19 COMPLETION AND ACCEPTANCE

Notify the RE, in writing, when the Work is complete. When the RE receives written notice, the Department will perform an inspection. If the Department determines that the Work is complete, the Department will issue a Certificate of Completion.

If the Department determines that the Work is not complete, the RE will respond within 30 days and provide the Contractor with the necessary instructions for completion and correction. Complete the Work and renotify the RE. Repeat this procedure until the Department issues a Certificate of Completion.

The date of the Contractor's acceptable notice is the date of Completion.

The Department will notify the Contractor of the date of Acceptance. After Acceptance, the Contractor is relieved of the duty of maintaining and protecting the Project. In addition, the Contractor is relieved of its responsibility for damage to the Work that may occur after Acceptance.

The Contractor, without prejudice to the terms of the Contract, is liable to the Department at any time, both before and after Acceptance, for latent defects, fraud, such gross mistakes as may amount to fraud, or actions affecting the Department's rights under any warranty or guarantee.

108.20 LIQUIDATED DAMAGES

The Contractor and the Department recognize that delays to Contract Time result in damages to the Department including the effect of the delay on the use of the Project, public convenience and economic development of the State, and additional costs to the Department for engineering, inspection, and administration of the Contract. Because it is difficult or impossible to accurately estimate the damages incurred, the parties agree that if the Contractor fails to complete the Contract or portion of the Contract within the Contract Time, the Contractor shall pay the Department the liquidated damages specified in the Special Provisions.

The Department will assess liquidated damages for each and every day that the Contractor has failed to complete the Work or portion of the Work within the Contract Time requirements as specified in 108.10. If the Department discovers that the work required to meet an Interim Completion requirement is unacceptable after the RE notified the Contractor that the work appeared to be complete, the Department has the right to assess liquidated damages for the time period required to correct the unacceptable work.

108.21 WARRANTIES

Enforce all subcontractors', manufacturers', fabricators', and suppliers' warranties, express or implied, respecting any work or materials, at the direction of the RE, for the benefit of the Department. Obtain the warranties that subcontractors, manufacturers, fabricators, and suppliers would give in normal commercial practice. If directed, require the warranty to be executed in writing to the Department. The RE has the right to direct the Contractor to undertake litigation to enforce a warranty.

SECTION 109 – MEASUREMENT AND PAYMENT

109.01 MEASUREMENT OF QUANTITIES

The Department will use the United States customary units to measure work completed under the contract. The Department will determine quantities of Work performed under the Contract using measurement methods and computations conforming to good engineering practice.

The Department will designate Items as Measured Items or as Proposal Items by having a suffix of P or M in the Item number respectively. The Department will measure quantities of Measured Items for payment.

For measured quantities, the Department will measure to the significant figure as specified in Table 109.01-1.

Table 109.01-1

Item Price	Significant Figure
<$50.00	1
$50.00 to $500.00	0.1
>$500.00	.01

For measured quantities that are measured by area, and where areas contain fixtures that are not part of the Item, the RE will only deduct the areas of individual fixtures having an area of greater than nine square feet.

For measured quantities that are measured by volume, the Department will calculate volumes using the end area method.

For measured quantities that are measured by weight, the Department will calculate weight using the net certified weight tickets corrected for any loss or waste.

Whenever the phrase "Contract quantity" is used in this Subsection, it is the quantity in the Proposal adjusted by Change Orders.

The Department will not measure quantities for Proposal Items, except quantities designated on the Plans as "if and where directed," for payment except at the request of the Contractor or the RE. If making a request, submit drawings, calculations, and other information demonstrating the as-built quantity. If the difference between the measured quantity and the Contract quantity is less than or equal to 10 percent of the Proposal quantity, the Department will make payment based on the Contract quantity. If the difference is more than 10 percent of the Contract quantity, the Department will make payment based on the measured quantity. For each Item that the Contractor requests a Proposal item be measured, and it is determined that the difference between the quantity measured and the Contract quantity is less than or equal to 10 percent of the Proposal quantity, the Department will deduct $500. The Department will measure quantities for Proposal Items that are designated on the plans as "if and where directed" for payment when the RE directs work using the "if and where directed" quantity.

109.02 SCOPE OF PAYMENT

The Department will make payment for the elements of work described under the "Construction" or "Procedure" subsection under the corresponding Item in the "Measurement and Payment" Subsection. The Items included under the "Measurement and Payment" Subsection are full payment for the materials described under the "Materials" Subsection and the work described under the corresponding "Construction" or "Procedure" Subsection. The Department will not make additional or separate payment for work or portion of work unless specifically provided for in the "Method and Measurement" Subsection. For Items subject to payment modification based on quality requirements, the Department will make the payment modification as specified.

The Contractor agrees to accept the payment provided for in the Contract as full payment for furnishing labor, materials, tools, equipment, and other resources necessary to complete the Work, and for performing the Work contemplated and embraced under the Contract in a complete and acceptable manner. Except where specified elsewhere in the Contract, payment will include full compensation for all risk, loss, damage, or expense of whatever character arising out of the nature of the Work or the prosecution thereof, or for the action of the elements that the Contractor may encounter during the prosecution of the Work.

109.03 PAYMENT FOR FORCE ACCOUNT

For work done under force account, the Department will make payment for the costs allowed as specified in 104.03.08 based on the following documentation submitted by the Contractor at the completion of each force account:

1. Copy of all RE preapprovals for: extraordinary labor as specified in 104.03.08.1; specific extraordinary expenses as specified in 104.03.08.6; and equipment as specified in 104.03.08.7.
2. Copy of daily and shift reports submitted as specified in 104.03.07.
3. Copies of the associated certified payrolls for all eligible labor and foreman charges.
4. Certified records documenting all eligible labor fringe benefit rates.
5. Certified records documenting all eligible indirect labor costs.
6. Certified records documenting additional insurance rates.
7. Copies of the vendor's paid invoices for eligible materials, including breakout for handling, transportation, discounts, and allowable sales tax.
8. Copies of paid invoices for all allowable specific extraordinary expenses.
9. Certified records of the eligible hours of Contractor-owned equipment and documentation of rates as specified in 104.03.08.
10. Copies of the fully executed rental agreements and the paid invoices for eligible rental equipment. For operating costs not covered by the rental agreement, provide certified records of the eligible hours and documentation of costs.
11. For each subcontractor, provide and certify the subcontractor's documentation for items 1 through 10 above.

Provide to the RE a summary of costs for the force account in an electronic format provided by the Department, and a certification stating the following:

> *All costs submitted have been incurred as a result of the force account, and all vendor invoices have been paid.*

The Department will adjust force account payment for those costs incurred that the Department determines to be the fault of the Contractor. The Department will further adjust the force account payment where the Contractor's prices in its Proposal for any affected original Items did not include all the costs to complete the affected work as originally provided in the Contract.

109.04 PAYMENT FOR DELAY DAMAGES

For eligible extensions, the Department will make payment for the costs allowed, as specified in 104.03.09, based on the following documentation submitted by the Contractor:

1. Copy of daily and shift reports signed off by Contractor's authorized representative.
2. Certified payrolls for all eligible labor and foreman charges.
3. Certified records on all eligible labor fringe benefits.
4. Certified records on all eligible indirect labor costs.
5. Certified records of additional insurance costs.
6. Certified records of the eligible hours of Contractor-owned equipment for payment at the rates approved by the RE.
7. Copy of the fully executed rental agreement and the paid receipt or canceled check for eligible rental equipment. For operating costs not covered by the rental agreement, provide certified records of the eligible hours at the rates approved by the RE.
8. Certified records of the eligible transportation costs for any equipment removed from the Project Limits.
9. Certified record of the eligible overhead
10. Documentation in the same format as above for each subcontractor with certification by the Contractor.

109.05 ESTIMATES

The Department will make monthly payments to the Contractor for work performed and for materials delivered, as specified in 109.06. The RE will calculate the payment in an Estimate consistent with the provisions of the Contract. If not otherwise described in the Contract, the RE will be the sole judge of the amount of progress payment due for partially completed work. The quantities provided in the Estimate may be approximations and may not be based on as-built quantity measurements. The Department will establish the date of the month that the Estimate is processed.

The RE will provide a summary of the Estimate to the Contractor. Before the issuance of each payment, certify, on forms provided by the Department, that:

1. Each subcontractor or supplier has been paid the amount due from the previous progress payment and shall be paid the amount due from the current progress payment and no retainage is being withheld from any subcontractor on Federally funded projects; or
2. There exists a valid basis under the terms of the subcontractor's or supplier's contract to withhold payment from the subcontractor or supplier, and therefore payment is withheld.

If the certification indicates that the Contractor has withheld or will withhold payment from a subcontractor or supplier, provide written notice, according to N.J.S.A. 52:32-40 and N.J.S.A. 52:32-41, of such non-payment to the subcontractor or supplier. Provide a copy of the notice to the Department and to the Surety that holds the performance bond. Include the reason for withholding payment and state the amount of payment withheld in the notice.

The date that the Department receives the certification will initiate the 20-day approval period under N.J.S.A. 2A:30A-1, *et seq*. The Department will not accept the certification before being requested by the RE.

If no valid basis exists for withholding payment, N.J.S.A. 52:32-40 and N.J.S.A. 52:32-41 authorize any subcontractor or supplier from whom payment is withheld to receive from the Contractor, in addition to any amount due, interest at a rate equal to the prime rate plus one percent if the subcontractor or supplier is not paid within 10 days after receipt by the Contractor of payment by the Department for completed work that is the subject of a subcontract or a material supply agreement. This interest begins to accrue on the tenth day after receipt of payment by the Contractor.

If court action is taken by a subcontractor or supplier to collect payments withheld by a Contractor and it is determined that a valid basis existed for the withholding of those payments, the subcontractor or supplier shall be liable for any court costs incurred by the Contractor in connection with the action.

The Department will not make payment for an Estimate having a value less than $5000, unless it is for the Final Certificate.

From the total Estimate amount, excluding amounts for subcontracted work on Federally funded projects, the Department will deduct and retain 2 percent until Substantial Completion.

In the first Estimate following Substantial Completion, the Department will reduce the retainage withheld to one percent of the total adjusted Contract price, excluding subcontracted work on Federally funded projects, unless it has been determined by the Department that the withholding of additional retainage is required. If retainage is held in cash withholdings, the reduction is to be accomplished by payment under the next Estimate. If retainage is held in bonds, the Department will authorize a reduction in the escrow account.

The RE has the right to not process an Estimate when, in the judgment of the RE, the work is not performed or proceeding as specified in the Contract or following the Department giving the Contractor and Surety notice of default as specified in 108.14.

The Department's processing or payment of an Estimate is not an approval of defective or improper work. The Department, upon determining that any payment under a previous Estimate was improper or unwarranted for any reason, has the right to recover erroneous payment from the Contractor.

109.06 MATERIALS PAYMENTS AND STORAGE

The Contractor may request payment for the cost of materials, including the storage cost, not incorporated into the Work. If approved by the RE, the Department will make payment for the cost of materials, including storage costs; however, the amount of payment may not exceed 85 percent of the bid price for the associated Item. The Department will not make payment for such materials until the RE is satisfied that:

1. The Contractor has properly stored and protected materials within the Project Limits or at locations owned or leased by the Contractor or the Department within the State, except that the Contractor may store structural steel outside the State with the prior approval of the Department.
2. The ME has inspected the materials and they appear to be acceptable based upon available supplier's certification and materials test reports.
3. The Contractor has provided the RE with the paid invoice or paid bill of sale for the materials and a fully executed Release of Liens for Materials Stored for Incorporation in Department of Transportation Project Form, including the transfer of ownership to the Department.

4. For material stored on property not belonging to the Department, the material is stored in a fenced area with access limited to the Department and the Contractor. Additionally, the Contractor has posted a sign at the location clearly identifying, and printed in large letters, that the materials are without encumbrances and are to be solely used for the Project.
5. When materials are stored in a leased area, the lease is made out to the Contractor and provides that it shall be canceled only with the written permission of the Department. Submit a copy of the lease to the RE.

Payment for materials does not constitute Department approval or Acceptance of the materials or work. If materials paid for are damaged, stolen, or prove to be unacceptable, the Department has the right to recover the costs from the Contractor. The Department will not make payment for plant materials until they are planted or installed.

109.07 BONDS POSTED IN LIEU OF RETAINAGES

The Contractor may deposit negotiable bonds of the State or any of its political subdivisions, which have been approved by the Department, in an escrow account to secure release of all or a portion of the retainage withheld as specified in 109.05. Establish the account under the provisions of an escrow agreement to be entered into between the Contractor, the Department, and a bank located in the State that is an authorized depository and with a trust department. Pay the charges of the bank for services rendered according to the terms and conditions of the escrow agreement.

The Contractor may obtain agreement forms and a list of approved bonds from the Department. Obtain bonds that have a rating of at least "B A A" by Moody's Investor Service or "B B B" by Standard and Poors Corporation.

If the market value of the bonds on deposit in the escrow account falls below the amount of retainage required by the Contract, deposit additional bonds of sufficient value in the escrow account to secure the release of retainage, or the Department will deduct from current payments amounts sufficient to ensure that the total bond value on deposit plus retainage withheld will equal the total retainage requirement for the Contract.

Ensure that the bonds deposited in the escrow account remain acceptable to the Department. If the Contractor does not replace unacceptable bonds with acceptable bonds, the Department will withhold from future payments amounts equal to the amount of retainage, the release of which was based upon the value of the now unacceptable bonds.

In the event of a declaration of default or an Order of Termination of the Contract, the Department will notify the bank in writing of the declaration of default or the Order of Termination. Following said written notification, the bank shall not dispose of, release, or compromise any bonds or the proceeds of called or mature bonds, without written instructions from the Department. If directed by the Department, the bank shall sell any bonds in the escrow account and pay the proceeds of such sale or the proceeds held in the account from called or matured bonds to the Department or to any payee designated by the Department. The Department will send a copy of the instructions to sell to the Contractor.

109.08 AS-BUILT QUANTITIES

Following Substantial Completion, the RE will finalize as-built quantities for all Items and provide a list to the Contractor for review. Accept or reject the proposed as-built quantities within 20 days of receipt. If rejecting, submit the disputed quantities and supporting calculations with a notice of rejection. The RE will review supporting calculations within 20 days, and will accept or reject, in part or in whole, the disputed as-built quantities.

If the Contractor fails to respond or fails to provide supporting calculations with a notice of rejection within the 20-day period, the Department will deem the Contractor to have accepted the proposed as-built quantities and will deem the Contractor to have waived any claim regarding the proposed as-built quantities.

109.09 AUDITS

All claims filed and force account work are subject to audit at any time following the filing, whether or not part of a suit pending in the courts of this State pursuant to N.J.S.A. 59:13-1, *et seq*. The audit may begin after the Department has given 15-day notice to the Contractor, subcontractor, or supplier. If an audit is to be commenced more than 60 days after Acceptance, the Department will provide the Contractor with reasonable notice of the time when such audit is to begin. Provide adequate facilities that are acceptable to the Department for such audit during normal business hours. Make a good faith effort to cooperate with the auditors. Failure to retain and maintain sufficient records to allow the Department's auditor to verify a claim submitted by the Contractor, subcontractor, or supplier constitutes a waiver of such claim and bars any recovery; if the Department has already made payment, the Contractor shall refund to the Department the amount so disallowed.

At a minimum, provide the auditors the following documents unless their availability is otherwise limited by the custody agreement specified in 103.05:

1. Daily time sheets and foreman's daily reports.
2. Union agreements.
3. Insurance, welfare, and benefits records.
4. Payroll registers.
5. Earnings records.
6. Payroll tax forms.
7. Material invoices and requisitions.
8. Material cost distribution worksheet.
9. Equipment records (list of company equipment).
10. Vendors', rental agencies', and subcontractors' invoices.
11. Subcontractors' payment certificates.
12. Canceled checks (payroll and vendors).
13. Job cost report.
14. Job payroll ledger.
15. General ledger.
16. Cash disbursements journal.
17. Financial statements for all years reflecting the operations on the Project.
18. Income tax returns for all years reflecting the operations on the Project.
19. Depreciation records on company equipment whether such records are maintained by the company involved, or its accountant, or others.
20. If a source other than depreciation records is used to develop costs for the Contractor's internal purposes in establishing the cost of owning and operating equipment, all such other source documents.
21. All documents that reflect the Contractor's actual profit and overhead during the years the Project was being performed and for each of the 5 years before the commencement of the Project.
22. All documents related to the preparation of the Contractor's bid, including the final calculations on which the bid was based.
23. All documents that relate to each and every request or claim together with all documents that support the amount of damages as to each.
24. Worksheets used to prepare the request or claim establishing the cost components for items of each including, but not limited to, labor, benefits and insurance, materials, equipment, subcontractors, and all documents that establish the time periods, individuals involved, and the hours and rates for these individuals.

Where payment for materials or labor is based on the cost thereof to forces other than the Contractor, the Contractor shall ensure that the cost records of such other forces are open to inspection and audit by the Department on the same terms and conditions as the records of the Contractor.

109.10 CONTRACTOR'S COMPLIANCE WITH N.J.S.A. 34:11-56.25, *ET SEQ.*

Provide the RE with a written statement on a form provided by the Department certifying that all employees employed by the Contractor or by any subcontractor have been paid wages not less than those required by the Contract in compliance with N.J.S.A. 34:11-56.25, *et seq*.

109.11 FINAL PAYMENT AND CLAIMS

The Final Certificate may result in either a Final Payment to the Contractor or a credit (payment) due the Department. After Acceptance and the as-built quantities are finalized, the RE will process an Estimate and the Department will issue the Proposed Final Certificate to the Contractor.

Within 30 days after receiving this Proposed Final Certificate, submit a release or conditional release to the Department on a payment voucher provided by the Department. If the Contractor has no reservation of claims and accepts the Proposed Final Certificate, provide a written release stating the following:

> *In consideration of the above payment, I hereby release the State of New Jersey, Commissioner of Transportation, the Department, their agents, officers, and employees from all claims and liability of whatsoever nature for anything done or furnished or in any manner growing out of the performance of the Work.*

If the Contractor has a reservation of specific claims, but otherwise has released all claims not specifically reserved and accepts the Proposed Final Certificate, state the following:

> *In consideration of the above payment, I hereby release the State of New Jersey, Commissioner of Transportation, the Department, their agents, officers, and employees from all claims and liability of whatsoever nature for anything done or furnished in any manner growing out of the performance for the Work except for_____.*

Include in the release the specific monetary amounts and the specific nature of the claims being reserved. Failure to state specific monetary amounts and the specific nature of the claim shall result in a waiver of such claims. The Contractor may reserve only those claims properly filed with the Department as specified in 107.12 and not previously resolved. If the Contractor reserves claims, proceed as specified in 107.12. The Contractor waives all claims for which the required notice has not been filed with the Department.

The Contractor's failure to submit written release or conditional release within said 30 days constitutes acceptance of the Proposed Final Certificate without exception and a wavier of all claims.

Upon receipt of the Contractor's written acceptance of the Proposed Final Certificate without exception or conditional release, or when the Contractor fails to provide written acceptance of the Proposed Final Certificate within 30 days of issuance, the Department will pay the entire sum due there under as provided by the N.J.S.A. 52:32-32, *et seq.*, provided the Final Certificate indicates a payment is due the Contractor. However, where the Final Certificate indicates a credit (payment) is due the Department, the Contractor shall remit said credit (payment) to the Department.

If the Contractor fails to remit the credit due the Department, as indicated on the Proposed Final Certificate, within 30 days of issuance of the Proposed Final Certificate, the Department has the right to recover the credit from the Contractor.

109.12 ETHICS STANDARDS AND CONFLICTS OF INTEREST

Both the Department and the Contractor have a duty to prevent conflicts of interest or the appearance of conflicts of interest. Ensure that all officers, employees, agents, and representatives are aware of these requirements. Obtain information regarding the State's Business Ethics Guide at www.state.nj.us/treasury/purchase/ethics.htm.

Do not pay, offer to pay, or agree to pay, either directly or indirectly, any fee, commission, compensation, gift, gratuity, or other thing of value of any kind to any Department employee, or agent as defined by N.J.S.A. 52:13D-13b. and N.J.S.A. 52:13D-13e., or to any member of the immediate family, as defined by N.J.S.A. 52:13D-13i., of any such officer or employee or agent, or any partnership, firm or corporation with which they are employed or associated, or in which such employee or agent has an interest within the meaning of N.J.S.A. 52:13D-13g.

Immediately report in writing the solicitation of any fee, commission, compensation, gift, gratuity or other thing of value by any State officer or employee or special State officer or employee from any State vendor to the Attorney General and the Executive Commission on Ethical Standards.

Do not, directly or indirectly, undertake any private business, commercial or entrepreneurial relationship with, whether or not pursuant to employment, contract or other agreement, express or implied, or sell any interest in such contract to any Department employee or agent having any duties or responsibilities in connection with the purchase, acquisition or sale of any property or services by or to any State agency or any instrumentality thereof, or with any person, firm or entity with which he is employed or associated or in which he has an interest within the meaning of N.J.S.A. 52:13D-13g.

Immediately report any relationships subject to this provision to the Executive Commission on Ethical Standards, which may grant a waiver of this restriction upon application of the Department's employee or agent and finding that the present or proposed relationship does not present the potential, actuality or appearance of a conflict of interest.

Do not influence, or attempt to influence or cause to be influenced, any Department employee or agent in his or her official capacity in any manner, which might tend to impair the objectivity or independence of judgment of said employee or agent.

Do not cause or influence, or attempt to cause or influence, any Department employee or agent to use, or attempt to use their official position to secure unwarranted privileges or advantages for the vendor or any other person.

The provisions cited above in this Subsection shall not be construed to prohibit a Department employee or agent from receiving gifts under the same terms and conditions as are offered or made available to members of the general public, subject to any guidelines the Executive Commission on Ethical Standards may promulgate.

Provide to the RE at the preconstruction meeting, on a form provided by the Department, a certification that the Contractor understands these obligations, has adhered to these ethics standards and shall continue to adhere to these ethics standards.

DIVISION 150 – CONTRACT REQUIREMENTS

SECTION 151 – PERFORMANCE BOND AND PAYMENT BOND

151.01 DESCRIPTION

This Section describes the requirements for providing a performance bond and a payment bond.

151.02 MATERIALS

(Intentionally Blank)

151.03 PROCEDURE

151.03.01 Performance Bond and Payment Bond

Using bond forms issued by the Department, provide a performance bond and a payment bond to the Department within 15 days of the date of Award or Conditional Award. Ensure that the penal sum of the bond is equal to at least the Total Contract Price less the bid price for PERFORMANCE BOND AND PAYMENT BOND. With the bond, provide a certification authorizing the attorney-in-fact to commit the Surety and a true and correct statement of the Surety's financial condition. Submit the broker's fees, the certified rate schedule, and the report of execution for the bond to the RE.

Obtain bonds from sureties listed in the US Treasury Department Circular 570 and authorized to do business in the State. Reinsurance is prohibited as per N.J.A.C 16:44-6.1(b)6. If the Surety becomes insolvent before Acceptance, provide a performance bond and a payment bond issued by another surety to the Department.

The Department may adjust Contract Time, require extra work, or issue other changes authorized by the Contract without obtaining the consent of the surety of the bonds.

151.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
PERFORMANCE BOND AND PAYMENT BOND	LUMP SUM

The Department will make payment for PERFORMANCE BOND AND PAYMENT BOND as follows:

$$B_{IP} = \text{the lesser of } B_B \text{ and } B_I$$

$$B_{FP} = \text{the lesser of } [B_{IP} + R(C_F - C_O)] \text{ and } B_F$$

Where:
B_B = Bid price of the PERFORMANCE BOND AND PAYMENT BOND.
B_I = Actual price of the PERFORMANCE BOND AND PAYMENT BOND at the start of Work.
B_F = Actual price of the PERFORMANCE BOND AND PAYMENT BOND at Completion of Work.
B_{IP} = Initial payment for the PERFORMANCE BOND AND PAYMENT BOND made by the Department at the start of Work.
B_{FP} = Final payment for the PERFORMANCE BOND AND PAYMENT BOND made by the Department at the Completion of Work.
R = Rate from the certified schedule.
C_O = Original Contract Price.
C_F = Final Contract Price.

The Department will make adjustments to PERFORMANCE BOND AND PAYMENT BOND in the final monthly Estimate. The Department will not make adjustments of less than $100.

SECTION 152 – INSURANCE

152.01 DESCRIPTION

This Section describes the requirements for providing and maintaining insurance until Acceptance.

152.02 MATERIALS

(Intentionally Blank)

152.03 PROCEDURE

152.03.01 Owner's and Contractor's Protective Liability Insurance

A. Policy Requirements. Procure and maintain insurance until Acceptance. The Department will not consider the Work or any portion as put to its intended use until Acceptance. The Contractor may only obtain insurance from companies that are licensed to provide insurance in the State. Ensure that polices are underwritten by companies with a current A.M. Best rating of A- with a Financial Size Category of VII or better. Before performing construction operations, provide the RE with certificates of insurance and policy declaration pages. The Department's Insurance Certificate (Form DC-175) is the only acceptable form as evidence of insurance. Ensure that insurance policies are endorsed to provide written notice by certified mail to the Department 30 days before changes to and/or cancellation of the policy. Upon request, provide the RE with a certified copy of each policy.

Submit documentation to identify all exclusions and deductible clauses. The limits of liability set forth below do not relieve the Contractor from liability in excess of such coverage. Deductibles for each policy are limited to $250,000 per occurrence. The Contractor is responsible for the deductible limit of the policy and all exclusions consistent with the risks it assumes under this Contract and as imposed by law.

B. Types. At a minimum, provide the following insurances.

1. Comprehensive General Liability Insurance. Procure Comprehensive General Liability insurance with a minimum limit of liability in the amount of $1,000,000 per occurrence as a combined single limit for bodily injury and property damage.

Ensure the coverage for the policy is at least as broad as that provided by the standard basic, unamended, and unendorsed comprehensive general liability coverage forms currently in use in the State. Ensure the policy is endorsed to include:

1. Personal injury.
2. Contractual liability.
3. Premises and operations.
4. Products and completed operations.
5. Independent contractors.
6. Waiver of Subrogation for all claims and suits, including recovery of any applicable deductibles.
7. Severability of Interest/Separation of Insureds.
8. Per project aggregate.

Ensure the policy is endorsed to delete any exclusions applying to property damage liability arising from:

1. Explosions.
2. Damage to underground utilities.
3. Collapse of foundations.

Ensure the policy names the State, its officers, employees, and agents as additional insured. On the Insurance Certificate, indicate the cost for providing the policy.

2. Comprehensive Automobile Liability Insurance. Procure Comprehensive Automobile Liability insurance to cover owned, non-owned, and hired vehicles with a minimum limit of liability in the amount of $1,000,000 per occurrence as a combined single limit for bodily injury and property damage. Ensure the policy is endorsed to include a Waiver of Subrogation for all claims and suits, including recovery of any applicable deductibles. Ensure the policy is endorsed to include Severability of Interest/Separation of Insureds clause.

3. **Owner's and Contractor's Protective Liability Insurance**. Procure a separate Owner's and Contractor's Protective Liability Insurance Policy with a minimum limit of liability in the amount of $4,000,000 per occurrence as a combined single limit for bodily injury and property damage. Ensure the policy is endorsed to include a Waiver of Subrogation for all claims and suits, including recovery of any applicable deductibles. Ensure the policy is endorsed to include Severability of Interest/Separation of Insureds clause. Ensure the policy names the State, its officers, employees, and agents as additional insured. Provide documentation from the insurance company that indicates the cost of the Owner's and Contractor's Protective Liability Insurance Policy.

4. **Workers Compensation and Employer's Liability Insurance.** Procure Workers Compensation Insurance according to the requirements of the laws of this State and include an all-states endorsement to extend coverage to any state that may be interpreted to have legal jurisdiction. Provide Employer's Liability Insurance with the following minimum limits of liability:

    1. $100,000 each accident.
    2. $100,000 Disease each employee.
    3. $500,000 Disease aggregate limit.

    If construction operations requires marine operations, including working from a barge or ship, or unloading material from a barge or ship on a navigable waterway in the United States, ensure the policy is endorsed to include US Longshore and Harbor Workers coverage and Jones Act coverage.

5. **Excess Liability Insurance.** Procure Excess Liability or Umbrella Liability insurance with limits in excess of the underlying policies for Comprehensive General Liability and Comprehensive Automobile Liability with minimum limits of liability of $10,000,000. Ensure the Excess Liability Insurance policy takes effect (drops down) if the primary coverage is impaired or exhausted. Ensure the excess or umbrella policy has the same terms and conditions as the primary underlying coverage.

6. **Marine Liability Insurance.** If construction operations require marine operations, procure Marine Liability Insurance with a minimum limit of liability in the amount of $2,000,000 per occurrence. Ensure the policy is endorsed to include:

    1. Personal injury.
    2. Contractual liability.
    3. Premises and operations.
    4. Products and completed operations.
    5. Independent contractors.
    6. Waiver of Subrogation for all claims and suits, including recovery of any applicable deductibles.
    7. Severability of Interest/Separation of Insureds.

    Ensure the policy names the State, its officers, employees, and agents as additional insured.

C. **Maintenance.** Submit an updated DC-175, Insurance Certificate, to demonstrate continued renewal of insurance. During any period when the required insurance is not in effect, the RE may suspend the Work. The Department may refuse to make payments due under this Contract or any other contracts with the Department until the required insurance coverage is in effect. The Department may use monies withheld to renew the insurance for the periods and amounts referred to above. Alternatively, the Department may default the Contractor and direct the Surety to complete the Project.

152.03.02 Railroad Protective Liability Insurance

If required by the Special Provisions, procure railroad protective liability insurance according to 23 CFR 646, Subpart A, as a combined single limit for bodily injury and property damage with minimum limits of liability in the amounts of $2,000,000 per occurrence and $6,000,000 per annual aggregate. Ensure that the railroad protective liability insurance meets the policy requirements specified in 152.03.01.A.

Additionally, ensure Comprehensive General Liability policy is endorsed to provide for independent contractors' coverage and deletes any exclusions applying to liability arising out of operations in proximity to railroad property. Ensure that the railroad protective liability insurance policy is endorsed to provide written notice by certified mail to the railroad company 30 days before changes to and/or cancellation of the policy.

Ensure the policy is endorsed to include a Waiver of Subrogation for all claims and suits, including recovery of any applicable deductibles. Ensure the policy is endorsed to include Severability of Interest/Separation of Insureds clause. Submit the policy for railroad protective liability insurance and endorsements to the Comprehensive General Liability Insurance to the railroad company for approval. The Department will list the name and address of the railroad company representative in the Special Provisions. Construction operations will not be permitted on railroad property before approval of insurance by the railroad company. Reconcile all policy requirements to the satisfaction of the railroad company and the RE.

The Special Provisions will contain an estimate of the percentage of the Contract cost located within or adjacent to the railroad ROW. The percentage is provided for informational purposes only and does not affect the amount of risk or coverage.

152.03.03 Pollution Liability Insurance

Procure Contractor's Pollution Liability insurance for bodily injury and property damage with minimum limits of liability in the amounts of $5,000,000 per occurrence and $10,000,000 aggregate. Ensure that the pollution liability insurance meets the policy requirements specified in 152.03.01.A.

If the policy is written on an occurrence form, ensure it will remain in effect until Acceptance, and ensure that completed operations coverage is provided for a period of no less than 2 years after Acceptance. If the policy is written on a claims-made basis, ensure an Extended Reporting Provision coverage is maintained for a period of no less than 2 years after Acceptance.

Ensure the policy provides coverage for:

1. Bodily injury and property damage to third parties.
2. Natural resource damages.
3. Environmental cleanup including restoration or replacement costs.
4. Legal defense.
5. Transportation of waste material by or on behalf of the Contractor away from the Project Limits.
6. Disposal liability for pollution conditions on, at, under, or emanating from any disposal site, location or facility used by or on behalf of the Contractor for disposal of waste.
7. Waiver of Subrogation for all claims and suits, including recovery of any applicable deductibles.
8. Severability of Interest/Separation of Insureds.

Ensure the policy does not contain any exclusions or limitations for:

1. Liabilities Assumed under an insured contract.
2. Lead, silica, or asbestos.
3. Underground storage tanks.
4. Insured versus insured exclusion that restricts coverage to the State.

Ensure the policy names the State, its officers, employees, and agents as additional insured. Provide documentation from the insurance company indicating the coverage, limitation of coverage, term of coverage, and cost of the pollution liability insurance policy.

152.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
OWNER'S AND CONTRACTOR'S PROTECTIVE LIABILITY INSURANCE	LUMP SUM
RAILROAD PROTECTIVE LIABILITY INSURANCE	LUMP SUM
POLLUTION LIABILITY INSURANCE	LUMP SUM

The Contractor shall provide all other insurance costs at the Contractor's expense.

The Department will make initial payment for OWNER'S AND CONTRACTOR'S PROTECTIVE LIABILITY INSURANCE, RAILROAD PROTECTIVE LIABILITY INSURANCE, and POLLUTION LIABILITY INSURANCE at the lesser of the bid amount, or actual costs as documented from paid invoices. The Department will make payment for any remainder with the final monthly Estimate.

SECTION 153 – PROGRESS SCHEDULE

153.01 DESCRIPTION

This Section describes the requirements for providing a progress schedule to monitor Contract progress and to evaluate impacts on Contract Time.

153.02 MATERIALS

(Intentionally Blank)

153.03 PROCEDURE

153.03.01 CPM Progress Schedule

Provide a detailed CPM schedule in XER format using the *NJDOT Capital Program Management Construction Scheduling Standard Coding and Procedures for Designers and Contractors Manual*, and the *NJDOT Scheduling Template*. The manual and template are available from the Department's website.

Determine the most feasible work sequence that meets the Contract requirements. Ensure that the schedule includes ROW availability dates, permits, submittals, working drawings, procurement, fabrication, delivery of materials, construction, and other activities necessary to complete the Work. Schedule the Work according to the staging requirements specified by the Contract. The Contractor may simultaneously perform work designated as part of separate stages where allowed by the Contract or approved by the RE.

The Contractor may propose alternate staging. Ensure that proposed alternate staging does not interfere with work done by Others. The Department may reject the proposed alternate staging if it causes an increase to the cost of work done by Others. The Contractor is responsible for the cost of changes or additional work required as a result of completing the work according to the proposed alternate staging.

If the Contractor proposes alternate staging, submit a plan detailing the proposed alternate. Submit a schedule showing the original staging and a schedule showing the proposed alternate staging. The RE may extend its review of the schedule submissions by a reasonable length of time. The Department will not grant time extensions or make payment for delays to construction resulting from extended review time of the proposed alternate staging by the RE, regardless of whether the Department accepts or rejects it. The RE may require the Contractor to submit the proposed alternate staging as a VE proposal as specified in 104.02.

Ensure that the schedule submission conforms to the following:

1. Provide 1 activity for each discrete component of each Item scheduled in the Proposal. The RE may allow grouping of similar Items into 1 activity. For certain Items, the RE may require the Contractor to provide additional detail for each component to be included in the progress schedule.
2. Provide activity descriptions to ensure that the start, completion, and intermediate status of the Work is readily identifiable. Do not use nonspecific activity descriptions like "Start," "Continue," "Complete," "X percent," "Y percent," "Z percent," or similar.
3. Use activity codes to identify responsibility, class, type, and WBS. Use area activity codes to distinguish the location of work, such as stationing and structure number.
4. For each activity, indicate the calendar used. Ensure that no activity has a duration of less than 1 workday.
5. Ensure that no construction activity has a duration greater than 30 days, unless approved by the RE.
6. Ensure that activity logic and durations are consistent with the Contract.
7. Ensure that all activities, except the project start milestone and project completion milestone, have predecessors and successors. The start of an activity shall have a start-to-start or finish-to-start relationship with preceding activities. The completion of an activity shall have a finish-to-start or finish-to-finish relationship with a succeeding activity. Do not use start-to-finish relationships.
8. Indicate time frames when work is restricted in sensitive areas, including wetlands, floodplains, waterbodies, and parklands, to ensure that appropriate staging and seasonal constraints are reflected.
9. Ensure that seasonal constraints are reflected for Items of work such as stripping, seeding, and planting.
10. Indicate time frames when work is restricted by work performed by Utilities or by Others.
11. Indicate time frames, as specified in 105.05, for the Department to review working drawings.

12. Identify the start and finish dates of stages with Finish Milestones.
13. Identify the Completion and interim completion dates specified in 108.10 with Finish Milestones with a Late Finish Constraint.
14. Use constraint dates only for Completion and interim completion milestones, unless approved by the RE.
15. Calculate the CPM schedule in working days. Ensure that the working day to calendar date relationship is based upon the Contractors proposed work week with allowance for weekends, legal holidays and any special requirements of the Contract.
16. Do not use resource loaded schedules.

The progress schedule does not constitute notice and does not satisfy the notice requirements as specified in 104.03.04. Approval of the schedule by the RE does not modify the Contract or constitute Acceptance of the feasibility of the Contractor's logic, activity durations, or assumptions used in creating the schedule. If the schedule reflects a completion date different than that specified in 108.10, this does not change the specified completion date. If the RE approves a schedule that reflects a completion date earlier than that specified as the Contract Time, the Department will not accept claims for additional Contract Time or compensation as the result of failure to complete the Work by the earlier date shown on the CPM schedule. Float is the amount of time that an activity may be delayed from its early start without delaying Completion. Float belongs to the Project and is not for the exclusive use of the Contractor or the Department.

Submit the preliminary schedule and baseline schedule as follows:

1. Preliminary Schedule Submission. Within 15 days after executing the Contract, submit 1 electronic copy of the preliminary schedule to the RE for review and approval. For contracts with a Total Contract Value of less than $40 million, provide the schedule for at least the first 90 days of the Project. For contracts with a Total Contract Value of more than $40 million, provide the schedule for at least the first 120 days of the Project. Provide a summary activity network for the remainder of Contract Time. Include a written narrative detailing the calendars, the use of multiple shifts per day, and the anticipated production rates.

The RE may require 3 paper copies of the preliminary schedule, Gantt Chart, as specified in 153.03.02.2.e, and a network diagram (PERT) printed on 36 × 22-inch plans detailing the activity relationships.

Ensure that the preliminary schedule includes milestone activities expected to be completed or partially completed before submission and approval of the baseline schedule.

Do not begin construction operations until the RE approves the preliminary schedule. Allow 14 days for the RE to review and approve or reject and return the preliminary schedule submission. If the preliminary schedule submission is rejected by the RE, revise and resubmit to the RE for approval within 7 days.

2. Baseline Schedule Submission. Ensure that the baseline schedule depicts the work plan for the entire Contract Time. Submit, as specified in Table 153.03.01-1, 1 electronic copy of the baseline schedule to the RE for approval. The RE may require the Contractor to submit 3 paper copies of the baseline schedule.

Table 153.03.01-1 Baseline Schedule Submission Timeline

Project Construction Cost (PCC) ($ million)	Days to Submit Baseline Schedule After Approval of Preliminary Schedule
PCC < 5	14
5 ≤ PCC < 15	21
15 ≤ PCC < 40	28
PCC ≥ 40	35

Ensure that the baseline schedule submission includes the following:

1. A written narrative explaining the schedule and the Contractor's general approach for achieving Substantial Completion and Completion as specified in 108.10, including an explanation of calendars used in the schedule.
2. A resource plan indicating the quantity and type of equipment that will be employed and the size and character of the proposed labor force for each operation.
3. The RE may require 3 paper copies of the tabular reports, as specified in 153.03.02.2, and a printed network diagram (PERT) on 36 × 22-inch sheets detailing the activity relationships.

Within 14 days, the RE will review the baseline schedule and approve or reject the submission. If rejected, revise and resubmit the baseline schedule, within 7 days, to the RE for review and approval. The RE will review the revised baseline schedule submission and approve or reject the resubmission within 7 days.

153.03.02 CPM Progress Schedule Updates

The RE will designate the due date for the first schedule update when the baseline schedule is approved. The first update is due approximately 2 months following the baseline schedule approval. The RE will designate the data date to be used for each schedule update.

Schedule progress review meetings to be held approximately 14 days before the schedule update due date. Prepare activity progress in advance of each meeting. Revise the logic to reflect the actual sequence of work. Do not submit schedules showing work performed out of sequence. Provide the RE with a report detailing actual start and actual finish dates of activities in progress during the previous 2 months. At the progress review meeting, present and review the progress during the previous 2 months for incorporation into the schedule.

Within 14 days from the date of the progress review meeting, submit the schedule update to the RE for approval with the agreed upon changes. Within 14 days, the RE will review the update schedule and approve or reject the submission. If rejected, revise and resubmit the schedule update, within 14 days, to the RE for review and approval. The RE will review the revised schedule update submissions and approve or reject the resubmission within 14 days.

Update and submit the subsequent schedule update even if the RE has not approved the previous schedule update.

Provide 1 electronic copy for each schedule update. Ensure that each schedule update conforms to the scheduling requirements specified in 153.03.01, and that each schedule update submission includes the following:

1. **Progress Narrative.** Provide 3 paper copies of the progress narrative. At a minimum include the following:

    1. A description of schedule status.
    2. A discussion of current and anticipated delaying problem areas and their estimated schedule effect.
    3. A discussion of intermediate milestones specified in the Contract that are behind schedule.
    4. A discussion of schedule slippage, pay revisions, and progress along the critical path in terms of days ahead or behind previously established dates.
    5. A listing of logic changes and an explanation for the revisions. Changes in duration, calendars, and revisions to activity relationships are considered logic revisions.
    6. A listing of revisions to scheduled activities not worked on during the update period.

2. **Tabular Reports.** The RE may require 3 paper copies of the longest path sort, total float sort, responsibility sort, area sort, and Gantt chart. Include the following information for each:

    1. Contract title.
    2. Data date.
    3. Activity ID.
    4. Activity description.
    5. Activity codes including responsibility, class, area, type, and WBS.
    6. Calendar used.
    7. Original activity duration and remaining activity duration in working days.
    8. Early start and early finish dates, and late start and late finish dates.
    9. Total float.
    10. Historical (actual) start and finish dates for activities completed or underway to replace calculated early and late dates.

    a. Longest Path Sort. Sort activities using the longest path filter.

    b. Near Critical Path Sort. Sort activities using the near critical path filter.

    c. Responsibility Sort. Group activities by responsibility, and then sort by early start.

    d. Area Sort. Group activities by WBS, area, and then sort by early start.

    e. Gantt Chart. Provide a precedence-type chart drawn using the early (or actual) start and finish dates. Ensure that the layout output is time-scaled and the size of each activity represented is proportional to the activity duration.

Group the activities by WBS and sort by area. Ensure that the titles appear on the left-hand side of the plot. Show completed activities. Clearly identify the critical path. Use a vertical line to indicate the data date and the start of each month. Show Milestones using symbols. Provide a legend explaining symbols and their meanings.

If the Contractor falls behind schedule, and cannot complete the Work by the Completion date, as specified in 108.10, the Contractor shall take the necessary steps to improve progress. The RE may direct the Contractor to increase the number of shifts, begin overtime operations, work extra days including weekends and holidays, or supplement its construction plant and to submit for approval a recovery schedule to show that the Contractor is meeting the directed acceleration.

153.03.03 Bar Chart Progress Schedule and Updates

A. Schedule. Determine the most feasible work sequence that meets the Contract requirements. Ensure that the schedule includes ROW availability dates, permits, submittals, working drawings, procurement, fabrication, delivery of materials, construction, and other activities necessary to complete the Work.

Schedule the Work according to the staging requirements in the Contract. The Contractor may simultaneously perform work designated as part of separate stages where allowed by the Contract or approved by the RE.

Approval of the schedule by the RE does not modify the Contract or constitute Acceptance of the feasibility of the Contractor's logic, activity durations, or assumptions used in creating the schedule. The progress schedule does not constitute notice and does not satisfy the notice requirements as specified by 104.03.04. Provide 3 paper copies of a bar chart progress schedule or similar type that is acceptable to the RE for approval as follows:

1. Provide 1 activity for each discrete component of each Item scheduled in the Proposal. The RE may allow grouping of similar Items into 1 activity. For certain Items, the RE may require the Contractor to provide additional detail for each component to be included in the progress schedule.
2. Provide activity descriptions to ensure that the start, completion, and intermediate status of the Work is readily identifiable. Do not use nonspecific activity descriptions like "Start," "Continue," "Complete," "X percent," "Y percent," "Z percent," or similar.
3. Ensure that no construction activity has a duration greater than 30 days, unless approved by the RE.
4. Include the planned start and completion dates for each activity, the duration of each activity, and the sequencing of the activities.
5. Identify the quantity and the estimated daily production rate for critical activities.
6. Indicate time frames when work is restricted in sensitive areas, such as wetlands, floodplains, waterbodies, and parklands, to ensure the appropriate incorporation of staging and seasonal constraints.
7. Ensure that seasonal constraints are reflected for Items of work such as stripping, seeding, and planting.
8. Ensure that the progress schedule is of suitable scale to clearly indicate the duration of each activity.

Within 14 days, the RE will review the schedule and approve or reject the submission. If rejected, revise and resubmit the schedule, within 7 days, to the RE for review and approval. The RE will review the revised schedule submission and approve or reject the resubmission within 7 days.

B. Updates. Update the progress schedule to reflect changing conditions. The RE will designate the due date for the first schedule update when the schedule is approved. The first update will be due approximately 2 months following the schedule approval. The RE will designate the data date to be used for each schedule update.

Provide a progress narrative with each update submission that includes the following:

1. A description of schedule status.
2. A discussion of current and anticipated delaying problem areas and their estimated schedule effect.
3. A discussion of all intermediate milestones specified in the Contract that are behind schedule.
4. A discussion of schedule slippage, pay revisions, and progress along the critical path in terms of days ahead or behind previously established dates.

153.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
PROGRESS SCHEDULE	LUMP SUM
PROGRESS SCHEDULE UPDATE	UNIT
BAR CHART PROGRESS SCHEDULE AND UPDATES	LUMP SUM

The Department will make payment for PROGRESS SCHEDULE when the baseline schedule submission is approved by the RE.

If the Contractor's update is not approved by the date of the progress meeting for the following update, the Department will assess liquidated damages to recover the Department's increased administrative costs. The Department will assess damages for each delinquent update as follows:

Missed or Unapproved Update	**Liquidated Damage**
First	$5000
Second consecutive	$10,000
Subsequent consecutive	$15,000

If, liquidated damages for delinquent updates are applied, and the Contractor subsequently provides an acceptable update, the Department will assess liquidated damages for the next delinquent update at the first liquidated damage rate.

The Department will make payment for BAR CHART PROGRESS SCHEDULE AND UPDATES as follows:

Schedule Submission	**Payment**
Approval of baseline schedule	50% of the lump sum
Approval of each update	50% prorated over the duration of the Contract

SECTION 154 – MOBILIZATION

154.01 DESCRIPTION

This Section describes requirements for mobilization.

154.02 MATERIALS

(Intentionally Blank.)

154.03 PROCEDURE

154.03.01 Mobilization

Mobilization consists of the preparatory work and operations, including moving personnel, equipment, supplies, and incidentals to the Project Limits. It also includes all other work performed and costs incurred before beginning work on various Items in the Contract.

154.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
MOBILIZATION	LUMP SUM

The Department will make payment for MOBILIZATION on a lump sum basis, regardless of the number of times the Contractor shuts down and returns to the Project. The Department will make payment as follows:

Work Completed	**Payment**
5% of the Work[1]	Lesser of 25% of bid price or 2.5% of Total Contract Price
10% of the Work[1]	Lesser of 50% of bid price or 5% of Total Contract Price
15% of the Work[1]	Lesser of 75% of bid price or 7.5% of Total Contract Price
20% of the Work[1]	Lesser of 100% of bid price or 10% of Total Contract Price
100% of the Work	Amount of bid price not previously paid

1. If the baseline schedule is not approved, the Department will not make payment for MOBILIZATION.

The Department will calculate the percentage of Work completed from the total of payments compared to the Total Contract Price. The total of payments excludes the amount paid for MOBILIZATION and the amount paid for materials furnished but not incorporated into the Work as specified in 109.06.

If MOBILIZATION is not included in the Proposal, include the costs in the various Items scheduled in the Proposal.

SECTION 155 – CONSTRUCTION FIELD OFFICE

155.01 DESCRIPTION

This Section describes the requirements for set up and maintenance of the Department's construction field office.

155.02 MATERIALS

(Intentionally Blank)

155.03 PROCEDURE

155.03.01 Field Office

Provide and maintain a safe and secure field office for the exclusive use of the Department at a location within or in the immediate vicinity of the Project Limits and approved by the RE. Do not use any building scheduled for demolition under the Contract as a field office. If the field office is a temporary structure, secure necessary permits from the New Jersey Department of Community Affairs, and remove the structure when directed by the RE.

Ensure that the field office is weatherproof with a minimum ceiling height of 7-1/2 feet and conforms to the requirements specified in Table 155.03.01-1. Ensure that 1 of the rooms of the field office has a minimum area of 288 square feet. Ensure that the other rooms have a minimum area of 144 square feet, except for conference rooms, which require a minimum area of 288 square feet. Ensure that the field office doors and windows have locks. Provide the keys to the RE. Ensure that the field office has one or more closets of sufficient capacity for the office's size.

1. Office Size Requirements. Provide the following, at a minimum, for the field office type specified:

Table 155.03.01-1 Office Size Requirements

Description	Field Office Type					
	A	**B**	**C**	**D**	**E**	**F**
Total Area (SF)	288	432	576	720	864	1008
Number of Rooms[1]	1	2	3	4	4	5
Conference Room	0	0	0	0	1	1
Desks with Swivel Chairs	2	4	6	8	8	10
Tables and chairs to seat	8	12	16	20	24	28
File Cabinets[2]	2	4	4	4	4	8
Plan Racks[3]	1	2	2	3	3	4
Parking spaces[4]	4	5	6	8	8	10

1. Including conference room.
2. Having a UL rating of 350 °F – 1 hour, 4 drawers, legal-size with lock and 2 keys.
3. Capable of holding 1200 plan sheets.
4. Free parking on a paved or hard surfaced area adjacent to the building.

2. Utilities and Lighting. Provide all utility services and connections including water, sewer, gas, electricity, telephone, and broadband internet. Provide a separate telephone line for each telephone, computer modem, and fax machine specified in 155.03.01.4. Provide a field office with sufficient natural and artificial light. Provide adequate insulation, heat, and air-conditioning to maintain an ambient temperature of 68 to 80 °F.

3. Lavatory. Provide a separately enclosed and properly ventilated room with washing and toilet facilities suitable for use by male and female employees. Ensure that the facilities have hot and cold running water. Equip the doors and windows with locks.

4. Communication Equipment. Provide the following communication systems:

a. Telephones. Provide a phone system as specified in the Special Provisions. Ensure that each phone is connected to the answering system.

b. Fax Machine. Provide a fax machine with built-in telephone, auto-dial, auto-re-dial, and auto-receive, and out-of-paper reception features.

c. Cell Phones. Provide cell phones as specified in the Special Provisions.

d. Computer System. Provide a computer system as specified in the Special Provisions.

Do not procure the computer system until reviewing the system requirements with the RE. Ensure that the computer system is compatible with the Department's construction management software and other specified software.

When the computer system is no longer required by the RE, the Department will erase the hard drive, and return the computer system to the Contractor. The Department will retain other data storage devices.

5. Office Furnishings. Provide the following:

1. Two book cases.
2. A drafting table and stool.
3. A supply cabinet.
4. A water cooler having both hot and cold water dispensers, and bottled water service.
5. A type ABC fire extinguisher having UL-approval.
6. A 24-person first-aid kit according to ANSI Z308.1, 1 tick removal tweezers, and 4 aerosol cans of insect repellent containing DEET. Restock first aid supplies and insect repellant as needed.
7. A wastepaper basket for each room.
8. Two 3 × 4 foot bulletin boards.
9. A 1.7 cubic foot refrigerator.

6. **Office Equipment.** Provide the following:

    1. A copier with automatic document feed, 15 pages per minute copy speed, variable reduce/enlarge capability, and letter, legal, and ledger size capabilities.
    2. A digital camera as specified in the Special Provisions.
    3. A video camcorder as specified in the Special Provisions.
    4. A printing adding machine.
    5. An electric typewriter, elite type, with 15-inch paper capacity.
    6. A paper shredder with a minimum throat of 8.75 inches, and a feed capacity of at least 10 sheets.

7. **Inspection Equipment.** Provide as specified in the Special Provisions.

155.03.02 Field Office Maintenance

Maintain the field office including furnishings, equipment, lavatories including toiletries, and utilities for the duration of the Contract or until no longer required by the RE. Provide services for utilities specified in 155.03.01.2. Provide for utility disconnection when the field office is no longer required by the RE. Assume that the field office will be required for a minimum of 3 months after Completion. Provide weekly janitorial and waste disposal service, and snow removal service as needed. Provide 1 case of letter, legal, and ledger sized paper every 2 months.

Repair or replace inoperable or defective communication, office, and inspection equipment within 24 hours. The Contractor is not responsible for replacing or repairing Items that are lost or damaged due to misuse.

155.03.03 Telephone Service

Telephone service consists of non-monthly and non-fixed charges, including their taxes, for telephone lines and cellular phones provided for the field office and materials field laboratory.

155.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
FIELD OFFICE TYPE ___ SET UP	UNIT
FIELD OFFICE TYPE ___ MAINTENANCE	MONTH
TELEPHONE SERVICE	LUMP SUM

The Department will make payment for FIELD OFFICE TYPE ___ MAINTENANCE for each month or portion of a month that the field office is required, except that the Department will not make payment for any month or fraction of a month that the Contractor is assessed liquidated damages as specified in 108.20.

The Department will make payment for TELEPHONE SERVICE for the actual costs of the non-monthly and non-fixed charges, including their related taxes, as evidenced by paid bills submitted within 60 days of receipt from the service provider for telephone and cell phones.

SECTION 156 – MATERIALS FIELD LABORATORY AND CURING FACILITY

156.01 DESCRIPTION

This Section describes the requirements for set up and maintenance of the Department's materials field laboratory and curing facility.

156.02 MATERIALS

(Intentionally Blank)

156.03 PROCEDURE

156.03.01 Materials Field Laboratory

Do not provide or procure the materials field laboratory or associated equipment until the RE notifies that this item is required.

Within 15 days of RE notification, provide and maintain a materials field laboratory for the exclusive use of the Department at a location approved by the ME. Do not use buildings scheduled for demolition under the Contract as a materials field laboratory. The ME will not conduct testing until the materials field laboratory is ready for use.

If the field laboratory is a temporary structure, secure the necessary permits from the New Jersey Department of Community Affairs, and remove the structure as directed by the RE. Provide a Uniform Code Type Four Fire Permit according to the New Jersey Department of Community Affairs regulations. The Contractor may obtain information concerning the permit fees and the permit application process from the Department's Bureau of Materials.

Ensure that the materials field laboratory is weatherproof with a minimum ceiling height of 7-1/2 feet. Ensure that one of the rooms has a minimum area of 450 square feet. Ensure that there is an additional room or enclosure with a concrete floor with a minimum area of 600 square feet. Ensure that each room has at least four 3-prong electrical outlets, having a minimum of two 20-ampere, 120-volt circuits.

Ensure that the materials laboratory doors and windows have locks, and provide the keys to the ME. Ensure that the materials field laboratory has one or more closets of sufficient capacity for the office's size. Provide the following for the materials field laboratory:

1. **Utilities and Lighting**. Provide all utility services and connections including water, sewer, gas, electricity, telephone, and broadband internet. Provide a separate telephone line for each telephone, computer modem, and fax machine specified in 156.03.01.4. Provide a field office with sufficient natural and artificial light. Provide adequate insulation, heat, and air-conditioning to maintain an ambient temperature of 68 to 80 °F.
2. **Lavatory.** Provide a lavatory as specified in 155.03.01.3.
3. **Parking.** Provide 6 free parking spaces on a paved or hard surfaced area adjacent to the materials field laboratory.
4. **Communication Equipment.** Provide the following communication systems:
   a. **Telephones.** Provide 2 cordless phones with auto-switching.
   b. **Fax Machine.** Provide 1 fax machine with built-in telephone, auto-dial, auto-re-dial, and auto-receive, and out-of-paper reception features.
   c. **Cell Phones.** Provide cell phones as specified in the Special Provisions.
   d. **Computer System.** Provide a computer system as specified in the Special Provisions.

      Do not procure the computer system until reviewing the system requirements with the ME. Ensure that the computer system is compatible with the Department's construction management software and other specified software.

      When the computer system is no longer required by the ME, the Department will erase the hard drive, and return the computer system to the Contractor. The Department will retain other data storage devices.
5. **Office Furnishings.** Provide furnishings, as specified in 155.03.01.5, and the following:
   1. Four desks with 4 desk chairs and 4 chairs.
   2. A work bench having a minimum area of 2-1/2 × 10 feet, and 2 stools.
   3. Shelving having a minimum area of 45 square feet.
6. **Office Equipment.** Provide the following:
   1. A copier with automatic document feed, 15 pages per minute copy speed, variable reduce/enlarge capability, and letter, legal, and ledger size capabilities.
   2. A printing calculator, with trigonometric function capability.
   3. A paper shredder with a minimum throat of 8.75 inches, and a minimum feed capacity of 10 sheets.

7. Laboratory Equipment. Provide the following:

a. Primary Laboratory Room. Equip the primary laboratory room with the following:

1. A 12-inch diameter exhaust fan or alternative means for venting heat, dust, and fumes.
2. Two gas stoves, each having at least 2 burners.
3. Either commercially bottled gas service or gas supplied by a Utility with at least 2 connections to be located as directed by the ME.
4. A sink with hot and cold running water, having adequate pressure, and equipped with 2 drain boards, and a drain-disposal system capable of handling elutriable material.
5. A metal stand to hold sieves used in washing elutriable material.
6. Two wheelbarrows.
7. A light duty oil-less air compressor listed by UL with a 2.5-gallon storage tank, a start/stop switch −94 pounds per square inch/125 pounds per square inch, a 115-volt universal motor, an ASME safety valve, and a 25-foot air hose, equipped with a quick-change blow gun kit and nozzle kit consisting of a high-flow safety nozzle, a 6-inch extension safety nozzle, a rubber tip nozzle, a needle tip nozzle, and an air screen safety nozzle.
8. An exhaust vent hood enclosed on 3 sides, top, and bottom, of such size to enclose the operations of drying and weighing a recycled concrete aggregate sample, and other operations in which a vapor or gas is emitted. Design and construct the hood so that any operation involving testing within the hood does not require the insertion of any portion of the tester's body, other than hands and arms. Ensure that the exhaust system is capable of producing an air speed of 80 to 120 feet per minute at the face of the opening.
9. Shovels and scoops for sampling soil aggregate and concrete.
10. Provide a nomograph. Supply the instruments necessary to measure air temperature, relative humidity, and wind speed, including 2 battery operated psychrometers, 2 concrete thermometers, and 2 wind gauges. Obtain certification from an independent, ME-approved laboratory that all instruments are in good working order and have been calibrated as requested by the ME.

b. Additional Room or Enclosure. Equip the additional room or enclosure with the following:

1. Two 12-inch diameter exhaust fans or alternative means for venting heat, dust, and fumes.
2. A 7-day spring-driven temperature recording device capable of producing a permanent record of the room temperature, with a supply of recording charts and pens.
3. Install a concrete block weighing a minimum of 200 pounds and measuring approximately 10 × 10 × 24 inches with a 10 × 10 × 1 inch steel plate fastened to the top. Install the block on a firm foundation at a location directed by the ME.
4. Two sound-dampened and dustproof cabinets constructed of at least 3/4-inch plywood or other suitable material and of sufficient size to house the mechanical sample shaker and the mechanical sieve shaker.
5. A separate cabinet for the purpose of housing and storing a nuclear density gauge. Ensure that the cabinet is constructed of 3/4-inch plywood or particle board and lead sheathing, or any other acceptable materials, to ensure that a radiation reading of no higher than 2 nanorads per hour is obtained by contact measurement of the outside wall of the storage cabinet. This second cabinet must be securable and have a door equipped with a heavy-duty lock with 2 keys provided. Before this cabinet is constructed, obtain approval from the ME of the exact location, materials to be used for its construction, and locking system.
6. Water tanks capable of storing three hundred 4 × 8-inch concrete cylinders fully submerged and in an upright position. Provide a 5/8-inch water hose at least 50 feet in length. Equip the water tank with a heater capable of maintaining a water temperature of 73 ± 3 °F.

8. Laboratory Testing Equipment. Provide testing equipment and apparatus conforming to that listed in AASHTO T 11 (including a mechanical washing machine), T 23, T 27, T 99, T 119, T 121, T 141, T 152, T 248, and T-309. Provide 4 units or the number specified by the ME, of the testing apparatus to satisfy the inspection and testing frequency anticipated. In addition, ensure that scales are electronic, except for those required for AASHTO T 121. Ensure that scales are inspected and certified by an independent scale company accredited according to the International Organization of Standards/International Electrotechnical

Commission 17025, or a State or county Office of Weights and Measures. Provide the ME with a copy of the certification at the time of installation. Ensure that the scales are re-certified annually, or every 6 months if directed by the ME.

156.03.02 Materials Field Laboratory Maintenance

Maintain the materials field laboratory including furnishings, equipment, lavatories including toiletries, and utilities for the duration of the Contract or until no longer required by the ME. Provide services for the utilities specified in 156.03.01.1. Provide for utility disconnection when the field office is no longer required by the ME. Provide weekly janitorial and waste disposal service, and snow removal service as needed. Provide 1 case of letter, legal, and ledger sized paper every 2 months.

Repair or replace inoperable or defective communication equipment, office furnishings, office equipment, laboratory equipment, and laboratory testing equipment within 24 hours. The Contractor is not responsible for cost of replacing or repairing items that are lost or damaged due to misuse.

156.03.03 Curing Facility

Do not provide or procure the curing facility or associated equipment until the RE notifies that this item is required.

Within 15 days of RE notification, provide and maintain a curing facility for the exclusive use of the Department at a location approved by the ME. Do not use buildings scheduled for demolition under the Contract as a materials field laboratory. The ME will not conduct testing until the curing facility is ready for use.

Maintain the curing facility until no longer required by the ME. Assume that the curing facility will be required for a minimum of 1 month after Completion. If the curing facility is a temporary structure, secure the necessary permits from the New Jersey Department of Community Affairs, and remove the structure as directed by the RE.

Ensure that the curing facility is weatherproof with a minimum ceiling height of 7-1/2 feet. Ensure that the curing facility has a concrete floor and a minimum area of 300 square feet. The room shall have a minimum of three 3-prong electrical outlets.

Ensure that the curing facility doors and windows have locks, and provide all keys to the ME. Provide the following for the curing facility:

1. **Utilities and Lighting.** Provide all utility services and connections including water, sewer, gas, and electricity. Provide a curing facility with sufficient natural and artificial light. Provide adequate insulation, heat, and air-conditioning to maintain an ambient temperature of 68 to 80 °F.

2. **Furnishings.** Provide the following:

    1. One work bench having a minimum area of 2-1/2 × 10 feet, and 2 stools.
    2. One type ABC, fire extinguisher having UL approval.

3. **Equipment.** Provide the following:

    1. One sink with hot and cold running water.
    2. One wheelbarrow.
    3. One light duty oil-less air compressor listed by UL with a 2.5-gallon storage tank, a start/stop switch −94 pounds per square inch/125 pounds per square inch, a 115-volt universal motor, an ASME safety valve, and a 25-foot air hose, equipped with a Quick-Change Blow Gun Kit and Nozzle Kit consisting of a high-flow safety nozzle, a 6-inch extension safety nozzle, a rubber tip nozzle, a needle tip nozzle, and an air screen safety nozzle.
    4. One 7-day spring-driven temperature recording device capable of producing a permanent record of the room temperature.
    5. Two 12-inch diameter exhaust fan or alternative means for venting heat, dust, and fumes.
    6. Water tanks capable of storing 300, 4 × 8-inch concrete cylinders fully submerged and in an upright position. Provide a 5/8-inch water hose at least 50 feet in length. Equip the water tank with a heater capable of maintaining a water temperature of 73 ± 3 °F.

156.03.04 Curing Facility Maintenance

Maintain the curing facility including furnishings and curing facility equipment for the duration of the Contract or until no longer required by the ME. Provide services for utilities specified in 156.03.03.1. Provide for utility disconnection when the curing facility is no longer required by the ME. Provide weekly janitorial and waste disposal service and snow removal service as needed.

Repair or replace inoperable or defective furnishings and curing facility equipment within 24 hours. The Contractor is not responsible for cost of replacing or repairing items that are lost or damaged due to misuse.

156.03.05 Nuclear Density Gauge

Provide for the Department's exclusive use and for the duration of the Project a nuclear density gauge calibrated to the manufacturer's specifications, with the following minimum features and capabilities:

1. Conformance to AASHTO T 310.
2. Backscatter and direct transmission modes.
3. 8-inch minimum length of probe.
4. Automatic warm-up and self test.
5. Automatic data storage and data transfer features, including an RS232 interface cable, specifically configured to transfer data from the density gauge to the microcomputer system and with data communication software.
6. Count times of 0.25, 1.0, and 4.0 minutes.
7. 0.25-pounds per cubic foot dry density precision in direct transmission at 120 pounds per cubic foot and at 1.0 minute, with ±0.3 percent accuracy.
8. 0.32-pounds per cubic foot moisture precision at 1.0 minute, with ±2.0 percent accuracy.
9. Type A certified package.

The Contractor may purchase a nuclear density gauge under the Contractor's United States Nuclear Regulatory Commission (USNRC) License, or lease from the gauge manufacturer on the Department's USNRC License. The Contractor is barred from purchasing gauges on the Department's USNRC License. Ensure that calibration and servicing of the gauge, other than routine wipe tests, is performed every 6 months.

156.03.06 Flexural Beam Testing Equipment

Provide the following testing equipment and apparatus:

1. A Flexural Beam Tester according to AASHTO T 97.
2. Twelve 6 × 6 × 21-inch reusable steel beam molds with handles according to AASHTO T 23.
3. Leaf type feeler gauges and carpenter's square.
4. Calipers capable of measuring inside and outside dimensions ranging from 0 to 300 millimeters in maximal calibrations of 0.25 millimeters.
5. A hand-held 180-millimeter Heavy-Duty Angle Grinder (120V, 15A, 6000 rpm) with an initial supply of 3 masonry grinding wheels. Provide additional grinding wheels within 48 hours of request.

Maintain and calibrate the testing equipment annually.

156.03.07 Concrete Compression Testing Equipment

Provide a Concrete Compression Tester according to AASHTO T 22. Ensure the testing equipment is maintained and calibrated annually.

156.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
MATERIALS FIELD LABORATORY SET-UP	UNIT
MATERIALS FIELD LABORATORY MAINTENANCE	MONTH
CURING FACILITY SET-UP	UNIT
CURING FACILITY MAINTENANCE	MONTH
NUCLEAR DENSITY GAUGE	UNIT

FLEXURAL BEAM TESTING EQUIPMENT	UNIT
CONCRETE COMPRESSION TESTING EQUIPMENT	UNIT

The Department will include the installation of telephone and cellular phone services in the MATERIALS FIELD LABORATORY SET-UP.

The Department will make payment for maintenance of the materials field laboratory for each month or portion of a month it is required, except that the Department will not make payment for any month or fraction of a month that the Contractor is assessed liquidated damages as specified in 108.20. The Department will include the monthly fixed charges for telephones and cellular phones in MATERIALS FIELD LABORATORY MAINTENANCE.

The Department will make payment for monthly toll call charges and non-fixed charges, including their related taxes, for all telephone lines and cellular phones under TELEPHONE SERVICE, as specified in 155.04.

The Department will make payment for CURING FACILITY MAINTENANCE for each month or portion of a month it is required, except that payment will not be made for any month or fraction of a month that the Contractor is assessed liquidated damages as specified in 108.20.

SECTION 157 – CONSTRUCTION LAYOUT AND MONUMENTS

157.01 DESCRIPTION

This Section describes the requirements for surveying and providing lines, grades, elevations, and reference marks as necessary to construct the elements of construction. This Section also describes the requirements for constructing monuments and monument boxes.

157.02 MATERIALS

Provide materials as specified:

Concrete	903.03
Reinforcement Steel	905.01
Sand	901.06.02

Provide monument markers according to ASTM B 19 and monument boxes according to AASHTO M 105, Class 20A or 20B.

157.03 PROCEDURE

157.03.01 Construction Layout

Perform a site investigation within the Project Limits to locate existing property markers and monuments. Protect property markers and monuments from disturbance and destruction. Notify the RE of the location of property markers and monuments that are in danger of being removed or disturbed. Do not remove or disturb existing property markers and monuments until obtaining RE approval.

Before removing a monument that is not owned by the Department, notify the agency to which the monument belongs of the need to remove the monument. Provide the RE with copies of correspondence with the agency, as well as the agency's written requirements or guidelines for setting monuments.

If a monument or marker is disturbed or removed without RE approval, the Contractor is responsible for reimbursing the Department for the cost to replace the monument.

Perform layout for the construction of the Contract using the control points and data shown on the Plans. Perform layout under the direct supervision of a land surveyor. Preserve control points throughout the duration of the Project. Reset control points that are damaged, lost, displaced, or removed.

Before beginning construction operations, verify the vertical and horizontal controls provided in the Plans using, at a minimum, third-order, Class I accuracy procedural standards and equipment. Notify the RE in writing of discrepancies

or errors and obtain resolution before proceeding with the work. Upon request, provide the RE with survey notes and calculations related to the field control verification.

Before beginning construction operations, establish lines for ROW, easement, and other restrictions, such as boundaries for environmentally sensitive areas to define the limits of construction and temporary operations. Do not encroach on private property, except as allowed by easements.

Provide the Utilities with the layout, and coordinate the Work with utility relocations. Ensure that relocated utility facilities do not conflict with proposed construction, including High Voltage Proximity Act conflicts.

Establish the exact location of the Work from the control points. Reference the Work to baselines that are established from the control points. Maintain baselines until Completion.

Provide and maintain offset baseline stakes for roadways, ramps, jughandles, or turnarounds outside the limits of grading and construction. Set offset stakes at a maximum interval spacing of 50 feet. Where baselines have a radius of less than 475 feet, provide offset stakes at a maximum interval spacing of 25 feet. Identify and mark each stake to show the offset distance from the baseline, and provide grade sheets to the RE showing the cut or fill to the finished profile lines with reference to the offset stakes. Provide grade sheets for construction of subbase that include calculations to establish the typical cross-section from the profile grade stake. Provide adequate and accurate offset lines during construction that requires occupation of the baseline points by construction operations. Provide the RE with assistance as requested for verification of lines, grades, boundaries, dimensions, and elevations.

Upon request, provide the RE with survey notes and calculations related to the alignment and horizontal and vertical control, and field notes to document the ROW, including easements and monument locations. Maintain survey notes in a bound field notebook in a professional manner.

If the Department discovers survey errors, the Department will deduct the costs of checking and correcting these errors from any money due to the Contractor.

157.03.02 Monument

Comply with the Map Filing Law N.J.S.A. 46.23-9.10 *et seq*. and N.J.A.C. 13:40-5.1 *et seq*. Set non-Department monuments according to the requirements of the agency. Set Department monuments at the specified location and elevation, and ensure that the monuments are held firmly in place. Excavate so that concrete for the monument base and sides can be placed against undisturbed in-situ material, ensuring that the base is wider than the shaft. If rock is encountered, drill into the rock to provide a rock socket to the satisfaction of the RE. Reuse excess excavated material as specified in 202.03.07.A. Place concrete, as specified in 504.03.02.D, and set the reinforcement steel and the monument marker at the time of the concrete pour. Ensure that the top surface of the monument is level, and the disk is in the true position. After the concrete has attained strength, punch the disk.

After the monuments have been set, survey the monuments. Submit the survey, signed and sealed by the Land Surveyor, to the RE.

157.03.03 Monument Box

Excavate so that concrete can be placed against undisturbed in-situ material, except place a layer of felt or tar paper along with a layer of sand around the top of the monument. Set the monument box frame so that the top of the box is flush with the proposed finished grade. Place concrete as specified in 504.03.02.D. Backfill as needed. Reuse excess excavated material as specified in 202.03.07.A.

157.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
CONSTRUCTION LAYOUT	LUMP SUM
MONUMENT	UNIT
MONUMENT BOX	UNIT

The Department will adjust payment for CONSTRUCTION LAYOUT based on the final contract amount and will calculate as follows:

$$CL = \frac{CL_B \times (C_F - E)}{C_O - E}$$

Where:
CL = Adjusted payment for CONSTRUCTION LAYOUT.
CL_B = Bid price for CONSTRUCTION LAYOUT.
C_O = Original Contract Price.
C_F = Final Contract Price.
E = Total cost of payment for CONSTRUCTION LAYOUT, PERFORMANCE BOND AND PAYMENT BOND, Incentive/Disincentives, Bonus/Penalties, and claim settlements.

SECTION 158 – SOIL EROSION AND SEDIMENT CONTROL AND WATER QUALITY CONTROL

158.01 DESCRIPTION

This Section describes the requirements for: providing pollution control measures to maintain water quality; constructing and maintaining permanent SESC measures; and constructing, maintaining, and removing temporary SESC measures.

158.02 MATERIALS

Provide materials as specified:

Coarse Aggregate (No. 2 and No. 8)	901.03
Temporary Riprap (6 to 9 inches)	901.08
Soil Aggregate (I-14)	901.11
Welded Wire Reinforcement	905.01.03
Temporary Slope Drain Pipe	909.02.03
Caution Fence	913.02.02
Seed Mixtures	917.05
Mulch	917.06
Sod	917.09
Miscellaneous Landscape Materials	917.11
Geotextiles	919.01
Inlet Filter, Type 1	919.01
Inlet Filter, Type 2	919.01
Sediment Control Bag	919.02
Haybales	919.03
Polyethylene Sheeting	919.12
Floating Turbidity Barrier	919.13

Provide wood stakes and posts that are solid, reasonably knot-free and conform to the nominal size shown on the Plans.

For temporary slope drains, provide pipe with a minimum of 8 inches in diameter. Use end sections and elbows of the same material as the pipe to which they are joined.

Provide absorbent booms, towels, and blankets made from UV-resistant, spunbound polypropylene skin and filler.

158.03 CONSTRUCTION

158.03.01 Environmental Manager

Assign a supervisory-level employee experienced in all aspects of soil erosion and sediment control, water quality control, and work site waste control. Submit the name and applicable experience of this employee to the RE for approval at least 15 days before beginning any construction operations, except construction layout, on the Project. Submit written notification and obtain approval from the RE before changing the environmental manager.

The environmental manager shall have the responsibility and sufficient authority for implementing the approved SESC and water quality methods of operations. The environmental manager shall coordinate, oversee, and supervise SESC and water quality operations on the Project. This includes both on-site and off-site activities, including those involving subcontractors. The environmental manager shall oversee and supervise all site waste control operations for the Project.

The environmental manager shall attend SESC and water quality meetings. The environmental manager, with the RE, shall inspect SESC and site waste control measures at least weekly. Perform additional inspections immediately after precipitation and other weather events that may damage SESC measures or cause uncontrolled erosion to occur. During extended periods of precipitation, perform inspections every 24 hours until the precipitation has ended. Submit original Environmental Compliance Check List and Inspection Form to the RE the same day that the inspection is performed. Perform corrective actions, if required, within 24 hours of the inspection, and resubmit the Environmental Compliance Check List and Inspection Form to the RE within 2 days indicating that the corrective action has been completed.

158.03.02 SESC Measures

Construct SESC measures, as required, before starting construction operations. With the approval of the RE, the Contractor may fell trees or cut other vegetation using hand methods before constructing SESC measures. Coordinate temporary SESC measures with the permanent measures and with other construction operations to ensure effective and continuous erosion and sediment control. Construct temporary SESC measures to correct unforeseen conditions that develop during construction. If the Contractor fails to comply with SESC or site waste control provisions, the RE will suspend the Work as specified in 108.13.

Maintain SESC measures regardless of construction season or other times when the Project is closed down or suspended to ensure that the SESC measures function properly. Immediately correct or replace non-functioning SESC measures to meet the specified functionality. If the Contractor fails to maintain SESC or site waste control measures, the RE will suspend the Work as specified in 108.13.

Ensure that clearing and grubbing does not interfere with the construction of permanent SESC measures or other operations. When unstabilized areas caused by site development, grading, or other soil disturbing activities exist beyond 14 days, seed and mulch the disturbed areas. The RE may limit the size of unstabilized areas due to clearing, grubbing, grading, or other soil disturbing activities based on site conditions and the Contractor's ability to install and maintain SESC measures. Upon completion of soil disturbing activities, permanently stabilize disturbed areas within 7 days as specified in 807.03.01. If seasonal limitations preclude permanent stabilization, provide temporary SESC measures as approved by the RE.

When excavation or embankment construction reaches the finished subgrade, areas where pavement is to be placed are exempt from the above stabilization requirements. Roadways and haul roads actively used for daily conveyance of equipment, as well as areas between temporary berms, except median areas, are also exempt.

Employ construction methods to minimize airborne dust and prevent soils and other materials from being deposited on existing roadways. Apply water or other RE approved materials to unpaved areas to control dust caused by hauling or other construction operations. Reuse, as specified in 202.03.07.A, dirt and other materials that have been spilled, washed, or tracked onto existing roadways by hauling or other construction operations.

Remove temporary SESC measures when necessary to allow for the installation of permanent measures, or as permanent measures become functional. Notify the RE 10 days before removing temporary SESC measures. Between Substantial Completion and Completion, remove temporary SESC measures unless the RE directs that specific Items remain in place.

Construct SESC measures as follows:

1. **Caution Fence.** Install caution fence at locations shown on the plans to delineate wetlands and other environmentally sensitive areas. Space posts at least every 10 feet.

2. **Silt Fence.** Install silt fence with geotextile buried securely in the existing soil. Join sections of the geotextile so that they work effectively as a continuous fence. The Contractor may install haybales instead of silt fence when approved by the RE.

3. **Heavy-Duty Silt Fence.** Install heavy-duty silt fence with geotextile securely buried in the existing soil. Join sections of the geotextile so that they work effectively as a continuous fence. Install fence posts at a slight angle toward the anticipated runoff source. Install the color of heavy-duty silt fence in locations as shown in the Plans. Do not substitute orange for black or black for orange.

4. **Haybale.** Embed haybales in the ground and place end to end to form a continuous line without gaps. Anchor haybales in place with wood stakes.

5. **Haybale Check Dams With Temporary Stone Outlets.** Embed haybales into the ground and anchor in place with wood stakes. Place temporary riprap in the center of each flow line. Place temporary No. 2 coarse aggregate immediately upgrade of each stone outlet. Place temporary riprap and No. 2 coarse aggregate on geotextile. When joining sections of geotextile, overlap the sections a minimum of 18 inches in the direction of flow.

6. **Temporary Stone Check Dams.** Construct temporary stone check dams in ditches to reduce flow velocity. Place No. 2 temporary coarse aggregate immediately upgrade of each check dam. Place temporary riprap and No. 2 coarse aggregate on the geotextile. When joining sections of the geotextile, overlap the sections a minimum of 18 inches in the direction of flow.

7. **Temporary Slope Drains.** Install temporary slope drains on embankment slopes to intercept surface runoff where concentrated runoff will cause excessive erosion of the slope. Stake the drainpipe to the slope or secure it with temporary riprap to prevent movement or displacement. Attach a flared end section at each end of the pipe, and install elbows that conform with the existing changes in slopes.

   Construct a temporary berm using suitable material, and place haybales at the top of slope in the vicinity of the slope drain to intercept runoff and channel the runoff to the slope drain. Embed the haybales into the ground, and anchor them with wood stakes.

   Place temporary riprap loosely on geotextile at both ends of the pipe to prevent scour. Drape the geotextile over the top of the earth berm and anchor it as necessary. When joining sections of the geotextile, overlap the sections a minimum of 18 inches in the direction of flow.

8. **Inlet Filters.** Provide Type 1 and Type 2 inlet filters as follows:

   a. **Type 1.** For new inlet structures, mold welded steel wire fabric around the inlet frames and grates, or inlet structures, and extend a minimum of 6 inches down each side of the new structures. Secure geotextile to the welded wire fabric. Place No. 2 coarse aggregate against the inlet structures to hold the inlet filter in place

      For existing inlet structures, place geotextile under the grates, over the curb pieces, and extend a minimum of 6 inches beyond. Place No. 2 coarse aggregate behind each curb piece and on the geotextile to secure the fabric in place.

      For existing or new inlets with curb pieces, wrap the geotextile around a piece of lumber. Place the lumber against the vertical opening to allow for flood overflow.

      Remove inlet filters within 12 hours of a paving operation.

   b. **Type 2.** Remove the inlet grate and place the inlet filter in the opening, holding out approximately 6 inches of the filter outside the frame. Replace the inlet grate to hold the filter in place. Empty the filter according to the manufacturer's recommendations. When removing the filter, ensure that sediment does not enter into the drainage system. Clean out the filter, dispose of the sediment as specified in 202.03.07.B, rinse and return the filter to its original shape, and replace the filter inside the inlet.

9. **Temporary Inlet Sediment Traps.** Construct temporary inlet sediment traps when the elevation of the surface runoff is lower than the inlet structure. Create a 6-inch diameter opening in the inlet and place a 3 × 3-foot piece of Type 1 inlet geotextile and No. 2 coarse aggregate over the opening to prevent sediment from entering the inlet. Place temporary inlet sediment traps in each flow line upgrade of the inlet structure.

   Before raising the elevation of the surface runoff, remove and dispose of the temporary inlet sediment trap and repair the opening in the inlet.

10. **Temporary Stone Outlet Sediment Traps.** Construct temporary stone outlet sediment traps with temporary basins and riprap spillways, within existing, new, and temporary ditches. Place No. 2 coarse aggregate immediately upgrade of the spillways. Place the riprap stones and coarse aggregate on geotextile that is anchored in the soil. If sections of geotextile need to be joined, overlap the sections a minimum of 18 inches in the direction of flow.

11. **Floating Turbidity Barriers.** At least 10 days before installation, submit floating turbidity barrier design and placement locations for Department approval. Install floating turbidity barrier in streams or other waterbodies to contain discharge from drainage pipes and construction operations before beginning work in that area. Install floating turbidity barriers radially from the point of discharge of drainage pipes, or from construction operations that could potentially impact the waterbody. Install floating turbidity barriers parallel and as close to the shore as possible while still enabling it to float. Ensure that at least 5 feet of each end of the floating turbidity barrier is anchored on shore.

    Clean out floating turbidity barriers and keep them free from debris. Ensure floating turbidity barriers remain in place until all of the work in the area is completed, the cofferdam is removed (if applicable), and the adjacent ground area has established a firm stand of vegetation (if applicable). Remove floating turbidity barriers in such a manner as to minimize the release of sediment and debris.

12. **Dewatering Basin.** At least 10 days before installation, submit to the RE for approval a plan detailing the size, materials, and location for all dewatering basins. Size dewatering basins to contain the expected discharge of water and sediment based on the flow rate of the pump to be used and the volume of area to be dewatered. Contain the turbid discharge from dewatering activities in a dewatering basin to control sediment and provide water filtration. As specified in N.J.A.C 7:9B or other applicable jurisdictional regulations, provide filtration to release clean and clear water into adjacent streams or other waterbodies. Install floating turbidity barriers where the basin outfall flows into a receiving waterbody. Ensure that the outfall of the basin does not cause erosion to or scour of the area onto which the water is being discharged.

    At the end of dewatering operations, remove the dewatering basin. Restore the disturbed area to the original condition.

13. **Sediment Control Bag.** At least 10 days before installation, submit to the RE for approval a plan detailing the size, location, details of aggregate base, anticipated discharge flow, and manufacturer's catalog cuts. If the outfall of the sediment control bag flows into receiving waterbody, ensure that floating turbidity barriers are installed as specified in 158.03.02.11.

    Install and maintain sediment control bags according to the manufacturer's recommendations. Size sediment control bags to accommodate anticipated sediment and flow rates. Place the sediment control bag on the slope to allow water to flow downhill through the bag. Place the discharge hose into the neck of sediment control bag and fasten to ensure that water does not leak at the connection. To increase the efficiency of filtration, place the bag on an aggregate bed to maximize water flow through the surface area of the bag. Size aggregate to prevent puncture of sediment control bags. Ensure that the discharge from the sediment control bag does not cause erosion to, or scour of, the area onto which the water is being discharged.

    When the sediment control bag is 90 percent full, can no longer efficiently filter sediment, or does not allow water to pass at a reasonable rate, remove and replace.

    Remove sediment control bags according to the manufacturer's recommendations and dispose as specified in 202.03.08. Restore the disturbed area to the original condition.

14. **Sediment Control Tank.** At least 10 days before installation, submit sediment control tank design and proposed location for Department approval. Design sediment control tanks to contain or control the expected discharge of water and sediment based on the flow rate of the pump to be used, the volume of area to be

dewatered, and the frequency of removal of water, sediment, or both. Provide a sediment control tank to capture sediment and floating debris from dewatering activities. Provide filtration to release clean and clear water into adjacent streams or other waterbodies. Relocate the tank as needed to dewater other locations. Inspect the tank daily for level of sediment, debris, and water. Remove tank contents before the tank reaches 50 percent of its capacity or when the tank no longer efficiently captures sediment or floating debris. Dispose of tank contents as specified in 202.03.07.B. If water from the tank is being discharged into a waterbody, install floating turbidity barriers to corral the discharge area. Protect the discharge area from erosion and scour.

15. **Construction Driveway.** To minimize tracking of dirt and other materials onto existing roadways, provide a construction driveway at each location where vehicles exit the work site as approved by the RE. Construct driveways using No. 2 coarse aggregate placed on geotextile. Ensure that the driveway is at least 15 feet wide. The Contractor may make driveways wider if approved by RE. Maintain the driveway by top dressing or by excavating and top dressing, as directed by the RE, with additional No. 2 coarse aggregate. When the driveway is no longer required, remove the driveway, backfill to the adjacent ground elevation, and restore the disturbed area to the original condition.

16. **Concrete Washout System.** At least 10 days before the first concrete placement, submit to the RE for approval a plan for the concrete washout system. Design the concrete washout system to fully contain the concrete washout needs, concrete slurry, and the Department's concrete testing of the Work.

    Ensure that each concrete washout facility prevents discharge from concrete trucks and equipment cleaning from entering into inlets and into surface or groundwater. Ensure that the location of concrete washout facilities are no closer than 50 feet from environmentally sensitive areas such as streams, wetlands, or other areas shown on the Plans. Use signs to designate concrete washout areas. Ensure that concrete washout facilities are limited to the designated areas.

    Ensure that the concrete washout system is in place before delivery of concrete to the site. Ensure that a secure, non-collapsing, non-water collecting cover over each concrete washout facility is in place during precipitation so that precipitation does not accumulate and cause the washout areas to overflow. If the concrete washout facility becomes 50 percent full, discontinue pouring concrete until the concrete washout facility is cleaned out. Remove hardened concrete and reuse as specified in 202.03.07.A. Allow slurry to evaporate, or dispose of as specified in 202.03.07.B.

    If a lined basin is used, replace the liner if it becomes damaged or compromised. Remove concrete washout facilities when no longer needed. Restore the disturbed area to original condition.

17. **Absorbent Boom.** Install the absorbent boom inside turbidity barrier or as shown on Plans to ensure that oil products do not escape the work site. If an oil spill occurs, remove absorbent boom after absorption of oil and dispose of as specified in 202.03.08. Replace as necessary to continually protect the waterbody.

18. **Oil-Water Separator.** At least 10 days before beginning the work, submit to the RE for approval a plan detailing the size, location, anticipated discharge flow and manufacturer's catalog cuts of the oil-water separator before installation. Provide an oil-water separator for removal of free product generated in dewatering excavations in each area of petroleum contaminated groundwater.

    Use a self-contained factory assembled oil-water separator meeting the following requirements:

    1. Capable of removing free petroleum product as required by Contractor-obtained discharge permits.
    2. Designed for intermittent, varied, or continuous flows of water, oil, or combinations of non-emulsified oil-water mixtures.
    3. Designed to minimize solids buildup in the separator's oil-water collection chamber.
    4. Capable of being moved about within the Project Limits as needed.

    Dispose of oils and sediments collected in the oil-water separators as specified in 202.03.08.

19. **Oil-Only Emergency Spill Kit.** Before start of construction operations, place oil-only emergency spill kits within the Project Limits, with each kit capable of cleaning up at least 95 gallons of spill. Include the following:

    1. An instruction manual and emergency response guide.
    2. Ten 5-inch × 10-foot oil-only absorbent booms.

3. Ten 3-inch × 10-foot oil-only absorbent booms.
4. One hundred 20 × 16-inch oil-only absorbent pads.
5. Twenty temporary disposal bags and ties.
6. A 40 pound bag of loose absorbent pellets.
7. A wheeled container for the above.

If a spill occurs, immediately contain the spill and notify the NJDEP Hotline (1-877-927-6337) and the RE. Clean up and remediate the spill as directed by the NJDEP. Separately stockpile, as specified in 201.03.04.3, the contaminated material and dispose of the contaminated material as specified in 202.03.08. Submit an incident report to the RE within 10 days after clean-up that includes a summary of the incident, the clean-up and containment measures taken, the time and date of the incident, and the NJDEP case number.

Replenish the kits to ensure that the specified number of complete kits are on-site at all times during construction operations.

158.03.03 Erosion Control Sediment Removal

Remove sediment from sediment traps and dewatering basins when they are 50 percent filled. Remove sediment from silt fences, stone outlet structures, dams, and haybales when the sediment reaches 50 percent of the height of the SESC measure. Remove the coarse aggregate and riprap from check dams when removing the sediment. Reuse the removed material as specified in 202.03.07.A. Replace the coarse aggregate and riprap removed from check dams.

158.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
CAUTION FENCE	LINEAR FOOT
SILT FENCE	LINEAR FOOT
HEAVY-DUTY SILT FENCE, ___	LINEAR FOOT
HAYBALE	UNIT
HAYBALE CHECK DAM WITH TEMPORARY STONE OUTLET	LINEAR FOOT
TEMPORARY STONE CHECK DAM	CUBIC YARD
TEMPORARY SLOPE DRAIN	LINEAR FOOT
INLET FILTER, TYPE 1	SQUARE FOOT
INLET FILTER, TYPE 2, ___ ' X ___ '	UNIT
TEMPORARY INLET SEDIMENT TRAP	UNIT
TEMPORARY STONE OUTLET SEDIMENT TRAP	SQUARE FOOT
FLOATING TURBIDITY BARRIER, TYPE ___	LINEAR FOOT
DEWATERING BASIN	UNIT
SEDIMENT CONTROL BAG	SQUARE FOOT
SEDIMENT CONTROL TANK	UNIT
CONSTRUCTION DRIVEWAY	TON
CONCRETE WASHOUT SYSTEM	LUMP SUM
ABSORBENT BOOM	LINEAR FOOT
OIL-WATER SEPARATOR	UNIT
OIL-ONLY EMERGENCY SPILL KIT, TYPE ___	UNIT
EROSION CONTROL SEDIMENT REMOVAL	CUBIC YARD
TEMPORARY RIPRAP	CUBIC YARD

The Department will measure INLET FILTER, TYPE 1 by the square foot based on the dimensions of the drainage structure opening.

The Department will calculate the square footage for each SEDIMENT CONTROL BAG from the nominal size of each bag as provided by the manufacturer.

The Department will make payment for top dressing of construction driveways with additional stone under CONSTRUCTION DRIVEWAY.

The Department will make payment for riprap for maintenance replacement for the various soil erosion and sediment controls Items under TEMPORARY RIPRAP.

The Department will make payment for floating turbidity barrier used in conjunction with DEWATERING BASIN, SEDIMENT CONTROL BAG, or SEDIMENT CONTROL TANK under FLOATING TURBIDITY BARRIER.

SECTION 159 – TRAFFIC CONTROL

159.01 DESCRIPTION

This Section describes the requirements for implementing controls to protect vehicular and pedestrian traffic. Traffic control includes providing, installing, placing, relocating, maintaining, and removing traffic control devices.

159.02 MATERIALS

159.02.01 Materials

Provide materials as specified:

Tack Coat PG 64-22 ..... 902.01.01
Tack Coat:
  Cut-Back Asphalt, Grade RC-70 ..... 902.01.02
  Emulsified Asphalt, Grade RS-1, SS-1, SS-1h, Grade CSS-1 or CSS-1h 902.01.03
HMA (12.5M64) 902.02
Construction Barrier 904.01
Signs 911.01
Sign Posts 911.02.01
Timber Sign Supports 911.02.04
Top and Side Mounted Delineators 911.03
Latex Paint 912.04.01
Temporary Pavement Marking Tape 912.04.02.A
Removable Black Line Masking Tape 912.04.02.B
Temporary Pavement Markers 912.04.03
Polymerized Joint Adhesive 914.03

159.02.02 Equipment

Provide equipment as specified:

Flashing Arrow Board 1001.01
Portable Variable Message Sign 1001.02
Traffic Control Truck with Mounted Impact Attenuators 1001.03
Vibratory Drum Compactor 1003.06
Bituminous Material Distributor 1003.07
HMA Plant 1009.01
HMA Trucks 1009.02

159.03 PROCEDURE

159.03.01 Traffic Control Coordinator

Before starting Work, submit to the RE the name, training, work experience, and contact information of an employee assigned as the on-site Traffic Control Coordinator (TCC). The TCC must be certified as having successfully completed the Rutgers CAIT Traffic Control Coordinator Program, or an equivalent course as approved by the NJDOT Office of Capital Project Safety. The TCC must also successfully complete an approved Traffic Coordinator refresher course every 2 years. The TCC is a full-time position and the employee designated as TCC must be available on a 24-hour a day, 7-days a week basis. The TCC shall have the responsibility for and authority to implement and maintain all traffic operations for the Project on behalf of the Contractor. The TCC's responsibilities and duties shall include the following:

1. Overseeing traffic control operations, including those performed by subcontractors.

2. Coordinating traffic control with subcontractors, other contractors, and Utilities.
3. Ensuring that set-up and removal is performed according to the Contract.
4. Performing daily traffic control inspections and providing written reports documenting the inspections, including detailed findings and corrections made.
5. Performing inspections at night and on weekends to ensure compliance with the TCP.
6. Ensuring that traffic control devices are correctly positioned and spaced.
7 Ensuring that signs are properly covered or uncovered.
8. Maintaining or replacing traffic control devices to ensure traffic control devices are in an acceptable condition and good working order. Maintenance also includes replacing lights bulbs and electrical components and refueling, recharging, or replacing batteries.
9. Ensuring that excavations and lateral drop-offs greater than 2 inches in depth are eliminated or protected by barrier or emergency escape ramps during non-working periods.
10. Ensuring that routine road maintenance is performed, including debris removal and road cleaning.
11. Ensuring that construction operations do not create flooding or icing conditions for lanes open to traffic.
12. Identify and correcting traffic control deficiencies immediately. Correct traffic control deficiencies directed by the RE within 2 hours of notification.
13. Ensuring that vehicles, equipment, and material stored adjacent to the road are behind barriers or stored at least 30 feet from the traveled way.
14. Ensuring that Contractor vehicles for material delivery enter or exit the traveled way in a safe manner.

Provide additional employees to assist the TCC as approved by the RE. The RE may request the TCC or additional employees to demonstrate their competency at any time. Notify the RE before performing daily inspections to provide the RE with the opportunity to observe the inspections.

159.03.02 Traffic Control Devices

Ensure that FHWA category 1, 2, 3, and 4 traffic control devices conform to the requirements of NCHRP 350. Ensure that traffic control devices meet or exceed an acceptable condition as described in the ATSSA guide Quality Standards for Work Zone Traffic Control Devices. Traffic control devices need not be new but must be in good condition. Provide traffic control devices according to MUTCD.

Erect traffic control devices before beginning construction operations. Trim vegetation that obscures the sight distance of traffic control devices. Keep the traffic control devices clean, and maintain in acceptable condition until no longer required. Relocate traffic devices as directed by the RE. Place traffic control devices as directed to provide traffic control for Department personnel doing inspections, sampling, testing, and taking measurements required for the Project.

1. Construction Signs. Install anchor posts with soil anchor plates, except when installing in rock or in concrete.

If construction signs are required for less than 3 days, the Contractor may place construction signs on portable sign stands instead of sign posts with the approval of the RE.

When construction signs or existing signs do not reflect work zone traffic conditions, cover the signs with black polyethylene sheeting. Ensure that the cover is opaque under all lighting conditions and completely conceals the entire front of the sign panel. Securely attach the cover to the back side of the sign without damaging the reflective sheeting. Do not tape the cover to the face of the sign. Ensure that the cover remains secure in all weather conditions. Overhead signs and large guide signs with areas greater than 200 square feet do not need a cover over the entire sign, but require a cover over the conflicting information. Do not alter the face of a sign with revised messages. Remove construction signs when no longer required, and restore the post hole to match the surrounding conditions.

2. Construction Barrier Curb. The Contractor may use Type 4, Alternate Design A or B construction barrier curb interchangeably in any location where Type 4 has been specified. Only use Alternate Design B, Joint Class D as bridge parapets. The Contractor may use construction barrier curb Type 4, Alternate B in any location where Type 1 has been specified. The Contractor may use construction barrier curb that is constructed using gray or white concrete. Do not place different types or colors of construction barrier curb in a continuous run. Do not use construction barrier curb having any of the following deficiencies:

1. Exposed steel at the connector flangeway.
2. Exposed reinforcement steel.

3. Cracking through the cross section.
4. An area of concrete missing larger than a 3-inch by 3-inch right triangle.
5. Debris in the keyway.
6. Non-functioning anchor bolt holes.
7. Non-functioning anchor rod hole.
8. Paint applied to the surface.
9. Objects protruding from the surface.
10. Previous repairs.

At least 30 days before delivering construction barrier curb to the Project Limit, provide the RE notice that the barrier curb is available for inspection. The RE will inspect the barrier curb and approve individual pieces for delivery to the Project Limits.

When installing construction barrier curb, ensure that the barrier curb is pulled taut. Remove slack from the connection key. Anchor the barrier curb, and grout the joints as required for the joint class. If required, ensure that anchor pins and anchor bolts do not project above the plane of the barrier curb. Before bolting barrier curb to a bridge deck, provide the proposed method of layout and drilling to the RE for approval.

Replace construction barrier curb that does not meet the specified requirements. Do not patch or repair construction barrier curb.

Provide top and side mounted flexible delineators on the construction barrier curb, except on flared portions when other traffic control devices delineate the traveled path. Install flexible delineators as specified in 607.03.01.G.

3. **Flashing Arrow Board.** Provide a flashing arrow board as specified in 1001.01.

4. **Portable Variable Message Sign (PVMS).** Place the PVMS at the locations directed by the RE. Ensure that a designated representative familiar with the operation and programming of the unit is available on the Project. Only display messages authorized by the Department for the Project. Repair or replace malfunctioning PVMS within 12 hours of notification by the RE.

5. **Temporary Crash Cushion.** Install inertial barrier systems as specified in 611.03.01. Install crash cushions as specified in 611.03.02. Immediately repair or replace crash cushions that become damaged or become inoperable. Maintain an adequate number of replacement parts to repair damaged units at all times. Keep the areas in front, atop, and around the crash cushions clear of snow accumulation of more than 4 inches in depth.

6. **Traffic Control Truck with Mounted Crash Cushions.** Provide the RE with a copy of the crash cushion manufacturer's recommendations. Position the traffic control truck to ensure that there is adequate stopping distance after impact and to prevent errant vehicles from traveling around the truck and endangering workers. When used in a fixed position, place manual transmission vehicles in second gear and place automatic transmission vehicles in park. Ensure that the parking brake is set, and the wheels are turned to avoid rolling into active traffic lanes. Do not use traffic control trucks in place of other temporary impact attenuators for more than 24 hours. Relocate the traffic control truck as specified by the TCP, or as directed by the RE. Do not use the truck to carry additional equipment, materials, or debris. When using ballast, ensure that it is secured to the truck. Submit working drawings for certification detailing the manner of securing the ballast, signed and sealed by a Professional Engineer, to ensure that it is capable of withstanding the impact forces for which the impact attenuator is rated.

7. **Channelizing Guide Posts.** Prepare the pavement surface to provide a clean, sound area to affix the post. Apply an epoxy or butyl adhesive according to the manufacturer's recommendations and bond the base of the post to the pavement surface. Provide only 4-inch diameter tubular channelizing markers. Remove when no longer required.

159.03.03 Removable Black Line Masking Tape

Apply black line masking tape over existing traffic stripes according to the manufacturer's recommendations and when the weather is favorable, as determined by the RE. Ensure that the black line masking tape completely covers existing stripes. Replace black line masking tape that becomes loose after placement within 2 hours. When black line masking tape is no longer required, carefully and completely remove without using heat, solvents, grinding, sanding, or water.

159.03.04 Temporary Pavement Markers

Apply temporary pavement markers with butyl adhesive pads to clean, dry pavement surfaces free of cracking, checking, or spalling. If the layout locates a marker at a joint or defect, relocate the marker longitudinally at least 2 inches beyond the joint or defect. Replace lost or damaged temporary pavement markers.

Only remove temporary pavement markers that will be replaced by striping in the same day. If striping cannot be finished in the same day, reinstall temporary pavement markers before opening the road to traffic.

159.03.05 Temporary Pavement Marking Tape

Install tape according to the manufacturer's recommendations when the weather is favorable as determined by the RE. Immediately before marking the pavement surface, clean the surface of dirt, oil, grease, and foreign material, including curing compound on new concrete. Clean the surface 2 inches beyond the perimeter of the marking to be placed.

Install tape on dry surfaces having a surface temperature between 50 °F and 150 °F, when the ambient temperature is at least 50 °F and rising. When splicing is required, install the tape using butt splices. Do not overlap the tape.

Tamp the tape for initial adhesion and then apply pressure by driving a truck slowly over the tape several times. Maintain tape by replacing loose or damaged tape within 2 hours. Remove tape when no longer required.

159.03.06 Temporary Traffic Stripes and Temporary Traffic Markings

Install temporary traffic stripes and markings when required for 14 days or less. Apply temporary traffic stripes and markings when the ambient and surface temperatures are at least 45 °F and rising and the surface temperature is no more than 140 °F. Apply the traffic paint in a wet film thickness of 6 ± 1 mil. Apply glass beads of the correct gradation to the wet paint in a uniform pattern and at the rate of 12 pounds per gallon of paint.

159.03.07 HMA Patch

The RE may direct the Contractor to sawcut existing HMA pavement to the depth of the area to be repaired. Sawcut lines parallel and perpendicular to the roadway baseline and 3 inches away, at the closest point, from the damaged area to be repaired. Remove loose material within the boundary of the repair, and clean the area. Reuse removed material as specified in 202.03.07.A. Ensure that the remaining pavement is not damaged.

Apply polymerized joint adhesive or tack coat to the vertical surfaces of the openings. Ensure that the temperature of the HMA when placed is at least 250 °F. Place HMA in 4-inch maximum lifts, and compact with a vibratory drum. For small areas, the RE may approve hand compacting methods. Compact until the top of the patch is flush with the adjacent pavement surface.

159.03.08 Traffic Direction

A. Flagger. Provide a flagger that has received formal training in flagging operations and the proper use of the STOP/SLOW paddle. The flagger must meet MUTCD qualifications and, when requested, demonstrate competency to the RE. Immediately replace flaggers who fail to demonstrate competency with a competent flagger. Ensure that flaggers wear a 360 °high-visibility retroreflective orange safety garment meeting ANSI/ISEA Class 3, Level 2 standards. Ensure that the flagger is equipped with a STOP/SLOW paddle meeting MUTCD requirements and follows MUTCD flagging procedures.

B. Police. Unless designated as local police at the preconstruction conference, police will be on-duty New Jersey State Police. Police are either provided by the RE as employees of the State, or by the local government as a vendor to the State. The use of police services by the RE does not relinquish or diminish the Contractor's responsibilities for work zone safety.

Submit a request for police services to the RE 72 hours before beginning construction operations that require police services. Activities requiring police services include:

1. Traffic direction through signalized intersections, where the integrity of the existing traffic signal system is impacted or where an override of the signal is required.
2. Rolling slow-down or temporary closure of all lanes on state highways and interstates.

Emergency situations may prevent police from arriving at the scheduled date or time. The RE will not permit construction operations that, by law, require police services if police are unavailable. The Department will not accept claims for interruptions or delays resulting from any failure of police to arrive as requested.

The Contractor may request police services to enhance the TCP. Submit a request for police services to the RE 72 hours before beginning construction operations that require police services. The RE will determine the need for, and direct the use of, police for the following activities.

1. Night operations;
2. TCP setup or removal on high speed and high volume roads; and
3. Major traffic pattern changes.

The RE must notify State and local police of cancellations 24 hours in advance. At least 24 hours before the scheduled start of work, notify the RE of any work cancellation for which police services were requested.

159.03.09 Emergency Towing Service

At least 30 days before the start of construction operations, submit to the RE for approval an emergency towing service plan for removing abandoned vehicles and vehicles that are disabled but not as the result of an accident. The police will arrange for towing services to remove vehicles that are disabled due to traffic accidents. Indicate in the plan the proposed manner of providing towing service, including the type, quantity, and location of towing equipment to be used.

Provide towing service to remove disabled and abandoned vehicles from the construction zone to the nearest location where the vehicle can be legally parked. Ensure that the towing service responds immediately upon notice of a disabled vehicle by the RE or Contractor personnel.

159.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
BREAKAWAY BARRICADE	UNIT
DRUM	UNIT
TRAFFIC CONE	UNIT
CONSTRUCTION SIGNS	SQUARE FOOT
CONSTRUCTION IDENTIFICATION SIGN, ___' X ___'	UNIT
CONSTRUCTION BARRIER CURB	LINEAR FOOT
FLASHING ARROW BOARD, ___' X ___'	UNIT
PORTABLE VARIABLE MESSAGE SIGN	UNIT
TEMPORARY CRASH CUSHION, INERTIAL BARRIER SYSTEM, ___ MODULES	UNIT
TEMPORARY CRASH CUSHION, ___	UNIT
TRAFFIC CONTROL TRUCK WITH MOUNTED CRASH CUSHION	UNIT
CHANNELIZING GUIDE POST	UNIT
REMOVABLE BLACK LINE MASKING TAPE, ___"	LINEAR FOOT
TEMPORARY PAVEMENT MARKERS	UNIT
TEMPORARY PAVEMENT MARKING TAPE, ____"	LINEAR FOOT
TEMPORARY TRAFFIC STRIPES, ___"	LINEAR FOOT
TEMPORARY TRAFFIC MARKINGS	SQUARE FOOT
HMA PATCH	TON
TRAFFIC DIRECTOR, FLAGGER	HOUR
EMERGENCY TOWING SERVICE	UNIT

For traffic control devices measured by the linear foot or unit basis, the Department will make payment for the maximum quantity in service at one time as required by the Contract. The Department will make payment for 50 percent of the Contract bid price for traffic control devices that are measured on a linear foot or unit basis upon approved placement. The Department will prorate the balance of payment over the duration of the Contract.

The Department will measure TEMPORARY PAVEMENT MARKING TAPE by the linear foot of 4-inch wide strips.

The Department will measure REMOVABLE BLACK LINE MASKING TAPE by the linear foot for each 4-inch width of existing stripe that is to be covered. The Department will not measure replacement temporary pavement stripes and markers for payment.

Except for unforeseen weather conditions, if the Contractor cancels work without providing at least 24-hour notice, the Department will deduct the cost of police services (4 hours for each police officer scheduled) from the Contract.

SECTION 160 – PRICE ADJUSTMENTS

160.01 DESCRIPTION

This Section describes the requirements for price adjustments for fuel and asphalt usage.

160.02 MATERIALS

(Intentionally Blank)

160.03 PROCEDURE

160.03.01 Fuel Price Adjustment

The Department will make monthly price adjustments for fuel usage for Items listed in Table 161.03.01-1. The Department will calculate fuel price adjustments based on the monthly pay quantities of listed Items using the fuel usage factors listed in Table 161.03.01-1.

Price adjustments may result in an increased payment to the Contractor for increases in the price index and may result in a reduction in payment for decreases in the price index.

If the as-built quantity of an Item listed in Table 161.03.01-1 differs from the sum of the quantities in the monthly Estimates, and the as-built quantity cannot by readily distributed among the months that the Item listed in Table 161.03.01-1 was constructed, then the Department will determine fuel price adjustment by distributing the difference in the same proportion as the Item's monthly Estimate quantity is to the total of the item's monthly estimates.

TABLE 160.03.01-1 Fuel Price Adjustments

Items	Fuel Usage Factor
EXCAVATION, UNCLASSIFIED	0.5 Gallons per Cubic Yard
EXCAVATION, REGULATED MATERIAL	0.5 Gallons per Cubic Yard
EXCAVATION, ACID PRODUCING SOIL	0.5 Gallons per Cubic Yard
REMOVAL OF PAVEMENT	0.25 Gallons per Square Yard
HMA MILLING, 3" OR LESS	0.25 Gallons per Square Yard
HMA MILLING, MORE THAN 3" TO 6"	0.25 Gallons per Square Yard
CONCRETE MILLING,	0.25 Gallons per Square Yard
HMA PROFILE MILLING	0.25 Gallons per Square Yard
BREAKING PAVEMENT	0.25 Gallons per Square Yard
RUBBLIZATION	0.25 Gallons per Square Yard
SUBBASE	1 Gallon per Cubic Yard
I-___ SOIL AGGREGATE	1 Gallon per Cubic Yard
SOIL AGGREGATE BASE COURSE, ___ " THICK	0.30 Gallon per Square Yard per Inch
SOIL AGGREGATE BASE COURSE, VARIABLE THICKNESS	1 Gallon per Cubic Yard
DENSE-GRADED AGGREGATE BASE COURSE, ___ " THICK	0.30 Gallon per Square Yard per Inch
DENSE-GRADED AGGREGATE BASE COURSE, VARIABLE THICKNESS	1.00 Gallon per Cubic Yard
CONCRETE BASE COURSE, ___ " THICK	0.25 Gallons per Square Yard
CONCRETE BASE COURSE, REINFORCED ___ " THICK	0.25 Gallons per Square Yard

TABLE 160.03.01-1 Fuel Price Adjustments	
ASPHALT STABILIZED DRAINAGE COURSE	2.50 Gallons per Ton
OPEN-GRADED ___ FRICTION COURSE	2.50 Gallons per Ton
MODIFIED OPEN-GRADED ___ FRICTION COURSE ___	2.50 Gallons per Ton
ULTRA-THIN FRICTION COURSE	2.50 Gallons per Ton
HOT MIX ASPHALT ___ ___ ___ SURFACE COURSE	2.50 Gallons per Ton
HOT MIX ASPHALT ___ ___ ___ INTERMEDIATE COURSE	2.50 Gallons per Ton
MIX ASPHALT ___ ___ ___ BASE COURSE	2.50 Gallons per Ton
STONE MATRIX ASPHALT ___ SURFACE COURSE	2.50 Gallons per Ton
CONCRETE SURFACE COURSE, ___ " THICK	0.25 Gallons per Square Yard
DIAMOND GRINDING OF CONCRETE SURFACE COURSE	0.25 Gallons per Square Yard
DIAMOND GRINDING EXISTING CONCRETE PAVEMENT	0.25 Gallons per Square Yard
CONCRETE BRIDGE APPROACH	0.50 Gallons per Cubic Yard
CONCRETE CULVERT	1.00 Gallon per Cubic Yard
CONCRETE FOOTING	1.00 Gallon per Cubic Yard
CONCRETE WING WALL	1.00 Gallon per Cubic Yard
CONCRETE PIER COLUMN PROTECTION, HPC	1.00 Gallon per Cubic Yard
CONCRETE PIER COLUMNS AND CAP	1.00 Gallon per Cubic Yard
CONCRETE ABUTMENT WALL	1.00 Gallon per Cubic Yard
CONCRETE PIER SHAFT	1.00 Gallon per Cubic Yard
CONCRETE PEDESTRIAN BRIDGE	1.00 Gallon per Cubic Yard
CONCRETE BRIDGE DECK	1.00 Gallon per Cubic Yard
CONCRETE BRIDGE DECK, HPC	1.00 Gallon per Cubic Yard
CONCRETE BRIDGE SIDEWALK	1.00 Gallon per Cubic Yard
CONCRETE BRIDGE SIDEWALK HPC	1.00 Gallon per Cubic Yard
CONCRETE BRIDGE PARAPET	1.00 Gallon per Cubic Yard
CONCRETE BRIDGE PARAPET HPC	1.00 Gallon per Cubic Yard
CAST-IN-PLACE CONCRETE PILES, DRIVEN ___ " DIAMETER	1.00 Gallon per Cubic Yard
RETAINING WALL, LOCATION NO.___ ___	0.10 Gallon per Square Foot

If an item listed in Table 161.03.01-1 has a payment unit which differs from that listed in Table 161.03.01-1, the Department will apply an appropriate conversion factor to determine the number of gallons of fuel used.

The Department will calculate fuel price adjustment on a monthly basis using the following formula:

$$F = (MF - BF) \times G$$

Where:
F = Fuel Price Adjustment
MF = Monthly Fuel Price Index
BF = Basic Fuel Price Index
G = Gallons of Fuel for Price Adjustment

The Department will post the monthly fuel price index every month on the Department's website: http://www.state.nj.us/transportation/business/trnsport/PriceIndex.shtm

The basic fuel price index is the previous month's fuel price index before receipt of bids. The Department will use the fuel price index for the month before the regular monthly estimate cut off date as the Monthly Fuel Price Index. If the Monthly Fuel Price Index increases by 50 percent or more over the Basic Fuel Price Index, do not perform any work involving Items listed in Table 161.03.01-1 without written approval from the RE.

160.03.02 Asphalt Price Adjustment

The Department will make monthly price adjustments for asphalt binder usage. The Department will calculate asphalt price adjustments based on the quantities of Items containing asphalt binder constructed during a given month.

Price adjustments may result in an increased payment to the Contractor for increases in the price index and may result in a reduction in payment for decreases in the price index.

The Department will calculate the asphalt price adjustment by the following formula:

$$A = (MA - BA) \times T$$

Where:
A = Asphalt Price Adjustment
MA = Monthly Asphalt Price Index
BA = Basic Asphalt Price Index
T = Tons of New Asphalt Binder[1]

1. The Department will determine the weight of asphalt binder for price adjustment by multiplying the percentage of new asphalt binder in the approved job mix formula by the weight of the item containing asphalt binder.

For TACK COAT and PRIME COAT, the Department will calculate asphalt price adjustments by the following formula:

$$A = B \times [(MA - BA)/BA] \times C \times M \times G$$

Where:
A = Asphalt Price Adjustment
B = Bid Price for Tack Coat/Prime Coat
MA = Monthly Asphalt Price Index
BA = Basic Asphalt Price Index
C = Petroleum Content of the Tack Coat and Prime Coat in Percent by Volume:
Use 100% for cutbacks
90% for inverted emulsions
60% for RS or similar type emulsions
M = Percentage of Bid Price Applicable to Materials Only: Use 82%
G = Gallons of Tack Coat and Prime Coat Furnished and Applied

The monthly asphalt price index, as determined by the Department, will be the average of quotations from suppliers serving the area in which the Project is located, and will be determined by the Department each month. The Department will post the monthly asphalt price index every month on the Department's web site http://www.state.nj.us/transportation/business/trnsport/PriceIndex.shtm.

The basic asphalt rice index is the asphalt price index for the month before the opening of bids. The Department will use the asphalt price index for the month before the regular monthly estimate cut off date as the monthly asphalt price index.

If the monthly asphalt price index increases 50 percent or more over the basic asphalt price index, do not perform work on Items containing asphalt binder without written approval from the RE.

160.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
FUEL PRICE ADJUSTMENT	LUMP SUM
ASPHALT PRICE ADJUSTMENT	LUMP SUM

SECTION 161 – FINAL CLEANUP

161.01 DESCRIPTION

This Section describes the requirements for performing final cleanup.

161.02 MATERIALS

(Intentionally Blank)

161.03 PROCEDURE

161.03.01 Final Cleanup

Clean the Project Limits, to the RE's satisfaction, of rubbish, excess materials, temporary structures, and equipment. Include borrow source areas, and equipment and material staging areas occupied in connection with the Work.

161.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
FINAL CLEANUP	LUMP SUM

DIVISION 200 – EARTHWORK

SECTION 201 – CLEARING SITE

201.01 DESCRIPTION

This Section describes the requirements for clearing site; clearing site for bridges and other structures; removing underground storage tanks; installing monitoring wells; sealing abandoned wells; and demolishing buildings.

201.02 MATERIALS

Provide materials as specified:

Soil Aggregate (I-14) 901.11
Concrete 903.03
Caution Fence 913.02.02
Polyethylene Sheeting 919.12

Provide a commercially available basement waterproofing.

201.03 CONSTRUCTION

201.03.01 Clearing Site

A. Preparation. Construct SESC measures, as specified in 158.03.02, before clearing site. Before beginning excavation or embankment construction, clear the site within the limits of construction. Clear the ground surface of designated trees, brush, weeds, roots, matted leaves, small structures, debris, and other objectionable material, vegetation, and growth.

B. Clearing and Grubbing. In cut sections, grub out tree stumps within the limits of the total cut area. In fill sections, the Contractor may leave tree stumps extending less than 1 foot above the original ground surface in those areas where the proposed subgrade, or proposed finished grade in non-pavement sections, is greater than 3-1/2 feet above the original ground surface. Grub out tree stumps that lie within 5 feet horizontally or vertically from any proposed structure, pipe, or duct.

Do not remove trees, shrubs, and other landscape features that do not interfere with the Work or are designated for preservation. Prevent damage or injury to existing trees, plants, and other vegetation that is to remain within or adjacent to the Project Limits.

At locations adjacent to operations performed by motorized equipment, erect and maintain a 4-foot high caution fence around trees, shrubs, and areas containing vegetation to be preserved.

Backfill and compact depressions in excavation areas that lie below the finished subgrade to finished subgrade using the directed method as specified in 203.03.02.C.

Clear slopes of cuts, embankments, ditches, channels, waterbodies, and structures, both old and new, of brush, hedges, weeds, heavy vegetation, and other objectionable material or growth. Clear to a maximum of 8 feet beyond the top of slopes of roadway excavation and 5 feet beyond the top of slopes of ditches and channels, except do not clear outside ROW.

Conduct clearing and removal activities in areas identified as containing regulated material according to the pre-excavation plans as specified in 202.03.04.1.

C. Mailbox and Sign Relocation. Remove and reset residential and commercial mailboxes at locations acceptable to the owners and according to United States Postal Service (USPS) requirements. Notify the USPS before relocating USPS mailboxes.

Remove local street and road signs and reset at locations and in the manner acceptable to local authorities. Ensure that Tourist Oriented Directional Signs and logo signs remain visible to motorists during and after stages of construction. Remove from the immediate work site and safely store existing signs that are to be reset.

D. Plugging Pipe. Seal abandoned pipes using concrete. Construct the plugs to a depth equal to the diameter of the pipe or 2 feet, whichever is less.

E. Removing Pipe, Inlets, and Manholes. Excavate for the removal of existing pipe, inlets, and manholes as specified in 601.03.01.B. Backfill with excavated material and compact using the directed method as specified in 203.03.02.C. The RE may require use of the density control compaction method as specified in 203.03.02.D, except that the RE may increase the frequency of measurements.

Reuse removed drainage structures as specified in 202.03.07.A. Unless designated for resetting on the Project, dispose of inlet and manhole castings as specified in 201.03.09.

F. Removing Sidewalks, Driveways, Curbs, and Gutters. Sawcut full depth at the limits of removal. Remove sidewalks, driveways, vertical curbs, sloping curbs, barrier curbs, and gutters, designated for removal, and reuse as specified in 202.03.07.A. Obtain RE approval of methods to remove barrier curb before beginning work. Repair damage to adjacent pavement courses caused by removal operations.

G. Removing Electrical Material and Equipment. Remove existing foundations and junction boxes that are abandoned under the Contract to a minimum depth of 2 feet below the finished grade. Remove foundations or junction boxes that interfere with the installation of a new system and backfill as specified in 203.03.02.C. Reuse concrete from foundations and junction boxes as specified in 202.03.07.A. Dispose of castings as specified in 201.03.09.

Remove other electrical material and equipment that are designated for removal, and dispose of as specified in 201.03.09. Obtain RE approval of methods of removal, and ensure remaining electrical equipment is left undamaged. Salvage and deliver to the Department removed, above-ground electrical material as required.

201.03.02 Clearing Site, Bridge and Clearing Site, Structure

Submit a demolition plan detailing the methods and equipment to be used to the RE for approval 30 days before demolition operations. Remove the substructures of existing structures to at least 3 feet below the natural stream bottom, and remove those parts outside of the stream to at least 2 feet below natural ground surface. Where such portions of existing structures lie wholly or in part within the limits of a new structure, remove them to accommodate the construction of the proposed structure.

When removing creosote timbers in waterbodies, surround the removal area with absorbent booms in addition to SESC measures. Dispose of absorbent booms as specified in 201.03.09.

Dismantle, with minimal damage, steel bridges and wood bridges that are to be salvaged for the Department as specified in the Special Provisions. Match-mark steel members unless such match-marking is waived by the Department. Remove salvageable material in sections or pieces, and store at specified places within the Project Limits.

Before placing the new work, complete blasting or other operations necessary for the removal of an existing bridge or structure that may damage new construction.

Prevent damage to existing structures designated to remain. If portions of the existing structure scheduled to remain are damaged by removal activities, submit a repair plan to the RE for approval. Repair damaged portions of existing structures according to the approved repair plan.

201.03.03 Temporary Shielding

Submit working drawings for certification for a system to protect vehicular, pedestrian, or railroad traffic or environmentally sensitive areas from falling debris, construction materials, or other objects. Temporary shielding requirements are in addition to forms and falsework required for construction. Design the temporary shielding system to conform to the following:

1. Withstands loads of at least 0.8 pounds per square inch, or greater if heavier loads are anticipated or if required by railroads.
2. Prevents small particles and dust from escaping the shield.

3. Seals the underside of the deck and extends outside of the deck and outside of the fascia stringers to enclose the soffits and parapets.
4. If parapet removal or parapet construction is required, provide an outrigging to enclose the soffit and parapet.
5. Does not bolt or weld the temporary shielding system to the beams.
6. Does not reduce the underclearance of the bridges to less than 14.75 feet over roadways and 22 feet over railroads or as specified in the Contract. If existing underclearance is less than these values, does not further reduce the underclearance. Show elements of the temporary shielding system, including design calculations, and the sequence of operations, and, when applicable, bonding and grounding over electrified rail lines.

Include with the working drawings a plan for removing material, dust, or debris that has fallen into active traffic lanes, railroads, and environmentally sensitive areas.

Install the temporary shielding according to the certified working drawings before performing any construction operations over vehicular, pedestrian, or railroad traffic or ecologically sensitive areas. The RE will not allow the installation of temporary shielding over active traffic lanes and pedestrian areas. When applicable, comply with the railroad's maintenance of traffic requirements, rules and regulations. Remove and reinstall the temporary shielding as required by construction staging. Do not allow dropped materials to accumulate on the temporary shielding, and remove dropped materials promptly. If debris falls from the shielding, promptly clean it up and repair the damage. Do not remove any portion of the shielding without the approval of the RE.

201.03.04 Removing Underground Storage Tanks

Refer to the Special Provisions for the locations and types of underground storage tanks to be removed.

Excavate test pits as necessary to confirm locations, types, and sizes of underground storage tanks as specified in 202.03.02. Use information gathered from the test pits to complete and submit the NJDEP's "Underground Storage Tank Facility Certification Questionnaire" and "Notice of Intent To Close An UST System." Upon completion of tank removal, submit a minimum of 1 Site Investigation Report per parcel. Submit copies of Site Investigation Reports to the RE, the Bureau of Landscape Architecture and Environmental Solutions, and the Department's environmental consultant.

Remove and dispose of underground storage tanks and piping systems, sample and analyze soils and water, recycle or dispose of contaminated soils, and install and seal monitoring wells according to N.J.A.C 7:14B and N.J.A.C 7:26E, and Federal, State, and local laws, rules, and regulations, and the following:

1. **Permits and Approvals.** Submit documents to obtain the permits and approvals necessary for this work. Register unregistered tanks that are regulated by N.J.A.C 7:14B.

   Submit the "Underground Storage Tank Facility Questionnaire" and "Notice of Intent To Close An UST System" to the RE for review before submitting it to the NJDEP. Obtain NJDEP approval before commencing removal operations.

   Notify the RE 45 days before the removal of underground tanks to allow the Department to obtain the EPA Identification Number (EPA ID#) for the tank contents.

   Ensure that the waste disposal or recycling facility planned for receipt of the material is properly permitted for acceptance. Submit a copy of the facility permit to the RE 7 days before disposal or recycling.

2. **Removal Operations.** Monitor the site with an explosimeter to indicate the presence and concentration of flammable vapors and gas. If this test reveals that unsafe working conditions exist, notify the RE and immediately suspend removal operations until it is determined that conditions are acceptable for resuming work.

   Remove liquids and sludge contained in the underground storage tanks and piping before removing the tanks and associated piping systems from the ground, and dispose of the removed contents according to NJDEP's N.J.A.C 7:26. Avoid leakage from the tanks onto the surrounding soil by properly pumping the contents of the tanks into permitted transport vehicles. If leakage or spillage occurs, immediately notify the RE. Notify the NJDEP's Environmental Action Hotline and the county health department within 15 minutes. Remediate leaks or spillage to the NJDEP's satisfaction according to their investigation and corrective action requirements.

Perform tank removal operations with the least disturbance to the soil surrounding the tanks. Erect caution fence around excavations. Ensure tanks are free of vapors before transporting off-site. Dispose of excavated tanks and piping systems as specified in 201.03.09.

If there is evidence of discharge in the excavated hole, notify the RE and contact the NJDEP's Environmental Action Hotline. Excavate and dispose of petroleum contaminated soil from the limits of the tank removal. Perform field tests to determine the extent of petroleum contaminated soils according to NJDEP requirements and to determine if additional soils must be excavated. Conduct post excavation soil sampling and analysis at the limits of the excavation.

Before backfilling, remove and dispose of contaminated water not associated with ground water. If directed, immediately backfill the excavated hole as specified in 201.03.07.5.

3. **Temporarily Storing Excavated Soil**. Temporarily store excavated soil in stockpiles as specified in 202.03.03.B. Construct stockpiles on polyethylene sheeting. Locate stockpiles where excavation equipment can place the soil from the excavation directly onto a stockpile.

   Segregate material of differing types and degrees of contamination to prevent cross-contamination of materials.

   Cover stockpiles with polyethylene sheeting of the same thickness as the underlying polyethylene sheeting. Secure cover polyethylene sheeting in place at all times. Overlap joints in the cover polyethylene sheeting a minimum of 12 inches, and secure the joints. Maintain the cover sheeting, and replace damaged cover polyethylene sheeting as needed.

   Provide protection for the stockpile to control the migration of contaminants.

   Dispose of excavated material, within 180 days of being stockpiled, as specified in 202.03.08.

   Clean equipment used to move excavated material at the end of each working day or before removing the equipment from the Project Limits. Install non-vegetative SESC measures to limit the movement of the excavated material from equipment cleaning areas. Temporarily store the material collected during equipment cleaning in stockpiles.

4. **Transporting, Recycling, and Disposing of Contaminated Soil.** Transport the contaminated soil to an approved recycling or disposal facility.

   Sample material as per the recycling or disposal facility requirements. Submit 1 copy of the documentation of the disposal facility's acceptance of the contaminated soil, including the weigh ticket slips, to the RE within 15 days of acceptance at the disposal facility.

201.03.05 Monitoring Wells

Install wells using a NJDEP certified well driller. If directed by the RE, perform ground water sampling and analyses according to N.J.A.C. 7:26E. Upon receipt of RE approval, seal monitoring wells according to N.J.A.C. 7:9-9.1 *et seq*.

201.03.06 Sealing Abandoned Wells

Fill and seal abandoned wells within the limits of clearing site or as shown on the Plans. Fill dug wells as specified in 201.03.07.5. Seal drilled wells according to N.J.A.C. 7:9D *et seq*. Provide a copy of the well abandonment records submitted to NJDEP to the RE.

If proposing an alternate method to seal the abandoned wells, obtain written approval from the NJDEP and from the RE.

201.03.07 Demolition

Refer to 108.12 of the Special Provisions for occupied properties and vacation dates and availability dates. Demolish and remove the required buildings in place. Only remove small structures and appurtenances outside the area to be cleared that are designated for removal.

Existing laws, ordinances, and regulations shall govern the parking, loading, and operation of trucks on existing highways or streets.

The Department assumes no responsibility for the condition of the various buildings or loss of fixtures, equipment, materials, or other objects between the submittal of the Proposal and the time of actual possession of the buildings.

On a daily basis, remove and dispose of, as specified in 201.03.09, materials, including fixtures, equipment, debris, and rubbish, and do not store removed materials within the Project Limits. Do not sell materials within the Project Limits.

Where others have removed buildings, arrange to disconnect and terminate remaining utility services. Remove foundation walls and steps to at least 3 feet below ground level. Remove detached buildings and fixtures, wood, and debris from the site and dispose of as specified in 201.03.09.

Remove heating oil tanks according to N.J.A.C. 7:14B and N.J.A.C. 7:26E, and Federal, State, and local laws, rules, and regulations.

Confine demolition operations to the limits shown, and perform work as specified by the following:

1. **Demolition Safety Plan.** Submit a Demolition Safety Plan to the RE for approval, 10 days before demolition. Include the following provisions in the plan:

    1. Type and location of warning signs, **KEEP OUT** signs, and barricades.
    2. Type and location of barrier around operations and openings in the ground.
    3. Type and location of lights and footway shelter platforms in the vicinity of pedestrian walkways.
    4. Methods for controlling dust from demolition operations.

    Follow the Demolition Safety Plan until the RE approves the removal of protective devices.

    For demolition of buildings having more than 3 floors, submit an additional plan to the RE for approval at least 10 days before beginning demolition. Include the demolition methods to be used and methods of protecting adjacent building and structures.

2. **Utility Disconnections.** Before demolishing any building, arrange to disconnect and terminate all utilities and facilities that are connected to the building, as specified by the municipalities and companies owning or controlling them.

    If only a portion of an occupied structure is to be demolished, conduct demolition and related operations so that service is not interrupted to the portion of the structure that is not demolished. Where it is necessary to reconnect any facilities to the undemolished portion of the structure, make reconnections permanent.

    Notify, in writing, the municipalities and companies concerned when such disconnections, terminations, or reconnections are required and provide copy to RE. Perform this work according to the municipalities and companies standard practices and requirements and under their supervision; otherwise arrange for the work to be performed with their forces.

3. **Rodent Control and Extermination.** Before beginning demolition operations, retain a qualified sanitation inspector to conduct a survey for evidence of current rodent activity. Initiate a control program by a certified pest control operator if the survey indicates that it is necessary.

    Apply exterminating materials according to N.J.A.C 7:30, *et seq*.

    At least 10 days before beginning demolition of any structures, the pest control operator shall begin ridding the structure and adjacent areas within the Project Limits of rodents or their carcasses and to prevent their migration to other adjacent areas.

    Where there is no competing water supply, the Contractor may use liquid anticoagulant baits at the discretion of the certified pesticide applicator.

    Place toxic bait in the form of a 1-pound paraffinized block in each manhole or inlet of storm or combination drains located on the same street as the building to be demolished and within the same block, including the entire intersections of the nearest cross streets. Place bait in suitable locations within the drainage structures, as determined by the pest control operator. Fasten the bait block in its location with wire.

    Inspect and renew toxic bait in structures or drains as necessary after initial baiting.

    Remove and dispose of carcasses to the satisfaction of the RE.

After the initial treatment and each follow-up inspection, submit a signed statement, from the pest control operator, reporting the amount and type of bait placed in each location and stating the visible results obtained from the rodent control program.

Ensure that the pest control operator is aware of the antidote noted on the rodenticide label.

4. **Demolition Operations.** Before demolishing buildings, remove and dispose of chemicals, miscellaneous cylinders, drums, above ground and underground heating oil tanks, asbestos, and garbage from the building according to applicable Federal, State, and local laws, rules, and regulations. Remove and recycle materials that are required to be recycled by the Federal, State, and local laws, rules, and regulations. Before beginning demolition operations, pump out and clean basements, wells, cesspools, and outbuildings within the areas to be cleared in a sanitary manner. After being disinfected as required by the health authorities, backfill to adjacent ground level as specified in 201.03.07.5.

   Maintain wells, cisterns, cesspools, and other openings in the ground outside the area to be cleared without hindering their functionality. Cap well casings securely and permanently as specified in 201.03.06, and cut off and cap pipes leading into or out of the well.

   Leave adjacent buildings in a safe condition, and do not deface, mar, or jeopardize them in any way. Repair or restore damaged buildings to the satisfaction of the RE.

   Ensure that the phases of demolition are performed within the designated limits and without hazard to adjacent properties or to the public. Do not set any structure on fire.

   Do not demolish or disturb chimneys common to adjacent properties other than to give them the necessary support for their continued stability. If necessary, repoint and cap them.

   When demolishing a portion of a building, shore, brace, and support the remaining part so that the integrity and support of all remaining walls, floors, roofs, and their supporting members are maintained and continued in such a way that shoring, bracing, and support is outside the ROW. Board up and seal the remaining portion of such a partially demolished building along the ROW, and weatherproof the new closure and its connections to the remaining portion of the severed building. Material for closure shall consist of adequately braced studding of 2 × 4-inch timbers placed no more than 16 inches on center with wood facing, or equal, nailed to the studding and without any holes appearing therein. Cover the wood facing with 2 layers of smooth-finished, 65 pounds per roll, roofing material according to ASTM D 224 and having an overlap of at least 4 inches.

5. **Backfilling.** Backfill and compact subsurface areas including cellars using the directed method as specified in 203.03.02.C. The RE may require compaction using the density control method as specified in 203.03.02.D. Use all available excavated material from within the Project Limits before bringing additional material for backfill to the Project Limits. If sufficient material is not available, backfill with I-14 soil aggregate. If excavated material or I-14 soil aggregate are recycled material, place the recycled material at least 2 foot above the water table.

   Ensure backfilling and grading establishes proper drainage. Before placing the first lift, break existing cellar floors and other surfaced areas into pieces having areas of less than 4 square feet with well-defined cracks through the full depth of the floors, or make holes of more than 1 square foot area through the floors on approximately 10-foot centers to provide vertical drainage. Remove wooden cellar floors.

   Clean, point, and apply 2 coats of waterproofing material to party wall foundations before backfilling against. If necessary, grade around the ground surface to eliminate water pockets.

   Backfill and level cellars and all other subsurface spaces to the adjacent ground elevation.

201.03.08 Asbestos Removal

Refer to the Special Provisions for asbestos removal requirements.

201.03.09 Disposal of Removed Materials and Debris

Dispose of or recycle removed materials and debris according to Solid Waste Management Act (N.J.S.A. 13:1E-1) and N.J.A.C 7:26 *et seq.* and according to the solid waste management plan developed by the solid waste management

district of origin. Submit proper documentation from the disposal facility to the RE and the county of origin within 15 days of acceptance at the disposal facility.

201.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
CLEARING SITE	LUMP SUM
CLEARING SITE, BRIDGE (___)	LUMP SUM
CLEARING SITE, STRUCTURE (___)	LUMP SUM
CLEARING SITE, TANK REMOVAL	UNIT
DISPOSING AND RECYCLING OF CONTAMINATED SOIL - TANKS	TON
MONITORING WELL	UNIT
POST EXCAVATION SOIL SAMPLING AND ANALYSES	UNIT
COMPOSITE SOIL SAMPLING AND ANALYSES	UNIT
GROUND WATER SAMPLING AND ANALYSES	UNIT
SEALING OF ABANDONED WELL	UNIT
DEMOLITION (___), PARCEL (___)	UNIT
REMOVAL OF ASBESTOS (___), PARCEL (___)	UNIT
TEMPORARY SHIELDING	LUMP SUM

A unit of POST EXCAVATION SOIL SAMPLING AND ANALYSES is each sample collected and analyzed. The Department will not include payment for post excavation soil sampling and analysis in CLEARING SITE, TANK REMOVAL. The Department will make payment for post excavation soil sampling and analysis under POST EXCAVATION SOIL SAMPLING AND ANALYSES. The Department will make payment upon receipt of a copy of sampling log, chain of custody form, and analytical report.

A unit of CLEARING SITE, TANK REMOVAL is each tank removed. The Department will not make payment without the Site Investigation Report and tank disposal receipt.

A unit of COMPOSITE SOIL SAMPLING AND ANALYSES is each composite sample collected and analyses performed. The Department will not include payment for composite soil sampling and analysis in MONITORING WELLS. The Department will make payment for composite soil sampling and analysis under COMPOSITE SOIL SAMPLING AND ANALYSIS. The Department will make payment for a unit upon receipt of a copy of sampling log, chain of custody form and analytical report.

A unit of GROUNDWATER SAMPLING AND ANALYSES includes sampling and analyses at each point sampled. The Department will not include payment for ground water sampling and analysis in MONITORING WELLS or CLEARING SITE, TANK REMOVAL. The Department will make payment for ground water sampling and analysis under GROUND WATER SAMPLING AND ANALYSIS. The Department will make payment for a unit upon receipt of a copy of sampling log, chain of custody form and analytical report.

The Department will reduce payment for DEMOLITION OF BUILDINGS or REMOVAL OF ASBESTOS accordingly by the deletion of any building as listed in the Supplement for Analysis of the Lump Sum Price Bid attached to the Proposal.

SECTION 202 – EXCAVATION

202.01 DESCRIPTION

This Section describes the requirements for stripping, excavating, removing pavement, reusing excavated material for backfill and embankments, and disposing of excess material.

202.02 MATERIALS

Provide materials as specified:

Coarse Aggregate (No. 56, 57, or 67)	901.03
Pulverized Limestone	917.04
Topsoil Stabilization Matting	917.08
Silt Fence	919.01
Haybales	919.03
Polyethylene Sheeting	919.12

202.03 CONSTRUCTION

202.03.01 Stripping

Before beginning the operations, obtain the RE's approval for stripping operations scheduled between November 15 and March 1. The RE will base approval on the Contractor's alternate method for stabilizing disturbed areas when seeding is not feasible due to seasonal constraints.

Strip vegetation and underlying soil to a depth of 4 to 6 inches below the existing ground surface. Confirm the thickness of stripping with the RE based on field conditions. Temporarily store in stockpiles, as specified in 202.03.03.B, stripped material including excess that is determined suitable for the future use of the Department. The Department will sample and analyze stripped material in stockpiles to determine suitability for use as topsoil. Store suitable stripped material within the Project Limits until placement. Reuse or dispose of unsuitable stripped material as specified in 202.03.07.

202.03.02 Excavating Test Pits

Before beginning Construction Operations, locate existing subsurface structures and utilities that may be affected by or interfere with the proposed construction. Obtain utility locations as specified in 105.07. If directed by the RE, excavate to obtain the utility location.

Excavate as specified in 202.03.03 and as directed by the RE. Excavate test pits or portions of a test pit by hand when in close proximity to utilities or when directed. Backfill test pits with excavated material in 6-inch lifts, and compact using the directed method as specified in 203.03.02.C.

202.03.03 Excavating Unclassified Material

A. Excavating. The Department, as the generator, is solely responsible for the designation of excavated material. Unclassified excavation consists of excavation and management of material of whatever nature encountered, except for regulated material or acid producing soil.

Excavate using equipment and methods that remove material to the specified excavation limits without disturbing the material outside of the excavation limits. While excavating, protect facilities and structures from damage and disturbance. Ensure that material outside excavation limits is not disturbed. If any material outside the excavation limits becomes disturbed, restore the area as directed by the RE. Excavate and grade to ensure proper drainage.

Do not excavate more than 15 feet in depth without stabilizing the slope either by temporarily seeding and mulching, or by topsoiling, permanently seeding, and mulching as specified in 806.03.01. Submit alternate methods for stabilizing slopes when seeding is not allowable due to seasonable constraints. Obtain RE approval of alternate methods before beginning embankment construction. Repair damaged seeded areas as specified in 806.03.01.

Notify the RE if excavation to the finished grade section results in unstable subgrade or slopes. Obtain RE approval before removing unstable material and backfilling the area with suitable material. Backfill with excavated material and compact using the directed method as specified in 203.03.02.C.

If a slope failure develops during excavation, immediately cease operations. Determine the limits of unstable material, and start backfilling immediately. Once the slope has been stabilized, resume excavation by RE approved methods.

The RE will check elevations of the roadbed subgrade as specified in 202.03.03.C. Ensure that the elevation is within ±1/2 inch of the specified elevation.

Use excavated material on the Project, as directed by the RE, or as specified in 202.03.07.

1. **Wet Areas.** If required, submit a dewatering plan including method of dewatering and controlling sediment and contaminants from entering adjacent waterbodies, wetlands, and environmentally sensitive areas. Obtain RE approval for dewatering operations before beginning the work. Excavate wet areas down to firm bottom within the lateral limits. Test the bottom of the excavation area at frequent intervals as the excavation progresses, by taking soundings, samples, or other tests, to determine when firm bottom is reached. The Department may require the Contractor to take additional borings or samples to determine if unsuitable material remains or is entrapped within the excavation limits.

   Excavate using equipment and methods \to the specified elevation without disturbing the material below that elevation. If the methods and equipment disturb the material below the specified elevation, immediately stop operations. Resume excavation using alternate methods and equipment as approved by the RE.

   The RE may allow the use of dikes, well points, or other means for dewatering the excavation areas if cofferdams are not shown on the Plans. If permits are required for this work, submit a copy of approvals, as specified in 107.01.02, to the RE before proceeding with the work.

2. **Foundation and Bridge Areas.** Excavate for footings to the limits shown in the plans causing minimal disturbance to the remaining embankment. If the underlying material is disturbed, compact it using the directed method as specified in 203.03.02.C. Backfill and compact the remaining excavated area using the density control method as specified in 203.03.02.D. Restore the embankment to the final section.

   Remove boulders or rock fingers projecting into the bottom of the excavation to a minimum depth of 6 inches below the bottom of footing. Backfill the space with coarse aggregate, and compact it using the directed method as specified in 203.03.02.C.

   In areas where the footing rests partly on soil and partly on rock, excavate the rock to 2 feet below the footing. Backfill the space with coarse aggregate, and compact it using the directed method as specified in 203.03.02.C.

   In areas where the footing rests entirely on rock, excavate to a firm, level, roughened surface. Clean out seams, and fill them with concrete or mortar before placing concrete for foundations.

   If shale is encountered at the bottom of the footing and the footing is not poured the same day, leaving the shale exposed to air or water, undercut the shale at least 4 inches. Seal the undercut with the same class of concrete as the overlying footing to the bottom of the footing elevation, and provide a rough finish.

   If during the course of the excavation, rock is shattered below the foundation elevation, remove the shattered rock and fill the void with the same class of concrete as the overlying footing.

   The RE may order, in writing, changes in dimensions or elevation of footings as necessary to secure an acceptable foundation.

   After completing the excavation to the elevation of the bottom of the footing, obtain the RE's approval before beginning footing construction or placement of coarse aggregate.

   When specified, place coarse aggregate following the completion of the excavation. Shape the material on which the coarse aggregate is to be placed to an even surface. Place coarse aggregate in 6-inch lifts and compact using the directed method as specified in 203.03.02.C.

3. **Rock Areas.** The Contractor may remove entire boulders extending beyond the specified limits of excavation. Backfill and compact space created outside the specified limits by such boulder removal using the directed method as specified in 203.03.02.C. Ensure that undrained pockets are not left in the surface of the rock.

   After completing the excavation of each lift of rock slope construction and before beginning the next lift, scale the completed slopes to remove loose rock fragments. The RE will examine rock slopes during the excavation to identify possible unstable conditions and to determine the need for stabilization. Provide assistance and equipment necessary for such examination.

If it is determined that in-place stabilization is required, use rock bolting or other stabilization techniques as directed. Before drilling and blasting, remove existing overburden to the top of rock. Take necessary precautions in drilling and blasting operations to preserve the rock remaining in the specified finished slope in a natural undamaged condition. Conduct blasting operations according to the following:

a. Blasting Plan. Submit a blasting plan at least 14 days before commencing drilling and blasting operations and before each subsequent shot thereafter. Include the full details of the drilling and blasting patterns and controls to be used for both the presplitting and production blasting. Additionally, include the following minimum information:

1. Station limits of proposed shot.
2. Plan and section views of proposed drill pattern, including free face, burden, blasthole spacing, diameters and angles, lift height, and subdrill depth.
3. Loading diagram showing type and amount of explosives, primers, initiators, and location and depth of stemming.
4. Manufacturers' data sheets for explosives, primers, and initiators to be employed.
5. Initiation sequence of blastholes including delay times and delay system.
6. Planned security measures for storage of explosives.
7. Safety plan for personnel and public.
8. Copy of blasting license.
9. Name and qualifications of blasting supervisor.

The blasting plan submittal is for quality control and record keeping purposes. A review of the blasting plan does not relieve responsibility for the accuracy and adequacy of the plan when implemented in the field.

b. Blasting Test Sections. Before commencing full-scale blasting operations, demonstrate the adequacy of the proposed blasting plan by drilling, blasting, and excavating short test sections, up to 100 feet in length, to determine which combination of method, hole spacing, and charge works best. The RE may direct additional test sections when field conditions warrant.

Conform to the requirements for controlled and production blasting operations when blasting in conjunction with the test shots.

Do not drill ahead of the test shot area until the test section has been excavated and the results evaluated. If the results of the test shots are unsatisfactory, revise methods to achieve the required results. Unsatisfactory test shot results include an excessive amount of fragmentation beyond the shown lines and grade, excessive flyrock, or violation of other requirements.

If, at any time during the progress of the work, the methods of drilling and blasting do not produce the desired result of a uniform slope and shear face, within the tolerances specified, drill, blast, and excavate in short sections, not exceeding 100 feet long, until a technique is arrived at that produces the desired results.

c. Safety. Handle explosive materials and conduct blasting operations as specified in 105.10. Use only standard explosives, blasting agents, detonating cord, delays, blasting caps, and other blasting accessories prepared and packaged by explosive manufacturing firms.

Restrict access to the entire blast area for a minimum of 5 minutes following a blast to guard against rock fall before commencing work in the cut.

The RE will prohibit or halt the blasting operations if it is apparent that through the methods being employed, the required slopes are not being obtained in a stable condition, or the safety and convenience of the traveling public is being jeopardized.

d. Methods of Drilling and Blasting.

(1) Presplitting. Presplitting is a controlled blasting method for constructing a shear plane along a specified cut slope through the controlled use of explosives and accessories in properly aligned and spaced drill holes.

After removing the overburden and weathered rock, drill slope holes for presplitting along the line and in the plane of the cut slope. Drill slope holes between 2-1/2 and 3 inches in diameter. Control operations to ensure that the drill holes do not deviate from the plane of the slope by more than 6 inches and do not deviate within the plane of the slope by more than 6 inches.

Ensure that the drilling equipment for drilling the presplit holes has mechanical devices affixed to accurately determine the angle at which the drill steel enters the rock. The RE will not allow presplit hole drilling if these devices are either missing or inoperative. Do not space slope holes more than 3 feet on centers, and adjust spacing as required to produce a uniform and stable shear plane between slope holes. Under certain conditions, to produce a uniform and stable shear plane, the RE may also require auxiliary holes, which are identical to the slope holes but are not loaded with explosives.

The Contractor may extend the length of the slope holes to the full depth of the cut, to a maximum of 50 feet, if hole alignment is maintained. Otherwise, drill and blast slope holes in lifts. If presplitting in lifts, the RE will allow a maximum offset of 6 inches to accommodate the drill head. Arrange lifts so that the toe of the finished cut slope coincides with the toe of slope. Before placing explosives or blasting agents, ensure that the hole is free of obstructions for its entire depth.

Provide explosives for use in presplit holes with a maximum diameter less than 1/2 the diameter of the presplit hole, and ensure that explosives do not touch the side of the hole. Use only standard explosives manufactured especially for presplitting in presplit holes, unless otherwise approved. Do not load bulk ammonium nitrate and fuel oil in the presplit holes.

Use an amount of explosives in the presplit hole that produces the shearing without causing overbreak. Ensure that the top of the load is far enough below the collar to avoid overbreak at the surface. Extend the detonator cord downline from the collar to the bottom of the bore hole and from the collar to the detonator trunkline or electric blasting caps. Prime the explosive charge according to the recommendations of the manufacturer of the commercial explosive or blasting agent.

If using fractional portions of standard explosive cartridges, firmly affix them to the detonating cord so that the cartridges do not slip down the detonating cord or bridge across the hole. Do not space fractional cartridges along the length of the detonating cord farther than 30 inches on center. Adjust spacing to give the desired results.

Assemble continuous column cartridge type of explosives used with detonating cord, and affix them to the detonating cord according to the explosive manufacturer's recommendations. Provide a copy of these instructions to the RE.

The Contractor may make the bottom charge of a presplit hole larger than the line charges but not so large as to cause overbreak. Place the top charge of the presplitting hole far enough below the collar, and reduce the charge sufficiently, to avoid overbreaking and heaving.

Stem the upper portion of presplit holes, from the topmost charge to the hole collar. Stemming materials shall consist of drill cutting or 3/8-inch clean stone chips.

The Contractor does not need to stem below the topmost charge unless the Department determines that the rock is very seamy and incompetent, in which case, the Contractor may need to full stem such zones.

The Contractor may detonate presplit holes instantaneously or on short delays between each hole. Ensure that delay detonating does not exceed 25 milliseconds between holes. Detonate presplit holes before detonating any production holes.

Extend presplitting a minimum of 50 feet ahead of the production blasting limits, but not more than 100 feet beyond the exposed presplit face.

(2) Production Blasting. Production blasting is a method of drilling and blasting to produce a high degree of fragmentation of the rock mass to be excavated.

Drill the adjacent line of production holes inside the presplit lines so as to avoid damage to the presplit face. If necessary, the Contractor may drill the first line of production holes parallel to the presplit face to reduce overbreak of this face.

The Contractor may vary hole diameter, spacing, delay patterns, explosives, blasting agents, and other variables to obtain a fragmentation acceptable to the RE, provided that the existing presplit face is not damaged.

B. Temporarily Storing. Temporarily store soil in stockpiles in well-drained areas no closer than 50 feet from streams, wetlands, floodplains, other waterbodies, and as shown on the Plans. Construct stockpiles on polyethylene sheeting. Overlap joints in the underlying polyethylene sheeting a minimum of 12 inches. Contain stockpiles with haybales or silt fence placed continuously at the perimeter of the stockpiles. Construct stockpiles to heights not exceeding 15 feet and with side slopes no steeper than 2H:1V. Segregate material of differing types and levels of contamination depending on reuse or disposal.

Protect and maintain the stockpile and embankment until reuse or disposal. Provide protection for the stockpile to control the stormwater run-off, erosion, and unauthorized contact. Where the material in the stockpile is saturated, pitch the bottom polyethylene sheeting towards a discharge basin to collect water drained from the stockpile. Manage the collected water in the same manner as that generated during dewatering operations.

Maintain the polyethylene sheeting or replace it as needed for as long as the stockpile remains. Periodically inspect stockpiles to ensure that material is not released into the surrounding environment.

When temporarily storing soil is not possible within the Project Limits, the Contractor may temporarily store soil at a site provided by the Contractor outside the Project Limits as approved by the RE and meeting the requirements of 105.08 and 108.04.

If the stockpile remains exposed for more than 15 days, temporarily seed, as specified in 806.03.01, and mulch stockpiles as specified in 809.03.01 or 809.03.02.

When the stockpile is removed, restore the area to the original condition.

C. Measuring Elevation. Using Contractor established grade stakes set outside the pavement box and at breaklines, the RE will check elevations within the roadbed limits using a stringline drawn taut between these stakes. Ensure that grade stakes indicate the vertical cut or fill measurement referenced to the finish grade. The RE will check elevations longitudinally every 50 feet and transversely at the edges, breaklines, and the center of each lane and shoulder. The RE may direct additional grade stakes in areas with rapid changes in grade so that intermediate longitudinal checks can be made.

202.03.04 Excavating Regulated Material

The Department, as the generator, is solely responsible for the designation of excavated material. Regulated material excavation consists of excavation and management of material of whatever nature encountered that is classified as regulated or hazardous in the NJDEP Solid Waste Regulations, N.J.A.C 7:26-1 *et seq.* or N.J.A.C 7:26-8.

Areas of known regulated material are identified on the Plans. Handle regulated material according to applicable Federal, State, and local laws, rules, and regulations; and as specified herein. Dispose of regulated material as specified in 202.03.08.

1. Pre-Excavation Plans. Submit 4 copies of the following plans to the RE 30 days before beginning construction operations. Update and resubmit plans to identify changes in the condition or operation of the Work. If the Contractor fails to follow the pre-excavation plans, the RE will suspend the Work.

a. Site-Specific Health and Safety Program (HASP). Perform a hazard assessment of each proposed work task, and make independent evaluations regarding the appropriate level of health and safety requirements.

Employ a Certified Industrial Hygienist (CIH) or Certified Safety Professional (CSP) to develop and oversee the Site-Specific HASP. The CIH/CSP shall prepare the Site-Specific HASP to protect the Contractor's employees, the subcontractor's employees, the Department's employees and consultants, and the public from contamination present in the areas requiring excavation as shown on the Plans. Ensure that the Site-Specific HASP complies with Federal, State, and local laws, rules, and regulations,

including the health and safety requirements of OSHA 29 CFR 1910 and 29 CFR 1926. Implement the Site-Specific HASP, as approved by the RE, at the beginning of construction operations.

Ensure that the CIH/CSP reviews site-specific data and addresses the proposed activities to the level of detail needed to ensure that site-specific data, appropriate regulations, and a description of the site conditions are incorporated into the Site-Specific HASP.

Describe workplace and emergency procedures so that the Project is constructed in a safe manner. The Site-Specific HASP shall govern all facets of the Project and encompass the activities of all persons who enter or work on the Project. Incorporate procedures that conform to Federal, State, and local laws, rules, and regulations pertaining to employee working conditions where appropriate, National Institute for Occupational Safety and Health, OSHA, USCG, EPA, and NJDEP.

Include requirements for a health and safety coordinator to monitor the working conditions during excavation procedures and during the handling of regulated material to ensure conformance with the approved Site-Specific HASP. The CIH/CSP shall evaluate the need for air monitoring during excavation and loading operations of regulated material. If deemed necessary, the CIH/CSP or an assigned coordinator, suitably trained and approved by the CIH/CSP for the work required, shall implement the air monitoring program. The CIH/CSP shall include in the Site-Specific HASP applicable training and qualifications documentation for each health and safety coordinator.

The Contractor shall provide initial and annual training and medical monitoring for Contractor employees scheduled to work in or with regulated material and, per the RE's request, up to 10 Department employees or their authorized representatives as specified in OSHA 29 CFR 1910. Provide the initial training for State employees or their authorized representatives 30 days before excavating.

b. Materials Handling Plan. Develop a Materials Handling Plan (MHP) for regulated material encountered, moved, and disposed of or recycled during construction. Ensure the MHP includes the following:

1. Techniques to be used in managing regulated material to protect adjoining properties and workers and visitors to the Project Limits against exposure to regulated material and to prevent release of regulated material to the environment.
2. Standard operating procedures for excavation, stockpiling, transporting, measurement, and disposal of regulated material.
3. Current receiving facility certification and permits.
4. Qualifications of the licensed hauler.
5. Proposed routes to receiving facilities and weighing facilities.
6. Waste characterization forms.
7. A sampling and analysis protocol for characterizing the regulated material for on-site reuse and off-site disposal. Include the name, address, and telephone number of the contact for the proposed environmental laboratory and the name and experience of the proposed environmental sampling technician. The proposed environmental laboratory and proposed environmental sampling technician are subject to the RE's review and approval.
8. Requirements of the receiving facility to accept the regulated material.

Implement the MHP, as approved by the RE, at the beginning of excavation. Perform planning, administrative, and control functions required to implement the MHP.

c. Pollution Prevention and Control Plan. Develop a Pollution Prevention and Control (PPC) Plan describing the methods of preventing discharge of regulated stormwater, ground water, sediments, and free product during stormwater control, excavation, and dewatering operations. Prepare the PPC Plan according to Federal, State, and local laws, rules, and regulations relative to regulated discharges. Implement the RE approved PPC Plan before beginning excavation.

Detail methods, personnel, equipment, and reporting requirements on how to discharge regulated stormwater, groundwater, sediments, and free product during stormwater control, excavation, and dewatering operations into a dewatering basin, storm/sewer system, or other approved system. Specify methods and equipment for collecting, pumping, treating, monitoring, and disposing of liquids generated by stormwater control. Specify measures to prevent stormwater run-on and runoff and measures for

dewatering of excavations, dewatering of sediments, decontaminating personnel and equipment, and storing fuels and chemicals. Include detailed water collection, treatment, monitoring, discharge activities, and reporting requirements. Provide daily construction reports to identify water collection, treatment, monitoring, and discharge activities; personnel and equipment; and relevant quantities. When dewatering in areas of petroleum contamination, provide an oil-water separator with the dewatering basin or sediment control tank as specified in 158.03.02.

2. **Excavating.** Excavate regulated material as specified in 202.03.03 and as shown on the Plans.

3. **Temporarily Storing.** Temporarily store regulated or hazardous material in stockpiles within the Project Limits and as shown on the Plans. Construct stockpiles on polyethylene sheeting. For hazardous material, if a stockpile area is not available within the Project Limits, sample and analyze materials in-situ for disposal. Excavate and place the hazardous regulated material directly into trucks, and haul it directly to the approved disposal facility.

   Cover stockpiles with polyethylene sheeting. Secure the cover in place at all times. Overlap joints in the polyethylene sheeting a minimum of 12 inches, and place securing materials along the joints. Maintain the cover, and replace damaged polyethylene sheeting as needed.

   Clean equipment used for the movement of excavated material at the end of each working day or before removing it from the Project Limits. Install non-vegetative erosion control features to limit the movement of the excavated material from equipment cleaning areas. Temporarily store the excavated material from equipment cleaning in stockpiles.

   If regulated material is not designated for reuse on-site, dispose of regulated material within 180 days of being stockpiled as specified in 202.03.08.

   Do not reuse hazardous regulated material. Dispose of hazardous regulated material as specified in 202.03.09 within 90 days of being stored in stockpiles.

4. **Sampling and Analysis.** Collect, transport, and analyze environmental samples required for facility acceptance of the material. Perform sampling, testing, and inspections conducted in areas containing regulated material according to the Site-Specific HASP.

   Perform sampling, testing, and data management procedures according to *NJDEP Field Sampling Procedures Manual*, *NJDEP Technical Requirements for Site Remediation*, *NJDEP Management of Excavated Soils Guidelines*, *Appendix 1 of the NJDEP Waste Classification Form*, and EPA requirements.

   Do not sample or analyze any part of the Project Limits for purposes of re-delineating designations of excavation.

5. **Document Control.** Provide the following items:

   a. **Soil/Sediment Usage Tracking Log.** Complete a tracking log for each working day involving excavation, stockpile, transport, and disposal of regulated material. Monitor and record the following information on the tracking log:

      1. Date.
      2. Location maps showing excavation and placement, including depth, of material.
      3. Type, volume, and characteristics of regulated material removed.
      4. Names and signatures of personnel responsible for preparing and executing the tracking log.

      Submit copies of daily tracking logs to the RE on a weekly basis.

   b. **Materials and Handling Reports.** Submit weekly reports to the RE documenting the excavation, stockpiling, sampling, off-site management, and on-site placement of regulated material. Indicate the location and dates of excavation, stockpiling, sampling, off-site management, and on-site placement of regulated material. Explain changes to or variations from the MHP. Additionally, include dates of planned excavation, sampling, and off-site management of regulated material for the coming months.

      Provide a final report documenting the management of regulated material, including the location and dates of excavation, stockpiling, sampling, off-site management, and on-site placement of regulated material. Include plans depicting placement of regulated material. Submit 4 copies of the final report to

the RE within 30 days of completing excavations of regulated material, off-site management of regulated material, and embankment/backfill operations reusing regulated material.

c. Sampling Logs and Analytical Reports. Submit to the RE 2 copies of the sampling logs, chain of custody, and analytical reports after each soil analysis is performed within 10 days of analysis.

d. PPC Logs. Maintain a PPC log for water collection, monitoring, and handling activities, and make the log available to the RE upon request. In the PPC log, note daily water removal, treatment and discharge volumes, effluent sampling activities and results, discharge or spill incidents, and sampling and reporting activities.

202.03.05 Excavating Acid Producing Soil (APS)

The Department, as the generator, is solely responsible for the designation of excavated material. Acid producing soil (APS) excavation consists of excavation and management of high acid producing soil, with a pH below 4.0 or soil containing iron sulfides. Areas of known APS are shown on the Plans. Dispose of APS as specified in 202.03.07.B.

1. **Pre-Excavation Plans.** Submit a Materials Handling Plan as specified in 202.03.04.1.
2. **Excavating.** Excavate APS material as specified in 202.03.03 and as shown on the Plans.
3. **Temporarily Storing.** Temporarily store APS in separate stockpiles as specified in 202.03.03.B within the Project Limits and as shown on the Plans. Construct stockpiles on polyethylene sheeting. Contain stockpiles using silt fence, haybales, or other non-vegetative erosion control features to limit movement of soil and possible acidic runoff. Cover stockpiles with polyethylene sheeting. Secure and maintain cover in place. Overlap joints in the polyethylene sheeting a minimum of 12 inches, and place securing materials along the joints. Maintain the cover, and replace damaged polyethylene sheeting as needed. Ensure that no stockpile is left uncovered and exposed to the air or precipitation for more than 8 hours to minimize oxidation.

   Clean equipment used for the movement of APS at the end of each working day and before removing it from the Project Limits to prevent spreading of APS to other areas within the Project Limits and to prevent tracking APS off-site. Install non-vegetative erosion control features around the equipment cleaning area to limit the movement of the APS and possible acidic runoff. Temporarily store the APS from equipment cleaning in the APS stockpile.
4. **Sampling and Analysis.** Test stockpiled soil at a NJDEP certified laboratory for APS according to the *NJDEP Technical Manual for Stream Encroachment*. Within 10 days of stockpiling, submit 3 copies of the results to the RE.
5. **Acid Soil Remediation.** When reusing excavated APS as backfill or embankment in areas to be vegetated, place APS at the bottom. Remediate the soil by covering the APS with a layer of pulverized limestone applied at a rate of 6 tons per acre (or 275 pounds per 1000 square feet) of surface area, and as follows:
   1. Where establishing turf, cover the limestone layer with a minimum of 12 inches of compacted soil with a pH of 5 or more.
   2. Where planting trees or shrubs, cover the limestone layer with a minimum of 24 inches of compacted soil with a pH of 5 or more.
   3. Do not place APS within 24 inches of a slope or bank surface (such as berms, stream banks, ditches, etc.) or structure to prevent potential lateral leaching.

   Immediately following remediation, place topsoil, fertilizer, seed, and mulch over APS not under pavement for permanent erosion control. Dispose of excess APS as specified in 202.03.07.B.
6. **Document Control.** Perform document control as specified in 202.03.04.5, except that PPC logs are not required.

202.03.06 Removing Pavement

Before removing HMA, concrete, or composite pavement, wet sawcut. Wet sawcut joint areas and overlying HMA courses full depth parallel to the centerline of the joint for the width designated. Use a saw capable of providing a neat cut for the full depth in a single pass.

Do not use equipment that involves a ball, weight, or punch to break or remove the concrete within 5 feet of a transverse joint or within 3 feet of any structure or pavement that is to remain in place. Break up or remove the concrete within restricted areas so as not to damage the adjacent joint structure, pavement, or other structure that is to remain.

Contain debris from the breaking of concrete base and concrete surface courses within the work site. Use necessary containment devices to protect adjacent vehicular or pedestrian traffic from flying debris. Reuse or dispose of material as specified in 202.03.07.

202.03.07 Reuse or Disposal of Excess Material

A. Reuse. Before using other excess materials, reuse regulated material as shown on the Plans or with RE approval.

The Contractor may use excavated material, if the requirements specified in 901.11 are met, to construct Items requiring soil aggregates. Submit written notification at least 15 days before reuse.

With approval, reuse excavated soil to widen or flatten slopes of embankment, to fade embankments into cuts, or as approved at other locations.

The Contractor may reuse broken concrete, HMA pieces, and millings in the lower portion of I-14 soil aggregate. Spread out pieces in layers, with the pieces lying flat and not arching, with spaces between the pieces filled with soil. Use pieces with a maximum individual size of 2 cubic feet, with a 2-foot maximum dimension on any side. Do not place the broken concrete, HMA pieces and milling within 2 feet of the final subgrade, less than 2 feet above the highest seasonal high ground water table or within 2 feet of any underground utility. Compact material using the directed method as specified in 203.03.02.C.

Dispose of excavated material that will not be reused as specified in 202.03.07.B.

B. Disposal. Dispose of excess regulated material as specified in 202.03.08. Dispose of excess APS at approved landfills according to applicable Federal, State, and local laws, rules, and regulations. For excavation not designated as regulated material or APS, provide the following before removing the excess excavation from the Project Limits.

1. At least 10 days before disposing, submit the disposal procedure and location to the RE for approval. Do not dispose of excavation on property proposed to be or used for parks, playgrounds, and other recreational purposes; educational facilities; environmentally sensitive areas such as wetlands; historic sites; or within sight of a State highway during all seasons.
2. On a Department provided form, obtain the property owner's notarized authorization of the acceptance of the excess material and where it is being placed.

Once material leaves the Project Limits, the Contractor is responsible for ensuring that the handling procedures, placement method, and disposal location are according to applicable Federal, State, and local laws, rules, and requirements, including permits that may be issued for the Project. If the disposal of excess material results in a violation notice from any governmental authority, immediately correct the violation. Indemnify and defend the Department for any violation incurred, penalty assessed, or any claims, suits, losses, demands or damages of whatever kind or nature arising out of, or claimed to arise out of, the improper disposal of excess materials.

If the Contractor does not correct the violation to the satisfaction of the governmental authority that issued the violation notice, the Contractor is responsible for assessed penalties including costs incurred by the Department to remedy the violations.

Dispose of other material or debris as specified in 201.03.09.

202.03.08 Disposal of Regulated Material

Load, transport, and dispose of regulated material that the RE determines to be excess, unusable, or unsuitable for the Project according to Federal, State, and local laws, rules, and regulations and as specified in 202.03.07.B. Pay fees associated with removal and disposal of regulated materials.

Submit the results of material sampling and analysis, waste facility applications and acceptance documentation, and fee payment requirements to the RE at least 15 days before planned removal of regulated material. Submit to the RE a bill of lading for each truckload of regulated material removed from the Project Limits. Ensure that the bill of lading and waste manifest include the following information:

1. Transport subcontractor name, address, permit number, and telephone number.
2. Type and quantity of material removed.
3. Weight of vehicle with weigh slip.
4. Recycling or disposal facility name, address, permit number, and telephone number.
5. Date removed from the Project Limits.
6. Signature of transport vehicle operator.

The RE will sign the bills of lading for the Department as the generator of the Project Limits. Submit 1 copy of the bill of lading to the RE by the end of each working day that the transport vehicle leaves the site.

The licensed hauler shall transport the regulated material to the disposal/recycling facility with no unauthorized stops in between, except as required by regulatory authority. The hauler shall use appropriate vehicles and operating practices to prevent spillage or leakage from occurring during transport. Remove excess soil adhering to the wheels or under carriage of the vehicles before leaving the Project Limits. If soil or water escapes to the public roads, immediately clean the road to restore it to the original condition and immediately notify the RE. Do not transport regulated material over public roads if they contain free liquid or are sufficiently wet to be potentially flowable during transport.

Submit 1 copy of the documentation of the disposal facility's acceptance of the regulated material, including the weight ticket slips, to the RE and the county of origin within 15 days of acceptance at the disposal facility.

Immediately submit written notification to the RE if problems arise, regarding the facility chosen to accept the regulated material for off-site management, that would require the return of waste, or if the chosen facility has violated any environmental regulation that may result in regulatory enforcement action. Propose an alternate disposal facility, and obtain the RE's written approval of off-site management at such facility.

202.03.09 Disposal of Regulated Material, Hazardous

Load, transport, and dispose of hazardous regulated material for the Project according to Federal, State, and local laws, rules, and regulations and as specified in 202.03.07.B. Pay fees associated with removal and disposal of hazardous regulated materials.

Submit the results of material sampling and analysis, waste facility applications and acceptance documentation, and fee payment requirements to the RE at least 15 days before planned removal of hazardous regulated material. For each truckload of hazardous regulated material removed from the Project Limits, submit to the RE a bill of lading and waste manifest that include the following information:

1. Transport subcontractor name, address, EPA ID number, and telephone number.
2. Type and quantity of material removed.
3. Weight of vehicle with weigh slip.
4. Recycling or disposal facility name, address, permit number, and telephone number.
5. Date removed from the Project Limits.
6. Signature of transport vehicle operator.
7. Waste manifest tracking number.

The RE will sign the manifest as the generator and will forward questions or concerns to the Bureau of Environmental Program Resources for resolution. The manifest will verify the type and quantity of hazardous regulated material being transported off-site.

The Uniform Hazardous Waste Manifests are required by the Federal Resource Conservation and Recovery Act (RCRA) (40 CFR Subpart B Parts 262.20 to 262.23) and N.J.A.C 7:26G for all off-site shipments of hazardous regulated materials. The Department is the generator of the waste. The Department will obtain an EPA Identification Number (EPA ID#) and supply this information to the RE for inclusion on the Uniform Hazardous Waste Manifest. The RE will provide the Contractor with an EPA ID# if the Project contains hazardous regulated material.

Complete the manifest form in accordance with all applicable regulations and mail to the Bureau of Environmental Program Resources at 951 Parkway Avenue, PO Box 600, Trenton, NJ 08625-0600 to ensure that the "final disposition" (TSD to Generator) copy of the manifest is mailed back to the office responsible for the record keeping requirements.

The RE will keep a copy of the original manifest for the Contract files. The Bureau of Environmental Program Resources will distribute the original manifests in accordance with the regulations and also for retention of the manifests per regulatory requirements.

The Contractor is responsible for all manifest discrepancies. Immediately report discrepancies to the RE and resolve to the satisfaction of the RE. The RE will forward a copy of manifest discrepancy letters to the Bureau of Environmental Program Resources.

The licensed hauler shall transport the hazardous regulated material to the disposal/recycling facility with no unauthorized stops in between, except as required by regulatory authority. The hauler shall use appropriate vehicles and operating practices to prevent spillage or leakage from occurring during transport. Remove excess soil adhering to the wheels or under carriage of the vehicles before leaving the Project Limits. If soil or water escapes to the public roads, immediately clean the road to restore it to the original condition and immediately notify the RE. Do not transport hazardous regulated material over public roads if they contain free liquid or are sufficiently wet to be potentially flowable during transport.

Submit 1 copy of the documentation of the disposal facility's acceptance of the hazardous regulated material, including the weight ticket slips, to the RE and the county of origin within 15 days of acceptance at the disposal facility.

Immediately submit written notification to the RE if problems arise, regarding the facility chosen to accept the hazardous regulated material for off-site management, that would require the return of waste, or if the chosen facility has violated any environmental regulation that may result in regulatory enforcement action. Propose an alternate disposal facility, and obtain the RE's written approval of off-site management at such facility.

202.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
STRIPPING	ACRE
EXCAVATION, TEST PIT	CUBIC YARD
EXCAVATION, UNCLASSIFIED	CUBIC YARD
PRESPLITTING	SQUARE YARD
EXCAVATION, REGULATED MATERIAL	CUBIC YARD
SOIL SAMPLING AND ANALYSES, REGULATED	UNIT
EXCAVATION, ACID PRODUCING SOIL	CUBIC YARD
SOIL SAMPLING AND ANALYSES, ACID PRODUCING SOIL	UNIT
ACID PRODUCING SOIL REMEDIATION	SQUARE YARD
REMOVAL OF PAVEMENT	SQUARE YARD
DISPOSAL OF ACID PRODUCING SOIL	TON
DISPOSAL OF REGULATED MATERIAL	TON
DISPOSAL OF REGULATED MATERIAL, HAZARDOUS	TON

If excavated materials are used to construct work using soil aggregates, other than I-14; the Department will deduct the volume of material used from EXCAVATION, UNCLASSIFIED. The Department will make payment for the soil aggregate under the item constructed.

If the use of excavated materials for soil aggregates, other than I-14, results in the need for I-14 SOIL AGGREGATE obtained from off-site to complete the embankments, provide a volume of I-14 SOIL AGGREGATE, at no cost to the Department, equal to the volume of soil aggregate constructed or equal to the volume of material required to complete the embankment, whichever is less.

When presplitting is shown on the Plans, the Department will not include payment under EXCAVATION, UNCLASSIFIED. The Department will make payment for presplitting under PRESPLITTING.

The Department will not make payment for EXCAVATION, REGULATED and EXCAVATION, ACID PRODUCING SOIL until the Contractor submits the required daily Soil/Sediment Tracking Logs.

A unit of SOIL SAMPLING AND ANALYSES, REGULATED and SOIL SAMPLING AND ANALYSES, ACID PRODUCING SOIL is each sample collected and analyzed. The Department will not include payment for soil sampling and analysis in EXCAVATION, REGULATED and EXCAVATION, ACID PRODUCING SOIL. The Department will make payment for soil sampling and analysis under SOIL SAMPLING AND ANALYSES, REGULATED and SOIL SAMPLING AND ANALYSES, ACID PRODUCING SOIL. The Department will make payment upon receipt of a copy of the sampling log, chain of custody form, and analytical report.

The Department will make payment for DISPOSAL OF REGULATED MATERIAL and DISPOSAL OF REGULATED MATERIAL, HAZARDOUS using certified weigh tickets.

The Department will make payment for SESC measures as specified in 158.04.

The Department will make payment for temporary seeding under FERTILIZING AND SEEDING, TYPE ___ as specified in 806.04.

SECTION 203 – EMBANKMENT

203.01 DESCRIPTION

This Section describes the requirements for constructing embankments and for preparing areas on which embankments are placed.

203.02 MATERIALS

203.02.01 Materials

Provide materials as specified:

Soil Aggregate (I-9, I-10, I-11, I-13, and I-14) 901.11

203.02.02 Equipment

Provide equipment as specified:

Pneumatic-Tired Compactor 1002.01
Dynamic Compactor 1002.02
Steel Wheel Roller 1002.03
Padfoot Roller 1002.04

203.03 CONSTRUCTION

203.03.01 Constructing Embankment

Before beginning embankment, excavate and stabilize side ditches, and install perimeter SESC measures as specified in 158.03.02. Ensure that the ground surface is not frozen and is free from snow, ice, and mud before constructing embankment.

Do not backfill or begin constructing embankment against a structure until the forms can be removed as specified in 504.03.02.G. Where existing pipes and conduit have insufficient soil cover during embankment construction, protect the pipes and conduit from damage by the equipment and operations.

Backfill and compact low areas, holes, channels, and ditches using the directed method, as specified in 203.03.02.C, before constructing embankment.

When placing more than 15 inches of embankment on existing pavement, break the pavement into pieces that are a maximum of 2 feet in any dimension.

When constructing an embankment against an existing slope or when constructing an embankment in stages, bench the existing slope against which the embankment is to be placed as the embankment is constructed in lifts. For each lift, bench a minimum of 6 feet into the existing slope to allow the new embankment to integrate with the existing slope. Compact benched areas with the new embankment.

If the RE determines that the moisture content of the existing ground, previously constructed embankment, or embankment material may adversely affect embankment construction, cease embankment construction until the moisture content is corrected.

Construct embankment to ensure adequate surface drainage is provided at all times. Construct the center of the roadbed higher than the sides, and keep the surface uniformly graded and compacted. At the end of each working day, construct temporary stabilized berms and slope drains along the top edges of the embankment to intercept surface runoff.

During embankment construction, allocate adequate space in the embankment for excavated material. Begin constructing embankment by placing initial lifts in the deepest portion of the embankment. Continue placing lifts approximately parallel to the finished pavement grade line. If constructing embankments with material that is obtained from more than 1 source, do not co-mingle materials.

When constructing embankment for the specified materials, the following apply:

1. **Concrete or HMA.** The Contractor may use concrete or HMA pieces to construct embankment if approved by the RE. Ensure that HMA or concrete pieces are at least 2 feet above the water table when constructing embankment.

2. **Soil Aggregate and Rock.** If I-14 soil aggregate is composed of soil aggregate and rock, fill the rock voids with soil aggregate. If constructing embankments outside the ROW or easement, construct the top 30 inches with I-14 soil aggregate that contains no aggregate exceeding 2 inches in any dimension.

3. **Rock.** Obtain RE approval before placing rock in embankments. Do not place rock in embankment in areas where piles or guide rail posts are to be driven, or drainage structures or utilities are to be constructed.

   Before placing rock on compacted embankment constructed of soil, grade the existing embankment surface to slope from the centerline to the sides at the rate of approximately 1 inch to the foot, and thoroughly compact the surface of the embankment.

   Place rock to form the base of embankments for the full width of the embankment. Place rock in uniform lifts to a depth that does not exceed 1-1/2 times the approximate size of the largest rock, but limited to a maximum lift depth of 3 feet. Reduce the size of rocks larger than 2 feet in any dimension. Distribute rock by blading or dozing to ensure proper placement in the embankment and to keep voids, pockets, and bridging to a minimum. Do not dump rock in final position.

   Ensure that the exterior 1-foot portion of the top and sides of rock in embankment contains no rock exceeding 8 inches in any dimension. Fill voids in the exterior 1-foot portion with granular material. Do not place rock in embankment within 2 feet of the finished subgrade elevation.

   When planting trees in the embankment, ensure that the exterior 2-foot portion of the top and sides of rock in embankment contains no rock exceeding 8 inches in any dimension. Fill voids in the exterior 2-foot portion with granular material.

   Construct the balance of the embankment with soil aggregate. Place and grade material in lifts not exceeding 8 inches, and then compact using the directed method as specified in 203.03.02.C.

When constructing embankment abutting structures before the abutments and wingwalls are completed, allow ample space for construction of the abutting structure. Construct the embankment abutting the structure at a slope of 5H:1V, or flatter. When the abutting structure is complete, finish placing the embankment to the structure. Place embankment around and adjacent to arches, rigid frame bridges, culverts, and piers simultaneously on both sides to the same elevation. Do not place embankment with pieces larger than 6 inches in any dimension within 2 feet of structures, utilities, and drainage facilities.

Place and compact material used for embankment as specified in Table 203.03.01-1:

Table 203.03.01-1 Placing and Compacting Methods

Placement Condition	Method
I-11 < 1 foot above water table or on unstable ground	End-Dumping
I-11 ≥ 1 foot above water table I-14 – Granular material	Control Fill
I-14 – Primarily rock or non-granular material	Directed
I-9/I-10	Density Control

During embankment construction, route construction equipment, both loaded and empty, over the lifts with the travel distributed evenly over the entire width of the embankment. Before placing subsequent lifts, regrade and compact areas rutted by traffic.

The RE will check the elevation of the subgrade as specified in 202.03.03.C. The allowable tolerance from the shown elevations is ±1/2 inch.

Stabilize slopes either by temporarily seeding and mulching, or by topsoiling, permanently seeding, and mulching as specified in 806.03.01. Do not construct embankment more than 15 feet high without stabilizing the slope. Submit alternate methods for stabilizing slopes when seeding is not allowable due to seasonable constraints. Obtain RE approval of alternate methods before beginning embankment construction.

203.03.02 Placing and Compacting Methods

A. End-Dumping Method. Do not begin end-dumping until the RE tests the bottom of the excavation to determine that the wet material has been removed down to firm bottom or the lower limit as shown on the Plans. Do not interrupt end-dumping except as necessary to allow for testing and measuring. When interrupted for more than 24 hours, do not end-dump until the RE retests the bottom of the excavated area and determines it to be in satisfactory condition.

Sequence excavation and end-dumping to ensure that wet material does not re-enter the excavated area. End-dump the embankment material only to an elevation that allows the use of compacting equipment. Construct the remainder of the embankment using the control fill method as specified in 203.03.02.B.

Fill and advance the embankment wedge so that the remaining wet material is forced to the sides of the excavation and is not entrapped under the embankment. Remove wet material that accumulates at the sides of the excavated area as the embankment wedge advances. Remove wet material spilled or otherwise deposited on the top or sides of the embankment during this operation.

When widening an existing embankment, place embankment material along and outward from the existing embankment in close coordination with the excavation to prevent entrapping wet material between the existing and new sections of embankment and displacing unstable materials that may be under the existing embankment.

Prevent settlement of or damage to existing roadways, utilities, or other facilities. Repair or replace roadways, utilities, or other facilities to the preconstruction condition.

B. Control Fill Method.

1. Control Strip. Construct a control strip to determine compaction requirements. Construct a new control strip for each change in the character or source of the material or for any change in the compaction equipment. Each control strip is to remain in place and become a portion of the completed embankment.

Obtain RE approval of the subgrade or course upon which a control strip is to be constructed before constructing the control strip. Construct a 400-square yard or greater control strip consisting of 3 equally thick lifts not exceeding 12 inches each.

Compact each of the first 2 lifts of the control strip using the directed method as specified in 203.03.02.C.

Compact the third lift of the control strip with a minimum of 2 passes of the compaction equipment. Continue compacting until additional passes result in no appreciable increase in density. The ME will determine density of the control strip according to AASHTO T 310 (Direct Transmission Method). Provide a final lift surface that is smooth, dense, and free from ruts and roller marks.

After the Contractor completes compaction of the control strip, the ME will perform a minimum of 10 tests at random locations to determine the average in-place dry density of the control strip. If the average dry density of the material in the control strip is equal to or greater than 95 percent of its maximum density as determined according to AASHTO T 99, Method C, including the replacement option, then the RE will approve the compaction equipment and its method of use for compaction of embankment of the same materials and thicknesses on the Project. If the control strip fails to achieve the required density, remove and construct a new control strip. Revise compaction operations for subsequent control strips to achieve the required density.

2. Embankment. Continue constructing the embankments in the same manner as the approved control strip. If an area is inaccessible to the compacting equipment used to construct the control strip, compact each lift to a

density of at least 95 percent of the maximum density as determined according to AASHTO T 99, Method C. The ME will determine the density of such inaccessible areas from the average of 5 randomly located measurements according to AASHTO T 310 (Direct Transmission Method).

C. Directed Method. Place embankment materials, except rock, in lifts not exceeding 8 inches thick. Place rock as specified in 203.03.01.3. Compact each lift as specified in Table 203.03.02-1.

Table 203.03.02-1 Compaction Requirements

Embankment Material	Equipment	Passes Per Lift
Sand, Sand and Gravel	Pneumatic-Tired Roller	5 minimum
	Dynamic Compactor	Number of passes to optimize density
Silt, Clay	Pneumatic-Tired Roller	5 minimum
	Padfoot Roller	8 minimum
Rock	3-Wheel 10-Ton Roller	4 minimum
	Dynamic Compactor (Vibratory roller with 6-ton min. static weight at drum)	2 to 5

If an area is inaccessible to the compacting equipment specified in Table 203.03.02-1, compact each lift following the density control method as specified in 203.03.02.D.

D. Density Control Method. If required, submit a dewatering plan including the method of dewatering and controlling sediment and contaminants from entering adjacent waterbodies, wetlands and environmentally sensitive areas. Dewater areas according to the dewatering plan before and during embankment construction if areas are below the water table. Construct embankment in lifts not exceeding 12 inches thick after compaction. Do not blend I-9 soil aggregate to meet gradation requirements at the placement site. Compact embankment materials to a density of at least 95 percent of maximum density. For bridge foundations without piles, determine maximum density according to AASHTO T 180, Method D, including the replacement option. For other instances, determine maximum density according to AASHTO T 99, Method C, including the replacement option. The ME will determine the compacted density of embankments by taking the average of 5 randomly located measurements for each course or at a minimum of each 3-foot increment of elevation according to AASHTO T 310 (Direct Transmission Method).

If any individual measurement is less than 90 percent of the maximum density, or the average is less than 95 percent of the maximum density, continue compaction or take corrective action until the ME verifies that the required density is achieved.

203.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
BREAKING PAVEMENT	SQUARE YARD
___ SOIL AGGREGATE	CUBIC YARD

The Department will not include payment for breaking pavement in ___ SOIL AGGREGATE. The Department will make payment for breaking pavement under BREAKING PAVEMENT.

Payment for I-14 SOIL AGGREGATE will not include quantities of I-14 SOIL AGGREGATE constructed from material excavated or reused from the Project.

The Department will make payment for SESC measures as specified in 158.04.

The Department will pay for temporary seeding under FERTILIZING AND SEEDING, TYPE ___ as specified in 806.04.

DIVISION 300 – SUBBASE AND BASE COURSES

SECTION 301 – SUBBASE

301.01 DESCRIPTION

This Section describes the requirements for constructing 1 or more courses of subbase.

301.02 MATERIALS

301.02.01 Materials

Provide materials as specified:

Soil Aggregate (I-3) 901.11

301.02.02 Equipment

Provide equipment as specified:

Pneumatic-Tired Compactor 1002.01
Dynamic Compactor 1002.02
Steel Wheel Roller 1002.03
Padfoot Roller 1002.04

301.03 CONSTRUCTION

301.03.01 Subbase

A. Preparing Subgrade. Before placing subbase, ensure that the subgrade has been graded and compacted to within a tolerance of ±1/2 inch of the required elevation. The RE will check elevations of the roadbed subgrade as specified in 202.03.03.C. Do not prepare the subgrade during freezing weather, when frozen, or when it is unstable. Correct damage to the subgrade caused by construction activities and maintain the corrected subgrade until the subsequent course is placed.

B. Spreading and Grading. Do not place subbase material when the subgrade is frozen or unstable. Notify the RE if the finished subgrade is unstable and obtain RE approval before removing unstable material. Backfill the area with suitable material and compact using the directed method as specified in 203.03.02.C.

Spread the subbase material with equipment except in limited or restricted areas where the use of hand spreading is allowed. If approved by the RE, end-dump the subbase material. Spread the subbase material in a manner that does not break down material and eliminates segregation, ruts, and ridges.

C. Compacting. Place the subbase in 8-inch maximum lifts and compact within a tolerance of ±1/2 inch of the required elevation. For subbase courses greater than 8 inches thick, construct the subbase course in 2 or more lifts of approximately equal thickness.

Begin compacting at the sides and gradually progress to the center. On superelevated curves, compact from the lower to the upper edge, parallel to the centerline, and uniformly overlap each preceding track until the entire surface has been compacted.

If constructing concrete base or surface courses directly on subbase, the ME will measure the compaction using the density control method as specified in 203.03.02.D. If constructing aggregate base course or HMA on the subbase, the ME will measure compaction using the control fill method as specified in 203.03.02.B.

Correct damage to the subbase caused by construction activities, and maintain the corrected subbase until the subsequent course is placed. Do not allow traffic on the subbase. Remove all standing storm water and obtain the RE's approval before constructing subsequent courses.

The RE will check elevations of the roadbed subbase as specified in 202.03.03.C to ensure that subbase elevations are within a tolerance of ±1/2 inch.

301.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
SUBBASE	CUBIC YARD

SECTION 302 – AGGREGATE BASE COURSE

302.01 DESCRIPTION

This Section describes the requirements for constructing aggregate base courses.

302.02 MATERIALS

302.02.01 Materials

Provide materials as specified:

DGA 901.10
Soil Aggregate (I-5) 901.11

Where I-5 soil aggregate is specified, the Contractor may substitute DGA with the approval of the RE.

302.02.02 Equipment

Provide equipment as specified:

Pneumatic-Tired Compactor 1002.01
Dynamic Compactor 1002.02
Steel Wheel Roller 1002.03
Padfoot Roller 1002.04

302.03 CONSTRUCTION

302.03.01 Aggregate Base Course

A. Preparing Subgrade or Subbase. Before placing base course on subgrade or subbase, prepare surfaces as specified in 301.03.01.

B. Density Control Strip. Obtain RE approval of the underlying surface before constructing the density control strip. Before constructing the aggregate base course, construct a density control strip using the same type of material from the same source as the aggregate base course. Construct additional density control strips if a change is made in the type or source of material, if a significant change occurs in the composition of the material from the same source, or if a change is made in the type of compaction equipment used, as determined by the ME. Provide at least 400 square yards for each density control strip. Construct a density control strip for each thickness specified for the aggregate base course. Ensure that the moisture content for the test strip material is within 2 percent of its optimum moisture content according to AASHTO T 99, Method C, including replacement option.

Place and spread aggregate base course as specified in 301.03.01.B. Place the base course and compact within a tolerance of ±1/2 inch of the required elevation. Ensure that no compacted lift exceeds a thickness of 8 inches. For base courses greater than 8 inches thick, construct the base course in 2 or more lifts of approximately equal thickness.

Compact the density control strip using the same type and weight of equipment that will be used for compaction of the aggregate base course. Compact the density control strip with a minimum of 2 passes of the compaction

equipment. A pass is defined as 1 passage of each compacting element in use of the compaction equipment over the entire surface of the course. After each pass of the compaction equipment transverses the density control strip, the ME will make 3 density determinations according to AASHTO T 310. Continue compacting until no appreciable increase in density is obtained by additional passes.

After the Contractor completes compaction of the control strip, the ME will take at least 10 density tests at random locations to determine the average in-place dry density of the density control strip. If the average density of the material in the density control strip is equal to or greater than 95 percent of its maximum density, as determined according to AASHTO T 99, Method C, including replacement option, then use the value of this average as the reference maximum density for courses of the same materials and thicknesses. Establish a density control strip satisfying the 95 percent density requirement, according to AASHTO T 99, Method C, before constructing additional base courses. If this density level in the density control strip is not achieved, the RE will reject the compaction equipment, its method of use, or both. If approved by the RE, the density control strips may remain in place and become a portion of the completed base course.

The RE will check elevations, as specified in 202.03.03.C, of the roadbed base course to ensure that base course elevations are within ±1/2 inch.

C. Aggregate Base Course Placement. Construct the aggregate base course in the same manner as the approved density control strip.

If less than 500 contiguous square yards of aggregate base course is being constructed, place and spread the aggregate base course as specified in 301.03.01.B. Place the base course and compact within a tolerance of ±1/2 inch of the required elevation. Compact the base course areas as specified in 203.03.02.D and ensure that no compacted lift exceeds a thickness of 8 inches. For base courses greater than 8 inches thick, construct the base course in 2 or more lifts of approximately equal thickness.

D. Thickness Requirements. The RE will measure thickness, by test holes or by calculating the difference in elevations between the base course and the underlying layer. Refill test holes with base course material and recompact using the directed method as specified in 203.03.02.C.

If the total thickness of base course differs from specified thickness by more than 1/2 inch, correct deficient areas as follows:

1. Scarify the base course to a depth of 3 to 4 inches.
2. Ensure that remaining material is contaminant free.
3. Add or remove base course material to obtain the required grade while the existing surface is in a loose, scarified condition.
4. Compact using the same method used for the density control strip.

E. Compaction Acceptance Testing. The ME will divide the base course into lots of approximately 5000 square yards or 1000 cubic yards. The ME will test each lot of completed base course for compliance. The ME will determine the 5 locations for density tests using a table of random numbers. The ME will make 1 density determination at each of the selected locations. To determine acceptability, use the following procedure:

1. Formula. Calculate Q using the following formula:

$$Q = \frac{\text{Average Lot Density - 0.95 of the Reference Maximum Density}}{\text{Range of Lot Density}}$$

Where average lot density is the average dry density of 5 randomly selected locations in the lot and the range of lot density is the absolute difference between the lowest and highest dry density values recorded at these same 5 locations. The reference maximum density is determined by the method specified in 302.03.01.B.

2. Criteria. Q must be equal to or greater than 0.36.

If a lot is unacceptable, rework or recompact the lot.

302.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
SOIL AGGREGATE BASE COURSE, ___" THICK	SQUARE YARD
SOIL AGGREGATE BASE COURSE, VARIABLE THICKNESS	CUBIC YARD
DENSE-GRADED AGGREGATE BASE COURSE, ___" THICK	SQUARE YARD
DENSE-GRADED AGGREGATE BASE COURSE, VARIABLE THICKNESS	CUBIC YARD

SECTION 303 – ASPHALT-STABILIZED DRAINAGE COURSE

303.01 DESCRIPTION

This Section describes the requirements for constructing asphalt-stabilized drainage course.

303.02 MATERIALS

303.02.01 Materials

Provide materials as specified:

Asphalt-Stabilized Drainage Course 902.06

303.02.02 Equipment

Provide equipment as specified:

HMA Paver 1003.03
HMA Compactor 1003.05
Vibratory Drum Compactor 1003.06
Bituminous Material Distributor 1003.07
HMA Plant 1009.01
HMA Trucks 1009.02

303.03 CONSTRUCTION

303.03.01 Asphalt-Stabilized Drainage Course

A. Paving Plan. At least 20 days before the start of placing the asphalt-stabilized drainage course, submit a detailed plan of operation to the RE for approval as specified in 401.03.03.A.

B. Weather Limitations. Comply with the weather limitations as specified in 401.03.03.B.

C. Transportation and Delivery of HMA. Transport and deliver HMA as specified in 401.03.03.D.

D. Spreading and Grading. Ensure that the prime coat has been applied as specified in 401.03.02.3. Place asphalt-stabilized drainage course at a laydown temperature of at least 250 ± 40 °F. Spread and grade asphalt-stabilized drainage course in 1 lift as specified in 401.03.03.E.

E. Compacting. Compact as specified in 401.03.03.F. Ensure that the temperature is 210 ± 40 °F before beginning compacting.

F. Thickness Requirements. Ensure that the thickness of the drainage course is within ±1/4 inch of the specified thickness and that the elevation of the compacted course is within ±1/4 inch of the required elevation. The RE will check elevations of the asphalt-stabilized drainage course as specified in 202.03.03.C.

G. Protecting. Protect the drainage course from damage and contamination. Remove and replace damaged and contaminated areas. Only allow equipment on the drainage course that is necessary for the construction of the subsequent pavement course.

303.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
ASPHALT-STABILIZED DRAINAGE COURSE	TON

The Department will measure ASPHALT-STABILIZED DRAINAGE COURSE by the ton as indicated on the certified weigh tickets excluding unused material and material used to replace damaged or contaminated.

The Department will make payment for PRIME COAT as specified in 401.04.

SECTION 304 – CONCRETE BASE COURSE

304.01 DESCRIPTION

This Section describes the requirements for constructing concrete base course.

304.02 MATERIALS

304.02.01 Materials

Provide materials as specified:

Concrete 903.03
Curing Materials 903.10
Epoxy Grout 903.08.02.B
Reinforcement Steel 905.01
Tie Bars (epoxy-coated) 905.03.01
Joint Ties (epoxy-coated) 905.03.01
Dowel Bars (epoxy-coated) 905.03.03
Joint Sealers 914.02

304.02.02 Equipment

Provide equipment as specified:

Sealer Application System 1003.08
Pavement Forms 1005.01
Spreading and Finishing Machine 1005.02
Vibrator 1005.04
Slip Form Paver 1005.05
Straightedge 1008.02
Pavement Saw 1008.04
Hot-Air Lance 1008.06
Concrete Batching Plant 1010.01
Concrete Trucks 1010.02

304.03 CONSTRUCTION

304.03.01 Concrete Base Course

Prepare the underlying material as specified in 405.03.01. At least 20 days before placing the concrete base course, submit a detailed plan of operation to the RE for approval as specified in 405.03.02.A. Comply with the concrete placing

limitations as specified in 504.03.02.C. When shown on the Plans, install longitudinal joint ties, tie bars, and contraction joint assemblies as specified in 405.03.02. When shown on the Plans, install dowel bars as specified in 453.03.01.C. When shown on the Plans, install reinforcement steel as specified in 504.03.01.

Place concrete for concrete base course as specified in 405.03.02.D. Ensure that the concrete is not exposed for more than 30 minutes after finishing. The RE will direct a suspension, as specified in 108.13, of concrete operations if the curing procedure is delayed or is not followed. Apply wet burlap and white polyethylene sheeting as specified in 504.03.02.F.2. Maintain the curing material for 7 days. Protect concrete, as specified in 504.03.02.I, for the duration of the curing period. Construct wood bridging for pedestrian crossovers at street intersections and at other established pedestrian crosswalks.

Sawcut relief joints as specified in 405.03.02.G. Saw and seal contraction joints as specified in 405.03.02.H.

The RE may randomly test thickness by taking 1 core, as specified in 405.03.03, per slab. If the thickness of any core measures less than the value of the design thickness minus 1/2 inch, remove and replace the deficient area between transverse joints using RE approved methods.

304.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
CONCRETE BASE COURSE, ___ " THICK	SQUARE YARD
CONCRETE BASE COURSE, REINFORCED, ___ " THICK	SQUARE YARD

The Department will make payment for UNDERLAYER PREPARATION as specified in 405.04.

When concrete curb is constructed monolithically with the base course, the Department will make payment for concrete curb under the various curb Items scheduled in the Proposal.

SECTION 305 – RUBBLIZING CONCRETE PAVEMENT

305.01 DESCRIPTION

This Section describes the requirements for rubblizing existing concrete pavement and seating before placing a HMA overlay.

305.02 MATERIALS

305.02.01 Materials

Provide materials as specified:

DGA 901.10

305.02.02 Equipment

Provide equipment as specified:

Resonant Method
- Breaking Equipment 1006.01.A
- Smooth Drum Vibratory Roller 1006.02.B

Multi-Head Method
- Breaking Equipment 1006.01.B
- Z-Grid Roller 1006.02.A
- Smooth Drum Vibratory Roller 1006.02.B

Provide breaking equipment, as required by the TCP, capable of operating within 1 foot of barrier curbs and structures.

305.03 CONSTRUCTION

305.03.01 Rubblizing

A. Existing Subsurface Facility Investigation. Obtain RE approval of the method of inspecting existing subsurface facilities for existing conditions. Inspect the existing subsurface facilities within the limits of rubblization.

B. Installing Drainage System. Ensure that the entire underdrain system is installed at least 15 days before beginning rubblization.

C. Removing Existing HMA Surfaces. Before beginning rubblization, remove existing HMA overlays and HMA surface patches from the concrete pavement surfaces to be rubblized. Remove existing full-depth HMA repairs and fill the void with DGA.

D. Sawcutting Joints. If the limit of the rubblization is not at an existing joint, or if the concrete being rubblized abuts concrete pavement to be rubblized in a subsequent stage, sawcut the concrete full-depth.

E. Rubblization Plan. Submit a rubblization plan to the RE 15 days before beginning rubblizing operations that includes the following:

1. Condition of existing subsurface facilities as determined in 305.03.01.A.
2. Rubblization method and associated equipment.
3. Seating method and associated equipment.
4. Rubblizing and paving sequence for the Project.
5. Method for locating grade corrections and placing DGA as specified in 305.03.01.J.
6. Method for protecting subsurface facilities.
7. Dust mitigation measures.
8. Method for performing a survey of the condition of the existing subsurface facilities after the rubblization operations.

Do not begin test strip until the RE accepts this plan. Submit an adjusted rubblization plan before making adjustments to the operation.

F. Test Strip. Before beginning rubblization, the RE will designate a 500-foot long, full lane width, or an area of approximately 600 square yards, for the test strip. Rubblize the test strip using varying intensities of energy until a technique is established that will rubblize the pavement as specified. At a location determined by the RE, excavate a full depth, 3-foot wide test pit for the full width of the test strip to determine that the breaker is producing pieces of the specified sizes. The RE may require additional test holes. Use DGA to backfill excavated areas. Place DGA in lifts and compact using the density control method as specified in 203.03.02.D.

If required results are not being obtained, cease rubblizing operations and submit an alternate rubblization plan capable of obtaining the specified results to the RE. Resume rubblizing operations upon acceptance of the alternate plan. Repeat this procedure as necessary to obtain the specified results.

G. Rubblizing. Rubblize the pavement full-depth in a manner that eliminates all slab action by fracturing into pieces 3 inches or less in any dimension in the top third of the pavement and 12 inches or less in any dimension in the bottom two-thirds of the pavement. Prevent rubblized debris from entering an active traffic lane.

Rubblize in partial widths when necessary to maintain traffic as shown on the plans. In areas where the roadway must be overlaid 1 lane at a time, extend initial rubblization a minimum of 6 inches beyond the width of the pavement to be overlaid.

For the resonant method begin at a free edge or previously broken edge and progress toward the opposite shoulder or longitudinal centerline of the road. When necessary, overlap passes to achieve rubblization.

Continuously monitor rubblization to ensure that the operation is achieving the specified results. Notify the RE of adjustments that may be required. The RE may require additional test holes to ensure that pieces are free of bond with reinforcement and to ensure that the pavement is being rubblized to the specific dimensions.

H. Seating. Seat rubblized pavement with rollers operating at a speed not exceeding 2-1/2 miles per hour. Seat rubblized pavement using the applicable method:

1. **Resonant Method.** Roll the rubblized pavement with a minimum of 3 passes over the entire width of the rubblized pavement with a vibratory roller.

2. **Multi-Head Method.** Roll the entire width of the rubblized pavement with 2 passes of a "Z-Grid" roller, followed by 2 passes of a smooth drum vibratory roller.

The RE may require additional passes in order to seat the rubblized pavement and provide a smooth surface that is ready for the HMA overlay. If the rubblized pavement becomes unstable due to excess moisture, cease rolling until the RE allows the operation to resume.

I. Removing Exposed Reinforcement Steel and Transverse Joint Assemblies. For reinforced concrete pavement, leave debonded reinforcement steel in place unless exposed. Cut exposed reinforcement steel 1 inch below the surface and remove. Remove exposed transverse joint assemblies. Remove exposed joint filler, expansion materials, or other similar items. Patch deficiencies left by removing joint assemblies as specified in 305.03.01.J.

J. Patching and Leveling with DGA. At the direction of the RE, remove unstable material full depth and replace with DGA. Compact DGA in lifts using the directed method as specified in 203.03.02.C.

If the seated rubblized pavement is more than 1-1/2 inch below grade, correct with DGA as approved by the RE. Place DGA and compact using the directed method as specified in 203.03.02.C.

K. Repairing Subsurface Facilities. If damage occurs to subsurface facilities during rubblization, immediately cease operations, notify the RE, and repair the damage as directed by the RE.

L. Final Subsurface Facility Survey. Perform a final survey of the subsurface facilities after completion of rubblization and submit to the RE. Repair damage as directed by the RE.

M. Protecting Rubblized Pavement from Damage. Protect the rubblized pavement from contamination and damage. Correct areas of the rubblized pavement damaged by construction operations or contamination before placing HMA. Only allow equipment on the rubblized pavement that is necessary for the construction of the subsequent pavement course.

Ensure that no more than 48 hours elapse between rubblizing the pavement and the placement of the first lift of the HMA overlay. If precipitation occurs before placing the HMA overlay, the RE may extend the time restriction to allow the rubblized pavement to dry.

305.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
RUBBLIZATION	SQUARE YARD

The Department will measure EXCAVATION, UNCLASSIFIED in unstable areas by the cubic yard of material actually excavated in the work. The Department will make payment for EXCAVATION, UNCLASSIFIED as specified in 202.04.

The Department will measure DGA used for DGA patching and leveling by the cubic yard of material actually used in the work. The Department will make payment for DENSE GRADED AGGREGATE BASE COURSE, VARIABLE THICKNESS ___ as specified in 302.04.

DIVISION 400 – PAVEMENTS

SECTION 401 – HOT MIX ASPHALT (HMA) COURSES

401.01 DESCRIPTION

This Section describes the requirements for constructing base course, intermediate course, and surface course of HMA.

401.02 MATERIALS

401.02.01 Materials

Provide materials as specified:

Tack Coat 64-22, PG 64-22 ..... 902.01.01
Prime Coat, Cut-Back Asphalt, Grade MC-30 or MC-70 ..... 902.01.02
Tack Coat:
Cut-Back Asphalt, Grade RC-70 ..... 902.01.02
Emulsified Asphalt, Grade RS-1, SS-1, SS-1h, Grade CSS-1 or CSS-1h 902.01.03
HMA 902.02
Joint Sealer, Hot-Poured 914.02
Polymerized Joint Adhesive 914.03

Use HMA specified for the roadway surface as patching material for HMA pavement repair. The Contractor may use a commercial type of cold mixture as patching material for filling core holes if HMA surface course is not being placed when coring. The Contractor may use an approved HMA surface course to fill core holes, provided the material remains hot enough to compact.

401.02.02 Equipment

Provide equipment as specified:

Materials Transfer Vehicle (MTV) 1003.01
HMA Paver 1003.03
HMA Compactor 1003.05
Vibratory Drum Compactor 1003.06
Bituminous Material Distributor 1003.07
Sealer Application System 1003.08
Milling Machine 1008.01
Hot-Air Lance 1008.06
HMA Plant 1009.01
HMA Trucks 1009.02
Mechanical Sweeper 1008.03

Provide a thin-lift nuclear density gauge according to ASTM D 2950.

Install a paver hopper insert with a minimum capacity of 14 tons in the hopper of the HMA Paver.

401.03 CONSTRUCTION

401.03.01 Preparing Existing Pavement

A. Milling of HMA. Mill HMA to the specified depth, profile, and cross slope. Operate milling machine to produce milled material that passes a 3-inch sieve. Use automatic grade controls to control the line and grade of the milling machine. Use either a stringline or ski reference system. Replace teeth in the milling drum that become dislodged, broken, or unevenly worn. Perform milling operation, including removal of the milled material, in a manner that prevents dust and other particulate matter from escaping into the air.

Ensure that the milled area is free from gouges, continuous grooves, ridges, and delaminated areas and has a uniform texture consisting of discontinuous longitudinal striations. Ensure that the striations do not deviate more than 1 inch in 200 feet from a line parallel to the center of the traveled way and do not exceed 3/8 inch in depth. Check at least every 25 feet to ensure that the depth of milling is within 1/4 inch of the indicated depth.

Mill HMA to the depth specified without damaging underlying HMA. If HMA below the specified milling level becomes dislodged or delaminated, remove and replace.

When profile milling, ensure the cutting depth is sufficient to remove ruts and corrugations and to scarify the remaining surface.

Using a mechanical sweeper, clean the milled area before opening to traffic and before subsequent construction or resurfacing. Reuse millings and sweepings as specified in 202.03.07.A.

If the milled area is opened to traffic, ensure that water can drain from the surface and does not become trapped. If the longitudinal edge height of a milled surface exceeds 2 inches, slope the edge to provide a smooth transition from the milled surface to the remaining pavement. At transverse edges of milled areas, provide a smooth transition from the milled surface to the remaining pavement.

In areas inaccessible to the milling machine, remove HMA with other equipment.

The Department will provide the time interval for resurfacing the milled areas in the Special Provisions.

B. Milling of Concrete. Mill concrete pavement to 1-inch depth at the locations shown on the Plans without damaging the underlying pavement. Ensure that the milled area is free from gouges, continuous grooves, ridges, and delaminated areas and has a uniform texture consisting of discontinuous longitudinal striations. Ensure that the striations do not deviate more than 1 inch in 200 feet from a line parallel to the center of the traveled way and do not exceed 3/8 inch in depth. Perform milling operations, including removal of the milled material, in a manner that prevents dust and other particulate matter from escaping into the air.

Mill 1 inch of concrete and any remaining HMA not removed by previous milling operations at locations shown on the Plans. Based on the condition of the remaining pavement, the RE may direct additional areas to be milled.

If milling transition areas for HMA overlays, mill the transition from 0 to 1 inch in depth over a length of 100 feet. Construct a keyway at the terminal transverse limit of the area to be milled by sawcutting and removing the material within this area by hand methods so as to produce a vertical face.

Using a mechanical sweeper, clean the milled area before opening to traffic and before subsequent construction or resurfacing. Reuse millings and sweepings as specified in 202.03.07.A.

If the milled area is opened to traffic, ensure that water can drain from the surface and does not become trapped. If the longitudinal edge height of a milled surface exceeds 2 inches, slope the edge to provide a smooth transition from the milled surface to the remaining pavement. At transverse edges of milled areas, provide a smooth transition from the milled surface to the remaining pavement.

In areas inaccessible to the milling machine, remove concrete with other equipment.

C. Sealing Cracks in HMA Surface Course. Seal cracks that are 1/4 inch wide or wider. Clean cracks to a depth of 1 inch using a random crack saw, carbide-tipped, rotary-impact router, commercial power-driven wire brush, or by other RE approved means. Provide acceptable protective screening if the cleaning operation causes damage to or interference with traffic in adjacent lanes.

Immediately before applying sealant, clean cracks and dry further with a hot-air lance.

At least 10 day before beginning the work, submit to the RE a copy of the manufacturer's recommendations for heating and applying the sealant. Seal cracks with hot-poured joint sealant according to the manufacturer's recommendations. Cut sealant into small pieces to facilitate slow and uniform melting with constant stirring. Ensure that the temperature of the sealant in the field application equipment does not exceed the recommended safe heating temperature. Do not heat sealant material at the pouring temperature for more than 6 hours and do not reheat.

Pour sealant into the cracks so that, upon completion of the work, the surface of the sealant is flush with or not more than 1/4 inch lower than the surface of the adjacent HMA surface course. If the sealant subsides to a lower level, perform another pouring. When more than 1 pour is required to fill the cracks, perform succeeding pours

immediately after shrinkage of the previous pouring. If spilling or overfilling occurs, immediately squeegee the crack. If the RE determines that the overfilled crack or spilled sealant creates a slippery, hazardous, or otherwise undesirable condition, initially correct the area by sprinkling a light application of abrasive (sand or grit material) to absorb the excess material, restore skid-resistance, and abate the condition caused by the overpour. After the excess material has been absorbed, hand sweep the area clean, and restore to its original condition or texture to the RE's satisfaction.

Do not allow traffic or construction equipment over the poured cracks until the sealant has hardened sufficiently to resist pickup. The RE may direct sprinkling of dry sand over poured areas to provide additional pickup resistance.

D. Repairing HMA Pavement. Sawcut existing HMA pavement to a maximum depth of 10 inches, or to the full depth of bound layers, whichever is less. Sawcut lines parallel and perpendicular to the roadway baseline and 3 inches away, at the closest point, from the damaged area to be repaired. For larger areas, the Contractor may use a milling machine for removal of HMA pavement.

Remove material within the boundary of the sawcuts to form rectangular openings with vertical sides, and clean the area. Shape and compact the underlying surface to produce a firm, level base. Ensure that the remaining pavement is not damaged.

Apply polymerized joint adhesive or tack coat to the vertical surfaces of the openings. Backfill with HMA as specified for the roadway surface. Ensure that the temperature of the HMA when placed is at least 250 °F, and compact as specified in 401.03.03.F. Compact areas not accessible to rollers with a vibratory drum. Compact until the top of the patch is flush with the adjacent pavement surface.

Reuse removed material as specified in 202.03.07.A.

401.03.02 Tack Coat and Prime Coat

Clean the surface where the HMA is to be placed of foreign and loose material. Immediately before beginning paving operations, ensure that the surface is dry. Do not place tack coat or prime coat unless the weather restrictions, as specified in 401.03.03.B, are met.

Do not apply tack coat or prime coat to asphalt-stabilized drainage course.

For curbs, gutters, manholes, and other similar structures, do not apply tack coat or prime coat. Clean the exposed surfaces of these structures and apply a uniform coating of polymerized joint adhesive to contact surfaces before paving.

In areas inaccessible to distributor spray bars, use hand spraying equipment for tack and prime coat. Do not allow traffic on tack coated or prime coated surfaces. Treat surfaces as follows:

1. **Tack Coat.** Uniformly spray tack coat when placing HMA on paved surfaces. Apply tack coat only to areas to be paved in the same day. Apply tack coat as specified in Table 401.03.02-1:

Table 401.03.02-1 Tack Coat Application

Material	Spraying Temp, °F	Gallons per Square Yard	Season
Cut-Back Asphalt:			
RC-70	120 to 190	0.02 to 0.08	Oct 15 to Apr 15
Emulsified Asphalt:			
RS-1	70 to 140	0.02 to 0.08	All year
SS-1, SS-1h	70 to 140	0.04 to 0.15	All year
CSS-1, CSS-1h	70 to 140	0.04 to 0.15	All year

Correct uncoated or lightly coated areas. Blot areas showing an excess of tack coat with sand or other similar material. Remove blotting material before paving. Ensure that the material is not streaked or ribboned.

Before paving, allow tack coat to cure to a condition that is tacky to the touch.

2. **Tack Coat 64-22.** When precipitation has occurred within 24 hours before application, the RE will determine whether to allow the work to proceed, or to wait until the surface is completely dry. Only apply tack coat that can be paved over in the same day. Apply tack coat 64-22 at a rate of 0.06 to 0.14 gallons per square yard and

at a spraying temperature of 325 °F. Adjust the spraying temperature and application rate to produce a uniform coating, with no excess material.

Correct uncoated or lightly coated areas and remove excess tack coat from affected areas. Ensure that the material is not streaked or ribboned.

3. **Prime Coat.** Apply prime coat of cut-back asphalt on unpaved surfaces as follows:

Table 401.03.02-2 Prime Coat Application

Cut-Back Asphalt	Spraying Temp, °F	Gallons per Square Yard	Season
MC-30	85 to 150	0.15 to 0.35	All year
MC-70	120 to 190	0.15 to 0.35	All year

Apply prime coat at least 12 hours before placement of the HMA and when the base courses are not saturated or frozen. Unless the prime coat is under asphalt-stabilized drainage course, the RE may waive the application of prime coat if more than 5 inches of HMA is placed on the unbound aggregate course before the roadway is opened to traffic. Take measures to prevent prime coat from entering into the drainage system or extending beyond the area to be paved.

401.03.03 HMA Courses

A. Paving Plan. At least 20 days before beginning placing the HMA surface course, submit a detailed plan of operation to the RE for approval that includes the following:

1. Asphalt paving construction technologist (APCT), certified by the Society of Asphalt Technologists of New Jersey, Inc. The Department will accept the equivalent certification by the Mid-Atlantic Regional Technician Certification Program.
2. Size and description of crew.
3. Number, type, and model of equipment.
4. Lighting plan for nighttime operations as specified in 108.06.
5. Method of locating and maintaining joint locations if sawing and sealing.
6. Manufacturer's recommendations for heating and applying joint sealant.
7. Paving procedures for maintaining continuous operation as specified in 401.03.03.D.
8. Manufacturer's recommended laydown temperature for modified binders.
9. Paving sequence. Ensure that the HMA surface course is constructed for the full width of the traveled way, shoulder, and auxiliary lanes as a single paving operation.
10. Schedule, hours of operation, and production rates for the Project.
11. Plant locations.
12. Method of maintaining HMA temperature during transportation.
13. Method of constructing and compacting joints as specified in 401.03.03.E.
14. Quality control plan outlining the use of the thin lift nuclear density gauge, quality control cores, and the control of the compaction process.

Do not begin paving until the RE approves this plan. Submit an adjusted pavement plan before making adjustments to the paving operation.

B. Weather Limitations. Do not place HMA if it is precipitating. Do not allow trucks to leave the plant when precipitation is imminent. The Contractor may resume operations when the precipitation has stopped and the surface is free of water.

When placing HMA, ensure that the base temperature meets the minimum temperature requirements specified in Table 401.03.03-1.

Table 401.03.03-1 Minimum Base Temperature

Lift Thickness, inches (t)	Minimum Base Temperature, °F
$t \leq 1$	50
$1 < t < 2$	41
$t \geq 2$	32

C. Test Strip. Construct a test strip for contracts with more than 5500 tons of HMA. Test strips are not necessary for temporary pavement. Ensure that the tack coat or prime coat has been placed as specified in 401.03.02, before placing HMA. Transport and deliver, spread and grade, and compact as specified in 401.03.03.D, 401.03.03.E, and 401.03.03.F, respectively, and according to the approved paving plan. Construct a test strip for the first 700 to 1200 square yards placed for each job mix formula. While constructing the test strip, record the following information and submit to the RE:

1. **Ambient Temperature.** Measure ambient temperature at the beginning and end of each day's paving operation.
2. **Base Temperature.** Measure the surface temperature of the existing base before paving.
3. **HMA Temperature.** Measure the temperature of the HMA immediately after placement.
4. **Roller Pattern.** Provide details on the number of rollers, type, and number of passes used on the test strip.
5. **Nuclear Density Gauge Readings.** Obtain the maximum density from the plant, and input it into the nuclear density gauge. Use the nuclear density gauge to read the bulk density and percent air voids.
6. **Quality Control Core Density Test Results.** Take 5 randomly selected quality control cores to test for the bulk specific gravity and the maximum specific gravity.

   Use drilling equipment with a water-cooled, diamond-tipped, masonry drill bit that shall produce 6-inch nominal diameter cores for the full depth of the pavement. Remove the core from the pavement without damaging it. After removing the core, remove all water from the hole. Fill the hole with HMA or cold patching material, and compact the material so that it is 1/4 inch above the surrounding pavement surface.

   Compare the nuclear density gauge readings and the core test results to establish a correlation. Use this correlation as a guide for the continued use of the nuclear density gauge for density control.

Upon completion of the test strip, the Contractor may continue paving. If the Contractor does not continue paving, the Department will accept the test strip as 1 lot regardless of size.

If the test strip does not meet requirements, make adjustments and construct a second test strip. If the second test strip does not meet requirements, suspend paving operations until written approval to proceed is received.

Before making adjustments to the paving operations, notify the RE in writing.

D. Transportation and Delivery of HMA. Deliver HMA using HMA trucks in sufficient quantities and at such intervals to allow continuous placement of the material. Do not allow trucks to leave the plant within 1 hour of sunset unless nighttime lighting is provided as specified in 108.06. The RE will reject HMA if the HMA trucks meet the requirements specified in 1009.02. The RE will suspend construction operations if the Contractor fails to maintain a continuous paving operation. Before the truck leaves the plant, obtain a weigh ticket from a fully automatic scale. Before unloading, submit for each truckload a legible weigh ticket that includes the following:

1. Name and location of the HMA plant.
2. Project title.
3. Load time and date.
4. Truck number.
5. Mix designation.
6. Plant lot number.
7. Tare, gross, and net weight.

A certified weighmaster shall sign and affix a seal to the weigh tickets.

In the event of breakdown of an automatic printer system, the RE will accept weigh tickets showing the tare, gross, and net weight of each truck, as entered and certified by a weighmaster for a period not exceeding the necessary repair time as certified by a licensed repairman.

When using an automated batching plant, obtain weigh tickets from the printer used in conjunction with an automated batching and mixing system. The printed ticket shall show the individual weights of the various components of the HMA in a batch, the total weight of each batch, and the sum of all batch weights in the truckload. At the completion of each day's work, a producer's representative shall certify that the total net weight supplied to each Contract was correct.

E. Spreading and Grading. If using a stringline reference system, ensure that the system is in place and approved by the RE before placing HMA. Ensure that the underlying surface meets line and grade as specified in 202.03.03.C. Before placing HMA, ensure that the tack coat or prime coat has been placed as specified in 401.03.02. Obtain RE approval of the underlying surface far enough in advance of spreading HMA to allow 1 day's paving operations.

Ensure that the certified APCT is present during paving operations.

Ensure that an MTV independently delivers HMA from the HMA trucks to the HMA paver.

Before beginning, ensure that the temperature of the screed on the HMA paver is heated to at least the laydown temperature of the HMA. Using the MTVs and HMA pavers, construct paving courses in lifts of at least 4 times the nominal maximum aggregate size of the HMA being constructed. Ensure that the grade and profile are maintained.

Where directed, use HMA having a nominal maximum aggregate size of 3/8 inch or less in transition (run out) areas. On areas where irregularities or unavoidable obstacles make use of a paver impractical, spread, rake, and lute HMA with hand tools. For these areas, dump, spread, and screed the HMA to obtain the required compacted thickness.

Construct joints as follows:

1. Longitudinal Joints. Perform paving with the spring-loaded end plates of the paver in the "down" position. The longitudinal joint in 1 lift shall offset that in the lift immediately below by approximately 6 inches. Offset the joint in the surface course from the lane lines by 6 inches. When constructing a joint between lanes of opposing traffic, offset the joint by 6 inches into either lane.

a. Echelon Paving. If a single paver does not spread the HMA the entire width of the roadway, use 2 or more pavers in echelon. Ensure that the trailing paver follows within 300 feet of the lead paver. Extend the screed and end gate of the trailing paver 1 inch over the uncompacted HMA placed by the lead paver. Ensure that the uncompacted HMA elevation from the trailing paver is equal to that from the lead paver at the joint. The Contractor may construct either a butt joint or a wedge joint. Do not rake the joint.

b. Cold Joint Paving. If echelon paving is not possible, construct the pavement using cold longitudinal joints. When constructing the first lane, compact so the line and grade of the edges of the HMA are not displaced. Construct longitudinal joints parallel to the centerlines within a tolerance of ±3 inches per 100 linear feet. If this tolerance is not met, trim or mill the edge of the HMA mat as necessary. Before paving the abutting lane, ensure longitudinal joints are free from dust and debris.

For surface course only, uniformly apply polymerized joint adhesive to longitudinal cold joint. Apply a 1/8-inch thick coating of polymerized joint adhesive over the entire joint face. Apply slowly to ensure an even coating thickness.

When maintaining traffic with a lift thickness greater than 2-1/4 inches, construct a wedge joint. The RE will permit a butt joint for lift thickness 2-1/4 inches or less when maintaining traffic, or for lift thickness greater than 2-1/4 inches when maintaining traffic is not required. Maintain a uniform width and depth of overlapped material at all times. Position the paver so that the HMA overlaps the edge of the lane previously placed by 1 to 2 inches. Leave the material sufficiently high to allow for compaction. Lute back overlapped material, pushing the material off of the cold HMA and onto the hot HMA mat directly over the joint. Remove excess material instead of broadcasting it across the new lift.

When compacted, ensure that the new mat at the joint is even or slightly higher (maximum 1/8 inch) than the previously placed adjoining mat. If the newly compacted mat results in a depression at the joint of 1/8 inch or more lower than the previously placed adjacent HMA lift, suspend all paving operations until corrective action is taken to prevent reoccurrence.

2. Transverse Joints. Construct transverse joints to provide a smooth riding surface. When using a bulkhead to form the joint, ensure that the bulkhead forms a straight line and vertical face. If a bulkhead is not used to form the joint, make the joint by sawing the compacted HMA for a sufficient distance behind the end of the placement to ensure full thickness and a smooth surface at the joint. Remove the full lift thickness of HMA ahead of the sawed joint. In either case, paint the joint face with polymerized joint adhesive before the fresh material is placed against it. Unless prohibited by field conditions, cross roll to obtain thorough compaction of these joints.

F. Compacting. Compact with the minimum number of rollers as specified in the Table 401.03.03-2.

Table 401.03.03-2 Compaction Requirements

Laydown Rate (r), yd^2/day	Minimum Number of Rollers
r ≤ 2000	1
2000 < r < 4000	2
r ≥ 4000	3

Orient the drive axles of the roller towards the paver during compaction operation. Operate rollers at a slow, uniform speed not exceeding 2-1/2 miles per hour. If necessary to prevent adhesion of the HMA to the rollers, keep the wheels moistened with water mixed with very small quantities of detergent.

Begin compacting at the sides and progress gradually to the center. On superelevated curves, compact from the lower to the upper edge parallel to the centerline and uniformly overlap each preceding track until the entire surface has been compacted.

Continue rolling until roller marks are eliminated and the air voids conform to the specified requirements.

Along forms, curbs, headers, walls, and other places not accessible to the rollers, compact the HMA by a vibratory drum compactor.

Remove and replace HMA that becomes loose, broken, or otherwise defective or that shows an excess or deficiency of asphalt binder material.

When paving in echelon, keep the rollers for the first lane approximately 6 inches from the unconfined edge adjacent to the second paving operation. After HMA from the second paver is placed against the uncompacted edge of the mat from the first paver, compact the HMA on both sides of the joint.

Prevent lateral or vertical displacement of the unconfined edge during the compaction operation. Ensure that the edge of the drums of the rollers extends over the free edge of the mat by at least 6 inches.

When compacting the butt or wedge joint, while paving the adjacent lane, place the roller on the newly placed HMA and overlap the joint by approximately 6 inches.

If a test strip was not required, establish a correlation between the nuclear density gauge and the cores as specified in 401.03.03.C.6. To adjust correlation with the thin lift nuclear density gauge, take 1 additional core every week during the paving operation. The RE may approve additional coring with valid cause presented by the Contractor. On a weekly basis, provide results of both the nuclear density and core testing to the RE. Provide core and nuclear density results that include the bulk specific gravity, the maximum specific gravity according to AASHTO T 209, and the percent air voids. Failure to submit the core and nuclear density test results from the previous week's paving will result in suspended paving operations.

G. Opening to Traffic. Remove loose material from the traveled way, shoulder, and auxiliary lanes before opening to traffic. Open HMA courses to traffic or construction equipment, including paving equipment, only after the surface temperatures meet the following requirements:

1. When using PG 64-22 or PG 70-22, do not allow traffic or construction equipment on the HMA course until the surface temperature is less than 140 °F.
2. When using PG 76-22, do not allow traffic or construction equipment on the HMA course until the surface temperature is less than 170 °F.

H. Air Void Requirements. Mainline lots are defined as the area covered by a day's paving production of the same job mixed formula between 1000 and 4000 tons for the traveled way and auxiliary lanes. The RE will combine daily production areas less than 1000 tons with previous or subsequent production areas to meet the minimum lot requirements. When the maximum lot requirement is exceeded in a day's production, the RE will divide the area of HMA placed into 2 lots with approximately equal areas.

Ramp pavement lots are defined as approximately 10,000 square yards of pavement in ramps. The RE may combine ramps with less than the minimum area into a single lot. If 2 or more ramps are included in a single lot, the RE will require additional cores to ensure that at least 1 core is taken from each ramp.

Other pavement lots are defined as approximately 10,000 square yards of pavement in shoulders and other undefined areas.

The ME will calculate the percent defective (PD) as the percentage of the lot outside the acceptable range of 2 percent air voids to 8 percent air voids. The acceptable quality limit is 10 percent defective. For lots in which PD < 10, the Department will award a positive pay adjustment. For lots in which PD > 10, the Department will assess a negative pay adjustment.

The ME will determine air voids from 5 cores taken from each lot in random locations. The ME will determine air voids of cores from the values for the maximum specific gravity of the mix and the bulk specific gravity of the core. The ME will determine the maximum specific gravity of the mix according to NJDOT B-3 and AASHTO T 209, except that minimum sample size may be waived in order to use a 6-inch diameter core sample. The ME will determine the bulk specific gravity of the compacted mixture by testing each core according to AASHTO T 166.

The ME will calculate pay adjustments based on the following:

1. **Sample Mean ($\overline{X}$) and Standard Deviation (S) of the N Test Results (X_1, X_2,..., X_N).**

$$\overline{X} = \frac{(X_1 + X_2 + \ldots + X_N)}{N}$$

$$S = \sqrt{\frac{(X_1 - \overline{X})^2 + (X_2 - \overline{X})^2 + \ldots + (X_N - \overline{X})^2}{N - 1}}$$

2. **Quality Index (Q).**

$$Q_L = \frac{(\overline{X} - 2.0)}{S}$$

$$Q_U = \frac{(8.0 - \overline{X})}{S}$$

3. **Percent Defective (PD).** Using NJDOT ST for the appropriate sample size, the Department will determine PD_L and PD_U associated with Q_L and Q_U, respectively. $PD = PD_L + PD_U$

4. **Percent Pay Adjustment (PPA).** Calculate the PPA for traveled way and ramp lots as specified in Table 401.03.03-3.

Table 401.03.03-3 PPA for Mainline Lots and Ramp Lots

	Quality	PPA
Surface	PD < 10	PPA = 4 − (0.4 PD)
	10 ≤ PD < 30	PPA = 1 − (0.1 PD)
	PD ≥ 30	PPA = 40 − (1.4 PD)
Intermediate and Base	PD < 30	PPA = 1 − (0.1 PD)
	PD ≥ 30	PPA = 40 − (1.4 PD)

Calculate the PPA for other pavement lots as specified in Table 401.03.03-4.

Table 401.03.03-4 PPA for Other Pavement Lots

	Quality	PPA
All Courses	PD < 50	PPA = 1 − (0.1 PD)
	PD ≥ 50	PPA = 92 − (1.92 PD)

5. **Outlier Detection.** The ME will screen all acceptance cores for outliers using a statistically valid procedure. If an outlier is detected, replace that core by taking an additional core at the same offset and within 5 feet of the original station. The following procedure applies only for a sample size of 5.

1. The ME will arrange the 5 core results in ascending order, in which X_1 represents the smallest value and X_5 represents the largest value.
2. If X_5 is suspected of being an outlier, the ME will calculate:

$$R = \frac{X_5 - X_4}{X_5 - X_1}$$

3. If X_1 is suspected of being an outlier, the ME will calculate:

$$R = \frac{X_2 - X_1}{X_5 - X_1}$$

4. If R > 0.642, the value is judged to be statistically significant and the core is excluded.

6. Retest. If the initial series of 5 cores produces a percent defective value of PD ≥ 30 for mainline or ramp lots, or PD ≥ 50 for other pavement lots, the Contractor may elect to take an additional set of 5 cores at random locations chosen by the ME. Take the additional cores within 15 days of receipt of the initial core results. If the additional cores are not taken within the 15 days, the ME will use the initial core results to determine the PPA. If the additional cores are taken, the ME will recalculate the PPA using the combined results from the 10 cores.

7. Removal and Replacement. If the final lot PD ≥ 75 (based on the combined set of 10 cores or 5 cores if the Contractor does not take additional cores), remove and replace the lot and all overlying work. The replacement work is subject to the same requirements as the initial work.

I. Thickness Requirements. Thickness requirements will apply when full-depth, uniform-thickness HMA pavement construction is shown. The size and the assigned number of thickness lots will match those of the surface course air void lots. The RE will not include areas consisting of different HMA mixtures or thicknesses in the same lot.

The ME will test for thickness using the full-depth cores taken for surface course air voids, evaluated according to NJDOT B-4. The ME will base acceptance on total thickness and thickness of the surface course.

1. Total Thickness. The ME will calculate the percent defective (PD) as the percentage of the lot that is less than the design thickness. The ME will consider 10 percent defective as the acceptable quality limit. For lots where PD < 10, the Department will award a positive pay adjustment. For lots where PD > 10, the Department will assess a negative pay adjustment.

The Department will base total thickness acceptance on the percentage of the lot estimated to fall below the specified thickness as follows:

a. Sample Mean ($\overline{X}$) and Standard Deviation (S) of the N Test Results (X_1, X_2,..., X_N). Calculate as specified in 401.03.03.H.1.

b. Quality Index (Q_l).

$Q_L = (\overline{X} - T_{des})/S$, and T_{des} is the design thickness.

c. Percent Defective (PD). Using NJDOT ST for the appropriate sample size, determine the percentage of material (PD) falling below the design thickness associated with Q_L (lower limit).

d. Percent Pay Adjustment (PPA). The Department will determine the pay adjustment based on the quantity of the surface course × PPA.

Table 401.03.03-5 Pay Equations for Thickness

Quality	PPA
PD < 30	PPA = 1 − (0.1 × PD)
PD ≥ 30	PPA = 40 − (1.4 × PD)

e. Retest. If the initial series of 5 cores produces a percent defective value of PD ≥ 30, the Contractor may elect to take an additional set of 5 cores at random locations chosen by the RE. Take the additional cores within 15 days of receipt of the initial core results. If the additional cores are not taken within the 15

days, the ME will use the initial core results to determine the PPA. If the additional cores are taken, the ME will recalculate the PPA using the combined results from the 10 cores.

f. Removal and Replacement. If the final lot PD ≥ 75 (based on the combined set of 10 cores or 5 cores if the Contractor does not take additional cores), remove and replace, or mill and overlay, the lot. The replacement work is subject to the same requirements as the initial work.

2. Surface Course Thickness. The ME will evaluate the surface course solely to determine whether a remove-and-replace or an overlay condition exists, not for pay adjustment. The ME will calculate the percent defective (PD) as the percentage of the lot that is less than the allowable thickness for the nominal maximum aggregate used in the surface course. The ME will accept pavement lots with PD ≤ 10 and will reject pavement lots with PD > 10.

The ME will base surface thickness acceptance on the percentage of the lot estimated to fall below the allowable thickness as follows:

a. Sample Mean ($\overline{X}$) and Standard Deviation (S) of the N Test Results (X_1, X_2,..., X_N). Calculate using the formula as specified in 401.03.03.H.1.

b. Quality Index (Q).

$Q_L = (\overline{X} - T_{all})/S$, where T_{all} is the minimum allowable thickness.

Table 401.03.03-6 Surface Course Thickness Requirements

HMA Mix Design Size Designation	Minimum Allowable Compacted Lift Thickness (T_{all})
9.5 MM	1.00 inch
12.5 MM	1.25 inches
19 MM	2.00 inches

c. Percent Defective. Using NJDOT ST for the appropriate sample size, determine the percentage of material (PD) falling below the allowable thickness associated with Q_L (lower limit).

d. Retest. If the initial series of 5 cores produces a percent defective value of PD > 10, the Contractor may take an additional 5 cores at random locations determined by the ME. Take the additional cores within 15 days of receipt of the initial core results. If the additional cores are not taken within the 15 days, the ME will use the initial core results to determine the PPA. When the additional cores are taken, the ME will recalculate the PPA using the combined results from the 10 cores to obtain the total PD.

e. Removal and Replacement. If the surface course fails to meet the acceptance requirement, the Department will require removal and replacement of the lot. The replacement work is subject to the same requirements as the initial work.

J. Ride Quality Requirements. The Department will evaluate the HMA surface course using the International Roughness Index (IRI) according to ASTM E 1926. The Department will use the measured IRI to compute the appropriate pay adjustment (PA). The PA may be positive for superior quality work or negative for defective work.

The Department will calculate the PA as specified in Table 401.03.03-7 and will base PA on lots of 0.01mile length for each lane, ramp, and shoulder.

1. Smoothness Measurement. The Department will test the longitudinal profile of the HMA surface course for ride quality with a Class 1 Inertial Profiling System according to AASHTO MP 11 approved according to AASHTO PP 49.

The Department will test the full extent of the pavement in the direction of travel in each wheel path. The single IRI value reported for each 0.01-mile lot of pavement is the average of 3 runs.

2. Control Testing. Perform control testing during HMA placement to ensure compliance with the ride quality requirements specified in Table 401.03.03-7.

3. Preparation for IRI Testing. Provide the necessary traffic control when the Department performs IRI testing. Perform required mechanical sweeping of the surface course before IRI testing. To facilitate auto triggering on laser profilers, place a single line of preformed traffic marking tape perpendicular to the

roadway baseline at the beginning and end of each lane, shoulder, and ramp to be tested. Submit the actual stationing for each traffic marking tape location to the RE.

4. Acceptance. The Department will determine acceptance and make payment adjustments based on the following:

a. Pay Adjustment. The pay equations in Table 401.03.03-7 express the pay adjustment in dollars per lot of 0.01 mile. For lots of any other length, the Department will scale the pay adjustment up or down in proportion to the actual length of the lot. IRI numbers are in inches per mile.

Table 401.03.03-7 – Pay Equations for Ride Quality for 0.01 Mile

Freeways / Limited Access Highways	**More than one lift**	
	IRI < 45	PA = $100
	45 ≤ IRI < 63	PA = $350 − ($5.5556 × IRI)
	IRI = 63	PA = $0
	63 < IRI ≤ 125	PA = (IRI − 63) × (−$16.1290)
	IRI > 125	Remove & Replace
	One lift	
	IRI < 60	PA = $50
	60 ≤ IRI < 75	PA = $250 − ($3.3333 × IRI)
	IRI = 75	PA = $0
	75 < IRI ≤ 145	PA = (IRI − 75) × (−$7.1429)
	IRI > 145	Remove & Replace
Highways Other Than Freeways/Limited Access	**More than one lift**	
	IRI < 60	PA = $50
	60 ≤ IRI < 80	PA = $200 − ($2.50 × IRI)
	IRI = 80	PA = $0
	80 < IRI ≤ 140	PA = (IRI − 80) × (−$8.3333)
	IRI > 140	Remove & Replace
	One lift	
	IRI < 70	PA = $50
	70 ≤ IRI < 85	PA = $283.33 − ($3.333 × IRI)
	IRI = 85	PA = $0
	85 < IRI ≤ 160	PA = (IRI -85) × (- $6.6667)
	IRI > 160	Remove & Replace
Other Roadways	IRI < 80	PA = $50
	80 ≤ IRI < 100	PA = $250 − ($2.50 × IRI)
	IRI = 100	PA = $0
	100 < IRI ≤ 170	PA = (IRI − 100) × (−$7.1429)
	IRI > 170	Remove & Replace
Ramps and Shoulders	IRI = 120	PA = $0
	120 < IRI ≤ 170	PA = (IRI − 120) × (−$10.00)
	IRI > 170	Remove & Replace

b. Retest provision. After testing, if the IRI exceeds the Remove and Replace value (RRV) in Table 401.03.03-7, the Department will retest the lot. The Department will average the IRI values from the initial test and the retest to determine the final result.

If there is definitive evidence that the initial test is invalid, the Department will disregard the initial test and will consider the retest as the initial test. If there is no evidence that the original test was invalid, the Department will average the IRI values from the initial test and the retest to determine the final result.

c. **Removal and Replacement.** If the average IRI is greater than the RRV after a retest is performed, remove and replace the lot. Any replacement work is subject to the same requirements as the initial work.

On contracts where only a small percentage (less than 8 percent) of paving lots falls under the RRV, the Department may allow the Contractor to submit a plan for corrective action. If the Contractor's plan for corrective action is not approved, the Department may require removal and replacement, or may allow the lot to remain in place and the lot will be subject to the pay adjustment as computed in Table 401.03.03-7. If the Contractor's plan for corrective action is approved and the lot is reworked, the Department will test and evaluate it as a new lot that must meet the same requirements as the initial work. Corrective action locations are not eligible for bonus payments.

401.03.04 Sawcutting and Sealing of Joints in HMA Overlays

Before paving over concrete pavement, identify joint locations and maintain references throughout paving operations. Ensure that the HMA overlay is sawcut directly over the existing concrete pavement joints. Make sawcuts between 1 and 5 days after placement of the overlay.

Existing transverse joints that are offset at the longitudinal joint by more than 1 inch, measured between the centers of the joints, require separate sawcuts terminating at the longitudinal joint. For full-depth HMA replacement of an underlying concrete slab, sawcut the overlay directly over the HMA/slab interfaces.

Sawcut as specified in Table 401.03.04-1:

Table 401.03.04-1 Sawcuts in HMA Overlays

Total Overlay Thickness (t), inches	Width of cut, inches	Depth of cut, inches
$t < 6$	1/4 to 3/8	2
$t \geq 6$	1/4 to 3/8	4

Sawcut the transverse joints the full width of the traveled way and 3 feet into the shoulder.

If the surface course is not to be constructed within 30 days of placing the base or intermediate course, within 5 days, make a 1/8-inch wide sawcut 2 inches deep over the joints. The RE will not require sealing or cleaning of these sawcuts. When placing the surface course, make a 1/4 to 3/8-inch sawcut the full depth of the surface course. If cracks appear in a base or intermediate course before placing the surface course, sawcut the surface course directly over the crack, rather than directly over the joint.

After sawcutting, immediately collect the slurry from the sawcut cavity and surrounding pavement surface and dispose of as specified 201.03.09. Clean sawcuts with a 150-pounds-per-square-inch water blast to remove remaining debris in the sawcut cavity, and then blow sawcuts with a hot-air lance to provide a dry surface. Immediately after blowing, seal sawcuts.

Seal joints with hot-poured joint sealer prepared according to the manufacturer's recommendations. Do not heat joint sealer at the pouring temperature for more than 6 hours and do not reheat. Fill the sawcuts so that after cooling the level of the sealer is not more than 1/4 inch above, or less than 1/8 inch below, the surface. Do not spread sand or other fine material on the sealed joints. Before opening to traffic, allow joint sealer to cure to prevent pickup.

401.03.05 Core Samples

Upon completion of an HMA lot, drill cores at random locations determined by the RE at least 12 hours after paving. Take cores in the presence of the RE.

Use drilling equipment with a water-cooled, diamond-tipped, masonry drill bit that shall produce 6-inch nominal diameter cores for the full depth of the pavement. Remove the core from the pavement without damaging it. After removing the core, remove all water from the hole. Fill the hole with HMA or cold patching material, and compact the material so that it is 1/4 inch above the surrounding pavement surface.

For test strip lots and the first traveled way lot, deliver cores within 48 hours of completing the lot. Deliver all other acceptance cores within 7 days of completing the lot.

After each air void lot is placed, drill cores so that the full depth of the course is recovered for air void acceptance testing. If thickness acceptance testing is required as specified in 401.03.03.I, drill the surface course air void cores for the full depth of pavement. The Department will test the full-depth cores for surface course air voids, surface course thickness, and total thickness.

Mark the Department assigned core number on the side of the sample. Place cores and corresponding forms in a ventilated container capable of being locked and sealed by the RE. Ensure that the container provides protection to prevent damage during transit. Before sealing the container, the RE will record the seal number on the laboratory form. Transport the sealed boxes to the Department Laboratory.

The Department will not accept damaged cores for testing. If the Department rejects any core, drill a replacement core at the same offset and within 5 feet of the original station and deliver to the laboratory within 48 hours.

401.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
HMA MILLING, 3" OR LESS	SQUARE YARD
HMA MILLING, MORE THAN 3" TO 6"	SQUARE YARD
CONCRETE MILLING	SQUARE YARD
HMA PROFILE MILLING	SQUARE YARD
HOT MIX ASPHALT PAVEMENT REPAIR	SQUARE YARD
SEALING OF CRACKS IN HOT MIX ASPHALT SURFACE COURSE	LINEAR FOOT
POLYMERIZED JOINT ADHESIVE	LINEAR FOOT
TACK COAT	GALLON
TACK COAT 64-22	GALLON
PRIME COAT	GALLON
HOT MIX ASPHALT ___ ___ ___ SURFACE COURSE	TON
HOT MIX ASPHALT ___ ___ ___ INTERMEDIATE COURSE	TON
HOT MIX ASPHALT ___ ___ ___ BASE COURSE	TON
SAWING AND SEALING JOINTS IN HOT MIX ASPHALT OVERLAY	LINEAR FOOT
CORE SAMPLES, HOT MIX ASPHALT	UNIT

The specified depth of the milling is measured from the original surface to the top of the high spots of the textured surface.

The Department will measure HOT MIX ASPHALT PAVEMENT REPAIR before overlay by the square yard of area bounded by the sawcuts.

The Department will measure TACK COAT, TACK COAT 64-22, and PRIME COAT by the volume delivered, converted to the number of gallons at 60 °F as calculated by the temperature-volume correction factors specified in 902.01.

The Department will measure HOT MIX ASPHALT ___ ___ ___ SURFACE COURSE, HOT MIX ASPHALT ___ ___ ___ INTERMEDIATE COURSE, AND HOT MIX ASPHALT ___ ___ ___ BASE COURSE by the ton as indicated on the certified weigh tickets, excluding unused material. When nominal maximum aggregate size 3/8-inch HMA surface course is directed for use in transition (run out) areas, the Department will include this weight with the weight for HOT MIX ASPHALT ___ ___ ___ SURFACE COURSE.

The Department will not include payment for polymerized joint adhesive in the various paving Items. The Department will make payment for polymerized joint adhesive under POLYMERIZED JOINT ADHESIVE.

The Department will not make payment for quality control cores or additional cores for retest under CORE SAMPLES, HOT MIX ASPHALT.

SECTION 402 – HMA FRICTION COURSE

402.01 DESCRIPTION

This Section describes the requirements for constructing open-graded friction courses (OGFC) and modified open-graded friction course (MOGFC). OGFC or MOGFC may be used as a porous surface.

402.02 MATERIALS

402.02.01 Materials

Provide materials as specified:

Tack Coat 64-22: PG 64-22 ..... 902.01.01
Open-Graded Friction Course 902.03
Modified Open-Graded Friction Course 902.03

Use HMA specified for the roadway surface as patching material for HMA pavement repair. Use a commercial type of cold mixture as patching material for filling core holes. The Contractor may use an approved HMA surface course to fill core holes provided the material remains hot enough to compact.

402.02.02 Equipment

Provide equipment as specified:

Materials Transfer Vehicle (MTV) 1003.01
HMA Paver 1003.03
HMA Compactor 1003.05
HMA Plant 1009.01
HMA Trucks 1009.02

Do not dust truck beds with mineral fillers, fine aggregates, slag dust, or other fine graded material.

402.03 CONSTRUCTION

402.03.01 Installing OGFC and MOGFC

A. Paving Plan. At least 20 days before the start of placing the HMA surface course, submit to the RE for approval a detailed plan of operation as specified in 401.03.03.A.

B. Weather Limitations. Do not place OGFC or MOGFC if it is precipitating. Do not allow trucks to leave the plant when precipitation is imminent. The Contractor may resume operations when the precipitation has stopped and the surface is free of water.

Do not pave if the ambient temperature is below 50 °F.

C. Test Strip. Construct a test strip as specified in 401.03.03.C. The Department will not require quality control cores or nuclear density testing.

D. Transportation and Delivery of HMA. Transport and deliver HMA as specified in 401.03.03.D.

E. Spreading and Grading. Apply tack coat 64-22 as specified in 401.03.02.2. Place OGFC at a laydown temperature of 225 °F. Place MOGFC at the laydown temperature recommended by the binder manufacturer. Ensure that the OGFC and MOGFC meet the thickness and tolerance requirements specified in Tables 902.03.03-1 and 902.03.03-2. Spread and grade OGFC and MOGFC as specified in 401.03.03.E. Do not apply polymerized joint adhesive or tack coat to longitudinal joints.

F. Compacting. Immediately after spreading and strike-off, compact friction courses with a minimum of 1 pass of a non-vibratory, 2-axle roller. The RE may direct additional passes to eliminate roller marks. The Contractor may use a vibratory roller if it is operated in static mode.

Orient the drive axles of the roller towards the paver during the compaction operation. Operate rollers at a slow, uniform speed not exceeding 2-1/2 miles per hour. If necessary to prevent adhesion of the OGFC or MOGFC to the rollers, keep the wheels moistened with water mixed with very small quantities of detergent.

Remove and replace OGFC or MOGFC that becomes loose, broken, or otherwise defective or that shows an excess or deficiency of asphalt binder material.

When paving in echelon, keep the rollers for the first lane approximately 6 inches from the unconfined edge adjacent to the second paving operation. After OGFC or MOGFC from the second paver is placed against the uncompacted edge of the mat from the first paver, compact the OGFC or MOGFC on both sides of the joint.

Prevent lateral or vertical displacement of the unconfined edge during the compaction operation. Ensure that the edge of the drums of the rollers extends over the free edge of the mat by at least 6 inches.

When compacting the butt or wedge joint, while paving the adjacent lane, place the roller on the newly placed HMA and overlap the joint by approximately 6 inches.

G. Opening to Traffic. Open to traffic as specified in 401.03.03.G.

H. Thickness Requirements. When required for thickness determination, drill cores as specified in 401.03.05. The Department will calculate total thickness as specified in 401.03.03.I. The Department will not evaluate surface thickness.

I. Ride Quality Requirements. The Department will evaluate the surface course placed in the traveled way as specified in 401.03.03.J.

402.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
OPEN-GRADED ___ FRICTION COURSE	TON
MODIFIED OPEN-GRADED ___ FRICTION COURSE	TON

The Department will measure OPEN-GRADED ___ FRICTION COURSE and MODIFIED OPEN-GRADED FRICTION ___ COURSE by the ton as indicated on the certified weigh tickets, excluding unused material.

The Department will make payment for TACK COAT as specified in 401.04.

The Department will make payment for CORE SAMPLES, HOT MIX ASPHALT as specified in 401.04.

SECTION 403 – ULTRA-THIN FRICTION COURSE

403.01 DESCRIPTION

This Section describes the requirements for constructing an ultra-thin friction course of gap-graded HMA placed on a polymer modified asphalt tack/seal coat.

403.02 MATERIALS

403.02.01 Materials

Provide materials as specified:

Polymer Modified Tack Coat 902.01.04
Ultra-Thin HMA 902.04

403.02.02 Equipment

Provide equipment as specified:

Ultra-Thin Paver	1003.04
HMA Compactor	1003.05
Vibratory Drum Compactor	1003.06
HMA Plant	1009.01
HMA Trucks	1009.02

403.03 CONSTRUCTION

403.03.01 Ultra-Thin Friction Course

A. Paving Plan. :At least 20 days before the start of placing the ultra-thin friction course, submit a detailed plan of operation to the RE for approval as specified in 401.03.03.A.

B. Weather Limitations. Do not place ultra-thin friction course if it is precipitating. Do not allow trucks to leave the plant when precipitation is imminent. The Contractor may resume operations when the precipitation has stopped and the surface is free of water.

Do not pave if the base temperature is below 50 °F.

C. Test Strip. Construct a test strip as specified in 401.03.03.C. The Department will not require quality control cores or nuclear density testing.

D. Transportation and Delivery of HMA. Transport and deliver HMA as specified in 401.03.03.D. Do not use an MTV.

E. Spreading and Grading. Ensure that the surface where the ultra-thin friction course is placed is clean of foreign and loose material. Clean the surface of existing pavement using a self-propelled power broom equipped with a vacuum collection system before placing the ultra-thin friction course. Ensure that the surface is dry when the paving operations are about to start.

Apply polymer modified tack at a temperature of 140 to 175 °F. Continuously monitor rate of spray, ensuring a uniform application rate over entire width to be overlaid. Apply at the rate of 0.20 ± 0.05 quarts per square yard. Do not allow traffic, equipment, tools, or any other disturbance to the polymer modified tack coat before placing the ultra-thin friction course.

Ensure that the temperature of the ultra-thin friction course behind the screed is at least 280 °F. Within 3 seconds of applying the polymer modified tack coat, place ultra-thin friction course at a rate of 65 to 95 pounds per square yard.

Construct longitudinal joints as specified in 401.03.03.E.1. If constructing a cold longitudinal joint, construct a butt joint and do not use polymerized joint adhesive. Construct transverse joints as specified in 401.03.03.E.2.

F. Compacting. Compact as specified in 401.03.03.F. Use a minimum of two 10-ton steel-wheel rollers.

G. Opening to Traffic. Remove loose material from the traveled way before opening to traffic. Do not allow construction equipment or traffic on the ultra-thin friction course until the mat cools to a temperature of less than 140 °F.

H. Thickness Requirements. When required for thickness determination, drill cores as specified in 401.03.05. The Department will calculate total thickness as specified in 401.03.03.I. The Department will not evaluate surface thickness.

I. Ride Quality Requirements. The Department will evaluate the surface course placed in the traveled way as specified in 401.03.03.J.

403.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
ULTRA-THIN FRICTION COURSE	TON

The Department will measure ULTRA-THIN FRICTION COURSE by the ton as indicated on the certified weigh tickets, excluding unused material.

The Department will make payment for CORE SAMPLES, HOT MIX ASPHALT as specified in 401.04.

SECTION 404 – STONE MATRIX ASPHALT (SMA)

404.01 DESCRIPTION

This Section describes the requirements for constructing stone matrix asphalt (SMA) surface course.

404.02 MATERIALS

404.02.01 Materials

Provide materials as specified:

SMA 902.05

404.02.02 Equipment

Provide equipment as specified:

Materials Transfer Vehicle (MTV) 1003.01
HMA Paver 1003.03
HMA Compactor 1003.05
Vibratory Drum Compactor 1003.06
HMA Plant 1009.01
HMA Trucks 1009.02

Provide a thin-lift nuclear density gauge according ASTM D 2950.

404.03 CONSTRUCTION

404.03.01 SMA

A. Paving Plan. At least 20 days before the start of placing the SMA, submit to the RE for approval a detailed plan of operation as specified in 401.03.03.A.

B. Weather Limitations. Do not place SMA if it is precipitating. Do not allow trucks to leave the plant when precipitation is imminent. The Contractor may resume operations when the precipitation has stopped and the surface is free of water.

Do not pave if the base temperature is below 50 °F.

C. Test Strip. Construct a test strip as specified in 401.03.03.C.

D. Transportation and Delivery of HMA. Transport and deliver HMA as specified in 401.03.03.D.

E. Spreading and Grading. Place SMA at a laydown temperature of at least 285 °F. Spread and grade SMA as specified in 401.03.03.E. Ensure that the screed is operated in the vibratory mode. If constructing a cold longitudinal joint, construct a butt joint. Do not rake the joint.

F. Compacting. Compact as specified in 401.03.03.F. Ensure that the compaction is completed before the mix cools down to 240 °F. If vibratory compaction causes aggregate breakdown or forces liquid asphalt binder to the surface, operate rollers in static mode only.

G. Opening to Traffic. Open to traffic as specified in 401.03.03.G.

H. Air Void Requirements. Drill cores as specified in 401.03.05. The Department will evaluate air void requirements as specified in 401.03.03.H.

I. Thickness Requirements. When required for thickness determination, drill cores as specified in 401.03.05. The Department will evaluate thickness as specified in 401.03.03.I.

J. Ride Quality Requirements. The Department will evaluate the surface course placed in the traveled way as specified in 401.03.03.J.

404.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
STONE MATRIX ASPHALT ___ SURFACE COURSE	TON

The Department will measure STONE MATRIX ASPHALT ___ SURFACE COURSE by the ton as indicated on the certified weigh tickets, excluding unused material.

The Department will make payment for CORE SAMPLES, HOT MIX ASPHALT as specified in 401.04.

The Department will make payment for POLYMERIZED JOINT ADHESIVE as specified in 401.04.

The Department will make payment for TACK COAT as specified in 401.04.

SECTION 405 – CONCRETE SURFACE COURSE

405.01 DESCRIPTION

This Section describes the requirements for constructing concrete surface courses.

405.02 MATERIALS

405.02.01 Materials

Provide materials as specified:

Sand	901.06.02
Concrete	903.03
Quick-Setting Patch Materials	903.07
Epoxy Grout	903.08.02.B
Curing Materials	903.10
Tie Bars (epoxy-coated)	905.03.01
Joint Ties (epoxy-coated)	905.03.01
Tie Bolts (epoxy-coated)	905.03.02
Dowel Bars (epoxy-coated)	905.03.03
Preformed Joint Filler	914.01
Joint Sealer (hot-poured)	914.02

405.02.02 Equipment

Provide equipment as specified:

Sealer Application System	1003.08
Pavement Forms	1005.01
Spreading and Finishing Machine	1005.02
Vibrator	1005.04
Slip Form Paver	1005.05
Grinding Machine	1006.08
Straightedge	1008.02
Mechanical Sweeper	1008.03
Pavement Saw	1008.04
Hot-Air Lance	1008.06
Concrete Batching Plant	1010.01
Concrete Trucks	1010.02

405.03 CONSTRUCTION

405.03.01 Underlayer Preparation

When placing concrete on an aggregate base or subbase, prepare the underlying surface to ±1/2 inch of the required elevation within 3 days of placing concrete. Do not grade and compact the underlying surface when the ambient temperature is below 34 °F, when frozen, or when it is unstable. Compact using the directed method, as specified in 203.03.02.C, to produce a firm and even surface. The RE will check the elevations as specified in 202.03.03.C. Correct damage to the underlying surface and maintain the corrected surface until the concrete is placed.

Immediately before placing concrete, spray the underlying surface with water to ensure that the underlying surface is damp to a depth of at least 1/2 inch without forming wet or unstable spots.

405.03.02 Concrete Surface Course

A. Concreting Plan. At least 20 days before placing the concrete surface course, submit to the RE for approval a detailed plan of operation that includes the following:

1. Certified Concrete Construction Technologist as certified by the NJACI.
2. Size and description of crew.
3. Number, type, and model of equipment.
4. Lighting plan for nighttime operations as specified in 108.06.
5. Method of setting forms. When using slipform paving, provide method for locating joints.
6. Plant locations and hauling equipment.
7. Paving procedures for maintaining continuous operation.
8. Paving sequence, production, and schedule for the Project.
9. Method of constructing joints including dowel, joint tie, and tie bar placement.
10. Method of curing the concrete. If using wet burlap, provide the location where burlap will be presoaked.
11. Method of sawcutting and sealing joints.
12. Method for constructing and maintaining concrete washout system. Include placement location.

Do not begin paving until the RE approves this plan. Submit an adjusted concreting plan before making adjustments to the paving operation.

B. Weather Limitations. Comply with the limitations of placing as specified in 504.03.02.C, except do not place concrete when the ambient temperature is above 85 °F. If within the 12 hours preceding the scheduled concrete placement the National Weather Service (refer to http://www.nws.noaa.gov/) locally forecasts a 40 percent chance or greater of precipitation during the scheduled concrete placement, postpone the placement of bridge decks and pavement.

C. Installing Longitudinal Joint Ties. If paving adjacent to existing concrete pavement, drill 9-inch-deep holes into the side of the existing slab. Clean holes with a 150-pounds-per-square-inch water blast to remove remaining

debris in the drilled cavity, and then blow out holes with a hot-air lance to provide a dry surface. Immediately after blowing, fill the hole with epoxy grout and insert the joint ties according to the manufacturer's recommendations. Support the joint ties in position until the grout has set.

D. Concrete Placing Methods. Appoint sufficient number of personnel, who are certified by the NJACI as Concrete Construction Technologist or by ACI as Concrete Transportation Construction Inspectors, to monitor daily operations for concrete placement. The certified personnel are responsible for ensuring proper dimensions of forms; position of reinforcement steel; proper handling, placement, consolidation, and finishing of concrete; and proper curing of the concrete.

When placing concrete on asphalt-stabilized drainage course, spread sand over the surface to ensure that the surface voids are filled.

1. Fixed Form Method.

a. Setting Forms, Ties Bars, and Joint Assemblies. Set forms, tie bars, and joint assemblies for the entire area to be paved at least 1 day before placing concrete. Set forms at grade in full contact with the underlying surface. Ensure that concrete does not seep beneath the form. Stake forms into place with at least 3 pins for each 10-foot section. Lock form sections together to prevent movement in any direction.

Install longitudinal tie bars through the forms and secure in place. Ensure that concrete does not seep around the bar. If longitudinal joint ties cannot be installed before placing concrete, install joint ties as specified in 405.03.02.C or use tie bolts as an alternate.

Install joint assemblies and secure in place with anchor stakes. Ensure that devices for contraction joint assemblies are capable of holding dowels firmly in place during the entire construction operation. Place dowels across joint assemblies, parallel to and level with the surface course.

Place 1/2-inch preformed joint filler along curb and around structures and other objects protruding into the slab.

Check the alignment and grade elevations of the forms and joint assemblies and make corrections before placing the concrete. Ensure that the forms do not deviate from the required alignment by more than 1/4 inch. Reset, or remove and replace, forms that settle or deflect under the spreading and finishing equipment. Clean the top and face of forms, and oil the face before placing concrete.

b. Placing Concrete. Obtain RE approval of forms and joint placement before placing concrete. Place concrete across the formed area to minimize rehandling. Ensure that concrete is not discharged into windrows or piles. Continuously place concrete between transverse joints without the use of intermediate bulkheads. If a slab is not completed from transverse joint to transverse joint, remove the incomplete slab and replace. Terminate each day's paving at a transverse joint. If concrete becomes segregated during placement, suspend operations and correct handling operations.

To prevent bowing or misalignment of the transverse joints, place concrete simultaneously on both sides of transverse joints without disturbing the joints.

c. Consolidation, Strike Off, and Finishing. Consolidate concrete using vibrators. Ensure that consolidating operations do not segregate the concrete or disturb the transverse joint assemblies, joint ties, the underlying surface, or side forms.

Immediately after consolidating the concrete, strike off the surface to ensure that a uniform ridge of concrete, of between 2 and 6 inches, is maintained in front of the screed along the entire width of the pavement.

Immediately after strike off, begin finishing operations to achieve the specified line and grade of the surface. Ensure that the finishing equipment is maintained true without lift, wobble, or other disturbances that could affect the specified line and grade. Use hand methods to finish variable-width areas or areas that would make the use of finishing equipment impractical. If the finishing equipment breaks down, the Contractor may use hand methods to screed and finish the concrete to the next joint assembly.

At expansion joint assemblies, advance the finishing equipment, avoiding damage to or misalignment of joint assemblies. If advancing the finishing equipment over expansion joints causes concrete segregation

or damage to, or misalignment of, the joint assemblies, stop the finishing equipment when the screed is approximately 8 inches from the joint assembly. Remove segregated concrete from the joint; lift the screed and set directly on top of the joint, and resume advancement of the finishing equipment.

If screeding operations produce a surface containing voids, bubbles, or other imperfections, then hand finish the surface with a metal float. Do not add water to the surface of the concrete to assist in finishing operations.

Texture the surface of shoulders with a broom after finishing the concrete.

d. Control Testing and Surface Correction. After advancing finishing equipment, check the concrete surface with a straightedge parallel to the centerline of the traveled way. Correct surface deviations determined by control testing before the concrete sets. Correct major deviations using the finishing equipment. Correct minor deviations and any defects caused by the control testing using a metal float. Do not add water to the concrete surface to assist in surface correction.

e. Removing Forms. Remove forms no sooner than 12 hours after completing concrete placement. If using mineral admixtures in the concrete, remove forms no sooner than 24 hours after completing concrete pavement. Repair voids and honeycombed areas.

2. Slip-Form Method. The Contractor may construct concrete pavement using the slip-form paving method.

To control the operation of the slip-form paver, 1 day before placing concrete, set string lines at least 25 feet beyond the length to be paved. Mark joint locations of the entire area to be paved 1 day before placing concrete.

Install and anchor each joint assembly before placing concrete, and ensure that each joint assembly is sufficiently secured to the underlying surface to prevent movement during paving. Place 1/2-inch preformed joint filler along the curb and around structures and other objects protruding into the slab.

Place the concrete for the full depth of the slab with a slip-form paver in 1 pass of the machine. Consolidate the concrete for the full width and depth of the concrete pavement. Before finishing the concrete, install longitudinal tie bars and joint ties. Ensure that surface deformations caused by the installation of longitudinal tie bars and joint ties is corrected by the finishing operation. Finish the concrete in such a manner that a minimum of hand finishing is necessary to provide a dense and homogeneous concrete pavement.

Operate the slip-form paver with a continuous forward movement, and coordinate all operations of mixing, delivering, and spreading concrete to provide uniform progress and to minimize stopping and starting of the paver. Texture the surface of shoulders with a broom after finishing the concrete.

Continuously place concrete between transverse joints without the use of intermediate bulkheads. If a slab is not completed from transverse joint to transverse joint, remove the incomplete slab and replace. Terminate each day's paving at a transverse joint.

Correct concrete edge deformities greater than 1/4 inch before the concrete has taken initial set. Modify operations to prevent recurrence.

E. Curing. Ensure that the concrete is not exposed for more than 30 minutes after finishing. The RE will direct a suspension, as specified in 108.13, of concrete operations if the curing procedure is delayed or is not followed. Apply curing compound as specified in 504.03.02.F.1, or wet burlap and white polyethylene sheeting as specified in 504.03.02.F.2. Maintain the curing material for 7 days.

F. Protecting Concrete Surface Course. Protect concrete, as specified in 504.03.02.I, for the duration of the curing period. Construct wood bridging for pedestrian crossovers at street intersections and at other established pedestrian crosswalks.

G Sawcutting Relief Joints. Relief joints are a preliminary step in the construction of transverse and longitudinal joints. The Contractor may begin sawcutting relief joints as soon as hardened concrete can support operations without spalling and must finish within 18 hours of placing concrete. Sawcut transverse relief joints above the joint assembly and sawcut longitudinal relief joints if more than 1 lane was paved in 1 paving operation. Sawcut 1/8-inch wide relief joints to a depth of 1/3 of the thickness of the concrete pavement. Do not sawcut expansion joints or butt joints created by 2 separate paving operations.

H. Sawcutting and Sealing Joints. After completion of diamond grinding operations as specified in 405.03.04 and before opening to traffic as specified in 405.03.02.K, sawcut 3/8-inch-wide transverse and longitudinal joints to a depth of 1/2 inch at relief joints and butt joints. After sawcutting, immediately remove sawing slurry from the sawcut cavity and surrounding pavement surface. Clean sawcuts with a 150-pounds-per-square-inch water blast to remove remaining debris in the sawcut cavity, and then blow sawcuts with a hot-air lance to provide a dry surface. Seal sawcuts immediately after blowing.

Seal joints with joint sealer before opening to traffic. Seal joints when the ambient temperature is between 50 and 80 °F. Pour joint sealer in the sawcuts, ensuring that joint sealer is not spilled on the surface of the concrete. If spillage occurs, immediately remove spilled joint sealer from the surface of the concrete. Fill joints to ensure that the joint sealer is 1/8 to 1/4 inch below the adjacent surface. Do not allow traffic over the poured joints until the joint sealer has hardened to resist pickup.

I. Thickness Requirements. The ME will divide the concrete pavement into lots of approximately 5000 square yards. The ME will divide each lot into 5 equal sections. The RE will direct the Contractor to drill 1 core, as specified in 405.03.03, from a randomly selected location within each section. The ME will test these cores for thickness as specified in ASTM C 174.

The Department will determine conformance with thickness requirements as follows and will assess the greater of the 2 pay reductions or direct the Contractor to remove and replace the lot:

1. Average Core Thickness. If the average core thickness is greater than or equal to the specified core thickness, the Department will not apply a payment reduction. If the average thickness is less than the specified thickness, but is greater than or equal to the specified thickness minus 1/2 inch, the Department will determine payment reduction by the following formula:

$$PPR = \frac{T_S - T_A}{T_S}$$

Where:
T_S = Specified thickness.
T_A = Average thickness.
PPR = Percent payment reduction

2. Individual Core Thickness. When more than 2 individual cores in the lot are less than the specified thickness minus 1/4 inch, the Department will reduce the payment for the lot by 2 percent.

3. Remove and Replace. If the average thickness is less than the specified thickness minus 1/2 inch, the RE will require that the lot be removed and replaced.

J. Ride Quality Requirements. Ensure that diamond grinding is completed before testing ride quality. The Department will evaluate ride quality acceptance as specified in 401.03.03.J using the Other Roadways equations.

K. Opening to Traffic. Ensure that diamond grinding is completed before opening to traffic. The RE will determine when the concrete surface is to be opened to traffic or construction equipment. Do not allow construction vehicles or equipment on the concrete pavement within 10 days of placing, or until the concrete has achieved a compressive strength of 3000 pounds per square inch as determined by 2 test cylinders that are field cured according to AASHTO T 23. For concrete containing fly ash, opening to traffic is governed solely by the 3000-pounds-per-square-inch compressive strength requirement and not by time elapsed.

405.03.03 Core Samples

Drill cores before performing diamond grinding operations. Drill cores in the concrete pavement at locations as directed by the RE for thickness testing. Drill 3-inch diameter cores through the entire thickness of the concrete pavement. Use a water-cooled, diamond-tipped, masonry-type drill bit capable of obtaining a valid test sample through the entire pavement thickness. Identify each core by painting the RE supplied number on the side of the sample, and accompany each with a laboratory form supplied by the RE. Transport samples to the Department Laboratory.

After removing the core from the pavement, pump water from the hole, and use a quick-setting patch to fill the hole flush with the adjacent pavement surface.

405.03.04 Diamond Grinding

Perform wet grinding operations in a longitudinal direction that is parallel to the pavement centerline. Do not overlap longitudinal passes more than 2 inches. Continuously remove grinding slurry from the pavement surface.

Ensure that the surface of the ground pavement has a corduroy texture consisting of grooves between 1/16 and 1/8 of an inch in width. Ensure that the peaks of the ridges are between 1/32 and 1/8 of an inch in width and are approximately 1/16 of an inch higher than the bottoms of the grooves.

Using a mechanical sweeper, clean the area before opening to traffic and before subsequent construction or resurfacing. Dispose of slurry and sweepings as specified in 201.03.09.

405.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
UNDERLAYER PREPARATION	SQUARE YARD
CONCRETE SURFACE COURSE, ___ " THICK	SQUARE YARD
CONTRACTION JOINT ASSEMBLY	UNIT
EXPANSION JOINT ASSEMBLY	UNIT
CORE SAMPLES, CONCRETE	UNIT
DIAMOND GRINDING OF CONCRETE SURFACE COURSE	SQUARE YARD

The Department will not include payment for contraction joint assemblies and expansion joint assemblies in CONCRETE SURFACE COURSE, ___" THICK. The Department will pay for contraction joint assemblies and expansion joint assemblies under CONTRACTION JOINT ASSEMBLY and EXPANSION JOINT ASSEMBLY, respectively.

DIVISION 450 – CONCRETE PAVEMENT REHABILITATION

SECTION 451 – CONCRETE SLAB STABILIZATION

451.01 DESCRIPTION

This Section describes the requirements for stabilizing concrete slabs by drilling injection holes and pumping a pozzolan grout or high-density polyurethane under the slab.

451.02 MATERIALS

451.02.01 Materials

Provide materials as specified:

Quick-Setting Patch Material, Type 1A 903.07
Pozzolan Grout 903.08.03.A
High-Density Polyurethane Grout 903.08.03.B

451.02.02 Equipment

Provide equipment as specified:

Grout Pumping Unit 1006.03
Mixer 1006.04
Injection Device 1006.05
Lift Monitoring Equipment 1006.06
Deflection Testing Equipment 1006.07
Grinding Machine 1006.08

451.03 CONSTRUCTION

451.03.01 Pozzolan Grout

A. Weather Limitation. Do not perform slab stabilization when the pavement surface temperatures are below 32 °F or if the subgrade or base course is frozen. If proper slab stabilization cannot be achieved due to excessive temperatures or direct sunlight, perform work at night.

B. Drilling Holes. Drill the hole pattern for grout injection as noted in the plans or as determined by the RE in consultation with the Contractor. Drill a minimum of 3 holes on either side of the transverse joint. Drill holes between 1 and 2 inches in diameter, vertically and round, to a depth sufficient to penetrate the concrete pavement. Ensure that the subbase penetration does not exceed 3 inches. Clean holes with air or water to create a small cavity or remove obstructions caused during drilling, allowing initial spread of grout.

C. Testing of Grout. The RE will perform flow cone testing of the grout at the beginning of pumping and at random times throughout pumping. Ensure that the grout is mixed so that the flow cone test result is 9 to 16 seconds.

D. Void Filling. Ensure that the movement of the concrete slab does not exceed 0.10 inch. If the pavement has been lifted in excess of the specified amount, the RE may require removal and replacement or grinding to the correct grade.

Pump grout into each hole until the maximum pressure is built up or material is observed flowing from hole to hole. Ensure that the maximum pressure is 58 pounds per square inch. Monitor the pressure using a gauge in the grout line. Protect the gauge from the grout slurry.

Ensure that mixed material is not held in the mixer or pump hopper for more than 1 hour after initial mixing. Dispose of material held longer than 1 hour as specified in 201.03.09. The RE may reduce this time if the grout becomes unsuitable for use in less than 1 hour.

Ensure that water displaced from the void structure by the grout is allowed to flow out freely. Excessive loss of the grout through cracks or joints or from back pressure in the hose or in the shoulder area will not be allowed.

If it is determined that continued grout injection at a specific location is no longer feasible due to major voids, the RE may direct the Contractor to cease grout injection at that location.

Upon completion of undersealing, fill drill holes full depth with a Type 1A quick-setting patch material. Ensure that the patch is flush with the surface of the pavement.

Do not allow traffic on the slabs for 1 hour after initial set.

E. Repairing Cracks. If transverse cracks develop between adjacent injection holes, the RE may direct repair of the cracks using retrofit dowel bars, as specified in 454.03.01, or removal and replacement of the entire panel.

If radial cracks develop from the injecting holes, immediately cease work and correct the operation. The RE may require repair or replacement of the damaged panel.

451.03.02 High-Density Polyurethane Grout

A. Contractor's Experience. At the preconstruction meeting, submit the name, experience, and material manufacturer's certification of a manufacturer's representative to the RE. Ensure that experience includes a minimum of 5 projects on which slab stabilization operations were successfully completed using high-density polyurethane. Ensure that the manufacturer's representative is at the work site during all high-density polyurethane slab stabilization. The Contractor may not begin the work until the RE approves the manufacturer's representative.

B. Weather Limitations. Do not perform slab stabilization if the underlying material is frozen.

C. Drilling Holes. Drill the hole pattern for grout injection as noted in the plans or as determined by the RE in consultation with the Contractor. Drill a minimum of 2 holes per side of transverse joint. Ensure that the minimum horizontal distance between holes is between 2 and 4 feet. Ensure that holes do not exceed 5/8 inch in diameter, drilled vertically and round, to a depth sufficient to penetrate below the concrete pavement and into the voids, and subbase beneath the slabs. Ensure that base penetration does not exceed 3 inches. Clean holes to remove any obstructions caused during drilling to allow flow of high-density polyurethane.

D. Slab Stabilization. During stabilization operations, ensure the upward movement of the pavement does not exceed 0.10 inch. If the pavement has been lifted in excess of the allowable amount, the RE may require removal and replacement or grinding to the correct grade.

After drilling the holes, inject high-density polyurethane under the slabs. As the polyurethane chemically reacts, it will expand and harden to create the necessary lifting forces. Using the pumping equipment, control the amount of rise by regulating the rate of injection of the material. When the nozzle is removed from the hole, remove any excessive material from the area, and seal the holes with high-density polyurethane.

Immediately clean up material extruded during the pumping operations as the work progresses.

Do not allow traffic on the slabs for 1 hour after initial set.

E. Slab Lifting. When lifting concrete pavement to correct surface defects, such as faulted and settled concrete slabs, lift the concrete slab in increments of 0.25 inch until the pavement is raised to the required elevation.

F. Repairing Cracks. If transverse cracks develop between adjacent injection holes, the RE may direct repair of the cracks using retrofit dowel bars, as specified in 454.03.01, or removal and replacement of the entire panel.

If radial cracks develop from the injecting holes, immediately cease work and correct the operation. The RE may require repair or replacement of the damaged panel.

451.03.03 Deflection Testing

Perform deflection testing of joints between midnight and 10 a.m. The RE may stop testing earlier if there is evidence of slab lockup due to thermal expansion of the slabs. The RE may allow testing to continue after the hour specified if the slabs are not interlocked or under compression.

Perform deflection testing after stabilization to determine the success of grouting. Use an applied load of between 7500 and 9500 pounds-force. Place the center of the loading plate within 9 inches of the slab corner. Ensure that the

deflections are normalized to a 9000-pound nominal load. If joints and cracks have deflection values greater than 10 mils, regrout an additional time in an attempt to reduce the deflection to below 10 mils. The RE may require deflection testing before grouting.

451.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
SLAB STABILIZATION, POZZOLAN GROUT	BAG
SLAB STABILIZATION, POLYURETHANE GROUT	POUND
SLAB STABILIZATION, DEFLECTION TESTING	UNIT

The Department will measure the quantity of SLAB STABILIZATION, POZZOLAN GROUT by the number of 94-pound bags of cement used in the manufacture of grout.

SECTION 452 – PARTIAL DEPTH CONCRETE PAVEMENT REPAIR

452.01 DESCRIPTION

This Section describes the requirements for constructing partial depth concrete pavement repair.

452.02 MATERIALS

452.02.01 Materials

Provide materials as specified:

Quick Setting Patch, Type 1A or 1B 903.07
White Polyethylene Sheeting 903.10.03

Use aggregate with maximum size no greater than 1/2 inch in the quick setting patch.

452.02.02 Equipment

Provide equipment as specified:

Pavement Saw 1008.04
Mobile Mixer 1010.03
Small-Batch Mixer 1010.04

452.03 CONSTRUCTION

452.03.01 Partial Depth Concrete Pavement Repair

A. Preparation. Sawcut repair areas to a depth of 1 inch around the perimeter of each repair area before removing the deteriorated concrete. Remove loose and disintegrated concrete from the areas to expose a sound concrete surface. Remove at least 1/4 inch of sound concrete. Clean and roughen the area by sandblasting. Ensure that the remaining concrete is not damaged. Use only pneumatic or hand tools to remove the disintegrated material and to prepare and shape the areas to be repaired. Do not use hammers that exceed 30 pounds. Remove concrete adjacent to exposed reinforcement steel by hand chipping. Do not damage or debond the reinforcement steel.

If corroded reinforcement steel is uncovered, clean the steel by sandblasting, waterblasting or wire brushing. If the concrete is debonded from the reinforcement steel or the steel is exposed, remove the concrete adjacent to the reinforcement steel to provide a 1/2-inch clearance.

If, during removal of concrete, more than 1/3 of the slab depth is removed, cease operations at that repair and immediately notify the RE. The RE may then direct that a full depth concrete pavement repair be constructed.

B. Concrete Placement. Place and consolidate patch materials as specified for concrete in 405.03.02.D.1.b and 405.03.02.D.1.c except that mechanical finishing is not required. Float finish and texture with a broom.

Cover the repair with white polyethylene sheeting. Overlap sections of white polyethylene sheeting at least 18 inches. Extend the polyethylene sheeting 2 feet beyond the edges of the repair.

C. Opening to Traffic. Do not open repair to traffic until compressive strength as measured by the average of 2 test cylinders is more than 2000 pounds per square inch. If the required compressive strength is not met by the time the roadway must be opened to traffic, open to traffic. Remove and replace the repair during the next available roadway closure.

452.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
PARTIAL DEPTH CONCRETE REPAIR	SQUARE YARD

SECTION 453 – FULL DEPTH CONCRETE PAVEMENT REPAIR

453.01 DESCRIPTION

This Section describes the requirements for constructing full depth concrete pavement repairs with concrete or HMA.

453.02 MATERIALS

453.02.01 Materials

Provide materials as specified:

Coarse Aggregate (No. 8)	901.03
Cutback Asphalt, MC-250	902.01.02
HMA	902.02
Concrete, Class A	903.03
Concrete, Class V or E	903.04
Epoxy Grout	903.08.02.B
Curing Materials	903.10
Reinforcement Steel	905.01
Joint Ties (epoxy-coated)	905.03.01
Dowel Bars	905.03.03
Preformed Joint Filler	914.01

Use an approved 9.5 or 12.5 nominal maximum size HMA surface course mix for patching areas after form removal. Use an approved HMA 25M64 base course for full depth HMA pavement repairs.

If Class V concrete is used and the item FLEXURAL BEAM TESTING EQUIPMENT is not provided in the Contract, deliver the flexural beam test specimens for testing 1/2 hour before the scheduled testing time to the location provided in the Special Provision or to where directed by the RE.

453.02.02 Equipment

Provide equipment as specified:

HMA Paver	1003.03
HMA Compactor	1003.05
Vibratory Drum Compactor	1003.06
Sealer Application System	1003.08
Forms	1005.01
Spreading and Finishing Machine	1005.02

Vibrator 1005.04
Grinding Machine 1006.08
Straightedge 1008.02
Pavement Saw 1008.04
Hot-Air Lance 1008.06
HMA Plant 1009.01
HMA Trucks 1009.02
Concrete Batching Plant 1010.01
Concrete Trucks 1010.02

For Class V, mix concrete in a concrete mobile mixer or transit mix truck.

Use a gang drill capable of maintaining vertical and horizontal alignment and drilling the group of holes in 30 seconds or less.

453.03 CONSTRUCTION

453.03.01 Full Depth Repair Using Concrete

A. Preparation. Sawcut full depth at the limits of the repair. Remove existing concrete or composite pavement using the lift out method. Do not use in-place breaking to remove concrete. Ensure that spalling of the remaining concrete does not occur during the lifting. Reuse removed pavement as specified in 202.03.07.A. The Contractor may sawcut the slab and drill the lift out holes up to 5 days before the concrete removal. Only remove concrete that can be replaced during the workday. Repair any damage to remaining pavements.

After the existing concrete has been removed, the RE will examine underlying material to determine its condition. If water or excess moisture exists in the area, remove the underlying material to the depth specified by the RE. Place and compact coarse aggregate using the directed method as specified in 203.03.02.C. Grade the underlying surface so that the thickness of the repair matches the existing slab thickness.

B. Placing Limitations. Comply with the concrete placing limitations specified in 504.03.02.C.

For Class V concrete, do not place concrete if the ambient temperature or the surface temperature of the underlying layer falls below 50 °F. Ensure that the temperature of the Class V concrete is at least 80 °F at the time of placement.

C. Setting Forms, Joint Ties, and Dowels. For the sides of repair areas that are not in contact with sound concrete, set forms for the entire area of the repair before placing concrete. Set forms at grade in full contact with the underlying surface. Ensure that concrete does not seep beneath the form. Stake forms into place with at least 3 pins for each 10-foot section. Lock form sections together to prevent movement in any direction.

Place 1/2-inch preformed joint filler along curb and around structures and other objects protruding into the slab.

For repairs that are 15 feet or shorter, do not install longitudinal joints ties. Coat the edge of existing slabs with cutback asphalt (MC-250) before placing concrete.

For repairs that are longer than 15 feet, install longitudinal joint ties in the abutting concrete face. Drill holes into the face of the existing concrete pavement not more than 1/4 inch in diameter greater than the maximum measured dimension of the joint tie.

For transverse joints abutting concrete pavement to remain, drill holes into the face of the existing concrete pavement not more than 1/4 inch in diameter greater than the dowels. Use a gang drill to install the dowels in the face of the slab. Maintain vertical and horizontal alignment during drilling and do not damage existing concrete surrounding the hole.

Before installing dowels and joint ties, clean the holes of cement dust, standing water, and materials that interfere with proper bonding of the epoxy grout.

Mix the epoxy grout according to the manufacturer's recommendations. Introduce the epoxy grout by low-pressure injection through a polyethylene tube, reaching to the end of the hole. Slowly withdrawn the tube as the hole is filled. Fill the holes to approximately 70 percent of their depth. Install plastic grout-retention disks to prevent the escape of grout. Insert the dowel or joint tie into the hole slowly and twist 1 full revolution to evenly distribute the

grout, ensuring that no bubbles are introduced within the grout. Ensure that there is sufficient epoxy grout so that it rises to the surface and overflows from the sides of the disk upon introduction of the dowel or joint tie. Spread overflow epoxy grout on the concrete face. Provide temporary support for dowels and joint ties after insertion to prevent movement and damage to the bond. Ensure that the dowels and joint ties are not disturbed before the final cure of the grout is achieved. Lightly coat the exposed end of the dowel bars with form oil or light grease. Do not coat joint ties.

When replacing portions of slabs greater than 20 feet in length, install joint assemblies and secure in place with anchor stakes. Ensure that devices for contraction joint assemblies are capable of holding dowels firmly in place during the entire construction operation. Place dowels across joint assemblies, parallel to and level with the surface course. Set joint assemblies in line with existing, adjacent joints and perpendicular to the existing longitudinal joint. Space additional joint assemblies equidistantly between transverse joints between 13 and 20 feet apart and perpendicular to the existing longitudinal joint.

Check the alignment and grade elevations of the forms and joint assemblies and make corrections before placing the concrete. Ensure that the forms do not deviate from the required alignment by more than 1/4 inch. Reset, or remove and replace, forms that settle or deflect under the spreading and finishing equipment. Clean the top and face of forms, and oil the face before placing concrete.

D. Placing, Consolidating, and Finishing Concrete. Place concrete as specified in 405.03.02.D.1.b. Consolidate, strike-off, and finish concrete as specified in 405.03.02.D.1.c, except for the following:

1. The Department will only require mechanical finishing equipment for repairs longer than 50 feet
2. Place concrete in 2 layers with the first layer placed to such a depth that the surface of the layer is at the proper elevation to receive the reinforcement steel. Place the reinforcement steel followed by the next layer of concrete. Remove and replace the lower layer concrete if it has developed initial set or has been in place more than 30 minutes before being covered with the next layer.
3. Texture the surface using a stiff broom.

E. Curing. Ensure that the concrete is not exposed for more than 30 minutes after finishing. The RE will direct a suspension, as specified in 108.13, of concrete operations if the curing procedure is delayed or is not followed. Except for Class V, apply curing compound as specified in 504.03.02.F.1, or wet burlap and white polyethylene sheeting as specified in 504.03.02.F.2. Maintain the curing material for 3 days.

For Class V, cure the concrete using wet burlap as specified in 504.03.02.F.2 and cover with an insulation blanket to retain the heat from hydration. Ensure that insulation blankets are secured to prevent lifting. When the concrete surface temperature exceeds 120 °F, remove the insulating blanket.

F. Sawcutting and Sealing Joints. Sawcutting relief joints may begin as soon as hardened concrete can support operations without spalling, and must be completed within 18 hours of placing concrete and before opening to traffic. Sawcut transverse relief joints above joint assemblies. Sawcut 1/8-inch-wide relief joints to a depth of 1/3 of the thickness of the concrete repair.

Sawcut 3/8 inch wide transverse and longitudinal joints to a depth of 1/2 inch at relief joints and butt joints. After sawcutting, immediately remove all sawing slurry from the sawcut cavity and surrounding pavement surface. Clean sawcuts with a minimum of 150-pounds-per-square-inch water blast to remove remaining debris in the sawcut cavity, and then blow sawcuts with a hot-air lance to provide a dry surface. Seal sawcuts immediately after blowing.

Seal joints with joint sealer when the ambient temperature is between 50 and 80 °F. Pour joint sealer in the sawcuts, ensuring that joint sealer is not spilled on the surface of the concrete. If spillage occurs, immediately remove spilled joint sealer from the surface of the concrete. Fill joints so that the joint sealer is 1/8 to 1/4 inch below the adjacent surface. Do not allow traffic over the sealed joints until the joint sealer has hardened to resist pickup.

G. Opening to Traffic. For Class V concrete, do not open repair to traffic until flexural strength as measured by flexural beams is more than 350 pounds per square inch. For Class A and E concrete, do not open repair to traffic until compressive strength as measured by the average of 2 cylinders is more than 3000 pounds per square inch.

If the required strength is not met by the time the roadway must be opened to traffic, open to traffic. Remove and replace the repair during the next available roadway closure.

453.03.02 Full Depth Repair Using HMA

A. Preparation. Prepare concrete as specified in 453.03.01.A.

B. Weather Limitations. Comply with weather limitations as specified in 401.03.03.B.

C. HMA Placement. Dump, spread, and screed the HMA in lifts no thicker than 6 times the nominal maximum size of the aggregate. In small areas, spread, rake, and lute HMA with hand tools. Compact using vibratory drum compactors or HMA compactors for a minimum of 4 passes.

D. Opening to Traffic. Remove all loose material from the repair before opening to traffic. Open repairs to traffic when the surface temperatures is below 140 °F.

453.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
FULL DEPTH CONCRETE PAVEMENT REPAIR, CONCRETE CLASS ___	SQUARE YARD
FULL DEPTH CONCRETE PAVEMENT REPAIR, HMA	SQUARE YARD

SECTION 454 – RETROFIT DOWEL BARS

454.01 DESCRIPTION

This Section describes the requirements for installing retrofit dowel bars in existing concrete pavement.

454.02 MATERIALS

454.02.01 Materials

Provide materials as specified:

Quick Setting Patch, Type 1, 1A, or 1B 903.07
Dowel Bars 905.03.03

Use aggregate with maximum size no greater than 1/2 inch in the quick setting patch.

For caulk, use a silicon sealer manufactured to adhere to concrete.

Use foam core insert of rigid styrofoam material or closed cell foam, faced with poster board or plastic material.

454.02.02 Equipment

Provide equipment as specified:

Pavement Saw 1008.04

454.03 CONSTRUCTION

454.03.01 Retrofit Dowel Bars

Demonstrate the method of sawcutting slots and placing the dowels or tie bars for the RE's approval. Sawcut slots in the pavement to a depth that allows placing the center of the dowel at mid-depth in the concrete slab. Perform multiple cuts parallel to the longitudinal joint to remove material from the slot. Use small demolition hammers with a weight less than 30 pounds to break loose the concrete. Sand blast and then clean exposed surfaces in the slot to provide an acceptable bonding surface.

Immediately before placing the dowel bar, caulk the existing transverse joint or crack at the bottom and the sides of the slot. Place the caulking to provide a smooth level surface and tight fit for the foam core insert and to prevent any of the quick setting patch from entering the joint or crack.

Place dowel bar end caps on each end of the dowel to provide a 3/4 inch long void for expansion. Lightly coat the dowel bar with form oil or light grease, and place the foam core insert around the middle of the dowel.

Place the dowel bar at the mid-depth of the slab, parallel to the longitudinal joint, and parallel to the pavement surface. For cracks that are skewed more than 45 degrees, place the dowel bar perpendicular to the crack. Ensure that the foam core insert fits tightly around the dowel and to the bottom and edges of the slot. Install the filler material so that it remains in a vertical position and tight to all the edges during placement of the quick setting patch.

Place quick setting patch to the bottom of the dowel bar. Hand-tamp the quick setting patch in place. Check the position of the dowel bar to ensure that it is parallel to the pavement surface and the longitudinal joint. Place and hand-tamp quick setting patch to fill the slot. Finish the surface flush with the pavement surface.

If the foam core insert shifts during placement of the quick setting patch, remove and replace the dowel bar. Ensure that the foam core insert is cut flush to the surface.

454.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
RETROFIT DOWEL BAR	UNIT

SECTION 455 – DIAMOND GRINDING EXISTING CONCRETE PAVEMENT

455.01 DESCRIPTION

This Section describes the requirements for diamond grinding of existing concrete pavements.

455.02 MATERIALS

455.02.01 Materials

(Intentionally Blank)

455.02.02 Equipment

Provide equipment as specified:

Grinding Machine 1006.08
Mechanical Sweeper 1008.03

455.03 CONSTRUCTION

455.03.01 Diamond Grinding Existing Concrete Pavement

Ensure that concrete pavement repairs are performed before diamond grinding. Perform joint sealing after diamond grinding.

Perform grinding operations in a longitudinal direction that is parallel to the longitudinal joint. Do not overlap longitudinal passes more than 2 inches. Continuously remove grinding slurry from the pavement surface.

Ensure that the surface of the ground pavement has a corduroy texture consisting of grooves between 1/16 and 1/8 of an inch in width. Ensure that the peaks of the ridges are between 1/32 and 1/8 of an inch in width and are approximately 1/16 of an inch higher than the bottoms of the grooves.

Do not grind to eliminate minor depressions if it lowers the overall profile of the pavement. Ensure that in any 3 × 100-foot test area at least 95 percent of the surface is ground and textured.

Test transverse joints and cracks to ensure that adjacent surfaces are in the same plane. Regrind misaligned joints and cracks in excess of 1/16 inch until the surfaces are flush.

Ensure that the surface, after grinding, meets ride quality requirements. The Department will evaluate the ride quality acceptance as specified in 401.03.03.J using the equations for Other Roadways.

Regrind deficient areas in the pavement surface. When regrinding to correct deficiencies is required, regrind the entire width of the lane in the area to be corrected.

Using a mechanical sweeper, clean the area before opening to traffic and before subsequent construction or resurfacing. Remove and dispose of slurry and sweepings as specified in 201.03.09.

455.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
DIAMOND GRINDING EXISTING CONCRETE PAVEMENT	SQUARE YARD

SECTION 456 – SEALING EXISTING JOINTS IN CONCRETE PAVEMENT

456.01 DESCRIPTION

This Section describes the requirements for cleaning and sealing transverse and longitudinal joints in existing concrete pavement.

456.02 MATERIALS

456.02.01 Materials

Provide materials as specified:

Joint Sealer 914.02
Backer Rod 914.02

456.02.02 Equipment

Provide equipment as specified:

Sealer Application System 1003.08
Hot-Air Lance 1008.06

456.03 CONSTRUCTION

456.03.01 Sealing Existing Joints in Concrete Pavement

Clean joints to be sealed to a depth of at least 2 inches by use of a rectangular plow, a diamond blade saw, or other suitable equipment. Remove joint material, incompressibles, rubble, and other extraneous materials present in the joint or adhering to the face of the adjacent concrete slabs. Clean both faces of the joint by sandblasting to the depth of the proposed sealer, leaving the faces clean and free of existing joint sealer and other contaminants. Blow the joint with a hot-air lance to provide a dry surface.

Insert the backer rod only in transverse expansion joints at a depth equal to the joint width plus 1/4 inch for the recess. Install the backer rod with a doublewheeled steel roller without stretching or puncturing the backer rod. Ensure that the backer rod is firmly seated to support the joint sealer in the joint.

Melt the joint sealer according to the manufacture's recommendations. Ensure that the application temperature of the joint sealer is approximately 295 °F, except do not exceed the manufacturer's safe heating temperature. Seal joints when the ambient temperature is above 40 °F.

Discard the first gallon of material to flow from the applicator wand. Pour joint sealer in the joints, ensuring that joint sealer is not spilled on the surface of the concrete. If spillage occurs, immediately remove spilled joint sealer from the surface of the concrete. Fill joints so that the joint sealer is 1/8 to 1/4 inch below the adjacent surface.

Remove the joint sealer for the full slab width and full seal depth from joints that are filled to within 1/8 inch of the elevation of the adjacent concrete. Completely clean and reseal the joints the same day as the joint overfilling occurred.

Do not allow traffic over the poured joints until the joint sealer has hardened to resist pickup.

456.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
SEALING EXISTING JOINTS IN CONCRETE PAVEMENT	LINEAR FOOT

DIVISION 500 – BRIDGES AND STRUCTURES

SECTION 501 – SHEETING AND COFFERDAMS

501.01 DESCRIPTION

This Section describes the requirements for constructing and removing cofferdams and sheeting.

501.02 MATERIALS

Provide materials as specified:

Concrete	903.03
Structural Steel	906.01
Steel Sheet Piles	906.02
Bolts	908.01

501.03 CONSTRUCTION

501.03.01 Temporary Sheeting

A. Working Drawings. At least 30 days before beginning work, submit working drawings for approval. Include the following:

1. Size, cross-section, section modulus, and physical properties of the sheeting that will provide the maximum longitudinal bending moment for proper functioning.
2. Bracing design to protect workers, adjoining properties, and the public.
3. The combined stress calculations to determine the maximum effect of the principal stresses on the sheeting. Include a check for the principal stresses against the appropriate material yield point.
4. The effects of bending stresses in the longitudinal direction and the transverse direction.
5. The maximum forces that the sheeting is subjected to during construction operations.
6. The Contractor may use the Hencky-von Mises (Yield Distortion Energy) criterion to combine stresses and relate the principal stresses to a failure criterion (Material Yield Point).
7. Method for removing obstructions.
8. Method for addressing underground facilities and utilities that coincide with sheeting.
9. If required, dewatering plan, including method of dewatering and controlling sediment and contaminants from entering adjacent waterbodies, wetlands and environmentally sensitive areas. Do not use earthen berms as a method of dewatering.

B. Construction. Excavate and remove materials that obstruct the installation as specified in 202.03. Do not install within 200 feet of concrete that is being placed or has been placed within the previous 24 hours unless approved by the RE. Ensure that the sheeting has no gaps and is continuous for its entire length.

C. Dewatering. If required, dewater as specified in the approved dewatering plan. Continue dewatering operations until the temporary sheeting is removed or as directed by the RE.

D. Removal. Remove temporary sheeting when it is no longer required. Backfill voids left from temporary sheeting to provide uniform finish grades. Except for timber, the RE may approve leaving the temporary sheeting in place. When temporary sheeting is left in place, remove the upper portion to at least 3 feet below finish ground.

501.03.02 Permanent Sheeting

Construct permanent sheeting as shown on the Plans. Ensure that the sheeting has no gaps and is continuous for its entire length.

At least 15 days before constructing sheeting, submit to the RE for approval a dewatering plan including method of dewatering and controlling sediment and contaminants from entering adjacent waterbodies, wetlands, and

environmentally sensitive areas. Dewater according to the approved dewatering plan. Continue dewatering operations until no longer required.

501.03.03 Temporary Cofferdams

A. Working Drawings. At least 30 days before beginning work, submit working drawings for approval. Include the following:

1. Size, cross-section, section modulus, and physical properties of the cofferdam that will provide the maximum longitudinal bending moment for proper functioning.
2. Bracing design to protect workers, adjoining properties, and the public.
3. The combined stress calculations to determine the maximum effect of the principal stresses on the cofferdam. Include a check for the principal stresses against the appropriate material yield point.
4. The effects of bending stresses in the longitudinal direction and the transverse direction.
5. The maximum forces that the cofferdam is subjected to during construction operations.
6. The Contractor may use the Hencky-Von Mises (Yield Distortion Energy) criterion to combine stresses and relate the principal stresses to a failure criterion (Material Yield Point).
7. A complete description of the proposed cofferdam, including brochures or other literature that indicates a proven performance history of the proposed system.
8. Dewatering plan, including method of dewatering and controlling sediment and contaminants from entering adjacent waterbodies, wetlands, and environmentally sensitive areas. Do not use earthen berms as a method of dewatering.

B. Construction. Construct cofferdams to ensure the stability of the excavation and to keep the excavation free of water. Construct the cofferdam with interior dimensions that allow clearance for the construction and inspection of forms and for the handling and pumping of water outside of the footing area. Extend the cofferdam below the bottom of the footings and brace cofferdams in all directions and ensure that they are maintained free of water until the subsequent work has been completed.

The Contractor may only extend timber or bracing of a cofferdam into or through the proposed substructure with RE approval. Ensure that vertical structural members supported on rock are toed-in to ensure stability.

C. Dewatering. Continue dewatering operations until the temporary cofferdam is removed or as directed by the RE.

D. Removal. Remove temporary cofferdams when no longer required. Restore disturbed areas, including watercourse beds, to original conditions.

The Contractor may request that the temporary cofferdam be left in place. If approved, the RE will designate the limits of the cofferdam to be left in place.

501.03.04 Permanent Cofferdams

A. Construction. Construct cofferdams to protect the foundation and the construction against damage and water. Ensure that vertical structural members supported on rock are toed-in sufficiently to provide stability against movement.

B. Placing Concrete Seal. When concrete seals are shown, submit a plan of operation to the RE for approval at least 30 days before placing concrete. Include the following in the plan:

1. Method of placing concrete.
2. Methods of controlling water and sediment intrusion.
3. Equipment models and quantity. Include backup equipment within the Project Limits at all times.
4. Size and description of crew.
5. Corrective action plan for equipment breakdown or cofferdam failure.

Maintain still water at the point of deposit. Do not place concrete in running water. Ensure that plastic concrete does not come in contact with water outside of the confines of the cofferdam. Place concrete in 1 continuous operation. To prevent segregation, place the concrete in a compact mass in its final position. Do not disturb the concrete after placement. Place concrete under water using 1 of the following methods:

1. Tremie Method. When using a tremie, ensure that the tube is at least 10 inches in diameter, and constructed in sections having flanged couplings fitted with gaskets. Support the tremie to allow free movement of the

discharge end over the entire placement area and to allow its being lowered rapidly to choke off or retard the flow. Ensure that the discharge end is completely submerged in concrete at all times and the tremie tube contains sufficient concrete to prevent water entry.

2. **Bottom-Dump Bucket Method.** When using a bottom-dump bucket to place concrete, ensure that the bucket has a capacity of at least 1/2 cubic yard and loose fitting top covers. Gradually lower the bucket until it rests upon the prepared foundation or upon concrete already placed. Then gradually raise the bucket while discharging the concrete, to maintain as near still water as possible at the point at discharge.

Ensure that depressions in the top of the seal are less than 6 inches below the specified elevation and peaks are less than 6 inches above the specified elevation. The RE will take soundings during placement of the final lift of each seal, before initial set. Cut areas exceeding the 6-inch tolerance to within the permissible height above the theoretical top of the seal.

C. Dewatering. If required, submit a dewatering plan to the RE for approval. Include the method of dewatering and controlling sediment and contaminants from entering adjacent waterbodies, wetlands, and environmentally sensitive areas. Do not use earthen berms as a method of dewatering. Before placing the tremie seal, clear the bottom of excavation of objectionable material. Do not dewater while placing concrete and for at least 24 hours after completion of the tremie seal.

Do not begin dewatering a sealed cofferdam until the seal has cured to withstand the hydrostatic pressure. Dewater the cofferdam and clean the seal of laitance.

D. Removal. Remove the cofferdam to the limits shown on the Plans after completion of the substructure. Restore disturbed areas, including watercourse beds, to original conditions.

501.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
TEMPORARY SHEETING	SQUARE FOOT
PERMANENT SHEETING	SQUARE FOOT
TEMPORARY COFFERDAM	LUMP SUM
PERMANENT COFFERDAM	LUMP SUM

The Department will measure the square footage of TEMPORARY SHEETING and PERMANENT SHEETING by multiplying the average height and length of sheeting that is driven. The Department will determine the average height by extending a line from the bottom of the excavation to a vertical plane of the top of sheeting.

SECTION 502 – LOAD BEARING PILES

502.01 DESCRIPTION

This Section describes the requirements for furnishing and installing concrete, steel, and timber piles.

502.02 MATERIALS

502.02.01 Materials

Provide materials as specified:

Concrete	903.03
Structural Precast Concrete	904.03
Prestressed Concrete	904.04
Reinforcement Steel	905.01
Steel Castings for H-Pile Tips (Medium Strength)	906.02
Steel Piles	906.02
Coal Tar Epoxy Paint	912.01.03

Round Timber Piling 915.02
Timber Treatment 915.05

502.02.02 Equipment

Provide equipment as specified:

Impact Hammers 1004.01
Vibratory Hammers 1004.02
Leads and Followers 1004.03

502.03 CONSTRUCTION

502.03.01 Furnishing Pile Driving Equipment

Perform a wave equation analysis program (WEAP) for each pile type and hammer combination. Ensure that the number of required hammer blows at the ultimate pile resistance indicated by the WEAP analysis is between 3 and 10 blows per inch. Also ensure that the compressive and tensile pile stresses are within the allowable limits.

Submit 4 copies of the WEAP analysis, signed and sealed by a Professional Engineer, and 4 copies of the NJDOT Pile and Driving Equipment Data Form to the Department for approval 30 days before delivery of the equipment to the Project Limits. Submit a separate WEAP analysis and NJDOT Pile and Driving Equipment Data Form for each pile type and hammer combination.

502.03.02 Preboring Holes

When preboring holes for round piles, use an auger with a diameter that is between 2 inches smaller than the average nominal diameter of piles. When preboring holes for steel H-piles, use an auger with a diameter that is 4 to 6 inches less than the nominal diagonal dimension of the piles. Backfill the void between the piles and the prebored holes with granular material.

502.03.03 Driving Piles

A. Wave Equation Analysis Program (WEAP). When Dynamic Pile Load Tests will not be performed, the RE will determine the ultimate bearing capacity of the pile, the anticipated number of hammer blows per inch, and the anticipated compressive and tensile pile stresses at the required ultimate pile capacity using the wave equation analysis.

B. Methods of Driving. Do not drive piles in embankments until the embankment work, including placement, compaction, and removal of surcharge has been completed. Do not drive piles within 200 feet of concrete that is being placed or has been placed within the previous 24 hours unless approved by the RE. When driving piles in groups, start from the center of the group and proceed outward in both directions, or start from the end of the group and proceed to the opposite end of the group.

When using followers in driving, drive 1 long pile in each group of 10 without a follower as a test pile to determine the average bearing capacity of the group.

Do not install precast and prestressed concrete piles for at least 21 days after fabrication. If at any point precast and prestressed concrete piles are cured at 40 °F or below, the RE may require additional curing time before the installation of the piles. Additionally, do not install precast and prestressed concrete piles in seawater, brackish water, or sulfate soils for at least 30 days after fabrication.

The Contractor may use vibratory pile drivers, with the approval of the RE, to advance steel bearing piles. Obtain RE approval before jetting piles. The RE will require use of an impact pile driver for at least the final 10 feet of penetration.

Drive piles as follows:

1. **Accuracy of Driving.** Ensure that piles are driven within 1/4 inch per foot from the vertical or batter. Ensure that the driven piles are within 6 inches of the specified position. Ensure that piles for trestle bents are driven

within 1/2 inch per foot from the vertical or batter. Ensure that the driven trestle bent piles are within 2 inches of the specified position.

The RE will prohibit excessive manipulation of the piles to force them into proper position.

2. **Penetration.** At least 10 days before beginning the work, submit a plan to the RE for approval for the types of piles, including those whose tip elevation is noted, for jetting, blasting, or the use of spuds and other work necessary to obtain the penetration required.

3. **Rock Bearing Piles.** Drive steel H-piles or other steel piles that are intended to bear on rock to the refusal necessary to penetrate the rock sufficiently to provide uniform and adequate bearing. The pile is considered as reaching refusal when a penetration of not less than 5 blows per 1/4 inch has been achieved.

C. Test Piles. The RE will determine the length of the test pile. Excavate the ground at each footing location to the elevation of the bottom of the footing before the pile is driven. Drive the test piles with the same type of equipment that will be used for driving production piles. Drive the test piles at the designated locations to the specified bearing capacity or hammer blow count, and tip elevation. Perform the following tests when shown on the Plans:

1. **Static Pile Load Test.** Obtain the services of a professional testing laboratory, or Professional Engineer with satisfactory pile load test experience, to conduct the load test, to record data, and to provide reports of the test results to the RE.

   Determine the top elevation of the test piles immediately after driving and again just before static load testing to check for heave. Redrive or jack piles that heave more than 1/4 inch relative to the original elevation prior to testing. Allow at least 3 days to pass between the driving of any anchor piles or the load test pile and the commencement of the load test.

   If pipe walls are not of adequate strength to sustain the static test loading when empty, place the required reinforcement and concrete before loading. Do not apply loads for static load tests for cast-in-place concrete piles until the concrete in the test pile has set at least 7 days. Refer to the Special Provisions to determine the total static test load to be applied to piles.

   Perform static load tests according to ASTM D 1143, using the quick load test method for individual piles, except perform the test to plunging failure or the capacity of the loading system. Provide testing equipment and measuring systems according to ASTM D 1143, except ensure that the loading system is capable of applying 150 percent of the ultimate pile capacity or 1000 tons, whichever is less. At least 20 days before beginning the work, submit detailed plans of the proposed loading apparatus, prepared by a Professional Engineer, to the RE for approval. Construct the apparatus to allow the various increments of the load to be placed gradually without causing vibration to the test pile. When the approved method requires the use of anchor piles that will be used as production piles, drive anchor piles of the same type and diameter as the production piles in the location of the production piles when feasible.

   Remove the loads after the completion of the tests. The RE may allow the test piles to become part of the structure if approved. If any pile is found unsatisfactory for use in the structure, the RE will direct removal of the pile or cutoff of the pile below the ground line or footing.

   Upon completion of each test, submit to the RE for approval 4 copies of the static load test records/reports signed and sealed by a Professional Engineer.

2. **Dynamic Pile Load Tests.** At least 30 days before beginning the work, submit verification to the RE that the components of the apparatus for obtaining dynamic measurements and the apparatus for recording, reducing, and displaying data have been calibrated by the equipment manufacturer within the past 12 months. Submit the name, qualifications, and previous experience of the person performing the dynamic pile load tests to the RE for approval.

   Perform dynamic testing according to ASTM D 4945. Take dynamic measurements while driving the piles specified as dynamic load test piles. Using pile analyzer instruments, determine the ultimate capacity of the pile. Monitor the stresses in the pile during driving operations to ensure that the pile is not damaged by excessive compressive or tensile stresses. Monitor the driving of test piles during the full length of driving and during restriking. Drive piles to the depth at which the dynamic equipment indicates that the required ultimate bearing capacity has been achieved and to the required tip elevation. If needed to maintain

acceptable stresses in the piles, modify the driving method. If the dynamic test equipment measurements indicate non-axial driving, immediately realign the driving system.

If restrike is specified in the Special Provisions or directed by the RE, wait a minimum of 24 hours and then reattach the instruments before restriking the dynamic load test pile. Warm up the hammer by applying at least 20 blows to another pile before restriking. Terminate the restrike when the ultimate capacity of the pile is reached; when the amount of penetration reaches 6 inches; or when the total number of hammer blows reaches 50, whichever occurs first. If the established hammer blow count is not attained on restrike, the RE may direct the Contractor to drive a portion of or all of the remaining test pile length and repeat the restrike procedure. After restrike, the RE will determine whether additional pile penetration and testing is required. The RE may require splicing of a test pile driven to plan grade that does not meet the required hammer blow count. Drive the spliced pile until the required bearing is obtained.

Within 48 hours of the completion of each test, submit 4 copies of the pile dynamic monitoring report to the RE. Include the Pile Dynamic Analyzer (PDA) test results, the Case Pile Wave Analysis Program (CAPWAP) results, and an interpretation of the data that is signed and sealed by a Professional Engineer.

D. Production Pile Lengths. When test piles or load tests are specified, the RE will use the data obtained in conjunction with other available geotechnical information to determine the lengths of production piles to be furnished. The RE will not prepare the order list for any portion of the foundation until the required test data has been completed.

The Contractor may increase the length of the production piles to be furnished to provide fresh heading or to suit the Contractor's method. Complete test piles before driving any production piles unless approved by the RE.

E. Cut-Offs and Cappings. Ensure that the tops of foundation piles are embedded in the concrete footing at least 1 foot. At locations where tremie concrete is used, ensure the piles project at least 12 inches above the top of the tremie concrete. Ensure that the length of pile cut-off is sufficient to allow the removal of all injured material. Ensure that the distance between the edge of a pile to the nearest edge of the footing is at least 9 inches. When the cut-off elevation for a precast concrete pile is below the elevation of the bottom of the cap, build up the pile from the butt of the pile to the elevation of the bottom of the cap with a reinforced concrete extension.

Cut-off piles at right angles to the axis of the pile at the designated elevation. Make the cuts in clean, straight lines.

F. Painting Steel Piles and Pipe Shells. When steel piles or pipe shells in the completed structure extend above the original ground line or finished ground surface, protect the piles or pipe with coal tar epoxy paint as specified in 511.03.01.C. Ensure the coating extends from an elevation 3 feet below the bed of waterbody or finished ground surface to the top of the exposed steel.

G. Defective Piles. Ensure that the pile driving procedure does not subject the piles to excessive and undue abuse, producing crushing and spalling of the concrete, injurious splitting, splintering and brooming of the wood, or deformation of the steel. Correct damaged or defective piles using 1 of the following methods:

1. Withdraw the pile and replace it with a new and, if necessary, longer pile.
2. Drive a second pile adjacent to the defective pile. Remove the defective pile to at least 24 inches below cut-off elevation, and fill the hole with sand if it is a cast-in-place pile.
3. Splice, build up the pile, or extend a sufficient portion of the footing to properly embed the pile.

Re-drive piles that heave by more than 1/4 inch as a result of the driving of adjacent piles or any other cause. If a pile cannot be driven as specified due to an obstruction, the RE will determine when adequate penetration has been achieved.

502.03.04 Splicing Piles

Use full length steel piles, pipes, shells, precast concrete piles, and prestressed concrete piles. Do not splice partial pile lengths to achieve the production pile length unless directed. At least 10 days before beginning the work, submit the method of splicing, splice location for each pile, and name of certified welder to the RE for approval. Do not splice timber piles.

502.03.05 Pile Shoes

Attach pile shoes as shown on the Plans.

502.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
FURNISHING EQUIPMENT FOR DRIVING PILES	LUMP SUM
PREBORED HOLE	LINEAR FOOT
TEST PILE, FURNISHED	LINEAR FOOT
TEST PILE, DRIVEN	LINEAR FOOT
STATIC PILE LOAD TEST	UNIT
DYNAMIC PILE LOAD TEST	UNIT
CAST-IN-PLACE CONCRETE PILE, FURNISHED, ___" DIAMETER	LINEAR FOOT
CAST-IN-PLACE CONCRETE PILE, DRIVEN, ___" DIAMETER	LINEAR FOOT
PRECAST CONCRETE PILE, FURNISHED, ___ X ___"	LINEAR FOOT
PRECAST CONCRETE PILE, DRIVEN, ___ X ___ "	LINEAR FOOT
PRESTRESSED CONCRETE PILE, FURNISHED, ___ X ___"	LINEAR FOOT
PRESTRESSED CONCRETE PILE, DRIVEN, ___ X ___"	LINEAR FOOT
PRESTRESSED CONCRETE PILE, FURNISHED, ___" DIAMETER	LINEAR FOOT
PRESTRESSED CONCRETE PILE, DRIVEN, ___" DIAMETER	LINEAR FOOT
STEEL H-PILE, FURNISHED, HP ___ X ___	LINEAR FOOT
STEEL H-PILE, DRIVEN, HP ___ X ___	LINEAR FOOT
TIMBER PILE, FURNISHED, ___" DIAMETER	LINEAR FOOT
TIMBER PILE, DRIVEN, ___" DIAMETER	LINEAR FOOT
SPLICE (___)	UNIT
PILE SHOE	UNIT

The Department will pay 75 percent of the lump sum price bid for FURNISHING EQUIPMENT FOR DRIVING PILES when the equipment necessary for driving piles is furnished and driving of test piles has started on an individual structure basis. The Department will pay the remaining 25 percent when the work of driving piles is completed on an individual structure basis.

The Department will measure prebored holes that are specified or directed by the RE by the linear foot from the bottom of the foundation excavation elevation to the bottom of the hole elevation.

The Department will make payment for the length of pile furnished based on the RE's order list. The Department will not make payment for the additional length of furnished pile to provide fresh heading, to drive through water, or to meet the Contractor's driving method. If the required penetration for any pile is greater than the length in the order list, the Department will include, for measurement in furnished piles, the additional length directed by the RE.

The Department will measure the length of piles driven by total length of linear foot installed and accepted, from the tip to the cut off elevation.

The Department will not include static pile load tests under driving piles. The Department will make payment for static pile load tests under STATIC PILE LOAD TEST.

The Department will not include dynamic pile load tests under driving piles. The Department will make payment for dynamic pile load tests under DYNAMIC PILE LOAD TEST. The Department will not make separate payment for dynamic pile load tests and CAPWAP analysis performed on piles that require restriking. The Department will include restriking and a CAPWAP analysis of a dynamic pile load test in the DYNAMIC PILE LOAD TEST. When dynamic pile load tests (Dynamic or PDA Monitoring) are used, the Department will not make payment for installation of test piles until recorded data is submitted to the RE.

The Department will make payment for splices within the pile order length if the order length is greater than 80 feet under SPLICE (___). The Department will not make payment for splices in piles that are less than 80 feet unless directed by the RE.

SECTION 503 – DRILLED SHAFT FOUNDATIONS

503.01 DESCRIPTION

This Section describes the requirements for installing and testing drilled shafts.

503.02 MATERIALS

503.02.01 Materials

Provide materials as specified:

Concrete	903.03
Self Consolidating Concrete	903.06.01
Grout	903.08.02
Reinforcement Steel	905.01.01
Drilled Shaft Casing	906.03
Structural Steel Paint (Organic Zinc)	912.01.01
Water	919.08

Provide clay-mineral based slurry (processed attapulgite or bentonite) for mineral slurry. Ensure that the mineral slurry has a mineral grain size that will remain in suspension and has sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system. Ensure that the percentage and specific gravity of the material used to make the mineral suspension is sufficient to maintain the stability of the excavation and to allow proper concrete placement.

Provide polymer slurry as recommended by the manufacturer.

503.02.02 Equipment

Provide equipment as specified:

Concrete Batching Plant	1010.01
Concrete Trucks	1010.02

Ensure that equipment does not introduce uncontrolled exhaust fumes into the surrounding areas, or other occupied areas adjacent to the work site. Crane and drilling engine exhaust fumes will require their own separate exhaust systems adequately vented to the atmosphere away from any confined work sites.

Ensure that equipment used for final bottom cleaning does not have a centralizing guide at the tip.

Use excavation and drilling equipment having adequate capacity, including power, torque, and down thrust to excavate a hole of both the maximum specified diameter and to a depth of 20 percent beyond the depths shown on the plans when operated at rated capacity.

Provide Crosshole Sonic Logging (CSL) test equipment that includes the following components:

1. A microprocessor-based CSL system for display of individual CSL records, analog-digital conversion and recording of CSL data, analysis of receiver responses, and printing of CSL logs.
2. Ultrasonic source and receiver probes for 1.5-or 2-inch inner diameter pipe, as appropriate.
3. An ultrasonic voltage pulser to excite the source with a synchronized triggering system to start the recording system.
4. A depth measurement device to determine and record depths.
5. Appropriate filter/amplification and cable systems for CSL testing.

503.03 CONSTRUCTION

503.03.01 Installation Plan

No later than 30 days after the date of the Notice to Proceed, submit to the RE for approval an installation plan that includes the following:

1. Names and descriptions of the last 3 drilled shaft construction projects completed, including the names and telephone numbers of owner's representatives.
2. Type, size, and number of equipment to be used.
3. Details of the overall construction operation sequence and the proposed sequence of shaft construction.
4. Details of planned shaft excavation methods.
5. Details of the methods to ensure shaft stability during excavation and concrete placement. Include a review of method suitability to the anticipated work site and subsurface conditions. If casings are proposed or required, provide casing dimensions, detailed procedures for permanent casing installation, and procedures for temporary casing installation and removal.
6. When slurry is specified or proposed, provide details of the methods for mixing, placing, circulating, and desanding the slurry. Also include the method of monitoring and continuously maintaining the slurry level. Provide the method of disposal.
7. Details of methods to clean and maintain the shaft excavation, including removal of loose rock and sediment from the shaft bottom.
8. Details of steel reinforcement lifting, splicing if necessary in a hanging position, insertion and securing, including support and centralization methods.
9. Mix design of the concrete and documentation showing that the mix design meets the approved mix and strength requirements.
10. The method used to fill or eliminate voids between the plan shaft diameter and excavated shaft diameter, or between the shaft casing and surrounding soil, if permanent casing is specified.
11. Methods to determine drilled shaft dimensions and the deviation from vertical for the entire depth of the drilled shaft.
12. Details of proposed methods to check shaft bottom cleanliness.
13. Procedures for control and removal of spoils on land, over water, or both.
14. Details of concrete batching and/or delivery to the work site, and concrete placement, including proposed operational procedures for concrete pump or tremie. Discuss the initial placement, raising tremie pipe(s) during placement, overfilling of the shaft concrete, the proposed method to accurately monitor the volume of concrete being placed at all times during the pour, and provisions to prepare the completed shaft top at its final shaft top elevation.
15. The qualification records of the testing organization to perform the O-Cell Load Test and the CSL.
16. Details of procedures, materials, and equipment for performing the O-Cell Load Test and the CSL. Provide a certificate of calibration for the load cell from an approved testing laboratory. Ensure that the calibration was performed for all ranges of proposed loading within the 2 months preceding the load tests. Ensure that the certified accuracy of the load cell is within 1 percent of the true load.
17. Concrete core drilling equipment and procedures to retrieve the core specimens that may be required to determine the integrity of concrete placed in the drilled shaft.

The RE will schedule a review meeting between the Contractor, designer, and the Department after reviewing the installation plan and at least 15 days before the start of work.

Within 30 days after receipt of the plan, the RE will notify the Contractor of any additional information required and changes that may be necessary.

If the RE rejects the plan or a part of the plan, submit revisions to the RE for reevaluation. The RE will notify the Contractor within 10 days after receipt of proposed changes of their acceptance or rejection.

503.03.02 Demonstration Drilled Shaft Installation

The Department will require a demonstration drilled shaft to verify the Contractor's methods. Locate the demonstration shaft as shown on the Plans or as directed by the RE. Excavate the demonstration shaft to the depth of the deepest

production shaft shown on the Plans. Construct the demonstration shaft as specified in 503.03.06. Include CSL as specified in 503.03.04.

Cut-off the concreted demonstration shafts 2 feet below finished grade or 3 feet below the mudline if in water. Restore disturbed areas at demonstration shaft holes to their original condition.

Once approval has been given to construct production shafts, do not change the personnel, methods, or equipment that were used to construct the approved demonstration shaft without written approval of the RE.

503.03.03 Load Tests

A. O-Cell Installation. Ensure that the installation and execution of the O-cell load tests are supervised by a Professional Engineer. Ensure that the O-cell, vibrating wire strain gauges, hydraulic supply, and other attachments are assembled according to the manufacturer's recommendations. Provide a reinforcement steel cage, as specified in 503.03.06.K, to attach the O-cell. Excavate using the approved method at the location shown on the Plans. After excavating a test drilled shaft, and obtaining approval from the RE, place a seating layer of concrete in the base of the drilled shaft. While the seating concrete is still plastic, install the reinforcement steel cage with the O-cell in the test shaft so that the O-cell rests firmly in the concrete.

After seating the O-cell assembly, place concrete in the drilled shaft as specified in 503.03.06.M. The ME will take at least 6 concrete compression test cylinders from the concrete used in the test shaft. At least 1 day before the load test, the ME will test at least 1 of the cylinders. The ME will test at least 2 cylinders on the day of the load test. Do not perform the O-cell test until 7 days after placing the concrete and the concrete achieves the specified compressive strength.

B. Load Testing and Reporting. Perform load tests according to ASTM D 1143. If the test apparatus shows signs of negative effects due to the construction activities, immediately cease testing and do not resume until the conditions are favorable for testing. Apply loads in increments equaling 10 percent of the maximum test load for the drilled shaft.

Take direct movement indicator measurements of the following:

1. Downward drilled shaft end-bearing movement (1 indicator required).
2. Upward top-of-drilled shaft movement (minimum of 3 indicators required).
3. Vibrating wire strain gauges (minimum of 8 per test required).

Apply loads at the specified intervals until the maximum test load shown on the Plans is reached in either end bearing or side shear or until the maximum capacity or maximum stroke of the O-cell is reached. In addition to the requirements of ASTM D 1143, at each load increment, or decrement, take readings of the movement indicators at 1.0, 2.0, and 4.0 minute intervals while holding the load constant. Ensure that strain gauge readings are concurrent with shaft movement readings. The RE may direct additional cycles of loading and unloading using similar procedures following the completion of the test cycle.

Ensure that dial gauges or Linear Variable Displacement Transducers (LVDTs) used to measure end bearing, side shear movement, and shaft compression have a minimum travel of 8 inches and are capable of being read to the nearest 0.0001 inch division. The Contractor may alternately monitor end bearing movement using LVDTs capable of measuring the expansion of the O-cell (6 inches). Ensure that the reference beam has a minimum length equal to 6 times the drilled shaft diameter. Monitor the reference beam for movement during load testing using a surveyor's level.

Provide the performance results of each load test to the RE the day after performing the load tests. Provide a report of the load test results to the RE within 10 days of completing the test. Ensure that the report includes data readings and plots of the readings, the details of the load test and set-up, and a determination of the end bearing and friction/adhesion of the rock and soil. Within 20 days, the Department will notify the Contractor if revisions to the foundation lengths and installation procedures will be made based on the results of the load tests. Do not begin construction of production drilled shafts without the Department's approval.

C. Post-Test Grouting Procedures. Grout the interior of the O-cell and annular space around the outside of the O-cell according to the manufacturer's recommendations. The Contractor does not have to grout test shafts that will not be used as production shafts.

503.03.04 Crosshole Sonic Logging (CSL)

A. CSL Tube Installation. Begin Crosshole Sonic Logging (CSL) on all production and demonstration drilled shafts 48 hours after placing concrete in the shaft. Ensure that the testing is completed within 20 days after placing concrete.

Ensure that the CSL tubes are watertight and have a round, regular, internal diameter free of defects or obstructions, including any at tube joints, to allow the free, unobstructed passage of 1.3-inch diameter source and receiver probes.

Ensure that each pipe is fitted with a watertight shoe on the bottom and a removable cap on the top. Attach the pipes securely to the interior of the reinforcement cage with a minimum cover of 4 inches. The RE may allow the Contractor to install tubes on the outside of the cage if adequate cover and clearance are available. Install the tubes as near to parallel as possible.

Ensure that the tubes extend from 6 inches above the shaft bottoms to at least 3 feet above the shaft tops. If the shaft top is sub-surface, extend the tubes at least 2 feet above the ground surface. Ensure that joints required to achieve full-length tubes are watertight.

Ensure that the tubes are not damaged during reinforcement steel cage installation. As the cage is being lowered into the shaft, monitor the tubes to ensure that they are vertical and parallel, and that connections are watertight. After installing the reinforcement cage, immediately fill the tubes with clean water. After the tubes are filled with water, cap or seal the tube tops.

Before placing concrete, plumb at least 1 tube per shaft and record the tube length. Note the stickup of the tubes above the shaft tops.

Do not remove the seals or caps until the concrete in the shaft has set. Remove the caps or plugs after installation and ensure not to apply excess torque, hammering, or other stresses that could break the bond between the tubes and the concrete.

B. CSL Testing and Reporting. Perform CSL tests between pairs of tubes. Perform the CSL tests with the source and receiver probes in the same horizontal plane, unless the tests indicate potential defects. Take CSL measurements at depth intervals of 2 inches or less, from the bottom of the tubes to the top of each shaft. Pull the probes simultaneously, starting from the bottoms of the tubes, over a depth measuring device. Remove slack from the cables before pulling to provide for accurate depth measurements of the CSL records. Test 2 principle diagonals through the center and between each tube pair around the perimeter of tested shafts.

If the tests indicate potential defects, the RE may direct the Contractor to evaluate questionable zone using tomography (source and receiver vertically offset in the tubes). Report defects indicated by longer pulse arrival times and significantly lower amplitude/energy signals to the RE, and conduct additional tests as required to evaluate the extent of such defects.

The RE will reject a shaft based on conclusive evidence that a defect exists in the shaft that will result in inadequate or unsafe performance under service loads. If the CSL records are complex or inconclusive, the RE may require additional testing to confirm the location of the defect. The RE may require coring to verify shaft conditions.

Submit to the RE a report, signed and sealed by a Professional Engineer, that includes recommendations as to the acceptability, unacceptability, and soundness of the drilled shaft. Include in the report a CSL log for each tube pair tested with analyses of:

1. Initial pulse arrival time versus depth.
2. Pulse energy/amplitude versus depth.
3. Defect zones.

The Department will evaluate the CSL test results and determine whether or not the drilled shaft construction is acceptable. If the Department determines that the drilled shaft is acceptable, dewater the CSL tubes and grout.

503.03.05 Core Drilling of Drilled Shaft Concrete

The Contractor may core drill drilled shafts that are determined to be unacceptable based on the CSL tests. The RE will determine the number and depth of cores required. Drill cores at a minimum diameter of 3 inches.

Keep an accurate coring log, properly mark cores with the depth at each interval of core recovery, and place the cores in a crate. Deliver the cores and 3 copies of the coring log to the Department Laboratory.

If the RE determines that the drilled shaft is acceptable, dewater and grout the core holes and the CSL tubes.

If the Department determines that the drilled shaft is unacceptable, submit working drawings for approval proposing corrective measures. Do not begin corrective measures until the Department approves the working drawings.

Do not proceed with construction above a drilled shaft until the quality of the shaft, as represented by the core samples, is determined to be acceptable and the RE provides notification to continue construction.

503.03.06 Constructing Drilled Shafts

A. Installation Plan. Submit the installation plan, as specified in 503.03.01. Do not begin constructing drilled shafts until the RE approves the plan.

B. Location and Alignment. Construct drilled shafts within 3 inches of plan position in the horizontal plane at the elevation of the top of the shaft. Ensure that the vertical alignment of a shaft excavation does not vary from the plan alignment by more than 1/4 inch per foot of depth. Ensure that the alignment of a battered shaft excavation does not vary from the plan alignment by more than 1/2 inch per foot of depth.

C. Construction Sequence Limitations. Excavate to the bottom of the footing elevation before beginning shaft construction. When constructing drilled shafts and placing embankment, construct drilled shafts after the placement of embankment. Repair disturbances caused by shaft installation to a subsequent drilled shaft area before beginning shaft construction.

Do not excavate a shaft if an adjacent shaft in the same substructure unit is open unless the RE's written approval is obtained. Do not perform blasting or vibrate to place casings until the concrete in adjacent shafts has reached 80 percent of the required 28-day compressive strength. Once the excavation of a shaft has begun, do not stop the excavation until the excavation is completed. If the excavation is stopped for more than 24 hours, maintain shaft stability as detailed in the installation plan.

D. Excavation Log. Maintain an excavation log during shaft excavation that includes the following:

1. Description and approximate top and bottom elevation of each soil or rock material encountered during shaft excavation.
2. Elevations at which seepage or groundwater flow are encountered, and remarks.
3. The type of tools used for the excavation.
4. Changes in the type of tools used for excavation.

Ensure that discrepancies noted on the log by the RE are resolved by the end of each day. Provide 2 copies of the final log to the RE within 24 hours after a shaft excavation is completed and approved.

Reuse excavated material as specified in 202.03.07.A.

E. Excavating. Use the appropriate method for constructing drilled shafts as follows:

1. Dry Method. Only use the dry method where the groundwater level and soil conditions allow construction of the drilled shaft in a relatively dry excavation, and where the sides and bottom of the shaft may be visually inspected by the RE before placement of reinforcement and concrete. The dry method will consist of drilling the shaft excavation, removing any accumulated water and loose material from the excavation, placing the reinforcement cage, and concreting the shaft in less than 3 inches of water.

2. Wet Method. Construct drilled shafts using the wet method where dry excavation cannot be maintained. The wet method will consist of using water or slurry, as specified in 503.03.06.G, to maintain stability of the drilled shaft perimeter while excavating to finished depth, placing the reinforcement cage, and concreting the shaft. The Contractor may use the static or circulation process of the wet method.

When the material encountered cannot be drilled using conventional earth drilling tools and equipment, provide rock drilling equipment, including air tools, approved blasting materials, and other equipment as necessary to construct the shaft excavation to the size and depth required. Obtain the RE's approval before switching from earth to rock drilling tools and equipment. Obtain the RE's approval before blasting.

The Contractor may overream with a grooving tool, overreaming bucket, or other RE approved equipment. The RE will direct the thickness and extent of sidewall overreaming.

The Department will require sidewall overreaming between 1/2 and 3 inches when the sidewall of the hole has either softened due to excavation methods, swollen due to delays in concreting, or degraded because of slurry cake buildup.

Immediately remove drilling tools that are lost in the excavation.

F. Constructing Using Casings. Construct drilled shafts using casings where shown on the Plans or where the dry or wet construction methods are inadequate to prevent caving or excessive deformation of the hole. The Contractor may either place casings in a predrilled hole or advance casings through the ground by twisting, driving, or vibrating. When installing casings that are left in rock for the purpose of shielding voids, ensure that the predrilled hole is not more than 2 inches bigger than the casing diameter. When downsizing of permanent casing is required, do not overlap more than 6 feet of casing.

When constructing drilled shafts in open water, extend the exterior casings from above the water elevation into the ground to protect the shaft concrete from water action during placement and curing of the concrete. Install the casing to ensure a positive seal at the bottom of the casing so that no seepage of water or other materials occurs into or from the shaft excavation.

When casings are not shown on the Plans, but the Contractor believes that casings are necessary, the Contractor shall submit, in the installation plan, details of the proposed casing method (including casing lengths and diameters) and the proposed procedures of casing installation to the RE for review. If the Contractor does not determine the need for casings until after work on the shafts has begun, the Contractor shall submit to the RE for review a revised installation plan proposing the casing installation method for review.

Ensure that casings are clean, round, straight, and free of weld breaks and holes that would allow passage of water or plastic concrete. With RE approval, the Contractor may provide casings larger in diameter than shown on the Plans.

1. Temporary Casings. Casings are temporary unless shown as permanent casings on the Plans. Telescoping, predrilling with slurry, and overreaming to beyond the outside diameter of the casing may be required to install casing.

Remove temporary casing before completing concrete placement in the drilled shaft. Before withdrawing the casing, ensure that the level of plastic concrete in the casing is at least 5 feet above either the hydrostatic water level in the formation or the level of drilling fluid in the annular space behind the casing, whichever is higher. As the casing is withdrawn, maintain an adequate level of concrete within the casing so that fluid trapped behind the casing is displaced upward and discharged at the ground surface without contaminating or displacing the shaft concrete.

If the Contractor removes a specified diameter or length of casing and substitutes a longer or larger diameter casing through caving soils, the Contractor shall stabilize the excavation using a slurry or backfill before the new casing is installed.

If temporary casings become bound or fouled during shaft construction and cannot be practically removed, the Department will designate the drilled shaft defective. Submit working drawings for approval proposing corrective measures. Do not begin corrective measures until the Department approves the working drawings.

2. Removable Casing. When the shaft extends above ground or through a body of water, the Contractor may use suitable, removable casing for the portion exposed above ground or through a body of water except when permanent casing is specified. Strip removable casing from the shaft and ensure that the concrete is not damaged.

The Contractor may remove casings when the concrete has attained a strength of at least 2800 pounds per square inch as determined from 2 concrete cylinders field cured according to AASHTO T 23, provided that curing of the concrete is maintained, as specified in 504.03.02.F. Do no expose the shaft concrete to salt water or moving water for 7 days.

3. **Permanent Casings.** When not shown on the Plans, the Contractor may use permanent casing if approved by the RE. Ensure casings are continuous between the top and bottom elevations shown on the Plans. After installation is complete, cut off the permanent casing at the specified elevation.

   After installing the casings, repair damage to coated surfaces of the casings exposed to the air by applying an organic zinc prime coat from the same manufacturer as the shop-applied inorganic zinc prime coat.

G. Constructing Using Slurries. When using slurry to construct drilled shafts, the Contractor may use mineral or polymer slurries. During construction, maintain the level of the slurry at a height sufficient to prevent caving of the shaft excavation. Use a temporary surface casing in the upper soils. Maintain the slurry level inside the shaft above the groundwater level during installation and cleaning out. In the event of a sudden significant loss of slurry to the hole, cease the construction until either a method to stop slurry loss or an alternate construction procedure has been approved by the RE.

Pump slurry into holding tanks to ensure that no slurry spills or contaminates the site. Provide physical or chemical treatment of the slurry according to the manufacturer's recommendations.

During construction, maintain the level of mineral slurry in the shaft at least 4 feet above the highest expected piezometric pressure head that is along the depth of the shaft. Maintain the level of polymer slurry at least 5 feet above the highest expected piezometric pressure head that is along the shaft. If the selected slurry construction method fails, in the opinion of the RE, to produce the desired final results, cease this method and propose an alternate method to the RE for approval.

Ensure that a heavily contaminated slurry suspension, which could impair the free flow of concrete, has not accumulated in the bottom of the shaft. Before placing concrete for shaft excavation, take slurry samples using a sampling tool approved by the RE. Take slurry samples from the bottom of the shaft and at intervals not exceeding 10 feet up the slurry column in the shaft, until 2 consecutive samples produce acceptable values for density, viscosity, sand content, and pH at each sampling depth.

When slurry samples are unacceptable, take corrective actions. Do not place concrete until the slurry is re-sampled and test results are approved.

If the slurry remains in the shaft for more than 12 hours or if caking develops, roughen or re-ream the shaft with appropriate new bottom cleaning and slurry testing before concreting. Place concrete on the same day as the completion of the excavation of the drilled shaft to the bottom elevation.

1. **Mineral Slurry.** Premix mineral slurry with water and allow time for hydration according to the manufacturer's recommendations before using during shaft excavation. Provide slurry tanks of adequate capacity for slurry circulation, storage, and treatment. Do not substitute excavated slurry pits with slurry tanks without obtaining approval from the RE. Do not mix the slurry in the shaft.

   Monitor the properties of the pre-mixed slurry as it is introduced into the borehole and periodically thereafter, including a final check of a bottom sample before placing concrete to verify that the density and sand content are within the limits for the proper slurry displacement during concreting. Use desanding equipment to control slurry sand content to less than 4 percent by volume at any point in the borehole at the time the slurry is introduced.

   Perform control tests on the mineral slurry in the presence of the RE to determine density, viscosity, and pH. Adjust the slurry to meet the requirements shown in Table 503.03.06-1:

Table 503.03.06-1 – Mineral Slurry[3]		
Property	**Range**	**Test**
Density at time of slurry introduction	64.3 – 69.1[1] lbs/ft^3	API 13B, Bentonite Slurry Section (Mud Balance) ASTM D 4380
Density in hole at time of concreting	64.3 – 75.0[1] lbs/ft^3	API 13B, Bentonite Slurry Section (Mud Balance) ASTM D 4380
Viscosity at time of slurry introduction	28 – 45[2] sec/quart	API 13B, Section 2 (Marsh Funnel and Cup)
Viscosity in hole at time of concreting	28 – 45[2] sec/quart	API 13B, Section 2 (Marsh Funnel and Cup)
Sand content by volume	4% max	API 13B, Section 4 (Sand Screen Set) ASTM D 4381
pH at time of slurry introduction	8 – 11	API 13B, Section 6 (Paper Test Strips or Glass-Electrode pH Meter)
pH in hole at time of concreting	8 – 11	API 13B, Section 6 (Paper Test Strips or Glass-Electrode pH Meter)

1. Increase by 2 lbs/ft^3 in salt water.
2. Standard measurements are in seconds per quart. One sec/quart = 1.06 sec/liter.
   a. Perform tests when the slurry temperature is above 40 °F.
   b. Ensure that the sand content does not exceed 4 percent (by volume) at any point in the borehole as determined by the API sand content test when the slurry is introduced.
3. Perform tests to determine density, viscosity and pH value during the shaft excavation to establish a consistent working pattern. Perform a minimum of 4 sets of tests during the first 8 hours of slurry use. When the results show consistent behavior, the Contractor may decrease the testing frequency to 1 set per every 4 hours of slurry use.

2. Polymer Slurry. Provide a slurry management plan to the RE that includes a set of the slurry manufacturer's written recommendations and results of the following tests, as a minimum:

1. Density Test (API 13B-1, Section 1).
2. Viscosity Test (Marsh funnel and cup, API 13B-1), Section 2.2 or approved viscometer.
3. pH Test (pH meter, pH paper).
4. Sand Content Test (API sand content kit, API 13B-1, Section 5).

Also include the tests to be performed, the frequency of those tests, the test methods, and the maximum and minimum property requirements that must be met to ensure that the slurry meets its intended functions. Ensure that all test reports are signed, and provide them to the RE on completion of each drilled shaft.

H. Removing Obstructions. The RE will determine if an object is considered an obstruction. Remove surface and subsurface obstructions at drilled shaft locations. The Contractor may need to use special procedures and tools when the drilled shaft excavation cannot be advanced using conventional augers fitted with soil or rock teeth, drilling buckets or underreaming tools. Special procedures and tools may include: chisels, boulder breakers, core barrels, air tools, hand excavation, temporary casing, and increasing the hole diameter. Do not blast without obtaining written approval from the RE.

I. Rock Socketing. The RE will determine the top of rock sound enough for the Contractor to begin the socket based on the existing borings and observations during shaft drilling. The RE will not consider weathered or highly fractured rock as the top of rock socket.

Prepare rock socket for concrete placement by roughening with drilling tools or by overreaming as directed by the RE. Rotate roughening tools against the rock socket area to remove accumulated slurry cake, to scale off loose rock fragments, and to roughen the finished rock socket surface.

J. Excavation Cleaning and Verification. Unless otherwise approved by the RE, ensure that at least 50 percent of the base of each shaft has less than 1/2 inch of sediment at the time of concrete placement. Ensure that the maximum depth of sediment or debris at any place on the base of the shaft does not exceed 1-1/2 inches.

In the presence of the RE, determine the cleanliness of the bottom of the shaft by the use of sounding, probe data, video camera, tape with weight, or other methods approved by the RE. After final cleaning, determine the dimensions, depth, and alignment as directed by the RE.

K. Constructing Reinforcement Steel Cages. Immediately after the shaft excavation has been inspected and approved, assemble and place the reinforcement steel cage, consisting of longitudinal and transverse bars, ties, cage

stiffeners, spacers, centralizers, and other necessary appurtenances before placing concrete. Remove internal stiffeners as the cage is placed in the drilled shaft hole before placing concrete.

Use concrete spacers or other approved noncorrosive spacing devices at sufficient intervals near the bottom, and at intervals not exceeding 10 feet up the shaft, to ensure concentric spacing for the entire cage length. If the size of the spacers is not shown on the Plans, provide spacers that will create a minimum 3-inch annular space.

Provide cylindrical concrete supports to ensure that the bottom of the cage is maintained at the specified distance above the base.

L. Concrete Placement Time Limitations. Place concrete according to the limitations specified in 504.03.02.C. Continuously place concrete from the bottom to the top elevation of the shaft.

Ensure that the concrete placement is completed within 2 hours. The RE may allow the concrete placement time to exceed 2 hours if the Contractor demonstrates that the slump of the concrete will not be less than 4 inches during the entire time of concrete placement.

M. Concrete Placement Methods. The Contractor may request 1 additional set of cylinders to be taken for determining strength for early form removal as specified in 504.03.02.G. If additional cylinders are requested, notify the RE at least 24 hours before placing.

When using SCC to construct drilled shafts, only place SCC using the tremie method.

When using a concrete pump to place concrete for the drilled shaft, provide a standby pump that is immediately available if there is a pump failure.

Check the elevation of the top of the steel cage before, during, and after concrete placement. If the final upward displacement of the rebar cage exceeds 2 inches or if the downward displacement exceeds 6 inches per 20 feet of shaft length, the RE will reject the drilled shaft. Correct the shaft to the satisfaction of the RE. Do not construct additional shafts until the rebar cage support system is corrected.

1. **Tremie Method.** Ensure that tremie tubes are of sufficient length, weight, and diameter to discharge concrete at the shaft base elevation. Ensure that the inside and outside surfaces of the tremie are clean and smooth to allow the flow of concrete during concrete placement and an unimpeded withdrawal of the tremie tube after concrete placement. Ensure that the tremie tube's inside diameter is at least 6 times the maximum size of aggregate used in the concrete mix. Do not use tremie tubes less than 10 inches in diameter. Ensure that the tremie tube thickness is adequate to prevent crimping or sharp bends. Do not use tremie tubes that have aluminum parts that will come in contact with concrete. Ensure that the tremie tube is watertight.

   Do not begin placing concrete underwater until the tremie is placed to the shaft base elevation. The Contractor may use valves, bottom plates, or plugs to ensure concrete discharge begins within one tremie diameter of the base. Remove plugs from the excavation or construct them using a material that will not cause a defect in the shaft if not removed. Construct the discharge end of the tremie to allow the free radial flow of concrete during placement operations.

   Ensure that the tremie tube discharge end is immersed at least 5 feet in concrete at all times after starting the flow of concrete. Maintain a continuous flow of the concrete at a positive pressure differential to prevent water or slurry intrusion into the shaft concrete.

   If the tremie tube discharge end is removed from the plastic concrete and discharges concrete above the rising concrete level, the RE will consider the drilled shaft defective. To correct this defect, the Contractor may: remove the reinforcement cage and concrete, complete necessary sidewall removal directed by the RE, and replace the shaft; or, the Contractor may replug the tremie tube, recharge with concrete, and insert a minimum of 5 feet below the existing top level of concrete before continuing placing concrete.

2. **Pumped Method.** Ensure that pump lines have a minimum diameter of 4 inches and are constructed with watertight joints.

   Ensure that the discharge end remains at least 5 feet below the surface of the plastic concrete. When lifting the pump line during concreting, temporarily reduce the line pressure until the discharge end has been repositioned at a higher level in the excavation.

If at any time during the concrete pour the pump line discharge end is removed from the fluid concrete column and discharges concrete above the rising concrete level, consider the shaft defective. In such case, remove the reinforcement cage and concrete, complete any necessary sidewall removal directed by the RE, and replace the shaft.

Ensure that waste concrete overflows the full top circumference of the casing evenly. Waste concrete is the top 24 inches of the initial concrete placed, plus the height of additional volume of waste concrete deposited in the shaft where concrete placement was halted and restarted, plus any additional amount necessary to produce full strength, non-segregated concrete at the plan shaft top level. Continue placing concrete until the waste concrete is pushed upward and ejected completely out of the top of the casing and wasted; or, place an additional 24 inches of concrete above the planned shaft top level and allow to cure in place for removal later. Remove waste concrete at the top of the shaft to maintain a uniform appearance and to meet the specified dimensions of the shaft.

Do not channel or bleed off waste concrete using notches, holes, or cuts in the casing top. The Contractor may remove or pump out plastic concrete in the casing that is above the top elevation of the drilled shaft after ejecting waste concrete to the top elevation.

N. Approval. Compare the computed theoretical volume of the excavation with the actual volume of concrete placed, and create a plot of depth versus volume. Provide results to the RE.

After placing the concrete, ensure that the top of the reinforcement steel cage is within −3 inches and +6 inches of the Plan elevation. Ensure that the top elevation of the completed drilled shaft is within −3 inches and +1 inch of the Plan elevation.

The RE may reject drilled shafts because of damage; failure to advance through; mislocation, misalignment, or failure to install the drilled shaft to the proper bearing stratum; or results of CSL testing indicating defects.

For each rejected drilled shaft, submit to the RE for approval a plan showing how to correct the problem and prevent its reoccurrence. Repair, augment, or replace the drilled shaft. If the RE rejects a drilled shaft, the Contractor shall cease the construction of all other drilled shafts until the Contractor demonstrates the ability to construct an approved drilled shaft.

Within 10 days after completing the installation of all drilled shafts, and before removing the drilled shaft installation equipment from the Project Limits, provide the RE with a plan certified by a land surveyor registered in the State of New Jersey showing the as-installed location of drilled shafts. The RE will analyze the total loads on individual drilled shafts based on the survey data. If the load on any drilled shaft exceeds 10 percent of the specified load capacity, correct the drilled shaft as directed by the RE. The corrections may include installation of additional drilled shafts.

Do not place substructure concrete on a drilled shaft until the concrete in the shaft reaches a minimum of 80 percent of the required 28-day compressive strength and until all CSL test results are approved and the CSL tubes have been dewatered and grouted.

503.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
FURNISHING DRILLED SHAFT EQUIPMENT	LUMP SUM
DEMONSTRATION DRILLED SHAFT	LINEAR FOOT
LOAD TEST	UNIT
CROSSHOLE SONIC LOGGING	UNIT
SHAFT CORING	LINEAR FOOT
DRILLED SHAFT IN SOIL ___" DIAMETER	LINEAR FOOT
DRILLED SHAFT IN ROCK ___" DIAMETER	LINEAR FOOT
OBSTRUCTION	LINEAR FOOT
TOMOGRAPHY	UNIT

The Department will make payment for each LOAD TEST completed and accepted.

The Department will not include payment for tomography under CROSSHOLE SONIC LOGGING. If the RE directs tomography, the Department will make payment for the number of 3-D evaluations performed and accepted under TOMOGRAPHY.

The Department will make payment under SHAFT CORING if the drilled core confirms that the shaft is acceptable. The Department will not make payment for shaft coring if the core confirms that there is a defect.

The Department will make payment for 60 percent of the lump sum price bid for FURNISHING DRILLED SHAFT EQUIPMENT when the equipment necessary for drilling shafts is furnished and drilling of shafts has began. The Department will make payment for the remaining 40 percent when all shafts have been drilled and all shaft concrete has been placed to the top of the shafts.

The Department will not include payment for removal of obstructions under DRILLED SHAFT IN SOIL. If an obstruction is encountered, the Department will make payment for removal of the obstruction under OBSTRUCTION.

The Department will make payment for sampling and analysis for regulated waste, including solids from dewatered slurry, under SOIL SAMPLING AND ANALYSES, REGULATED as specified in 202.04.

The Department will make payment for off-site transport and disposal and recycling of regulated waste or hazardous waste, including solids from dewatered slurry, under DISPOSAL OF REGULATED MATERIAL or DISPOSAL OF REGULATED MATERIAL, HAZARDOUS as specified in 202.04.

SECTION 504 – STRUCTURAL CONCRETE

504.01 DESCRIPTION

This Section describes the requirements for constructing cast-in-place concrete.

504.02 MATERIALS

504.02.01 Materials

Provide materials as specified:

Grit	901.07
Concrete	903.03
High Performance Concrete	903.05
Mortar	903.08.01
Curing Materials	903.10
Reinforcement Steel	905.01
Welded Wire Reinforcement	905.01.03
Epoxy Waterproofing	912.02.02
Preformed Joint Filler	914.01
Joint Sealer (Hot-Poured)	914.02
Waterstops	919.06

504.02.02 Equipment

Provide equipment as specified:

Sealer Application System	1003.08
Spreading and Finishing Machine	1005.02
Vibrator	1005.04
Straightedge	1008.02
Pavement Saw	1008.04
Hot-Air Lance	1008.06
Concrete Batching Plant	1010.01
Concrete Trucks	1010.02

504.03 CONSTRUCTION

504.03.01 Reinforcement Steel

A. Handling. Store reinforcement steel above ground level. When unloading coated reinforcement steel, minimize scraping of the bundles, bar-to-bar abrasion, and sags in the bundles. For coated reinforcement steel, do not skid the bundles from the truck bed to the ground. Ensure that equipment used for handling the bars is equipped with nylon slings. Do not use wire rope slings or chains. Lift bundles of bars to ensure that sagging does not occur. Ensure that coated bars or bundles of coated bars are not dropped or dragged during handling.

B. Storing. Coordinate deliveries of coated reinforcement bars to the work site with the placing of the bars in the structure. Store reinforcement steel as close as possible to the area where it will be placed to minimize handling. Store the bars above the ground on timbers or other suitable protective cribbing and space the dunnage to prevent sags in the bundles. When storing a large quantity of bars in a small area, stack bundles of straight bars with adequate blocking placed between the layers of bundles to provide stability and prevent sagging.

Do not store reinforcement bars at the work site for more than 60 days unless approved by the RE. If long term storage is approved, protect non-metallic tags on the bundles or attach additional galvanized metal tags on all bundles of bars to maintain identification. If long term storage is approved, cover the bars with white polyethylene sheeting or other suitable protective material. For stacked bundles, drape the white polyethylene sheeting over the sides of the bundles around the perimeter of the stack. Secure the covering and provide air circulation around the bars to prevent condensation under the polyethylene sheeting.

C. Field Cutting. Obtain RE approval before field cutting reinforcement steel. Do not flame cut epoxy-coated reinforcement steel. If coated reinforcement bars are cut in the field, coat the cut ends and repair damage to the coating as specified in 504.03.01.G.

D. Field Bending. Obtain RE approval before field bending reinforcement steel. Use the cold method to make minor adjustments to reinforcement steel bars in the field. Do not bend galvanized reinforcement steel more than 10 degrees. With the approval of the RE, the Contractor may use the heat method to perform minor adjustments to uncoated bars. Preheat the bar to between 1000 and 1200 °F, and then gently bend in a gradual arc. For bars partially embedded in concrete, ensure that the concrete is not damaged by heating the bars.

E. Placing and Fastening. When placing, ensure that reinforcement steel is free of dirt, detrimental scale, paint, oil, or other foreign substances. Tie bars at all intersections except where spacing is less than 12 inches in each direction, in which case tie alternate intersections. Use stays, blocks, ties, hangers or chairs, to maintain the specified concrete cover. If using blocks, ensure that the blocks are precast concrete. Ensure that blocks are not used where they are exposed in a finished surface.

When using galvanized reinforcement steel, ensure that all miscellaneous hardware that comes in contact with or is used to support, position, or fasten the reinforcement steel are also galvanized according to AASHTO M 232. When using epoxy-coated reinforcement steel, use only plastic-coated or epoxy-coated tie wires and ensure that all miscellaneous hardware used to support, position, or fasten the reinforcement are dielectric, plastic-coated, or epoxy-coated.

If using welded wire reinforcement, overlap sheets at least 1 grid in width. Fasten overlaps securely at the ends and edges.

Repair damage to epoxy-coating or galvanized coating as specified in 504.03.01.G. Do not place concrete before inspection and approval of the reinforcement steel.

F. Splices. When splicing is not specified, submit a plan for splicing to the RE for approval. Include size, location, and splicing method.

The Contractor may use mechanical coupling devices listed on the QPL. When using galvanized reinforcement steel, ensure that mechanical coupling devices are galvanized according to AASHTO M 232. When using epoxy-coated reinforcement steel, ensure that mechanical coupling devices are epoxy coated according to AASHTO M 284.

When using mechanical connections, remove the coating from the ends of the reinforcement steel over the length of the sleeve and at least 2 inches from the ends of the sleeves, or more if recommended by the Supplier.

Repair damage to epoxy-coating or galvanized coating as specified in 504.03.01.G.

G. Field Repairing of Coatings. The RE will allow field repair when there are less than 6 damaged areas in any 10-foot length of bar. The RE will reject material with more than 6 damaged areas within a 10-feet span and any material with a damaged area more than 4 square inches in size. Repairable damage is any bare or loose spots, or breaks in the coating that affect an area smaller than 4 square inches. Ensure that grease, dirt, mortar, concrete, mill scale, injurious rust, or any other foreign substance is removed before repairing.

1. **Epoxy-Coating.** Repair damage to epoxy-coating according to AASHTO M 317.

2. **Galvanized-Coating.** Repair damage to the galvanized coating according to ASTM A 780.

H. Protecting Exposed Reinforcement Steel. When non-coated embedded reinforcement steel is partially exposed at construction joints for more than 30 days, protect the exposed portion of the bar with a coat of neat cement mixed with water within 5 days of the initial concrete placement. Remove loose coating by lightly tapping within 5 days of the subsequent concrete placement.

504.03.02 Constructing Concrete

A. Falsework. When forms and concrete require support, construct falsework on sills resting on foundations capable of carrying the loads without settlement. If falsework cannot be founded on solid footings, support with falsework piling.

Construct the falsework to support the forms and the structure so that there is no deflection. Provide camber in the falsework and forms to allow the joints to tighten in the forms and supporting falsework.

When constructing centering for arches, correct any deflection due to placing the concrete by jacking, as the concrete is being placed.

B. Forms. Construct forms that are true to line and grade; that are mortar tight; and that provide a smooth, even concrete surface. Ensure that forms are rigid to prevent distortion. Prevent the opening of the joints or movement in any direction. Ensure that all bolts are countersunk on the face forming the concrete surface.

Ensure that forms are free from rust, grease, and other foreign matter. Clean the top and face of forms, and oil the face before erecting. Ensure that the form oil does not discolor the concrete.

Provide a system to monitor settlement or movement in the falsework and forms. Check the alignment and elevation of the forms and make corrections before placing the concrete. Reset or remove and replace forms that deviate from the specified line and grade.

Provide a chamfer to form edges as shown. Ensure that all chamfer strips are straight, of uniform width, and dressed.

Construct forms so that they can be removed without damaging the waterstops. Splice, weld, or solder metallic waterstops, as necessary, to form continuous, watertight joints. Install nonmetallic waterstops in continuous strips, without splices. The RE will allow splices at changes in direction when necessary. Splice nonmetallic waterstops according to the manufacturer's recommendations. When splicing PVC waterstops, ensure that the heat used is sufficient to melt but not char the plastic. Secure waterstops to prevent movement during concrete placement.

When epoxy-coated reinforcement steel is used, use epoxy-coated or galvanized metal ties. When metal ties and anchorages remain in the forms, remove to a depth of at least 1 inch from the face without damaging the concrete. Provide cones if using wire ties.

The Contractor may use manufactured fiber tubes as column forms for round columns of concrete. Ensure that fiber tubes are rigid and circular in section. Store fiber tubes above ground on supports in a dry area. Ensure that fiber tubes are not exposed to moisture before use. When erecting column forms, hold forms in a vertical position to prevent distortion during concrete placement.

C. Limitations of Placing. At least 30 days before placing concrete, submit to the RE for approval a plan for hot and cold weather concreting. Include the method that will be used to ensure that the temperature of the concrete is between 50 and 90 °F during mixing and placing.

Do not place concrete when precipitation is imminent as determined by the RE. If it begins precipitating during concrete placement, the RE may direct the Contractor to suspend placement operations and protect the plastic concrete as specified in 504.03.02.I. If placement cannot be resumed within 30 minutes, the RE may direct the construction of a construction joint.

If, during the concrete placement or within the 24 hours preceding the scheduled concrete placement, the National Weather Service http://www.nws.noaa.gov/ locally forecasts the ambient temperature to be below 40 °F or above 75 °F during the scheduled concrete placement or curing period, follow the appropriate temperature condition procedure. Do not place concrete when the ambient temperature is below 20 °F or above 100 °F.

1. **Cold Weather Concreting.** The RE will prohibit the placement of concrete when the ambient temperature is below 40 °F, unless all surfaces in contact with the concrete placement are preheated to between 50 and 80 °F and access is provided for measuring the temperature of the in-place concrete. For access, establish a 1/2 inch diameter hole that is 6 inches deep at a 45 degree angle by placing a greased bolt through the forms prior to concrete placement.

   Use 1 or more of the following protective measures to maintain the concrete temperature:

   a. **Insulated Forms.** Before placing concrete, construct insulated forms to protect concrete. Ensure that the forms are free of ice, snow, and frost at time of placing concrete.

   b. **Insulated Blankets.** Use insulated blankets to protect concrete. Place the blankets on top of polyethylene sheeting within 30 minutes of placing concrete.

   c. **Heating and Housing.** Before placing concrete in the forms, provide housing for the section of concrete to be placed so that the temperatures specified can be maintained within the enclosure. Construct the enclosures to allow removal of forms and finishing of concrete surfaces without interruption of the heating.

      Maintain the heating system to provide uniform heating within the enclosure. Ensure that the heating system has been operating so that the temperature of form surfaces, reinforcement steel and abutting construction to be in contact with the concrete is between 50 and 80 °F before placing the concrete.

      Provide a sufficient number of back-up heaters at the Project Limits to maintain the temperature of the housing in the event of a breakdown of the primary heating system. In the event of a breakdown, operate the back-up heaters until the primary heating system is repaired.

   Maintain the protective measures for arches, culverts, deck slabs, and approaches for at least 7 days. For other concrete placements, maintain for at least 5 days. Ensure that the temperature of the concrete is maintained between 60 and 160 °F for 5 days after placement. The RE will check the temperature of the concrete in the established hole. If the temperature of the concrete falls below 60 °F within 5 days after placing, maintain the protective measures in place for an additional 5 days. If the temperature of the concrete rises above 160 °F, the RE may direct the forms to be loosened or protective measures to be removed. If the temperature of the concrete falls below 32 °F or rises above 180 °F within 5 days of placement, the RE will direct that the concrete be removed and replaced. After the concrete temperature has been maintained for 5 days at a minimum of 60 °F, ensure that the temperature of the concrete does not fall more than 10 °F in 12 hours.

2. **Hot Weather Concreting.** When the ambient temperature reaches 75 °F, use the following procedures before and during concreting operations.

   1. Schedule work so that concrete can be placed continuously. If necessary, start concrete placement at night or early morning.
   2. Use a water-reducing admixture or a water-reducing and retarding admixture as specified in 903.02.02 and according to the manufacturer's recommendation.
   3. Prevent absorption by sprinkling the underlying material and the wood forms just before concrete placement so that they do not absorb water from the mix.
   4. Begin curing within 5 minutes after finishing.

   If the temperature of the plastic concrete reaches 85 °F, take immediate steps to cool either the mixing water or the aggregates, or both, according to the plan of action. Do not place concrete when its temperature in the plastic state exceeds 90 °F at the time of placement.

D. Placing and Consolidating Concrete. The Contractor may request 1 additional set of cylinders to be taken for determining strength for early form removal as specified in 504.03.02.G. If additional cylinders are requested, notify the RE at least 24 hours before placing.

Appoint sufficient number of personnel, who are certified by the NJACI as Concrete Construction Technologists or by ACI as Concrete Transportation Construction Inspectors, to monitor daily operations for concrete placement. The certified personnel are responsible for ensuring proper dimensions of forms; position of reinforcement steel; proper handling, placement, consolidation, and finishing of concrete; and proper curing of the concrete.

Ensure that all forms, joints, and reinforcement steel have been placed, inspected, and approved before placing concrete. Ensure that utilities, pipe, conduit, ducts and any other items to be encased in concrete are in place and secure before placing concrete. Secure or provide rigid bracing for items to be encased in concrete during concrete placement to prevent their displacement. Ensure that forms for weep holes through concrete are PVC or unreinforced concrete drain pipe.

Do not place concrete until all laitance and loose, deleterious material on reinforcement bars and previously placed concrete has been removed. Clean forms of all debris immediately before placing concrete. Wet the surfaces not treated with oil, paraffin, or epoxy bonding compound.

Do not place concrete that is below 60 °F or above 90 °F. Begin placing concrete at the lowest elevation and proceed upgrade. Place the concrete so that segregation does not occur and there is no displacement or movement of reinforcement and forms using 1 of the following methods:

1. **Chutes and Troughs and Other Conveyances.** Do not dump or drop concrete from a distance greater than 5 feet, unless using closed chutes or pipes to confine concrete. Ensure that buggies, chutes, troughs, and pipes used for placing concrete are kept clean and free from coatings of hardened concrete.

2. **Pumped Concrete.** At least 30 days before beginning operations, submit a plan to the RE according to ACI 304.2R. Include the method and procedures along with a list of adequate descriptions of equipment and manpower proposed for use, including contingency equipment and manpower. The RE will prohibit the use of aluminum alloy pipe as a conveyance for the concrete or for any pieces of equipment in contact with the concrete. For flatwork concrete, ensure that the pipeline is horizontal for at least 6 feet at the discharge end.

   If the concrete remaining in the pipeline is to be used, discharge the concrete in such a manner that there is no contamination or segregation.

   Take samples of the plastic concrete according to AASHTO T 141 from the discharge end of the pipeline. Immediately deliver the samples to the ME for testing. If the RE determines that this is not feasible, the ME will sample the concrete before and after pumping and will develop adjustment factors for slump and air content. The ME will use the adjustment factors to determine the acceptability of slump and air content.

When using spreaders to separate forms, remove spreaders while placing the concrete. If the reinforcement steel or forms settle or move, cease placing concrete and immediately notify the RE. Place concrete uniformly to avoid rehandling. After initial placement of the concrete, do not jar forms or place strain on the ends of projecting reinforcement.

Consolidate the concrete using internal mechanical vibrators. When required, supplement vibrating by hand spading to ensure proper and adequate consolidation. Provide at least 1 additional standby vibrating unit for individual concrete placements in excess of 10 cubic yards.

Use vibrators to work the concrete around the reinforcement steel and embedded fixtures and into corners and angles of the forms. Ensure proper vibration of the concrete to avoid honeycombing and voids. Do not use vibrators to move or spread concrete into position. Do not over vibrate concrete.

Float the external surface of concrete during placing to force coarse aggregate from the surface and to bring mortar against the forms to produce a smooth finish substantially free from water and air pockets or honeycombs. For sidewalks, driveways, and islands, apply surface texture using a broom before applying curing materials.

After placing concrete for elevated structures, check and, if necessary, adjust forms and falsework to the specified position before the concrete has taken its initial set.

When placing concrete for bearing areas, finish concrete to the specified elevation. If the elevation of the finished surface is higher than specified, bushhammer to the specified elevation. If the elevation of the finished surface is lower than specified, submit a plan to the RE for approval detailing the method to correct the deficiency.

Monitor the internal temperature of the concrete 6 inches below the surface. If the temperature of the concrete exceeds 160 °F, the RE may direct the forms to be loosened or opened.

E. Placing Mass Concrete. When mass concrete is shown on the Plans submit a thermal curing plan to the RE at least 30 days before placing concrete. At a minimum, include the following requirements in the plan:

1. Concrete mix design, including pozzolanic materials to control concrete temperature.
2. Adjustments to form removal and loading times for slower strength gains for high pozzolan mixes.
3. An analysis of the anticipated thermal developments within placements using proposed materials and casting methods.
4. A plan outlining specific measures to be taken to control the temperature differential within the limits.
5. The proposed monitoring system.
6. Outline of corrective actions to control the temperature differential and maximum internal temperature.
7. Proposed methods of repairs or corrective actions if the mass concrete member is not accepted.

Place concrete as specified in 504.03.02.D.

When curing concrete, ensure that the temperature differential of the mass concrete does not exceed 35 °F between the internal and external temperature of concrete. Measure the internal temperature as close as possible to the center of the member, but not less than 12 inches from the surface. Measure the external temperature of the concrete at an exposed surface.

Monitor the temperature differential and the maximum internal temperature with monitoring devices that continuously record temperature for 15 days. Provide the RE with a copy of each set of readings. Provide temperature-monitoring devices to record temperature between the interior and exterior of the member at points approved by the RE and monitor the mass placement to measure temperature differentials. Monitor the temperature until the interior temperature is within 35 °F of the lowest ambient temperature or a maximum of 15 days. Provide the RE with a copy of each set of readings as they are taken and a temperature chart for each mass placement member showing temperature readings versus time.

If monitoring indicates that the proposed measures are not controlling the concrete temperature differential to within 35 °F and the maximum internal temperature of 160 °F, implement corrective actions according to the thermal curing plan to maintain the temperature differential.

F. Applying Curing Materials. After float finishing and when marring of the concrete will not occur, apply curing materials within 30 minutes after finishing. The RE will suspend concrete operations if the curing procedure is delayed or is not followed. Cure the concrete using the following materials:

1. Curing Compound. Apply 2 coats of curing compound, as provided by the manufacturer, each at a rate of 1 gallon per 200 square feet of surface in a continuous, uniform film with pressure spraying equipment. Do not apply curing compound to exposed construction joint areas. Apply the second coat between 15 and 30 minutes of applying the first coat. If the method of applying the curing compound produces a nonuniform film, discontinue application and correct the procedure. If the procedure cannot produce the required results, use another curing option.

Protect the treated surface, as specified in 504.03.02.I, from damage for at least 72 hours. If precipitation falls on the newly coated concrete before the film has dried sufficiently to resist damage, or if the film is damaged in any other way, apply an additional coat of curing compound at the original specified rate.

Do not apply curing compound to concrete surfaces that will receive a subsequent concrete placement. Remove curing compound from concrete surfaces that will receive a subsequent concrete placement.

2. Wet Burlap and White Polyethylene Sheeting. Pre-soak burlap strips for at least 24 hours before placing. Cover the concrete with strips of wet burlap at least 4 feet longer than the width of the slab to cover the sides. Lay the strips across the slab and overlap at least 1/2 the width of the strip to provide a double thickness of burlap. Ensure that the burlap remains wet throughout the specified curing period. Ensure that the wet burlap does not add excess water to the concrete surface.

Cover the wet burlap with white polyethylene sheeting. Overlap sections of polyethylene sheeting at least 18 inches. Place the white polyethylene sheeting and weigh down to ensure that it remains in contact with the surface. Where reinforcement steel protrudes, ensure that the white polyethylene sheeting is draped, and overlapped over the structure to protect any exposed areas. Extend white polyethylene sheeting 4 feet beyond the edges of the concrete. Replace or restore polyethylene sheeting that is damaged or disturbed.

3. **White Polyethylene Sheeting.** Overlap sections of polyethylene sheeting at least 18 inches. Place the polyethylene sheeting and weigh down to ensure that it remains in contact with the surface. Where reinforcement steel protrudes, ensure that the polyethylene sheeting is draped and overlapped over the structure to protect any exposed areas. Extend the polyethylene sheeting 4 feet beyond the edges of the concrete. Replace or restore polyethylene sheeting that is damaged or disturbed.

Maintain curing materials for arches and culverts for at least 7 days; for other concrete placements, maintain for at least 3 days. When using protective measures for cold weather concreting, as specified in 504.03.02.C.1 maintain the curing materials until the protective measures are removed.

G. Removal of Forms and Falsework. The Department may require concrete strength tests as specified in the Special Provisions for removal of forms and falsework. Remove forms without damaging the surface. The Contractor may remove forms 24 hours after placing concrete, except for the following:

1. Remove barrier curb and parapet forms as soon as the concrete holds its shape to facilitate finishing.
2. When using concrete that contains more than 20 percent fly ash by weight of total cementitious material, maintain the forms for at least 3 days.
3. The Contractor may remove forms for wing walls after 3 days if the concrete has attained a strength of 3000 pounds per square inch as determined from 2 concrete cylinders field cured according to AASHTO T 23. If concrete cylinders for wing walls are not tested, or do not meet a strength 3000 pounds per square inch when tested before 14 days, the Contractor may not remove forms until 14 days after the concrete has been placed.
4. The Contractor may remove forms for battered columns or pier caps after 3 days if the concrete has attained a strength of 4000 pounds per square inch as determined from 2 concrete cylinders field cured according to AASHTO T 23. If concrete cylinders for battered columns or pier caps are not tested, or do not meet a strength 4000 pounds per square inch when tested before 14 days, the Contractor may not remove forms until 14 days after the concrete has been placed.
5. The Contractor may remove forms for arches or culverts after 7 days if the concrete has attained a strength of 4000 pounds per square inch as determined from 2 concrete cylinders field cured according to AASHTO T 23. If concrete cylinders for arches or culverts are not tested, or do not meet a strength of 4000 pounds per square inch when tested before 14 days, the Contractor may not remove forms until 14 days after the concrete has been placed. Do not remove falsework and centering for spandrel-filled arches before the abutments have been placed up to the spring line.
6. Do not remove falsework supporting the deck of rigid frame structures until the embankment has been placed behind the vertical legs.
7. When using protective measures for cold weather concreting, as specified in 504.03.02.C.1, do not remove the forms until the protective measures are removed regardless of concrete cylinder strength.
8. Do not remove the forms for decks for 14 days.

For elevated formwork, lower centering gradually to prevent damage to the structure. Remove falsework from continuous or cantilevered structures to ensure that the structure is gradually subjected to its working stress.

H. Finishing Concrete Surface. Finish the surface of the concrete immediately after removing the forms. Apply a Class 1 finish to surfaces not exposed to view. Apply a Class 2 finish to all surfaces exposed to view.

Do not begin finishing a surface until the entire face of the structure is completed to ensure a uniform texture and color. For barrier curb and parapet, apply a Class 2 finish within 48 hours of placing concrete. The classes of concrete finish are as follows:

1. **Class 1, Surface Finish.** Remove projecting wire or metal devices that have been used for holding the forms in place. If the wire or metal device cannot be removed, cut the wire or metal device at least 1 inch below the surface of the concrete. Remove lips of mortar and irregularities caused by form joints. Ensure that all construction and expansion joints are tooled and free of mortar and concrete.

Patch holes, depressions, voids, and honeycombs by chipping away coarse or broken material until a dense uniform surface of concrete exposing solid coarse aggregate is obtained. Cut away feathered edges to form faces perpendicular to the surface. Saturate the surfaces of the deficient area with water, then fill the deficient area with stiff mortar. Finish the surface of the mortar with a wooden float before initial set takes place.

When patching large or deep areas as determined by the RE, patch the area using the same mix design concrete as the surrounding concrete. Chip away coarse or broken material until a dense uniform surface of concrete exposing solid coarse aggregate is obtained. Cut away feathered edges to form faces perpendicular to the surface. Saturate the surface of the area with water, then apply a layer of bonding compound to the area. Fill the area with the concrete. Finish the surface of the concrete with a wooden float before initial set takes place.

The Department may reject a structure for having areas of excessive honeycombs as directed by the RE.

2. **Class 2, Rubbed Finish.** After performing a Class 1 finish, rub surfaces with a wetted wooden block or a medium coarse carborundum stone, using a small amount of mortar on its face. Do not use the carborundum stone until the concrete has hardened to the state where the sand grinds rather than ravels or rolls. Continue rubbing until form marks, projections, and irregularities have been removed, voids are filled, and a uniform surface has been obtained. Leave the paste produced by this rubbing in place. After the entire surface of the structure has been rubbed and the paste has dried, obtain the final finish by rubbing with a fine carborundum stone and water until the entire surface is of a smooth texture and uniform color.

I. Protecting Concrete Structures. Post warning tape around flatwork such as bridge decks, pavement, sidewalks, driveways, and islands during the curing period. Provide wet burlap or polyethylene sheeting to protect the edges and surface of the plastic concrete from precipitation.

Do not drive piles within 200 feet of concrete that is being placed or has been placed within the previous 24 hours unless approved by the RE. Ensure that salt or brackish water does not come in contact with the concrete for a period of 28 days after being placed.

J. Loading Concrete Structures. Do not allow anything other than the curing materials on concrete surfaces for 24 hours after placing the concrete. The Contractor may begin constructing forms for subsequent concrete placements after the forms from the underlying concrete can be removed as specified in 504.03.02.G. After the forms have been constructed and at least 3 days after the underlying concrete has been placed, the Contractor may perform subsequent concrete placements. The Contractor may begin storing materials, backfilling, or other loading on the concrete surface 3 days after the concrete has been placed if the forms can be removed as specified in 504.03.02.G.

504.03.03 Epoxy Waterproofing

Provide a copy of the manufacturer's recommendations to the RE at least 5 days before applying epoxy waterproofing. Apply epoxy waterproofing to abutment and pier seats after applying the finish and at least 3 days after stripping the forms, and to the tops of slabs of culverts having less than 2 feet of fill and an HMA overlay directly over that slab. Do not apply epoxy waterproofing to riding surfaces.

Immediately before application, clean the surfaces of dirt, grease, form oil, or other foreign material that may have accumulated. Do not apply epoxy waterproofing unless the ambient temperature is between 40 and 85 °F at the time of application. Mix and apply the epoxy waterproofing according to the manufacturer's recommendations. If necessary, bushhammer bearing surfaces to their proper elevations before applying the epoxy waterproofing. Apply 2 coats of epoxy waterproofing using a brush or roller. Allow the first coat to dry before applying the second coat. Ensure that the total thickness of the coatings is 10 mils.

While the second coat is still tacky, broadcast grit at uniform rate of 5 pounds per square yard over the top surfaces by hand, except on masonry plate bearing areas. After the epoxy waterproofing has set, brush off excess grit and dispose of as specified in 201.03.09.

Allow the epoxy waterproofing to completely dry before placing any material against the concrete member.

504.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
REINFORCEMENT STEEL	POUND
REINFORCEMENT STEEL, EPOXY-COATED	POUND
REINFORCEMENT STEEL, GALVANIZED	POUND
CONCRETE CULVERT	CUBIC YARD
CONCRETE FOOTING	CUBIC YARD
CONCRETE WING WALL	CUBIC YARD
CONCRETE PIER COLUMN PROTECTION, HPC	CUBIC YARD
CONCRETE ABUTMENT WALL	CUBIC YARD
CONCRETE PIER COLUMN AND CAP	CUBIC YARD
CONCRETE PIER SHAFT	CUBIC YARD
CONCRETE PEDESTRIAN BRIDGE	CUBIC YARD
EPOXY WATERPROOFING	SQUARE YARD

SECTION 505 – PRECAST AND PRESTRESSED STRUCTURAL CONCRETE

505.01 DESCRIPTION

This Section describes the requirements for manufacturing, furnishing, and erecting prestressed members, precast reinforced concrete culverts, and precast concrete arch structures.

505.02 MATERIALS

505.02.01 Materials

Provide materials as specified:

Coarse Aggregate (No. 57) 901.03
Concrete 903.03
Non-Shrink Grout 903.08.02.A
Structural Precast Concrete 904.03
Prestressed Concrete 904.04
Reinforcement Steel 905.01
Dowels 905.01.05
Post-Tensioning Reinforcement 905.02.03
Bearing Pads 907.03
Anchor Bolts 908.01.03
Epoxy Waterproofing 912.02.02
Preformed Joint Filler 914.01
Subsurface Drainage Geotextile 919.01
Water 919.08

Provide post-tensioning grout that complies with the requirements for Class B or C grout according to Section 10 of the *AASHTO LRFD Bridge Construction Specifications*.

505.02.02 Equipment

Provide grouting equipment according to the *AASHTO LRFD Bridge Construction Specifications*.

For each tensioning jack, provide the RE with jack calibrations charts certified by a testing laboratory approved by the Department to show the relationship between the dial gauge and the force delivered. Ensure that jacks and the gauges are calibrated as a unit, and are recalibrated every 6 months.

505.03 CONSTRUCTION

505.03.01 Prestressed Concrete Structures

A. Working Drawings. Submit working drawings for certification that include the class of concrete, the pattern and schedule for releasing strands before detensioning, detensioning concrete strength, and tensioning and detensioning patterns.

If the design requires post-tensioning, include end blocks in the design. In the case of multiple span structures, if the design of beams of any 1 span requires end blocks, include end blocks for all spans of the fascia beams.

B. Shipping and Storing. Notify the RE at least 5 days before shipping. Transport and store precast girders and slabs in an upright position, and ensure that the points of support and directions of the reactions with respect to the member are approximately the same during transportation and storage as when the member is in its final position. Obtain RE approval to transport or store precast units in a position other than upright. When shipping members that are pre-tensioned, ensure that no creep occurs.

C. Erection Plan. Submit a plan of operations to the RE for approval at least 30 days before the pre-erection meeting. Include, at a minimum, the following in the plan:

1. Number and type of manpower and equipment.
2. Shipping procedures.
3. Lifting procedures.
4. Erecting sequence.
5. Temporary bracing.
6. Manufacturer's recommendations.
7. Procedures for employee safety.
8. Traffic control and protection.
9. Method of post-tensioning and determining friction loss.
10. Anchorage details and design calculations, signed and sealed by a Professional Engineer.

D. Erecting. Notify the RE to schedule a pre-erection meeting at least 20 days before the start of erection. Before erecting prestressed concrete beams, follow the loading requirements for substructure members as specified in 504.03.02.J. Place the embankment backfill behind the abutment walls to at least 50 percent of their height before erection, unless otherwise approved.

Set bearing pads according to the manufacturer's recommendation. Set structural bearing assemblies or reinforced elastomeric bearing assemblies as specified in 506.03.02.C.

Anchor prestressed concrete voided slabs and box beams to abutments and piers using dowels as anchors.

E. Post-Tensioning of Prestressed Slabs and Box Beams. Do not splice strands unless approved by the RE. Install post-tensioning reinforcement through preformed ducts before grouting the longitudinal keyways. Tension the rods and strands to the value shown on the Plans. Continuously monitor the tension being applied during the tensioning process.

After tensioning the post-tensioning reinforcement, remove the exposed ends at the fascia members so that no part of the post-tensioning reinforcement or end fittings extend beyond a point 1 inch inside the exterior face of the prestressed concrete member. Do not flame-cut the post-tensioning reinforcement. Permanently protect exposed strand or rod ends at end fittings from corrosion using a method approved by the RE. Fill the recessed pockets at the fascia with mortar matching the concrete surface.

F. Grouting.

1. Concrete Beams. Grout according to Section 10 of the *AASHTO LRFD Bridge Construction Specifications*.

2. Concrete Box Beams and Concrete Slab Beams. Sandblast the keyway surface clean to ensure bonding before erection. The Contractor may sandblast at the fabrication plant if shown on the certified working drawings. The Contractor may substitute waterblasting for sandblasting.

Immediately before grouting, clean the keyway by waterblasting. Ensure that the water does not puddle. After cleaning, seal the keyway with closed cell foam backer rod at least 1/4 inch below the keyway bottom.

Seal the ends of the keyway to prevent grout loss. Do not grout the keyway before the RE's inspection and approval.

Mix and place non-shrink grout according to the manufacturer's recommendations. Begin the grouting operation at 1 end of the keyway and proceed continuously to the opposite end without interruption. Fill only 1 keyway with grout at a time. Consolidate the grout as it is placed in the keyway, and finish the grout flush with the top of the keyway.

Ensure that the ambient temperature is between 40 and 85 °F when placing grout. When the ambient temperature is expected to fall below 40 °F, provide measures to maintain the concrete surface temperature between 40 and 85 °F. Provide curing blankets and place over the grout no later than 1 hour after the grout placement. Keep the curing blankets on the grouted keyways for at least 48 hours.

Allow the grout in the keyways to cure at least 72 hours before allowing traffic or equipment on the bridge.

505.03.02 Precast Concrete Culverts

A. Working Drawings. Submit working drawings for approval that show plan, elevation, and sections as well as details for all appurtenances such as headwalls, cutoff walls, wingwalls, and aprons. In addition, include details of the neoprene gasket between the precast concrete culvert units as well as all threaded inserts, bar extensions, waterproofing, and end anchorage details for the post-tensioning reinforcement. Provide erection details including handling points, neoprene gasket details, the method for pulling the culvert boxes together, section lengths, and the method of installing the units.

B. Shipping and Storing. Notify the RE at least 5 days before shipping. Ship and store precast units according to the manufacturer's recommendations.

C. Erection Plan. Submit a plan of operations as specified in 505.03.01.C.

D. Erecting. Notify the RE to schedule a pre-erection meeting at least 20 days before the start of erection. Construct a minimum 2-foot thick, coarse aggregate layer that extends 12 inches past each side of the precast culvert. Compact the coarse aggregate layer using the directed method as specified in 203.03.02.C.

Tie the precast units together with a minimum of 4 longitudinal rods or strands to ensure an adequate seal and to provide continuity and concrete shear transfer between the precast units. Provide a flexible, watertight, neoprene gasket according to ASTM D 1056 at the joint between the precast units. Ensure that the gasket is continuous around the circumference of the joint and has only 1 splice.

Before backfilling, place a 2-foot wide strip of subsurface drainage geotextile over the top and side transverse joints. If precast concrete culvert units are used in parallel for multicell installations, fill the space between the units with non-shrink grout or Class A concrete.

E. Post-Tensioning. Place a longitudinal rod or strand through a preformed hole located in each corner of the units and stressed to a tension of 30,000 pounds each. After tensioning, cut the exposed end of the post-tensioning reinforcement to 1 inch below the surface of the anchorage pocket. Do not flame cut the post-tensioning reinforcement. Galvanize all hardware associated with the end anchorage system. Apply 2 coats of bituminous paint to the exposed parts of the end fittings.

F. Grouting. Fill hand hole pockets, post-tensioning reinforcement sleeves, and lifting lugs with non-shrink grout after the joints are sealed and the post-tensioning reinforcement are tensioned. Apply 1 coat of an epoxy waterproofing to all top slab hand hole pockets or lifting holes that are grouted in the field after the grout has properly cured.

G. Backfilling. Backfill and compact around the culvert as specified in 203.03.

505.03.03 Precast Concrete Arch Structures

A. Working Drawings. Submit working drawings for approval that include the following:

1. Concrete compressive strength value.
2. When the earth cover over the precast concrete arch unit is less than 24 inches, provide corrosion protected reinforcement in the outside mat of reinforcement.

3. Plan, elevation, and sections as well as details for all appurtenances, such as headwalls, cutoff walls, wingwalls, and aprons.
4. Details of the neoprene gasket between the precast concrete arch units as well as all threaded inserts, bar extensions, waterproofing, backfilling and loading requirements, and end anchorage details for the post-tensioning reinforcement.
5. Profiles and dimensions of all precast concrete arch structures, lifting loads of all components, and reinforcement steel layout.
6. Erection details of the joint seal between the precast concrete arch structures, joint seal details, section lengths, and the method of installing the units.

B. Shipping and Storing. Notify the RE at least 5 days before shipping the precast concrete arch units. Ship precast units according to the manufacturer's recommendations. Store the precast concrete arch units according to the manufacturer's requirements. To prevent cracking of the structures, support the precast concrete arch units with timber members.

C. Erection Plan. Submit a plan of operations as specified in 505.03.01.C.

D. Erecting. Notify the RE to schedule a pre-erection meeting at least 20 days before the start of erection. Construct footings using Class B concrete. Ensure that the surface of the footing does not vary more than 1/4 inch in 10 feet. Provide a float finish to the footing. Ensure that the concrete reaches a compressive strength of 3000 pounds per square inch, as determined from test cylinders cast during placing of the concrete, before installing the precast concrete arch structure.

Install precast concrete arch units on footings according to the manufacturer's erection instructions. Connect the foundations for the precast concrete arch units and other appurtenances with reinforcement or suitable mechanical connections to form one monolithic body.

Fill the footing keyway and lifting points with non-shrink grout.

E. Joints. Seal and cover the butt joint made by 2 adjoining precast concrete arch units, the joint between the end unit and the headwall, and the joint between the end unit and wingwall according to the manufacturer's recommendations. Ensure that the joint surface is clean before the sealing operations. Cover the joint continuously from the bottom of a precast concrete arch unit section leg across the top of the arch and to the opposite arch unit section leg. Ensure that all laps that result in the joint wrap are a minimum of 6 inches long with the overlap running downhill.

F. Backfilling. After the RE has approved the precast arch structure, place I-9 soil aggregate in 8-inch lifts or less. When placing backfill, ensure that the difference between the heights of the backfill on the opposite sides of the arch structure does not exceed 12 inches.

Use mechanical tampers to compact the backfill adjacent to each side of the arch units and over the top of the arch units until they are covered to a minimum depth of 12 inches. Do not operate heavy equipment (weighing in excess of 12 tons) over the structure until a depth of backfill has been placed that will support the equipment.

505.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
PRETENSIONED PRESTRESSED CONCRETE BEAM, ___"	LINEAR FOOT
PRESTRESSED CONCRETE BOX BEAM, (TYPE ___), ___" BY ___ "	LINEAR FOOT
PRESTRESSED CONCRETE SLAB BEAM, (TYPE ___), ___" BY ___ "	LINEAR FOOT
PRECAST CONCRETE CULVERT	LINEAR FOOT
PRECAST CONCRETE ARCH STRUCTURE	LINEAR FOOT

The Department will make payment for structural bearing assemblies as STRUCTURAL BEARING ASSEMBLY as specified in 506.04. The Department will make payment for reinforced elastomeric bearing assemblies as REINFORCED ELASTOMERIC BEARING ASSEMBLY as specified in 506.04.

SECTION 506 – STRUCTURAL STEEL

506.01 DESCRIPTION

This Section describes the requirements for furnishing and erecting bridges, structures, structural bearings and reinforced elastomeric bearings and associated elements that include use of structural steel and miscellaneous metals.

506.02 MATERIALS

Provide materials as specified:

Grout 903.08.02
Structural Steel 906.01
Structural Steel Fabrication 906.04
Structural Bearing Assemblies 907.01
Reinforced Elastomeric Bearing Assemblies 907.02
Bearing Pads 907.03
Bolts and Bolting Materials 908.01
Anchor Bolts 908.01.03
Direct Tension Indicators (DTI) 908.03
Organic Zinc Coating System 912.01.01
Epoxy Mastic Coating System 912.01.01

506.03 CONSTRUCTION

506.03.01 Structural Steel

A. Working Drawings. Submit working drawings for approval.

B. Erection Plan. At least 30 days before the pre-erection meeting, submit a plan of operations to the RE for approval. Include, at a minimum, the following in the plan:

1. Number and type of manpower and equipment.
2. Shipping procedures.
3. Lifting procedures.
4. Beam erecting sequence, including method of setting bearings and diaphragms.
5. Manufacturer's recommendations.
6. Procedures for employee safety.
7. Traffic control and protection.

C. Shipping and Handling. At least 5 days before shipping the steel, submit to the RE for approval all shipping and storage details. Ensure that structural steel is handled and shipped as specified in 906.04.04. Ensure that the steel is protected from the binding chains during shipping using softeners approved by the ME. Use padded hooks and slings to hoist steel. Space diaphragms and similar pieces to ensure that the coatings are not damaged by rubbing during shipment. Do not store steel on the ground. Ensure that members do not fall or rest on each other.

D. Erecting. Ensure that stringers and built-up girders involving field splices are completely preassembled in the shop, with account taken to their relative position in the finished structure as to grade, camber, and curvature. The Contractor may erect the built-up stringer or girder as a unit, as allowed by traffic conditions.

Obtain Department approval before welding to members or parts of members subject to tension or reversal of stress. If necessary to weld in these areas, ensure that the actual stress range at the point of attachment does not exceed the value for Category F according to the *AASHTO LRFD Bridge Design Specification*. If field welded splices are made, inspect splices using nondestructive tests at the site of erection.

Unless otherwise approved, construct embankments in back of the abutment walls to at least 50 percent of their height, before placing structural steel.

Erect structural steel according to Section 11 of the *AASHTO LRFD Bridge Construction Specifications*. Ensure that temporary attachments or supports for scaffolding or forms do not damage the coating system of the steel. Use sufficient support pads for fascia bracing.

Provide lateral support when hoisting members into position so as to prevent lateral buckling or other damage. Ensure that bolt heads of high-strength bolts are on the outside of fascia stringers.

E. Installing High-Strength Steel Bolts. Check galvanized bolts and nuts to verify that a visible lubricant is on the threads. Check black bolts and nuts to verify that they are oily to the touch.

Provide a Skidmore-Wilhelm calibrator or an acceptable equivalent tension measuring device on the Project during erection. Verify each lot of DTIs using the Skidmore-Wilhelm calibrator as specified in NJDOT S-3.

Before beginning bolt installation, perform the rotational-capacity test, as specified in 908.02.02.C, on 2 assemblies from each rotational-capacity lot. If assemblies do not meet the rotational capacity requirements when tested at the work site, the Contractor may clean and relubricate the bolt assemblies in the rotational-capacity lot. After cleaning and relubricating, retest the assemblies for compliance to the rotational capacity requirements.

Ensure that the bolt, nut, and washer are from the same rotational-capacity lot. If the DTI is used under the nut, place an additional washer between the nut and the protrusions on the DTI. If recommended by the bolt manufacturer, the Contractor may use wax lubricant, beeswax, or a water wax emulsion to aid in installation. Hold the bolt head stationary while tightening the nut.

Install bolts in all of the holes of the connection and tighten to a snug-tight condition to compact the joint. Ensure that the number of spaces in the DTI in which a 0.005-inch feeler gauge is refused after snugging does not exceed the maximum snug-tight refusals as specified in Table 506.03.01-1. If the number of refusals exceeds the maximum, remove the assembly, insert a new DTI, and resnug.

Tighten the assemblies successively from the most rigid part of the connection to the free edges by turning the nuts while holding the bolts stationary. Tension the assemblies until the number of spaces in which the 0.005-inch thickness gauge is refused meets or exceeds the minimum final tension refusals specified in Table 506.03.01-1.

Table 506.03.01-1 Criteria for DTI Spaces for A 325 Bolts

Bolt Diameter, Inches	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4
Number of Spaces on DTIs	4	4	5	5	6	6	7
Maximum Snug Tight Refusals[1]	1	1	2	2	2	2	3
Minimum Final Tension Refusals[2]	2	2	3	3	3	3	5

1. If the DTI is coated and under the nut, the maximum snug tight refusals is the number of spaces on the DTI minus one.
2. If the DTI is coated and under the nut, the minimum final tension refusals is the number of spaces on the DTI.

If an assembly is tightened so that there are no visible gaps remaining in any of the spaces on the DTI, the assembly has been over-tightened. Remove and replace over-tightened assemblies.

For painted steel, apply 3 coats of an organic paint system, supplied by the same manufacturer as the originally applied inorganic zinc system, to the field bolted connections.

F. Repairing Damaged Coating. Repair damaged coatings as directed by the RE. Use an organic zinc coating system for the paint repair, supplied by the same manufacturer as the originally applied inorganic zinc system. If the originally applied coating system is not available, the ME will designate an alternate system.

506.03.02 Bearings

A. Working Drawings. Submit for approval working drawings that include the following:

1. The total quantity of each kind of bearing required (fixed, guided-expansion, or non-guided expansion), grouped first according to type (load range) and then by actual design capacity.
2. Plan view and section elevation including all relative dimensions.
3. Details of components and sections showing all materials incorporated into the bearing.
4. All ASTM, AASHTO, and other material designations.
5. Any required revisions or additions to concrete members, reinforcement steel, or other facilities.
6. Details of the connections of the isolator load plates to the mounting plates.
7. Vertical, horizontal, rotation, movement, and load capacity.
8. A schedule of all bearing offsets.
9. Alignment plans.

10. Paint or coating requirements.
11. Installation scheme.
12. Anchorage details.
13. Bearing pre-set details.

B. Shipping and Storing. Ensure that bearings are handled and shipped as specified in 907.01.03. Store bearing devices and components in an area at the work site that provides protection from environmental and physical damage.

Inspect bearings within 1 week after the bearings arrive on the Project. Following the inspection, re-wrap the bearings and keep the bearings clean until installation. Do not dismantle bearings at the work site unless necessary for inspection or installation. If it is necessary to open or dismantle bearings at the work site, obtain RE approval and do so under the direct supervision of the manufacturer.

When installing, ensure that the bearings are clean and free of all foreign substances.

C. Installing Bearings. Install bearings as follows:

1. Anchor Bolts. Provide anchor bolts in abutments and piers for bearings that are either cast-in-place, cast in 3-inch diameter corrugated sleeves, or cast in holes drilled after the concrete has set; however, the RE will prohibit drilling in rigid frame and T-type piers. If using anchor bolt sleeves, ensure that the anchor bolts are circumferentially corrugated and are galvanized steel or plastic. Ensure that the wall thickness of the sleeves is sufficient to withstand the construction loads applied to them. If drilling holes to cast bolts in, core drill the holes at least 1 inch larger in diameter than the diameter of the bolts. Ensure that the reinforcement steel is not damaged during core drilling.

Prevent the collection and freezing of water in holes during the time between when the anchor bolts are set and when the bearings are placed. Fill holes with an environmentally safe antifreeze, seal the top with a watertight cap, and coat with a rubber-asphalt joint sealer. Before setting the bearing, remove the environmentally safe antifreeze and other foreign material from the holes. Set the bolts by filling the holes with non-shrink grout.

2. Bridge Seat Bearing Areas. Do not place bearing plates on bridge seat bearing areas that are irregular or improperly finished or deformed. Ensure that the epoxy waterproofing has been applied and is cured before placing bearings. Immediately before placing the bedding material and installing bearings or masonry plates, clean the contact surfaces of the concrete and steel.

Ensure that all bearing plates are set level in position and have full contact. When setting bearing plates on masonry, pad the plates using an elastomeric bearing pad.

3. Setting Bearings. Allow for the effect of stress deformation and temperature changes when setting bearings. Use swedged or threaded anchor bolts to ensure a secure grip upon the material used to embed them in the holes.

When using seismic isolation bearings, install the isolators level and perpendicular to the gravity load. Accommodate superstructure gradients with beveled sole plates. Ensure that there are no obstructions, including bolt extensions that prevent the isolators from deforming horizontally in any direction. Clean the area around each isolator of all debris and construction materials at the completion of the Contract. Connect the isolators to the superstructure and substructures by bolting. Do not weld steel in contact with an isolator.

506.03.03 Shear Connectors

Ensure that shear connectors conform to Section 7 of the ANSI/AWS D1.5 Bridge Welding Code. When galvanized reinforcement steel bars are used, use galvanized shear connectors.

Install using automatically timed stud welding equipment shear connectors in the field only after the structural steel is erected, after the deck forms are installed, and before the reinforcement steel is placed.

506.03.04 Steel Pedestrian Bridges

Submit an erection plan, as specified in 506.03.01.B, at least 20 days before erecting the steel pedestrian bridge. Apply intermediate and finish coats of paint to the units either in the shop or on the work site before erection. Repair painted areas that are damaged during transportation or erection as specified in 506.03.01.F.

506.03.05 Steel Grid Flooring

At least 45 days before beginning the work, submit working drawings for approval.

Construct steel grid flooring according to Section 12 of the *AASHTO LRFD Bridge Construction Specifications*. Place concrete for filled type grid flooring as specified in 504.03.02.D.

506.03.06 Repair Galvanizing

Where limited areas of galvanized surfaces are damaged during shipping or erection, repair the areas using any of the 3 methods in ASTM A 780. Ensure that the repair achieves the minimum coating thickness specified for the item.

Paint galvanized surfaces only when directed by the RE. If painting is directed, treat the galvanized surface according to the manufacturer's recommendations, the apply the epoxy intermediate and urethane finish coats only.

506.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
STRUCTURAL STEEL	LUMP SUM
REINFORCED ELASTOMERIC BEARING ASSEMBLY	UNIT
STRUCTURAL BEARING ASSEMBLY	UNIT
SHEAR CONNECTOR	UNIT
SHEAR CONNECTOR, GALVANIZED	UNIT
STEEL PEDESTRIAN BRIDGE	LUMP SUM
STEEL GRID FLOORING	SQUARE FOOT

SECTION 507 – CONCRETE BRIDGE DECK AND APPROACHES

507.01 DESCRIPTION

This Section describes the requirements for constructing concrete bridge decks, parapets, deck joint systems, and approaches.

507.02 MATERIALS

507.02.01 Materials

Provide materials as specified:

Concrete 903.03
HPC 903.05
Non-Shrink Grout 903.08.02.A
Epoxy Grout 903.08.02.B
Reinforcement Steel 905.01
4-Bar Open Steel Parapet 906.07
Bearing Pads 907.03
Preformed Joint Filler 914.01
Preformed Elastomeric Joint Assemblies 914.04.01
Strip Seal Expansion Joint Assemblies 914.04.02
Modular Expansion Joint Assemblies 914.04.03

507.02.02 Equipment

Provide equipment as specified:

Sealer Application System	1003.08
Pavement Forms	1005.01
Spreading and Finishing Machine for Concrete Bridge Decks	1005.03
Vibrator	1005.04
Slip-Form (Extrusion) Machine	1005.06
Straightedge	1008.02
Pavement Saw	1008.04
Hot-Air Lance	1008.06
Concrete Batching Plant	1010.01
Concrete Trucks	1010.02

507.03 CONSTRUCTION

507.03.01 Joint Assemblies

A. Working Drawings. Submit working drawings for certification for strip seal expansion joint assemblies, preformed elastomeric joint assemblies, and modular expansion joint systems. As a minimum, indicate the following information on the working drawings:

1. Plan, elevation, and section of the joint system for all movement ratings and roadway width limitations, as well as relative dimensions and tolerances.
2. All ASTM, AASHTO, or other material designations.
3. Method of installation including sequence of installation, relative temperature settings, setting anchorage, and installation at curb lines.
4. Corrosion protection system or material.
5. Details of temporary supports for shipping and handling. Include lifting mechanisms and locations.
6. Design calculations for all structural elements. As warranted, include fatigue design calculations and strength design calculations. Indicate locations of all welded splices.
7. Design the joint system as 1 continuous unit without field splices. If due to shipping or construction requirements, splices are necessary indicate that the locations of the splices are to be in areas outside the main traffic lanes. Provide field splicing procedures.
8. Ensure that the removal and reinstallation of the strip seal can be accomplished from above the joint without full closure of the roadway.
9. Ensure that the expansion joint assembly seals do not protrude above the top of the joint. Use preformed neoprene strip seals that are mechanically held in place.

In addition, for modular expansion joint systems, incorporate the following design criteria:

1. Design the expansion joint system to accommodate all expected longitudinal movements as well as vertical and horizontal rotations. Incorporate strip seal glands with a maximum movement range of 3.15 inches per seal. Support each separation beam with an independent support bar that is welded to the separation beam. Suspend the support bars over the joint opening by sliding elastomeric bearings. Incorporate an equidistant control system that develops its maximum compressive force when the joint is at its maximum opening. Do not use bolted connections between the separator beams and support bars.
2. Design the splices to consist of a bolted separator beam splice.
3. Design and fatigue test the transverse separation beams, support bars, and other structural elements according to *NCHRP Report 402 Fatigue Design of Modular Bridge Expansion Joints* and Chapter 14 of the *AASHTO LRFD Bridge Design Specification*.
4. Design the elastomeric springs and bearings to be removable and replaceable.

B. Installation. Ensure that expansion joint systems are self-supported and continuous across the full width of the deck and continue into traffic barriers and curbing. Provide to the RE a copy of the manufacturer's recommendations for the joint system's installation. Provide a joint installation temperature chart on the working drawings ranging from −10 to 110 °F. Install one of the following joint systems according to the manufacturer's recommendations:

1. **Strip Seal Expansion Joint Assemblies.** Strip seal expansion joint assemblies include molded neoprene rubber gland, parallel steel rail sections, and all hardware necessary to form a mechanical connection between the metal components and the bridge deck.

   For strip seal expansion joint assemblies, place closed-cell foam backer rod in the seal cavity of the steel retainer rails before placing the deck slab concrete. Ensure that the backer rod remains in place until the rubber gland seal is installed. Do not field splice molded neoprene rubber glands or preformed elastomeric compression seal. Repair galvanized coating that is damaged before or during installation.

2. **Preformed Elastomeric Joint Assemblies.** Preformed elastomeric joint assemblies include preformed elastomeric compression seal, parallel steel rail sections, and all hardware necessary to form a mechanical connection between the metal components and the bridge deck.

3. **Modular Expansion Joint Assemblies.** Modular expansion joint assemblies include preformed neoprene strip seals that are held in place by steel edge and separation beams, a support bar to support the separation beam, and sliding elastomeric bearings. These assemblies contain no bolted connections.

Take precautions to protect the joint system from damage after installation. Provide a bridge, or a method to protect the joint system from construction vehicle damage to the satisfaction of the RE.

When installing the joints, ensure that they are in the correct position during the concrete placement. Ensure that the installed joint system matches the roadway profile and finished grades. Adjust the opening at expansion joints to correspond with the installation temperature chart.

507.03.02 Constructing Bridge Decks

A. Forms. Construct forms as follows:

1. **Stay-In-Place (SIP) Forms.** Submit working drawings for certification that include the following:

   1. Deck reinforcement location.
   2. Grade of steel.
   3. Galvanizing specification.
   4. Physical and section properties for all permanent steel bridge deck form sheets.
   5. Locations where the forms are supported by steel flanges subject to tensile stresses.

   Provide form cut and fill grade sheets. Weld form supports to the flange of stringer or floor beam, except in the areas where flanges are subjected to tensile stress. Ensure that SIP forms do not rest directly on the top of the stringer or floor beam flanges. Fasten SIP forms to form supports and ensure that a minimum bearing length of 1 inch at each end is achieved. Do not flame-cut SIP forms. Cut vertical legs for form supports at or below the bottom of the deck slab to maintain the required concrete cover for reinforcement steel at all locations.

   Do not use SIP forms where longitudinal deck construction joints are located between stringers or outside of the fascia stringers.

   Weld SIP forms according to ANSI/AWS D1.5 Bridge Welding Code pertaining to fillet welds. The Contractor may use a 1/8-inch fillet weld. Do not weld flanges in tension or structural steel bridge members fabricated from non-weldable grades of steel.

   Repair permanently exposed form metal whose galvanized coating has been damaged as specified in 506.03.01.F.

2. **Removable Forms.** Construct removable forms as specified in 504.03.02.B. Do not use shoring to support stringers along the span length where the superstructure, under live load and impact loads, is designed for composite action.

B. Deck Placement Plan. At least 15 days before the start of placing bridge deck concrete, submit to the RE for approval a plan of operation that includes the following:

1. SIP form cut and fill grade sheets.
2. A screed and rail erection plan.
3. Deck grades.

4. Sequence and rate of placing concrete.
5. Number and type of personnel performing the work.
6. Number, type, and model of equipment to be used in handling, placing, and finishing the concrete including the weight of the finishing machine.
7. Request for a change in the number, location, or configuration of construction joints.
8. Method of maintaining the evaporation rate below 0.15 pounds per square foot per hour.
9. Type of fog misting equipment if used.

C. Meeting. Within 10 days before the start of deck placement, conduct a meeting with the RE, the ME, and the concrete supplier to discuss the plan of operation and to coordinate the deck placement.

D. Installing Joint Assemblies. Ensure that joint assemblies are installed as specified in 507.03.01.B.

E. Installing Reinforcement Steel. Ensure that reinforcement steel is installed as specified in 504.03.01.

F. Limitations of Placing Concrete. Comply with the limitations of placing specified in 504.03.02.C, except do not place concrete when the ambient temperature is above 85 °F. If within the 12 hours before the concrete placement the National Weather Service http://www.nws.noaa.gov/ locally forecasts a 40 percent chance or greater of precipitation during the scheduled concrete placement, postpone the placement of bridge decks and pavement.

Do not place concrete when the atmospheric evaporation rate is greater than 0.15 pounds per square foot per hour. The Contractor may use fog misting, wind shields, or other methods approved by the RE to keep the evaporation rate below 0.15 pounds per square foot per hour. If using fog misting, ensure that the fog misting equipment is capable of delivering 2 to 3 gallons of water per minute at 2000 to 2500 pounds per square inch using a 40-degree to 50-degree wide-angle nozzle. Position the fog nozzle 6 feet above the concrete surface. Do not use fog misting to apply water for finishing purposes. Immediately cease fog misting if water accumulates on the surface.

The ME will measure air temperature, relative humidity, and wind speed at the location of the deck placement. The ME will measure concrete temperatures from the sample used for slump and air content tests. The ME will perform measurements and calculations at least once every 2 hours beginning 1 hour before concrete placement.

G. Performing the Dry Run. Perform a dry run with the finishing machine over the full length of the bridge segment. Ensure that the screed rail supports are spaced no more than 3 feet apart. Adjust the screed to its finishing position before performing the dry run. During the dry run, check the height and deflection of screed rails, the cover for reinforcement steel, and forms. Make necessary corrections before notifying the RE for inspection.

If the supports for the rails are located in the deck concrete, ensure that the supports can be removed without disturbing the concrete, or partially removed so that no part remains less than 2-1/2 inches below the finished concrete surface.

The RE will not inspect the dry run until it is evident that the placement and finishing operation can be completed within the scheduled time, that any required weather protective materials are in place, and that all necessary finishing tools and equipment are on hand at the work site.

The RE will check to ensure that elevations are within ±1/4 inch of the specified elevations. The RE will check elevations longitudinally every 10 feet and transversely at the edges of breaklines, joint assemblies, gutter grades, and the center of each lane and shoulder. The RE may direct placement of additional grade stakes in areas with rapid changes in grade so that intermediate longitudinal checks can be made.

Once the RE has approved the dry run, do not make adjustments to the operation without RE approval.

H. Placing Deck Concrete. Provide work bridges or other RE approved means of access to the surface of the deck for the purpose of finishing, straightedging, making corrections, and for other operations requiring access to the surface of the deck after the passing of the screed. Before placing deck concrete, construct bulkheads in the shape of the required deck cross-section.

When multiple concrete placements are required within a deck structure, follow the numbered sequence shown on the Plans, beginning with the lowest number. The Contractor may submit a written request to the RE for approval to have this requirement waived if the succeeding sections can be completed within 4 hours after the start of the initial section placement. The RE will not allow these requirements to be waived for deck slabs on prestressed concrete beams that are continuous for live load.

Do not place a deck section until the previously placed concrete within the unit has cured for 72 hours.

Coordinate concrete placement and initial strike-off by a transverse finishing machine so that initial strike-off is between 6 and 8 feet behind the concrete placement.

Deliver, place, and consolidate the concrete, as specified in 504.03.02.D, at a uniform rate in a continuous operation. Ensure that stoppages of concrete placement do not exceed 30 minutes. If there is a stoppage of more than 30 minutes, the RE may direct the deck segment be removed and replaced. When placing concrete, maintain a minimum rate of 30 cubic yards per hour for deck slabs of 180 cubic yards or less. Maintain a minimum rate of 40 cubic yards per hour for deck slabs of more than 180 cubic yards of concrete.

Make as few passes of the machine as are necessary to obtain a smooth, dense surface of the required contour. Maintain a small uniform quantity of concrete ahead of the screed on each pass. Ensure that the quantity of concrete carried ahead of the screed is not great enough to cause slipping or lifting of the finishing machine on the rails at any time.

If improper adjustment or operation of the finishing machine results in unsatisfactory consolidation, reinforcement cover, or surface requirement, immediately correct the unsatisfactory condition.

If the supports for the rails are located in the deck concrete, remove them before initial set has taken. Fill the resulting holes with deck concrete. If the concrete has hardened, fill the holes with non-shrink grout.

Ensure that all deck concrete is placed before placing sidewalks, curb, and parapet.

I. Deck Slab Surface Texture Finish. Texture concrete bridge deck slabs using a broom or burlap drag immediately after final strike-off. When using burlap drag, attach a single, full width strip to the finishing machine. Texture the concrete deck slab in a transverse direction. Clean the broom or burlap as necessary to provide a uniform texture. Provide a smooth finish within 1 foot of curbs and drainage structures. Provide a final finish on sidewalks and top of curbs with a fine-bristle broom.

J. Curing. Within 30 minutes of texturing, apply wet burlap and white polyethylene sheeting as specified in 504.03.02.F, and maintain for at least 14 days. Ensure that the water used for curing does not leave the bridge deck. Do not allow anything on the deck during the 14-day curing period except for personnel necessary to maintain curing materials and protective measures. Post warning tape around flatwork during the curing period.

K. Underdeck Inspection. If the RE determines that underdeck inspection is warranted, the RE will direct the removal of at least 1 SIP panel for each span at the location and time selected. As soon as the form is removed, the RE will inspect the concrete surfaces for cavities, honeycombing, and other defects. If the RE finds irregularities that do not justify rejection of the work, submit a plan to the RE for approval to repair the irregularities. Give the concrete a Class 2 finish as specified in 504.03.02.H.2. If the RE determines that the concrete where the form is removed is unsatisfactory, remove additional forms for inspection. Remove or repair unsatisfactory concrete. If the inspection shows excessive irregularities in the slab, modify the placement plan before placing additional slabs.

Repair the adjacent metal forms and supports to present a neat appearance, and ensure they are securely fastened.

L. Saw Cut Grooved Surfacing. Saw cut the deck no earlier than 15 days after placing the concrete. Saw cut before opening to traffic.

Provide 2 approved gauges to the RE to verify groove depth before sawcutting. Include the manufacturer's recommendations for use with the gauges.

Cut grooves using multi-bladed sawcutting equipment fitted with diamond-tipped circular saw blades. The RE will allow the use of single blade saw equipment where necessary to complete the work, as required.

Cut grooves perpendicular or radial to the centerline of the traveled way. Radially groove in partial-width passes. Limit each pass to 1 lane width. Ensure that grooves are between 0.10 and 0.15 inches wide and 1/4 and 3/8 inches deep. Space the blades to achieve the distance specified in Table 507.03.02-1 between the centerlines of each groove to form a random pattern.

Table 507.03.02-1 Groove Spacing

3/4"	1-1/4"	5/8"	1"	5/8"	1-1/4"	3/4"

Perform consecutive passes within 2 inches of the previous pass. Do not cut grooves over an area that has been already grooved, or introduce a cutting blade into a groove that has been already established.

During grooving operations, the RE will randomly check the groove dimensions. If the minimum groove depth has not been achieved, stop grooving operations and make the necessary adjustments.

Ensure that slurry or debris from the grooving operations does not accumulate in the grooves. Continuously collect slurry and dispose of as specified in 201.03.09. Ensure that the slurry does not enter the structure or highway drainage system.

M. Loading the Deck. Before allowing anything on the deck, ensure that the deck has cured for a minimum of 14 days. The RE may allow the Contractor to place a finishing machine on the deck 72 hours after placing concrete for the previous segment. After a minimum of 14 days, the Contractor may load a total of 80,000 pounds on the deck if the deck has attained a strength of at least 4000 pounds per square inch, as determined from 1 set of cylinders field cured according to AASHTO T 23. After a minimum of 28 days, the Contractor may load more than 80,000 pounds if the deck has attained the design strength and if approval has been obtained from the Department. To obtain approval, submit stress analysis calculations for the load and the location of the load on the deck. The Department will not approve stresses that exceed the design allowable by more than 20 percent. If placement of the load is allowed, provide matting to protect the surface from damage.

N. Concrete Deck Surface Requirements

1. Acceptance Testing. Construct deck slabs so that less than 9 percent of the measured length of the lot exceeds a 1/8-inch tolerance in 10 feet. The ME will test the surface of concrete bridge deck slabs with a rolling straightedge that automatically marks the length of deck surface variations that exceed the tolerance of 1/8 inch in 10 feet.

The RE will determine conformance to the surface tolerance for concrete deck slabs in lots, each lot being equal to the number of cubic yards of deck concrete placed in the designated lanes of traffic from joint assembly to joint assembly. The RE will calculate such lot quantity using the specified nominal deck thickness, excluding the quantity of concrete placed in haunches, end dams, and diaphragms.

The RE will base acceptance on the percentage of the total length of the lot having surface variation exceeding 1/8 inch in 10 feet, this percent noncompliance being defined as the Lot Percent Defective Length. To compute the lot percent defective length, add the lengths of individual surface defects exceeding the specified tolerance, and divide this sum by the total length tested, then multiply by 100 to convert to percent.

The RE will test the full extent of the lot in the longitudinal direction. The transverse location of the test generally is in the wheelpaths of vehicle travel, which are defined as the 2 imaginary lines located approximately 3 feet on each side of the centerline of the lane and extending for the full length of the lane.

If the lot percent defective length equals or exceeds 25 on any machine finished deck (irrespective of whether such machine finishing was required or optional) or 35 on a manually struck and finished deck, the RE may order any or all of the concrete in the lot to be removed, replaced, and retested for acceptance. If the RE allows the concrete to remain in place, apply a 15 percent reduction to the payment request for the lot.

Table 507.03.02-2 Reduction Per Lot of Deck Slab Concrete Due to Nonconformance with Surface Requirements

Lot Percent Defective Length	Reduction Per Lot, Percent
0 - 8.9	none
9.0 - 13.9	1.0
14.0 - 24.9	7.0

2. Surface Remedial Measures. Regardless of the overall surface conformity of a lot of bridge deck concrete, if surface deviations have a detrimental effect on deck drainage or reinforcement steel cover, the RE may require appropriate remedial measures to restore any or all of the deck slab surface to the required grades and surface tolerance. When such remedial procedures are ordered by the RE, submit a plan detailing the intended limits of the surface restoration and the methods, equipment, and materials proposed for use.

After completion of the surface restoration measures, the ME will retest the lot containing the affected area.

O. Opening to Traffic. Do not allow vehicular traffic of any kind on the deck slab until the deck has been saw cut grooved finished as specified in 507.03.02.L.

507.03.03 Date Panel

Submit a sample of the date panel showing the coloring and surface finish to the RE for approval. Ensure that the date panel is cast true and straight in a single unit that includes anchors. Ensure that the material used to color the concrete is nonfading. Ensure that the arrises are clean and accurate. Install the date panel into the parapet using epoxy grout.

507.03.04 Concrete Bridge Sidewalk

Ensure that the concrete deck has cured for at least 14 days before beginning sidewalk construction. Construct forms as specified in 504.03.02.B. Ensure that the reinforcement steel is placed as specified in 504.03.01. Place concrete as specified in 504.03.02.D. Float-finish concrete before applying a surface texture with a broom. Apply curing materials as specified in 504.03.02.F and maintain for 3 days. Post warning tape around the sidewalk during the curing period. Follow the loading restrictions as specified in 504.03.02.J.

507.03.05 Concrete Parapet and Barrier Curb

Ensure that the concrete deck has cured for at least 14 days before beginning parapet or barrier curb construction. Construct moldings, panel work, and bevel strips true to line and grade with neatly mitered joints. Ensure that corners in the finished work are true, clean cut, and free from cracks, spalls or other defects. Construct barrier curb using the fixed form method. Construct parapet to support bridge lighting foundations using the fixed-form method. Construct parapet not supporting bridge lighting foundations using 1 of the following methods:

1. **Fixed-Form Method.** Construct forms as specified in 504.03.02.B. Ensure that the reinforcement steel is placed as specified in 504.03.01. Place concrete as specified in 504.03.02.D. Remove the forms as soon as the concrete holds its shape, and immediately apply the Class 2 finish as specified in 504.03.02.H.2. Ensure that the application of the Class 2 finish is completed within 48 hours of placing concrete.

2. **Slip-Form Method.** At least 20 days before beginning the work, submit the proposed equipment, methods, and processes for the construction of the slip-formed concrete parapet to the RE for approval. Provide, to the RE, evidence of successful history and operation of the slip-form machine or other equipment. Design and construct a support system to restrain the reinforcement cage during slip-forming, so that displacement will not occur. Locate the reinforcement steel so that after the joints are saw cut the reinforcement steel will have the minimum concrete clear cover as shown on the Plans.

   Ensure that the slip-forming machine consolidates the freshly placed concrete in 1 complete pass of the machine. Ensure that the forming portion of the slip-form machine is readily adjustable vertically, during the forward motion of the machine. If information on the history is not available, construct a test section, at least 100 feet long, at the Project Limits, to verify that the proposed equipment, material, and methods are capable of producing the required concrete parapet.

   Attach a grade line gauge or pointer to the machine to ensure that a continual comparison can be made between the barrier being placed and the established grade line as indicated by the offset guide line.

   When using the slip-form method, supply concrete to the slip-form machine at a uniform rate to produce a completely shaped parapet. Ensure that the machine is operated to produce consolidated concrete free from surface pits larger that 1/2 inch in diameter and 1/4 inch in depth and that requires no additional handling.

   If concrete placement is interrupted, protect from drying by covering the placed concrete with several layers of wet burlap. If the interruption exceeds 30 minutes, install a construction dam or bulkhead. If the interruption exceeds 90 minutes, discontinue any further placement. The Contractor may resume concrete placement at the joint beyond the bulkhead after 12 hours, measured from the start of delay, has elapsed. If the RE determines that the length of placement between the bulkhead and the next joint cannot be slip-formed, form the section by methods other than slip-forming.

   Remove all loose and otherwise unsatisfactory materials from the surface of the cold joints. Obtain approval from the RE before using tools for this purpose. Scrub the surface with a wire broom and keep wet until new concrete is placed. Immediately before placing concrete, apply the epoxy bonding coat according to the manufacturer's recommendations.

   Within 4 hours of slip-forming, saw cut contraction joints to a maximum depth of 1 inch past the troweled "V" notch groove to prevent shrinkage cracking.

Cure using curing compound as specified 504.03.02.F. If drilling is required for subsequent construction, allow the concrete to cure for a minimum of 3 days before drilling.

507.03.06 4-Bar Open Steel Parapet

Ensure that the deck has cured for at least 14 days before placing concrete for 4-bar open steel parapet. Place concrete for 4-bar open steel parapet as specified in 504.03.02.D. Do not drill for 4-bar open steel parapet installation until the concrete has cured for at least 3 days. Install as shown on the Plans.

507.03.07 Bridge Approach

Prepare the underlying surface as specified in 405.03.01.

Set forms as specified in 504.03.02.B, place reinforcement steel as specified in 504.03.01, and set joint ties for the entire area to be paved at least 1 day before placing concrete. Set forms at grade in full contact with the underlying surface. Install longitudinal joint ties through the forms and secure in place. Ensure that concrete does not seep around the bar. If longitudinal joint ties cannot be installed before placing concrete, install as specified in 405.03.02.C.

Check the alignment and grade elevations of the forms and joint ties and make corrections before placing the concrete. Ensure that the forms do not deviate from the required alignment by more than 1/4 inch. Reset, or remove and replace forms that settle or deflect under the spreading and finishing equipment. Clean the top and face of forms, and oil the face before placing concrete.

Comply with the limitations of placing specified in 507.03.02.F. Place concrete as specified in 507.03.02.H. Apply the surface texture as specified in 507.03.02.I. Cure the concrete as specified in 507.03.02.J. Saw cut the surface as specified in 507.03.02.L.

Follow the loading restrictions as specified in 507.03.02.M. Do not allow vehicular traffic of any kind on the approach until the it has been saw cut grooved finished.

507.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
___" BY ___ " PREFORMED ELASTOMERIC JOINT ASSEMBLY	LINEAR FOOT
STRIP SEAL EXPANSION JOINT ASSEMBLY	LINEAR FOOT
MODULAR EXPANSION JOINT ASSEMBLY	LINEAR FOOT
CONCRETE BRIDGE DECK	CUBIC YARD
CONCRETE BRIDGE DECK, HPC	CUBIC YARD
DATE PANEL	UNIT
CONCRETE BRIDGE SIDEWALK	CUBIC YARD
CONCRETE BRIDGE SIDEWALK, HPC	CUBIC YARD
CONCRETE BRIDGE PARAPET	LINEAR FOOT
CONCRETE BRIDGE PARAPET, HPC	LINEAR FOOT
4-BAR OPEN STEEL PARAPET	LINEAR FOOT
___" X___" CONCRETE BARRIER CURB, BRIDGE	LINEAR FOOT
CONCRETE BRIDGE APPROACH	CUBIC YARD

The Department will include payment for reinforcement steel under the various concrete Items. The Department will make payment for reinforcement steel under REINFORCEMENT STEEL, REINFORCEMENT STEEL, EPOXY-COATED, and REINFORCEMENT STEEL, GALVANIZED as specified in 504.04.

The Department will measure ___" BY ___ " PREFORMED ELASTOMERIC JOINT ASSEMBLY, STRIP SEAL EXPANSION JOINT ASSEMBLY, and MODULAR EXPANSION JOINT ASSEMBLY of the various sizes by the linear foot along the centerline, including the vertical face of curbs and tops of sidewalks and brush curbs.

The Department will make pay adjustments for surface requirements as specified in Table 507.03.02-2 and will apply to the lot volume for concrete in deck slabs and approach.

SECTION 508 – BRIDGE DRAINAGE

508.01 DESCRIPTION

This Section describes the requirements for constructing scuppers, inlets, and downspouts for surface drainage of bridge decks.

508.02 MATERIALS

Provide materials as specified:

Bolts and Bolting Material 908.01
Steel Alloy Pipe 909.02.07
Gray Iron Casting Frame 909.03
Ductile Iron Casting Grates 909.03

If inlet frames, grates, and scuppers are fabricated from steel, galvanize as specified in 912.02.01.

508.03 CONSTRUCTION

508.03.01 Inlet Frames, Grates, and Scuppers

Ensure that the bearing surfaces of frames and grates are machined so that the grates have uniform bearing on the frames. Ensure that the bearing surfaces are match marked before being delivered.

Ensure that the frames are set flush with the deck surface.

508.03.02 Steel Alloy Pipe

Repair areas where galvanizing has been damaged as specified in 912.02.01. Obtain RE approval of the type of threaded concrete inserts for support brackets and clamp.

508.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
INLET FRAME AND GRATE	UNIT
SCUPPER	UNIT
___" STEEL ALLOY PIPE	LINEAR FOOT

SECTION 509 – BRIDGE RAILING AND FENCE

509.01 DESCRIPTION

This Section describes the requirements for constructing metal railing, fence, and guide rail on bridges.

509.02 MATERIALS

Bearing Pads 907.03
Bolts and Bolting Material 908.01
Anchor Bolts 908.01.03
Adhesive Anchor Bolts 908.01.04
Chain-Link Fence 913.02.01
Bridge Railing 913.03

Ensure that the railing is fabricated to allow for minor adjustments in both horizontal and vertical directions.

509.03 CONSTRUCTION

509.03.01 Bridge Railing

At least 30 days before beginning the work, submit working drawings for certification. Indicate material specifications for adhesive, anchors, washers, and nuts on the working drawings.

Base the design embedment of the adhesive anchor bolts on a concrete compressive strength of 4000 pounds per square inch. Ensure that the embedment depth of the adhesive anchors shown on the working drawings is sufficient to obtain the required pullout strength as required for the proof load testing as specified in 908.01.04.

Ensure that the railing is fabricated to allow for minor adjustments in both horizontal and vertical directions. Install 1 or 2-rail aluminum railing on top of the concrete parapet as shown on the Plans. Do not use expansion type anchor bolts.

1. **Cast-in-Place Type.** Set anchor bolts before placing concrete using a rigid template for each anchor assembly. When placing concrete, ensure that bolts do not move and spacing is maintained between the rigid templates. Ensure that the exposed threaded ends of the anchor bolts remain clean and protected from concrete. Clean the anchor bolts before installing the specified hardware.

2. **Adhesive Type.** Do not drill for installation until the concrete has cured for at least 3 days. Install adhesive anchors according to the manufacturer's recommendations. When drilling, ensure that spalling does not occur and existing utilities are not damaged. Do not use a rotary hammer to drill the holes. Repair damage to the existing concrete, utilities, and reinforcement steel as a result of drilling. Clean and dry drill holes before and during installation of the adhesive anchors.

Repair damage to galvanized coating as specified in 912.02.01.

509.03.02 Chain-Link Fence for Bridge

Erect fence as specified in 605.03.01.

509.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
BRIDGE RAILING (___RAIL, ALUMINUM)	LINEAR FOOT
BRIDGE RAILING (___RAIL, STEEL)	LINEAR FOOT
CHAIN-LINK FENCE, ALUMINUM-COATED STEEL, BRIDGE, ___' ___" HIGH	LINEAR FOOT
CHAIN-LINK FENCE, PVC-COATED STEEL, BRIDGE, ___' ___" HIGH	LINEAR FOOT
CHAIN-LINK FENCE, GALVANIZED STEEL, BRIDGE ___' ___" HIGH	LINEAR FOOT
CHAIN-LINK FENCE, ALUMINUM-COATED STEEL, BRIDGE ___' ___" HIGH, CURVED TOP	LINEAR FOOT
CHAIN-LINK FENCE, PVC-COATED STEEL, BRIDGE ___' ___" HIGH, CURVED TOP	LINEAR FOOT
CHAIN-LINK FENCE, GALVANIZED STEEL, BRIDGE, ___' ___" HIGH CURVED TOP	LINEAR FOOT

SECTION 510 – TIMBER STRUCTURES

510.01 DESCRIPTION

This Section describes the requirements for constructing structures or parts of structures, other than piles, composed of treated or untreated timber, or a combination of both, on prepared foundations.

510.02 MATERIALS

Provide materials as specified:

Round Timber Piling 915.02
Timber for Sheet Piling 915.03
Timber for Structures 915.04

Timber Treatments 915.05
Timber Connectors and Hardware 915.06

510.03 CONSTRUCTION

510.03.01 Timber Structures

Construct timber structures according to Section 16 of the *AASHTO LRFD Bridge Construction Specifications* and according to the details provided in the contract documents.

Do not use cant hooks, peaveys, pikes, or hooks for handling of the timber members.

510.03.02 Sheeting and Wales

Submit working drawings for approval of the design of ring or shear plate timber connectors. Ensure that connectors are made of corrosion-resistant metal. Include the following:

1. Timber and steel material designations.
2. Hardware requirements, such as nails, bolts, nuts, washers, drift bolts and dowels.
3. Timber dimensions.
4. Timber connector type, its dimensions and installation method.
5. Hole dimensions.
6. Bracing requirements.

Refer to the Special Provisions for corrosion requirements for metal components.

510.04 METHOD OF MEASUREMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
TIMBER STRUCTURE	LUMP SUM
TIMBER SHEETING	CUBIC FOOT
TIMBER WALE	CUBIC FOOT

SECTION 511 – BULKHEAD, FENDER, AND DOLPHIN SYSTEMS

511.01 DESCRIPTION

This Section describes the requirements for constructing bulkhead, fender, and dolphin systems using concrete, steel, timber, or composite piles.

511.02 MATERIALS

511.02.01 Materials

Provide materials as specified:

Concrete 903.03
Precast Structural Concrete 904.03
Prestressed Concrete 904.04
Structural Steel 906.01
Steel Piles 906.02
Bolts and Bolting Material 908.01
Coal Tar Epoxy Paint 912.01.03
Zinc Coating on Steel 912.02.01
Sawn Timber Posts 915.01
Timber Bearing Piles 915.02

Timber Sheet Piles 915.03
Timber for Structures 915.04
Timber Treatment 915.05
Fiber Reinforced Plastic Lumber (FRPL) 916.01
Fiberglass Reinforced Plastic Piles (FRPP) 916.02
Fiberglass-Concrete Composite Piles (FCCP) 916.03

Provide tie rods, plate washers, turnbuckles, nuts, bolts, washers, and all other hardware in bulkheads made of steel with a dual coating system consisting of zinc coating (galvanizing) and coal tar epoxy paint.

511.02.02 Equipment

Provide equipment as specified:

Impact Hammers 1004.01
Vibratory Hammers 1004.02
Leads and Followers 1004.03

511.03 CONSTRUCTION

511.03.01 Bulkhead, Fender, and Dolphin Systems

A. Working Drawings. At least 30 days before beginning work, submit working drawings for approval for steel or concrete sheet piling, composite piles, and FRPL.

1. Steel and Concrete Sheet Piling. Include design calculations, member size, member location, and penetration depth.

2. Composite Piles. When using composite piles, the Contractor may use FCCP or FRPP. Include the following for composite piles:

1. Calculations and certifications showing structural properties, including ultimate and flexural strength.
2. The location of any embedded or attached lifting devices and use of pick-up or support points.
3. The location of the roughened surface where skin friction is needed between the pile and the soil.
4. The location of detailing of any splices, shoes, and top of pile connections required.
5. Catalog cuts, manufacturer's recommendations, schedules, diagrams, performance charts, physical appearance, and other characteristics.
6. Pile driving recommendations, including recommended driving energies.
7. For FCCP, include the outside diameter and wall thickness of the composite reinforcement tube and the concrete placement method.
8. For FRPP, provide certification and lab reports from an independent testing facility that FRPP meets the plastic material properties and structural properties specified in 916.02.

3. FRPL. Include the following for FRPL:

1. Written certification from the FRPL manufacturer, as specified in 106.07, that their product satisfies the requirements of 916.01.
2. Catalog cuts, manufacturer's recommendations, schedules, diagrams, performance charts, physical appearance, and other characteristics of FRPL.
3. Lab reports from an independent testing facility including calculations that confirm that the FRPL meets the ultimate strength requirements specified in 916.01.

B. Shipping, Storing, and Handling. Ship, store, and handle components, including fiberglass tubes, protective coatings, and concrete to avoid damage. When pile tips are required, attach to the pile before shipping. Store piles on a minimum of 6-inch wide timber cribbing arranged to support and to maintain straightness within the specified tolerance. Store components so that they may be easily inspected. When storing components, protect from exposure to extreme heat or impact. Only use fabric slings to move composite, timber, and concrete materials.

C. Coating Steel. Apply coal tar epoxy paint immediately after the installation of all connections, except for tie rods that do not have threaded ends. Paint unthreaded tie rods at least 72 hours before installation. Clean galvanized

surfaces receiving coal tar epoxy paint according to SSPC-SP 6. Ensure that galvanizing is not damaged during the cleaning process.

Blast clean surfaces of sheeting, plates, and wales according to SSPC-SP 6. Coat the surfaces with coal tar epoxy paint as follows:

1. Immediately after blast cleaning, apply 2 coats of coal tar epoxy paint at a maximum coverage rate of 125 square feet per gallon. Ensure that the total dry film thickness of the 2 coats is less than 16 mils at any point. Apply the coating by brush, roller, or spray. The Contractor may thin the first coat with a maximum of 10 percent of solvent according to the coating manufacturer; however, the Contractor may not thin the second coat. Allow the first coat to thoroughly dry before applying the second coat. Allow the second coat to dry and harden before handling the steel.
2. Clean damaged or rejected areas of coating of foreign or loose material and promptly recoat the area. Remove the loose or damaged coating in the surrounding area, and brush the adjacent surface of the remaining sound film with methyl isobutyl ketone to provide a good bonding surface for the new coats.
3. Allow the top coat to cure for at least 72 hours before driving.

D. Constructing Bulkhead, Fender, and Dolphin Systems. When constructing with timber, drive nails flush with the surface of the wood. Ensure that driving does not cause hammer marks in wood surfaces. Drift sharpen the lower ends of timber sheet piling to wedge against the adjacent timbers. If the tops are battered in driving, leave slightly high and then cut off at the required elevation. After cutting, coat the ends of sheeting members and wales with 2 applications of coal tar epoxy paint.

Drive piles as specified in 502.03.03.B. The Contractor may use lighter driving equipment or vibratory pile drivers. Ensure that the completed piling is vertical, in line, driven to the prescribed depth, cut off to a straight line at the shown elevation, and watertight at the joints.

Ensure FRPL is cut, beveled, drilled, countersunk, and otherwise fabricated according to manufacturer's recommendations. Set material accurately to the required levels and lines, with members plumb and true and accurately cut and fitted. Securely attach FRPL to substrate by anchoring and fastening as shown on Plans.

E. Extensions and Splices. Splice piles as specified in 502.03.04.

F. Cut-Offs and Cappings. Cut off and cap piles as specified in 502.03.03.E.

511.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
CONCRETE SHEET PILING	SQUARE FOOT
STEEL SHEET PILING	SQUARE FOOT
TIMBER SHEET PILING	SQUARE FOOT
COMPOSITE PILE	LINEAR FOOT
FIBERGLASS REINFORCED PLASTIC LUMBER	CUBIC FOOT

The Department will measure FIBERGLASS REINFORCED PLASTIC LUMBER (FRPL) in cubic feet computed on the basis of volume of the shortest commercially available length that is placed.

The Department will measure the square footage of CONCRETE SHEET PILING, STEEL SHEET PILING, and TIMBER SHEET PILING by multiplying the average height and length of sheeting that is driven. The Department will determine the average height by extending a line from the bottom of the excavation to a vertical plane of the top of sheeting.

SECTION 512 – SIGN SUPPORT STRUCTURES

512.01 DESCRIPTION

This Section describes the requirements for constructing sign support structures.

512.02 MATERIALS

512.02.01 Materials

Provide materials as specified:

Concrete	903.03
Reinforcement Steel	905.01
Sign Structures	906.05
Anchor Bolts	908.01.03
Electrical Conduit and Fittings	918.01

512.02.02 Equipment

Provide equipment as specified:

Vibrator	1005.04
Concrete Batching Plant	1010.01
Concrete Trucks	1010.02

512.03 CONSTRUCTION

512.03.01 Sign Structures

A. Working Drawings. At least 30 days before beginning work, submit working drawings for certification.

B. Storage and Handling. Load, transport, unload, and erect structural materials so that the metal is kept clean and free from injury in handling.

Store structural materials above the ground on platforms, skids, or other supports. Keep the structural materials free from accumulation of dirt, oil, acids, or other foreign matter.

C. Erection Plan. At least 15 days before erecting posts, tower shafts, and trusses, submit a plan to the RE showing the proposed equipment to be used. Include calculations and lift points to maintain the truss assembly in plumb position during placement, detailed erection instructions and drawings of all structures, and the proposed scheme for traffic control during the erection of the towers and trusses. Ensure that the plan includes the method to install walkways, luminaires, signs, and miscellaneous attachments within the same 8-hour period that the trusses are erected unless otherwise approved by the RE.

D. Excavating. Excavate as specified in 202.03.03. Shape and compact the underlying material to produce a firm, even surface. Obtain RE approval before finishing excavation. If the RE determines that the bottom of the excavation is unstable, undercut, backfill, and compact as directed by the RE.

E. Placing Concrete for Pedestals. Set anchor bolts into a template to maintain alignment and elevation. Secure in position to prevent displacement while placing concrete. Before placing the concrete, place reinforcement steel as specified in 504.03.01 and conduit. Ensure that concrete placement complies with the limitations specified in 504.03.02.C. Place concrete as specified in 504.03.02.D. Cure concrete as specified in 504.03.02.F.

F. Installing Electrical Material. Provide and install galvanized steel conduit ells in pedestals. Where this conduit is not to be extended to a junction box, terminate the lower end of each ell 3 feet from the face of the pedestal and 18 inches below grade, and cap with a standard galvanized steel pipe cap. The upper end of each ell shall project above the pedestal for a sufficient distance to terminate at the level of the bottom of the handhole in the sign support post or tower shaft, or at a maximum of 2 inches below such level. Terminate the ell by ground bonding bushing (with closure disk in conduit not to be extended).

Where a cable passes through a hole or runs along a surface at any point on the complete assembly, ensure holes and surfaces are deburred and free of sharp edges or protuberances that may damage the cable.

G. Erecting Posts, Trusses, and Tower Structures. Straighten any deformed structural material before being laid out, punched, drilled, or otherwise worked on in the shop. The RE will reject structural material with sharp kinks or bends. Verify bolt alignment before erecting towers. Do not erect posts and tower shafts on the completed pedestals until approved by the RE. Backfill footings before erection.

1. Trusses. Connect the truss abutting chord splices according to Subsection 11.5.6 of the *AASHTO LRFD Bridge Construction Specifications*.

Provide 2 working platforms that allow the bolt assembly tightening from opposite sides of the structure. Provide 2 impact wrenches. Sequentially tighten by initiating and progressing the tightening of the bolts in a pattern whereby a 180-degree opposite side repetition is maintained. Sequentially tighten each bolt and nut to the same calibrated increment.

Install high-strength steel bolts as specified in 506.03.01.E.

2. Posts and Tower Shafts. Clean and lubricate threads of anchor bolts and nuts before installing post or tower shaft. Ensure that the top of the concrete pedestals or caissons is free of dirt or other foreign materials. Install the top and bottom bolt assemblies as shown on the Plans and set level and as specified in 506.03.01.E.

After erecting the posts or tower shafts and tightening all nuts as outlined above, add a second nut to each anchor bolt and adjust snug tight. The Contractor may use self locking nuts to maintain the connection. After installing the second nut, or self-locking nut, adjust the leveling nuts to a snug tight condition. Snug tight is defined as the tightness that exists when all surfaces on the joint are in firm contact with one another. Leave the space between the top of the pedestal and the bottom of the post open.

At least 15 days before erecting VMS structures, provide 2 stainless steel mounting U-bolts per lot, to the NJDOT Bureau of Materials.

Verify the location of an electrical power source in the field before foundation construction and before fabrication of the structure.

512.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
CANTILEVER SIGN SUPPORT, STRUCTURE NO.___	UNIT
BRIDGE MOUNTED SIGN SUPPORT, STRUCTURE NO. ___	UNIT
BUTTERFLY SIGN SUPPORT, STRUCTURE NO. ___	UNIT
OVERHEAD SIGN SUPPORT, STRUCTURE NO. ___	UNIT

The Department will make payment for excavation as specified in 202.04.

The Department will make payment for concrete and reinforcement steel as specified in 504.04.

The Department will make payment for load bearing piles as specified in 502.04.

SECTION 513 – RETAINING WALLS

513.01 DESCRIPTION

This Section describes the requirements for constructing cast-in-place retaining walls, prefabricated modular wall systems, mechanically stabilized earth (MSE) wall systems, and other alternate retaining wall systems.

513.02 MATERIALS

513.02.01 Materials

Provide materials as specified:

Coarse Aggregate (No. 57)	901.03
Soil Aggregate (I-9)	901.11
Soil Aggregate (I-15)	901.11
Concrete	903.03
Mortar	903.08.01
Curing Materials	903.10
Precast Concrete Units	904.02
Reinforcement Steel	905.01
Welded Wire Reinforcement	905.01.03
Structural Steel Plates and Bars	905.01.04
High-Strength Steel Bolts	908.02
Coal Tar Epoxy Paint	912.01.03
Preformed Joint Filler	914.01
Joint Sealer (Hot-Poured)	914.02
Subsurface Drainage Geotextile	919.01
HDPE Geomembrane	919.05
Waterstops	919.06

Provide soil reinforcement strips according to ASTM A 572, Grade 65. Provide tie strips according to ASTM A 1011, Grade 50.

513.02.02 Equipment

Provide equipment as specified:

Vibrator	1005.04
Concrete Batching Plant	1010.01
Concrete Trucks	1010.02

513.03 CONSTRUCTION

513.03.01 Proprietary Retaining Walls

A. Working Drawings. At least 30 days before beginning the work, submit working drawings for approval that include, at a minimum, the following:

1. Design calculations giving complete information as to the proposed method of fabrication and erection of precast units and related components.
2. General notes, design parameters, soil characteristics, and factors of safety.
3. An elevation view of the wall showing elevations at the top of the wall, the beginning, and at the end.
4. Plan view of the wall showing the offset from the construction baseline to face of wall units at all changes in horizontal alignment.
5. Distance from front of wall to the extreme limit of module.
6 Typical sections of the wall indicating how internal drainage and surface drainage behind the wall is handled. Typical cross-sections of cut and fill sections. Limits and extent of select granular backfill material placed above original ground. Location of proposed ground line.
7. Panel or unit length and size and designations.
8. A numbered panel layout for fabrication and erection purposes.
9. Typical panels, as well as special panels, such as at bends; dimensions necessary to construct the member; the location of reinforcement steel in the member; and the location of reinforcement attachment devices that are embedded in the panels.
10. Designation of breaks in vertical alignments and elevations at whole stations and at 25-foot increments and treatment.

11. All details for footings and leveling pads, including step details, locations, and elevations, and actual maximum bearing pressure.
12. Architectural details, such as special facing finish, texture, and color.
13. The location of the proposed final ground line.
14. ROW limits and their relationship to the wall, with offsets and stations to corners.
15. Location of any noise walls or sign structures near the wall by station and offsets.
16. Centerline of any drainage structures or utilities behind and passing through or under walls.
17. Location of all piles on any adjoining structure's foundation plans with details to avoid any conflict.
18. Connections to barriers, copings, signs, lights, railing, fences, noise barriers, or any other element.
19. Details for the construction of walls and soil reinforcement around obstructions including bridge supports, drainage facilities, sign footings, or any other element.
20. Details for required electrical systems, including highway lighting bases, junction boxes, and conduit.
21. Limits and extent of common structure volume, such as excavation, volume of concrete, reinforcement steel, and backfill.
22. Numbers and types of precast units/panels.
23. Manufacturer's recommendations, including suggested sequence of construction.

B. Shipping, Handling, and Storing. Ensure that the precast units have cured for at least 72 hours and have attained the minimum 28-day compressive strength before shipping.

Provide galvanized handling devices according to ASTM A 123. Store, transport, hoist, and handle units to prevent cracking or damage. After galvanizing, coat attachment surfaces not to be embedded in concrete with coal tar epoxy paint. Replace or repair units damaged by improper storing, transporting, or handling.

C. Wall Foundation. Excavate as specified in 202.03.03. Shape and compact the underlying material to produce a firm, even surface. Obtain RE approval before finishing excavation. If the RE determines that the bottom of the excavation is unstable, undercut, backfill, and compact as directed by the RE. Grade the foundation for the structure level for a width that exceeds the length of the soil reinforcement by at least 2 feet.

Place concrete, as specified in 504.03.02.D, for an unreinforced concrete leveling footing, or provide a precast concrete leveling pad according to the manufacturer's recommendations.

Before placing wall units, install underdrains and drainage pipes.

D. Installing. Provide 2 copies of the manufacturer's recommendations to the RE. If a section of wall is to be cast-in-place, construct the section as specified 504.03.02.D. Obtain RE approval of the foundation for the structure before beginning erection. Install the units according to the manufacturer's recommendations. For erection, handle units with lifting devices set into the upper edge of the panels. Place units in a horizontal course. Do not place the subsequent course until the previous course is backfilled within 2 inches of the top of the course.

Provide external bracing for the initial course. While erecting each course, examine line, and grade, and correct deviations to prevent cumulative inaccuracies in alignment. Vertical tolerance and horizontal alignment tolerance shall not exceed 1/2 inch, when measured along a straightedge. Install joint filler and rubber pads according to the manufacturer's recommendations. Close joints at corners or angle points.

Ensure that all wall units above the first course interlock with the lower courses. Vertical joint openings on the wall's front face shall not exceed 3/4 inch. The front face vertical joints shall have 12-inch wide strips of subsurface drainage geotextile behind each joint starting 2 feet below grade.

E. Back of Wall Drainage. Place a stone pocket, subsurface drainage geotextile, and an 8-inch corrugated steel underdrain pipe as shown on the Plans.

When constructing weep holes, place ports or vents for equalizing hydrostatic pressure below low water. Use 4-inch PVC or unreinforced concrete drain pipe as forms for weep holes through concrete.

F. Backfilling. For MSE walls, place reinforcement perpendicular to the face of the wall, unless otherwise shown on the Plans or directed. Before placing soil reinforcement, compact the backfill material as specified in 513.03.01.G.

For modular bin walls, fill wall units 4 feet or less in height in 1 lift and then thoroughly compact with a vibratory tamping device. Fill wall units more than 4 feet in height in 2 approximately equal lifts and thoroughly compact after each layer is placed.

Backfill after erecting each course of wall units. Verify that the reinforcements and wall units are not damaged, disturbed, or misaligned while backfilling. Correct misalignment and remove and replace damaged units of the wall units before placing the next course. Backfill using 1 of the following materials:

1. **Soil Aggregate (I-15) or Soil Aggregate (I-9) and Coarse Aggregate No. 57.** For MSE walls, use I-15 soil aggregate. The Contractor may use I-9 soil aggregate or No. 57 coarse aggregate in place of I-15 soil aggregate for modular walls.

   Do not exceed 10 inches loose measurement for the maximum lift thickness of the backfill. Decrease this lift thickness to obtain the specified density.

   The ME will determine the optimum moisture content as specified in AASHTO T 99, Method C. Ensure that the moisture content of the backfill is uniform throughout each layer and has a placement moisture content that is less than or equal to the optimum moisture content. Remove and rework backfill that has a placement moisture content in excess of the optimum moisture content until the moisture content is uniformly acceptable throughout the entire layer.

   Ensure that backfill placed within 1 foot of a drainage structure or utility does not have any particle greater than 3 inches in maximum dimension.

2. **Coarse Aggregate.** Do not exceed 8 inch lift thickness of coarse aggregate. Place subsurface drainage geotextile at the interface of the coarse aggregate and regular roadway materials and embankments.

   At each reinforcement strip level, level and compact the coarse aggregate before placing the reinforcement.

G. Compacting. Compact backfill material without damaging, disturbing, or misaligning the wall units before placing the next block level. Roughly level each course of backfill to an elevation approximately 2 inches above the level of the next course of units. Compact in a direction parallel to the wall. For MSE walls, do not use sheepsfoot or grid-type rollers for compacting backfill within the limits of the soil reinforcement. Compact for the specified material as follows:

1. **Soil Aggregate (I-15) or Soil Aggregate (I-9).** With the exception of the 5-foot zone directly behind the units, compact I-15 soil aggregate or I-9 soil aggregate with large, smooth drum, vibratory rollers using the density control method as specified in 203.03.02.D.

   Within 5 feet of the wall, use small, single or double drum, hand operated, walk-behind vibratory rollers, or walk-behind vibrating plate compactors. Make at least 3 passes.

2. **Coarse Aggregate.** To provide the proper density of the broken stone, compact by making at least 4 passes with a vibratory roller that has a total operating weight of 8 to 10 tons. Set the roller in the vibratory mode between 1.5 and 2.5 mph.

   Within 5 feet of the wall, use small, single or double drum, hand operated, walk-behind vibratory rollers, or walk-behind vibrating plate compactors. Make at least 3 passes.

   When there is evidence of wall displacement or disturbance, compact with a smooth drum static roller.

At the end of each day's operation, slope the last placed layer of backfill away from the wall units to direct runoff of rainwater away from the wall face. Do not allow surface runoff from adjacent areas to enter the work site. Ensure that the overall vertical tolerance of wall does not exceed 1/2 inch per 10 feet of wall height.

H. HDPE Geomembrane Liner for MSE Walls. Deliver HDPE geomembrane liner systems and store to prevent damage to the material before installation.

Before placing HDPE liner, ensure that the area to be lined is smooth and free of sharp objects or debris. Do not use equipment or tools that may damage the HDPE liner while handling, moving, or installing.

Place the HDPE liner below the pavement and just above the first row of reinforcements. Slope the HDPE liner to drain away from the wall units.

Align seams parallel to the line of maximum slope. Overlap seams at least 2 feet and seam according to the manufacturer's recommendations. Conduct field testing of seams, according to the manufacturer's specifications, to verify satisfactory seaming conditions.

When backfilling, prevent damage to the HDPE liner system. Do not allow equipment or traffic within 10 feet of the HDPE liner. Slope the last placed level of backfill away from the wall units to direct runoff of rainwater away from the wall face. Do not allow surface runoff from adjacent areas to enter the work site.

513.03.02 Cast-in-Place Retaining Walls

Place reinforcement steel as specified in 504.03.01. Construct concrete as specified in 504.03.02.

513.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
RETAINING WALL, LOCATION NO. ___	SQUARE FOOT
RETAINING WALL, CAST-IN-PLACE, LOCATION NO. ___	SQUARE FOOT

The Department will measure retaining walls by the square foot. The area measured is the product of the average height determined by extending the final ground lines at the top and bottom of the wall to a vertical plane of the front face of wall and the total length of wall shown.

SECTION 514 – TEMPORARY STRUCTURES

514.01 DESCRIPTION

This Section describes the requirements for constructing and removing temporary structures.

514.02 MATERIALS

The Contractor may use any material or combination of materials that are approved with the working drawings.

514.03 CONSTRUCTION

514.03.01 Temporary Structures

A. Working Drawings. At least 30 days before beginning the work, submit working drawings for approval.

B. Erection Plan. At least 30 days before beginning work, submit to the RE a plan that includes the proposed equipment, detailed erection instructions and drawings of all structures, and the proposed scheme for traffic control during the erection and use.

C. Structures. For overpass and waterbody structures, construct to provide horizontal and vertical clearance that is at least equal to the clearances provided by the existing structure. If there is no existing structure, construct the temporary structure to provide horizontal and vertical clearance that is at least equal to the clearances provided by the new structure. Remove temporary structures after the new work is open to traffic.

514.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
TEMPORARY STRUCTURE, ONE-WAY	LUMP SUM
TEMPORARY STRUCTURE, TWO-WAY	LUMP SUM
TEMPORARY STRUCTURE, PEDESTRIAN BRIDGE	LUMP SUM

The Department will pay 75 percent of the lump sum price bid when the temporary structure is opened to traffic. The Department will pay the remaining 25 percent when the temporary structure has been removed.

DIVISION 550 – STRUCTURE REHABILITATION

SECTION 551 – BRIDGE DECK REHABILITATION

551.01 DESCRIPTION

This Section describes the requirements for repairing or scarifying existing concrete bridge decks.

551.02 MATERIALS

551.02.01 Materials

Provide materials as specified:

Coarse Aggregate	901.06.01
Fine Aggregate	901.06.02
Concrete	903.03
Quick-Setting Patch Materials	903.07
Curing Materials	903.10
Reinforcement Steel	905.01
Rebar Coupling Devices	905.04

551.02.02 Equipment

Provide equipment as specified:

Spreading and Finishing Machine for Concrete Bridge Decks	1005.03
Vibrator	1005.04
Scarification Equipment	1006.09
Straightedge	1008.02
Mechanical Sweeper	1008.03
Pavement Saw	1008.04
Concrete Batching Plant	1010.01
Concrete Trucks	1010.02
Mobile Mixer	1010.03
Small-Batch Mixer	1010.04

Submit technical data sheets for the proposed pneumatic hammers to the RE for approval.

551.03 CONSTRUCTION

551.03.01 Repair of Concrete Deck

A Deck Condition Survey. The RE will perform the deck condition survey before scarification, if scheduled, and after the removal of any existing HMA overlay and waterproofing membrane. Submit written notice to the RE at least 15 days before the work site is available for a deck condition survey. The Department will schedule surveys during daylight hours unless the working time is restricted in the Contract. The RE will perform surveys only if the ambient temperature has been above 40 °F for at least 72 hours before the beginning of the survey and only if the deck is dry. The RE will use the data obtained to determine the repair limits.

B. Sawcut and Removal. When Type C repair is specified or full depth repair is required, provide temporary shielding, as specified in 201.03.03, to prevent debris from falling below the deck. Saw cut repair areas to a 3/4-inch depth.

Remove loose and disintegrated concrete from the areas to be repaired to a sound concrete surface. Ensure that the remaining concrete is not damaged during concrete removal. Ensure that the reinforcement steel is not damaged or debonded during concrete removal. The Contractor may remove concrete or prepare and shape repair areas with

power chipping or hand tools. Do not use pneumatic hammers heavier than 33 pounds. The Contractor may start such tools in the vertical position but must immediately tilt to a 45-degree operational angle. Do not operate pneumatic hammers and chipping tools at an angle exceeding 45 degrees relative to the surface of the deck slab. Do not use pneumatic hammers heavier than 20 pounds for chipping areas directly below the top longitudinal reinforcement steel or within 6 inches of the primary girder reinforcement steel, such as stirrups in prestressed concrete girder configurations.

Remove concrete to the depth specified for the following type of repair.

1. **Type B Repair.** For Type B repair, remove delaminated, deteriorated, and designated deck concrete to a minimum depth of 1 inch below the bottom of the top layer of existing reinforcement steel to a maximum depth of 50 percent of the thickness of the existing concrete deck. The RE may require the Contractor to remove sound concrete to achieve the limits of the designated repairs.

2. **Type C Repair.** For Type C repair, remove delaminated, deteriorated, and designated deck concrete for the full depth of the existing deck. The RE may require the Contractor to remove sound concrete to achieve the limits of the designated repairs. Collect the concrete and reuse as specified in 202.03.07.A.

C. Cleaning and Splicing Reinforcement Steel. Clean corroded, uncoated reinforcement steel by sandblasting, waterblasting, or wire brushing. For coated steel, clean areas where the coating is damaged by wire brushing and repair the coating according to AASHTO M 284. For reinforcement steel that has lost 25 percent or more of its original cross-sectional area, splice in or couple new epoxy-coated reinforcement steel of the same size. Lap the reinforcement steel at least 15 bar diameters from each end of the damaged area and wire tie together. If necessary, perform additional chipping of adjacent concrete to provide for this lap. Where reinforcement steel is broken or missing, lap new bars at least 30 bar diameters from each end of the break.

D. Patching. The Contractor may use Class A concrete or Type IA or IB quick-setting patch material, whichever is specified. For Type C Repair, provide forms for placing the patch material.

1. **Class A Concrete.** Perform patching within the limitations specified in 504.03.02.C. Place concrete as specified in 405.03.02.D.1.b; consolidate and strike-off as specified in 405.03.02.D.1.c; and texture with a broom. Cure the repair areas as specified in 504.03.02.F.

   Do not place traffic, equipment, or other loading on the patch material until the concrete has cured 72 hours and has attained a minimum strength of 4000 pounds per square inch as determined from 2 test cylinders cast during placement and field cured.

2. **Quick Setting Patch.** For Type IA or IB quick-setting patch material, place according to the manufacturer's recommendations. Wet cure the patched area using wet burlap, as specified in 504.03.02.F.2, immediately after placing and finishing. Keep the patched area covered for 3 hours.

   Do not open repair to traffic until compressive strength as measured by the average of 2 test cylinders is more than 2000 pounds per square inch. If the required compressive strength is not met by the time the roadway must be opened to traffic, open to traffic. Remove and replace the repair during the next available roadway closure.

551.03.02 Scarification

Before beginning concrete removal, perform a field survey for each stage of construction to establish existing grades and cross slopes and determine finished grades and cross slopes. Take elevations longitudinally every 10 feet and transversely at the gutterlines, breaklines, and the center of each lane and shoulder. The RE may direct additional elevation checks in areas with rapid changes in grade so that intermediate longitudinal checks can be made. Submit the field survey to the RE 5 days before scarifying.

Scarify the surface and ensure that the existing transverse and longitudinal joints are not damaged. Remove concrete and other materials that result from scarifying by hand, mechanical sweeper, or vacuum, and reuse as specified in 202.03.07.A. Do not use water or air to remove the scarified material.

If the RE designates additional areas of deteriorated concrete for repair after scarification, repair the areas as specified in 551.03.01.

551.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
REPAIR OF CONCRETE DECK, TYPE ___	SQUARE FOOT
SCARIFICATION	SQUARE YARD

At bridge deck repair areas outlined as either Type B or Type C Repair on the Plans or at locations designated, the Department will make final payment for each outlined area for only one of the 2 repair types as determined by the final depth as measured in the field and as specified in the construction details regardless of original designation or preparatory work for another repair type.

SECTION 552 – PRESSURE INJECTION SEALING

552.01 DESCRIPTION

This Section describes the requirements for repairing cracks in concrete using pressure injection sealing.

552.02 MATERIALS

552.02.01 Materials

Provide materials as specified:

Epoxy Injection Material 919.11

Use an epoxy crack sealant recommended by the epoxy injection material manufacturer.

552.02.02 Equipment

Provide equipment as specified:

Epoxy Resin Injection Equipment 1005.07

Submit technical data sheets for the proposed core stopper drill or an equivalent drill to the RE for approval.

552.03 CONSTRUCTION

552.03.01 Pressure Injection Sealing

A. Crack Repair Survey. The RE will examine the structure to verify the repair limits shown on the Plans. At least 15 days before the start of crack repair, notify the RE in writing and make the work site available for this examination. The RE may increase or decrease the limits of repair based on the examination. The RE will schedule surveys during daylight hours unless the working time is restricted in the Contract.

B. Preparing for Repair. Remove deteriorated, damaged, and loose concrete from the crack area. Drill port holes at 3-foot intervals along the crack. Perform additional surface preparation requirements according to the epoxy manufacturer's recommendations.

C. Sealing Surface Cracks. Seal the surface of the crack with an epoxy crack sealant. Ensure that this sealer does not obstruct the port holes for the pressure injected epoxy resin and is capable of containing the injected epoxy resin. Ensure that the sealant is hard before injecting the epoxy resin adhesive.

D. Injecting Epoxy Resin Adhesive. Mix and apply the epoxy resin adhesive according to the manufacturer's recommendations and the following. Begin by injecting the lowest entry port and continue until the epoxy adhesive has reached the next port hole in the crack. Stop injection and immediately seal the port hole before moving the injection to the next port hole. Continue the operation by injecting the epoxy resin adhesive into the next port hole in the crack. Continue the operation until the crack is filled.

E. Finishing the Surface. When the crack has been filled and the epoxy resin adhesive has cured, grind smooth the surface of the crack repair area to match the surrounding concrete.

552.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
PRESSURE INJECTION, CONCRETE CRACKS	LINEAR FOOT

SECTION 553 – PNEUMATICALLY APPLIED MORTAR

553.01 DESCRIPTION

This Section describes the requirements for removing and restoring deteriorated concrete with pneumatically applied mortar.

553.02 MATERIALS

553.02.01 Materials

Provide materials as specified:

Fine Aggregate 901.06.02
Cement 903.01
Curing Materials 903.10
Reinforcement Steel 905.01
Water 919.08

553.02.02 Equipment

Submit technical data sheets for the proposed pneumatic hammers to the RE for approval.

553.03 CONSTRUCTION

553.03.01 Pneumatically Applied Mortar

A. Limits of Repair. The RE will examine the structure to verify the repair limits shown on the Plans. Submit written notice to the RE at least 15 days before the work site is available for examination. The RE may increase or decrease the limits of repair based on the examination. The RE will schedule surveys during daylight hours unless the working time is restricted in the Contract.

B. Preparing and Cleaning. Remove deteriorated concrete to a sound surface and at least 1 inch beyond the first mat of reinforcement steel. Do not use pneumatic hammers heavier than nominal 30-pound class (33 pounds maximum) to remove the concrete. For abutment, pier seat, or column repairs, do not extend removal under the bearing seats without approval of the RE. Clean and replace reinforcement steel as specified in 551.03.01.C.

Chip concrete encasement cavities so their sides are perpendicular to the exposed surface for at least 1/2 inch in depth. Remove loose particles from the areas receiving mortar by flushing or scouring with compressed air jets

C. Test Panels. Construct test panels using the equipment, materials, and mix proportions proposed for each type of repair on the Project. Construct test panels that are at least 30 × 30 × 3 inches for each mix, for each type of repair, and for each shooting position to be encountered on the job, including the overhead position. Construct test panels to the same thickness as the repair, but not less than 3 inches thick. Apply the mortar for the test panels, against similar support conditions to simulate actual field conditions for concrete repairs. The ME will mark the test panels at the time of application. Field cure panels in the same manner as the work for 7 days. Deliver the test panels to the ME after the field cure is complete.

The ME will take 3 cores from each test panel. If the average compressive strength at 28 days is less than 3500 pounds per square inch, the test panel fails. Modify the mix proportions or the shooting procedure and construct a new test panel for approval of the repair.

D. Applying Mortar. Protect pedestrian, vehicular, and other traffic upon, underneath, or adjacent to the structure, and all portions of the structure against damage or disfigurement by spatters and splashes. If RE determines that the Contractor's method is deficient, cease applying mortar and submit working drawings for approval detailing a new method.

Apply mortar according to the manufacturer's recommendations. Ensure that successive layers fully bond to the previous layer during application. Blend the edges of the repair area to meet the existing surface.

Immediately remove mortar dropped or splattered on adjacent surfaces, the superstructure, and the substructure.

E. Curing. After applying the final layer of mortar, apply 2 coats of curing compound each at a rate of 1 gallon per 200 square feet of surface in a continuous, uniform film with power-operated pressure spraying equipment. Apply the second coat between 15 and 30 minutes of applying the first coat. If the method of applying the curing compound produces a nonuniform film, discontinue application and correct procedure.

553.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
PNEUMATICALLY APPLIED MORTAR	SQUARE FEET

SECTION 554 – PAINTING EXISTING BRIDGES

554.01 DESCRIPTION

This Section describes the requirements for cleaning and painting structural steel and metal surfaces on existing bridges using an epoxy mastic coating system or an organic zinc coating system.

554.02 MATERIALS

554.02.01 Materials

Provide materials as specified:

Structural Steel Paint..... 912.01.01

Use an organic zinc paint system or epoxy mastic paint system as shown on the Plans.

Use a reclaimable abrasive blast cleaning medium capable of providing the specified anchor profile. If the RE determines that work site conditions prohibit the use of a reclaimable abrasive medium, the Contractor may use low dusting, silica-free abrasives. Ensure that the pH level of the abrasive is between 6.0 and 8.5. At least 5 days before blast cleaning, submit samples of the proposed abrasive to the RE for approval.

554.02.02 Equipment

Ensure that equipment that uses compressed air has oil traps and moisture separators installed in the air supply lines. Change the traps and separators on a regular basis, according to the manufacturer's recommendations. Ensure that compressed air complies with the requirements of the blotter test according to ASTM D 4285.

Only use approved rubber rollers on scaffold fastenings or other protective devices that will not mar the coated surface.

554.03 CONSTRUCTION

554.03.01 Pollution Control System

At least 30 days before removing paint, submit a pollution control system to the RE for approval. Keep a copy of the approved plan on Project Limits. Submit updates to the plan to the RE for approval as necessary to reflect new information, new practices or procedures, changing site environmental conditions, or other situations that may affect site workers. Do not change or deviate from the approved pollution control system without the approval of the RE. The pollution control system applies to all personnel entering the Project Limits.

Ensure that the pollution control system and any other equipment does not encroach upon the bridge clearances over traveled roads or navigable water, unless approved by the RE.

If any part of the pollution control system fails to function at the required level of efficiency during operations, immediately suspend the operations. Do not resume work until modifications to correct the cause of the failure have been made and approved by the RE. If the failure is due to adverse weather conditions such as high winds, immediately suspend the operations until the weather conditions become favorable.

Include the containment plan, the waste disposal plan, the lead health and safety plan, and the equipment storage plan in the pollution control system. Ensure that the certified industrial hygienist (CIH) certifies monthly, in writing, to the RE that the Contractor is in compliance with the Pollution Control System.

1. **Containment Plan.** Describe, in detail, the method of providing, erecting, maintaining, and removing enclosures as required to contain and collect waste resulting from the removal of coatings in the preparation of steel surfaces for painting. Ensure that the containment system is at minimum a Level-1 Containment System according to SSPC Guide 6i (con). Ensure that visible emissions meet or exceed Section 5.5.1.1, Level 1 Emissions. Containment may consist of "local" systems, such as small enclosures where power tools are used, or certain enclosed vacuum blasting techniques where suction captures the abrasive and paint residue directly from the surface, removes paint and fine particles, and returns the abrasive to the blast nozzle.

   Submit working drawings for approval that include, at a minimum, the following:

   1. Specific design of the containment plans to be employed.
   2. Types of materials used.
   3. Method for reclaiming the blasting medium.
   4. Design of hangers.
   5. Assembly and disassembly procedures.
   6. An analysis of maximum loading and deflection signed and sealed by a Professional Engineer that will be added to the existing structure by the proposed system when put into use. Ensure that the proposed system does not induce a load on the superstructure or substructure that creates an adverse overstress condition or otherwise induces an undesirable effect on the structure and affected members.
   7. Type of solid/rigid floor (specify maximum load). Detail how the floor will be constructed, dimensions, and how funnels may be used. When using the ground as solid/rigid flooring, describe how it will be secured and incorporated into the containment enclosure. When using a floating or suspended platform, include details about its construction. Describe how waste is to be off-loaded from the platform, how the platform is to be tied off, and how storage drums are to be handled if they are to be loaded onto the platform.
   8. Type of dust proof and wind resistant enclosures designed to contain, as well as facilitate, the collection of waste resulting from the surface preparation.
   9. Type of connection to structure. Do not weld; obtain RE approval before bolting.
   10. Type of lighting inside the containment structure during blasting and inspection.
   11. Type of dust collection equipment. Design air flow inside the containment structure to meet applicable OSHA standards. Describe how the dust collector will be incorporated in the containment enclosure and how make-up air will be provided.
   12. Type of vacuum truck or equivalent method to capture, contain, collect, store, and dispose of all rust and paint particles, dust, and all other contaminated material generated by the work, either in the vicinity of or within the containment system.
   13. The run-off route from existing deck drains through the enclosure.

Include an emergency management plan outlining specific procedures to be followed in the event that the primary containment system fails to contain the materials and results in pollution of the environment. Provide details of equipment, materials, and methods that will effectively contain material that escapes during a failure of the primary system. Provide the necessary components of the emergency management plan at the Project Limits at all times when the work is in progress.

Also include an outline of people to be notified in the event of a failure resulting in pollution of the environment according to the rules and regulations of the applicable agencies.

2. Waste Disposal Plan. Describe, in detail, the means of handling, storing, transporting, and disposing of the waste generated by the removal of the existing paint systems. Include the following:

1. Description and quantity of storage containers sized for the job that conform to 49 CFR 173 and 178. Ensure that each storage container has a protective liner and removable lid.
2. The proposed method to contain the stored material and all necessary permits or licenses required.
3. The location and design of temporary storage and loading facilities.
4. Commitment letters from properly licensed and insured waste transporters; the name and EPA identification number of the transporter; name, address, and telephone number of responsible contact for the transporter; list of all types and sizes of transportation vehicles and equipment to be used; transportation methods and procedures for transporting waste materials; necessary permit authorizations; and previous experience in performing the type of work.
5. The transportation/storage/disposal (TSD) facility, including a commitment letter from the TSD facility indicating that it has the capacity to accept the estimated volume of waste material and stating that it will be open for business during the Contract duration to accept the estimated volume of waste materials specified herein. Also submit at least 2 alternative TSD facilities in the event the approved facility ceases to accept waste materials generated under the Contract.

3. Lead Health and Safety Plan (LHASP). Employ a CIH to develop the LHASP. Include in the plan the means to implement and maintain the protocols necessary for protecting personnel from hazards associated with the Project operations and activities. Establish and describe how policies, programs, and procedures that are necessary to comply with all Federal, State, and local laws, rules, and regulations will be maintained. Do not modify or change this plan without approval of the CIH and the RE. At a minimum, include the following elements:

a. Introduction. Include scope; structure locations; names, addresses, and telephone numbers for the Contractor's project manager, field superintendent, CIH, occupation physician, health and safety officer (HSO), and available emergency assistance; organization and responsibilities; and an approval sheet with the signatures of the project manager, field superintendent, and qualified person.

b. Physician Requirements. Qualification and responsibilities of the physician, certified in occupational medicine by the American Board of Preventive Medicine, that will provide the medical surveillance, removal, and protection program.

c. HSO Requirements. Qualifications of HSO, including laboratory experience, studying field conditions, formal experience necessary to perform technical monitoring, consulting, testing, and inspecting and the authority to take prompt corrective measures to eliminate the hazards.

d. Exposure Monitoring Procedures. Ensure that no employee is exposed to lead at concentrations greater than 50 micrograms per cubic meter of air averaged over an 8-hour period. Include the method of compliance for determining if any employee is or will be potentially exposed to airborne concentrations of lead at or above the action level. The Contractor may use the task "trigger" method outlined in 29 CFR 1926.62(D)(2) until the actual exposure assessment is documented.

e. Protective Equipment. Provide the following:

1. Type and number of respiratory protection according to 29 CFR 1926.62 (F).
2. Type and number of protective work clothing and equipment according to 29 CFR 1926.62 (G), 1926.28(A), 1910.132, and 1910.94

f. Facilities. Provide the following:

1. Hygiene facilities and practices including changing and showering facilities.
2. Eating facilities for employees exposed above the permissible exposure level, without regard to respirators, including method to ensure that employees do not eat or drink in contaminated areas according to 29 CFR 1926.62 (I), 1926.21, 1926.51, and 1910.141.
3. Method to keep all work sites clean and free of lead to the extent that the work process allows according to 29 CFR 1926.62 (H), 1926.25, and 1926.20. Only use a vacuum with a H.E.P.A. filter or wet cleaning methods when removing lead dust.

g. Medical Surveillance Program. Include removal and protection procedures according to 29 CFR 1926.62 (J). Include, at a minimum, the following:

1. Method of providing a pre-employment physical exam for all employees that consist of a medical questionnaire that ascertains previous medical history related to lead exposure and symptomatology of lead exposure or exposure to any other toxins; blood lead and zinc protophrphyrin (ZPP) counts together with hemoglobin and hematocrit, blood urea nitrogen, and serum creatinine; physician's approval for employee to wear negative pressure respirators; and a thorough hands-on physical exam that includes special attention to systems affected by lead, such as renal, hematological, neurological, gastrointestinal, cardiovascular, and reproductive.
2. Method of conducting monthly blood lead sampling and ZPP counts and evaluating and posting the levels monthly, at the Project Limits, for the duration of the lead-exposed portion of any Project.
3. Method of removing workers whose blood lead levels exceed 50 micrograms per 100 grams of whole blood from further airborne lead exposure in excess of 30 micrograms per cubic meter of air averaged over an 8-hour period, based upon biological monitoring or a physician's determination.
4. Method for retraining employees, and upgrading respiratory protection for employees whose blood lead levels exceed 40 micrograms per 100 grams of whole blood at any time during their employment.
5. Method of conducting post employment or yearly physical exams (whichever comes first) for employees who had blood lead levels in excess of 40 micrograms per 100 grams of whole blood at any time during their employment. This examination shall include as a minimum, blood lead and ZPP counts and a thorough hands-on physical.
6. Ensure that any physician who provides these physical exams and tests has been made aware of the employee's job duties, any airborne lead levels, the inherent lead exposure, and if applicable, all previous medical history and blood levels generated by other physicians.
7. Name and address of New Jersey clinical laboratory approved by OSHA that has demonstrated proficiency in blood lead analyses to conduct blood monitoring.
8. Method of providing copies of individual blood lead levels and ZPP levels and explaining results to the employee within 5 days of receiving the results.

h. Information Distribution. Provide the following:

1. Employee information and training procedures that inform employees of the hazards of lead and train in the precautions to take when working with lead.
2. System of posting warning sign where exposure is above the permissible exposure limit. Use illuminated, clean, and visible signs according to 29 CFR 1926.21 and 1926.59.
3. Record keeping including method to maintain and provide employee access to exposure records and their individual medical records.

i. Protection Procedures. Procedures to protect personnel and the general public in case of emergencies including potential emergency situations such as, but not limited to, overt personnel exposure, personnel injury, fire or explosion, and environmental incident.

j. Chain of Command. Include the chain of command and responsibilities for emergency situations, including a contingency plan for large-scale emergencies such as site evacuation or other situations requiring significant outside emergency services and interactions.

k. Decontamination procedures. Provide a detailed decontamination method.

4. Equipment Storage Plan. Describe, in detail, the locations of non-working hour storage of equipment to be utilized, the type and number of additional and special traffic control devices needed to safely maintain the storage area, and any permits and local permissions, if required. Ensure that the plan is site specific for each stage of operation, and provide an escort vehicle to assist slow-moving equipment entering or exiting the work zone.

554.03.02 Cleaning and Painting

A. Protection of Environment, Structure, Person, and Property. Protect pedestrian, vehicular, and other traffic upon, underneath, or adjacent to the bridge, and all portions of the bridge superstructure and substructure against damage or disfigurement by spatters, splashes, and smirches of paint or paint materials. Provide canopies and drop cloths for such protection. Do not use drilling holes, field welding, or bolted connections to secure the containment system to the bridge structure.

The Contractor is hereby advised that the existing paint systems on the bridges may include red lead or basic lead silica chromate paint or both red lead and basic silica chromate paint as components.

For contracts that involve lead paint abatement, ensure that the personnel that perform the lead paint abatement are trained and certified in the applicable workers' programs that concern health and safety compliance and that concern environmental regulations regarding lead abatement. The Department of Health and Senior Services shall train personnel. The Department of Community Affairs, Division of Codes and Standards, shall certify personnel.

Ensure that only trained and certified personnel perform lead abatement activities. Only use lead abatement practices as described in the *Industrial Lead Paint Removal Handbook*. The Department of Labor will monitor contracts for compliance with the training and certification requirements.

B. Cleaning. Remove signs mounted on the fascia beams of the structures before cleaning. Mount vertical under clearance signs on the fascia beam or containment system until the cleaning is finished.

Ensure that the containment enclosure extends from the bottom of the deck down to ground level or to a solid work platform. Frame and fasten materials for the enclosure to prevent billowing or opening from the weather. When using tarpaulins, ensure that all edges and seams have a flap that clamps over the connecting edges for the entire enclosure. Fasten these flaps along the tarpaulin edges to prevent dust from escaping.

Do not begin cleaning or blasting until the pollution control system and all required permits for the handling, storage, and transportation of waste have been approved and the RE approves the containment enclosure.

When organic zinc coating is specified, only blast-clean structural steel members.

When spot blast cleaning is specified, before the cleaning operations, remove accumulated dirt and dust, and complete a thorough examination and survey of the existing surfaces to identify areas of paint failure and corrosion that will require blast cleaning outside the limits designated.

Clean existing structural steel that has been previously painted and surfaces of other metal. Protect all components and materials that are not scheduled for blast cleaning during those operations.

1. Hand or Power Tool Cleaning. Before hand or power tool cleaning, remove all visible oil, grease, and salts by solvent cleaning as specified in SSPC-SP 1. Roughen all existing paint left on the surface after hand or power tool cleaning before applying paint. Ensure that existing surfaces to be prepared by hand or power tool cleaning, or a combination of both, complies with the requirements of SSPC-SP 2 and SSPC-SP 3, respectively.

2. Blast Cleaning. Before blast cleaning, scrape the tops of bottom flanges to remove accumulated dust, dirt, and debris. Remove all visible oil, grease, and salts by solvent cleaning according to SSPC-SP 1.

Prepare existing surfaces by near-white blast cleaning according to SSPC-SP 10. Ensure that the blast cleaning produces the required anchor profile of 1.5 to 3.0 mils, in a dense, uniform pattern of depressions and ridges. Verify the profile depth by the Testex replica tape.

Do not blast clean a surface area of steel greater than the surface area of steel that can be prime coated within 24 hours.

Remove all fins, tears, slivers, and burred or sharp edges that are present on any steel member or that appear during the blasting operations by grinding. Reblast the ground area and ensure that the reblasted area meets the required anchor profile.

Contain, capture, and collect blasting residues, spent blasting medium, rust particles, paint particles, and dust associated with the work.

Collect blast medium and paint residue from steel surfaces with a commercial grade vacuum cleaner equipped with a brush-type cleaning tool or by double blowing with clean air. If the double blowing method is used, vacuum the top surfaces of all structural steel after the double blowing operations are completed. Keep the steel clean until the prime coat is applied.

Protect freshly coated surfaces from subsequent blast cleaning operations. Thoroughly wire brush blast damaged primed surfaces. If visible rust occurs, reblast to the required condition. Vacuum and reprime the wire brushed or blast cleaned surfaces.

During blast cleaning, if the containment enclosure is allowing waste to escape, stop work until the enclosure is repaired. Clean up any waste released from the enclosure immediately. If the wind velocity is high enough to cause the containment enclosure to billow, cease blast cleaning and lower the enclosure after cleaning up all the waste.

C. Waste Disposal. Provide, install, and maintain any temporary loading and storage facilities on-site as required until completion of material handling activities.

The RE will review the storage containers and storage location. Locate storage containers so as not to prevent a traffic or safety hazard. Locate storage containers in areas that are properly drained and where run-off water will not pond around or near the containers. Close storage containers and cover with tarpaulins at all times except during placement, sampling, and disposal of the waste.

After removing and collecting the waste from surface preparation work, the RE will designate the rust, paint particles, and dust associated with the work as "Hazardous Waste," with the corresponding USEPA hazardous waste code D008.

Place expendable material and decontamination liquids generated from construction activities within the containment area, including respirator cartridges, protective clothing, boots, and gloves, in watertight containers. Separately store all personnel protection equipment, decontamination liquids that become contaminated due to contact with hazardous waste or materials containing hazardous substances, and other expendable wastes, and dispose in containers identified in the waste disposal plan. Ensure that these containers do not have indentations or shipping damage that would allow leakage of the contained material.

Store waste in the on-site loading facility and storage area until transportation vehicles arrive for off-site disposal. Dispose of all hazardous waste within 75 days or before Substantial Completion, whichever comes first.

Continuously monitor the quantity of the waste captured, contained, collected, stored, and disposed of. Document the handling, sampling, manifesting, transporting, and disposal of hazardous waste. Maintain a complete and accurate record, located with the Project Limits, of all blasting medium purchased, delivered, and used during the execution of the Work. To allow for verification inspections, submit, to the RE on a weekly basis, both the record of the blasting medium delivered and used, and the waste handling, sampling, manifesting, transporting, and disposal documentation.

Move the contained waste materials to the storage area or dispose of at regular intervals (once each working day, minimum) during the work, according to the waste disposal plan, field conditions, and the direction of the RE. Remove errant waste from the bridge deck, structural steel, piers, abutments, and other areas, at least once a day or more frequently if required or directed. Clean any spillage of waste that may occur during disposal operations, including during the loading, transport, and unloading of materials, according to NJDEP regulations N.J.S.A. 58:10-23.11, *et seq.*

Only use the transporters identified in the waste disposal plan. Do not substitute or use additional transporters without approval from the RE. Do not combine contaminated material from other projects with material from this Project. Obtain and submit a copy of the test results of the waste from the TSD facility to the RE.

Comply with the manifesting requirements specified in 202.03.09.

Ensure that the waste transporter's vehicles and operating practices prevent spillage or leakage of hazardous or contaminated material while transporting to the final disposal site.

D. Conditions for Painting. Provide a suitable facility for the storage of paint that will comply with the latest OSHA regulations. Store and protect paint and thinners from the weather in enclosed structures at 40 to 110 °F. Equip the enclosure with a recording thermometer.

Comply with the conditions for painting according to SSPC-PA 1.

Do not apply epoxy coating or organic zinc coating when the temperature is below 50 °F or when the relative humidity is above 90 percent. Do not apply the urethane coating when the temperature is below 40 °F or when the relative humidity is above 90 percent. Do not apply any coatings when the wind velocity exceeds 20 miles per hour, when the air is misty, or when, in the opinion of the RE, conditions are unsatisfactory for the work. Also, do not paint on damp or frosted surfaces or when the metal is hot enough to cause the paint to blister, produce a porous paint film, or cause the vehicle (binder) to separate from the pigment.

Do not paint when the steel surface temperature is lower than 5 °F above the dew point. The RE will determine the dew point using a psychrometer and appropriate tables. The Contractor may presume the dew point requirement to be satisfied if a thin, clearly defined film of water, applied to the cleaned vertical surface with a damp cloth, evaporates within 15 minutes, as determined by the RE.

Do not apply coatings when the temperature of the air, paint, or metal, or the relative humidity is expected to be outside of specified limits before the paint is fully cured.

E. Paint Application.

1. Mixing Paint. Mix coatings according to SSPC-PA 1 and the manufacturer's recommendations.

2. Thinning Paint. If it is necessary to thin the coating for proper application, thin the paint according to the manufacturer's recommendations.

In cool weather, the Contractor may warm the paint to reduce the viscosity. The Contractor may heat the paint by placing the paint containers in water or on steam radiators.

3. Preparing the Surface. When surfaces requiring repainting are in contact with concrete, use a non-aluminum epoxy mastic primer approved by the Department's Bureau of Materials.

When full depth deck repair or replacement is specified, apply a prime coat to the top surfaces of top flanges of existing steel girders excluding the shear connectors.

Do not paint aluminum alloy metal work, copper, SIP forms for concrete decks, and bridge deck grid flooring.

Remove zinc salts, oil, dust, dirt, and other contaminants before applying each coat of paint and any repair coats in the field. Clean the primed surfaces with a high pressure water washing (800 pounds per square inch minimum).

When applying paint to a galvanized surface, use epoxy intermediate and urethane finish coats only. When using the epoxy mastic coating system, apply the full coating system.

4. Applying Paint. Apply paint only on clean dry surfaces according to SSPC-PA 1. Apply paint using brushes, rollers, spray equipment, or any combination of equipment that will attain satisfactory results and the film thickness specified. Apply paint uniformly and smoothly so that every part of the surface will be covered with the minimum specified thickness. On surfaces that are inaccessible for painting by regular means, apply paint by sheepskin daubers or spray, or by other means if necessary, to ensure coverage of the proper thickness of paint.

Whenever painting operations are interrupted, expel the remaining paint in the fluid hose from the hose. Thoroughly clean spray equipment at the end of each workday with an approved solvent. Properly dispose of the left over solvent and paint waste material.

If the paint coating is too thin or if areas of the surface are not completely coated, repaint these areas of the work. Where excessive coating thickness produces surface defects such as "mud-cracking," remove coating back to soundly bonded coating, and recoat the area to the required thickness. In areas of deficient primer thickness, recoat according to the manufacturer's recommendations.

5. **Coating Thickness.** The RE will use a magnetic dry film thickness gauge to determine the dry film thickness for each coat. Calibrate the gauge and use according to SSPC-PA 2. Use a Tooke film thickness gauge according to ASTM D 4138 to verify the coating thickness when requested by the RE. If the Tooke gauge shows that the prime coat is less than the specified minimum thickness, the RE will reject the entire coating system.

   a. **Epoxy Mastic Coating System.** Apply at least 1 coat of each of the following in the field: spot prime (over blast cleaned or exposed surfaces), prime, and finish coats. Place a full prime coat over the entire surface, including areas that have been spot primed.

      Ensure that the dry film thickness of the paint is at least 5 mils for the spot prime coat, at least 3 mils for the prime coat, and at least 2 mils for the finish coat.

   b. **Organic Zinc Coating System.** Apply at least 1 of each of the following coats in the field: prime, intermediate, and finish coats.

      Ensure that the dry film thickness of the paint is at least 5 mils for the prime coat, at least 3.5 mils for the intermediate coat, and at least 2 mils for the finish coat.

6. **Prime or Spot Prime Coat.** Tint the primer to contrast the base metal. Apply the prime or spot prime coat immediately after obtaining RE approval of the surface preparation. Apply the prime or spot prime coat the same day the metal is cleaned, but not until the cleaning operation is far enough ahead to eliminate the danger of dirt or other material from the cleaning operations from falling or blowing onto the fresh paint. Prime or spot prime all blast cleaned surfaces the same day before any contamination, formation of rust, or any other deterioration of the prepared surface.

7. **Curing.** Comply with the manufacturer recommended curing time between coats. If the manufacturer's recommended curing time is exceeded, follow the manufacturer's recommendation to prepare the surface for succeeding coats.

8. **Striping.** Before applying the full prime coat, apply a prime coating (striping) to all edges of plates and rolled shapes, corners, crevices, welds, and exposed parts of bolts. Do not apply the full prime coat until the striping has set to touch.

9 **Cleanup.** Replace signs that were removed during cleaning and painting to their original position. Remove paint dropped on concrete surfaces and all debris from the cleaning operations from the superstructure and the substructure. Remove over-sprays on adjacent portions of the structures. Remove paint containers and refuse from the Project Limits.

F. Stenciling. Stencil the following information on the outside web of both fascia beams, on both ends of the structure, and as specified below:

1. The 7-digit structure number.
2. The month and year of completion.
3. The paint system code number.

Stencil uniform 4-inch high, C-series letters or numerals with the same type of paint except use a color that contrasts the structure. Locate markings at least 2 inches above the lower flange and not more than 3 feet from the abutment. In the case of a bascule bridge, stencil information 3 feet from the heel of the bascule span.

In addition, thoroughly clean all memorial or commemorative metal plaques that are affixed to the structure or appurtenance. Submit the method of cleaning along with a sample of the materials intended for use to the RE for approval. Clean the plaques to the satisfaction of the RE according to the approved method, and ensure the removal of accumulated dirt, extraneous markings, and corrosion without marring, eroding, or staining the plaques in any way.

G. Unsatisfactory Paint Performance and Removal. The Department will consider the paint performance unsatisfactory if rusting occurs, if the paint coat lifts, blisters, wrinkles, has excessive runs or sags, or shows evidence of application under unfavorable conditions, if the workmanship is poor, if impure or unauthorized paint has been used, or for other such reasons determined by the RE.

Remove any unsatisfactory paint, and reclean and repaint the metal.

554.03.03 Testing, If and Where Directed

The RE may direct the Contractor to conduct or to obtain the services of others to conduct air quality, water quality, or such other testing that will determine the quantity of any materials that may be escaping from the containment plan employed on the Project. If it is determined that pollution of the environment adjacent to the site has occurred due to the Contractor's operations, stop cleaning and painting and immediately submit a plan to the RE for approval detailing the corrective actions necessary to restore the area. Correct the containment measures. Do not continue cleaning or painting until the RE directs the work to begin.

The Department may conduct additional testing using the Department Laboratory.

554.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
POLLUTION CONTROL SYSTEM	LUMP SUM
HAND/POWER TOOL CLEANING AND PAINTING	LUMP SUM
NEAR-WHITE BLAST CLEANING AND PAINTING	LUMP SUM
TESTING, IF AND WHERE DIRECTED	LUMP SUM

The Contract quantity of TESTING, IF AND WHERE DIRECTED is lump sum and the bid price is $10,000 for each occurrence in the Contract. The Department will base payment for TESTING, IF AND WHERE DIRECTED on the actual cost as evidenced by paid receipts from the testing laboratory. The Department will not make payment for overhead or profit for this item.

DIVISION 600 – MISCELLANEOUS CONSTRUCTION

SECTION 601 – PIPE

601.01 DESCRIPTION

This Section describes the requirements for constructing storm drains for surface drainage, for constructing subbase outlet drains, and for cleaning existing pipe.

601.02 MATERIALS

Provide materials as specified:

Coarse Aggregate (No. 57)	901.03
Concrete	903.03
Mortar	903.08.01
Controlled Low Strength Material (CLSM)	903.09
Class A Bedding	909.01.01
Class B Bedding	909.01.02
Class C Bedding	909.01.03
Class D Bedding	909.01.04
Reinforced Concrete Pipe (RCP)	909.02.01
HDPE Pipe	909.02.02
Corrugated Aluminum Alloy Pipe and Pipe Arches	909.02.04
Corrugated Aluminum Alloy Underdrain Pipe	909.02.05
Corrugated Steel Underdrain Pipe	909.02.06
Subsurface Drainage Geotextile	919.01

If CORRUGATED METAL PIPE or CORRUGATED METAL PIPE ARCH is shown on the Plans, the Contractor may use corrugated aluminum alloy or corrugated steel.

Use a pipe cap of the same material as the pipe.

601.03 CONSTRUCTION

601.03.01 Installing Pipe

A. Storing and Handling. Handle and store pipe to prevent damage such as cracking, denting and breaking. Lift pipe off of the delivery vehicle to avoid damage while unloading. Do not dump or drag pipe off the delivery vehicle. Store pipe in an area where it will not be damaged during construction operations. Use blocks or straps when stacking pipe. Alternate the bells and spigots to reduce the load on the bells. The RE will reject pipe that is damaged, bowed, or considered unacceptable for other reasons.

B. Excavating. Maintain the existing drainage system during construction until the new drainage facilities are completed and placed into service.

Excavate the same distance on each side of the centerline of the pipe to ensure that the pipe is in the center of the trench. Ensure that the trench is at least 18 inches wider than the outside diameter of the pipe. Provide vertical sides for excavations within the traveled way, shoulder, sidewalk areas, and where existing facilities require protection.

Except where necessary to maintain flow, do not excavate trenches or place drains in embankment until the embankment has been constructed to an elevation of at least 3 feet above the top of the pipe or to the top of the embankment, whichever is lower. Do not excavate trenches more than 300 feet in advance of installing the pipe unless approved by the RE.

Obtain RE approval before finishing excavation. If the RE determines that the bottom of the trench is unstable, undercut as directed by the RE and backfill with Class B bedding.

If the material at the bottom of the trench is rock or other hard material, remove at least 6 inches of the material for RCP or at least 12 inches of the material below the bottom of the pipe for corrugated metal, steel, aluminum alloy pipe, or HDPE. Backfill the undercut with Class C bedding.

For trenches in the traveled way, shoulder, and within 30 feet of the outside edge of the shoulder, backfill and restore the pavement structure to match the surrounding pavement before opening to traffic. The Contractor may submit working drawings for approval for temporary protection instead of backfilling trenches.

Provide and maintain trench crossings where necessary. For trenches not in the traveled way and shoulder, do not leave trenches open overnight unless protected with fence. Maintain trenches according to 29 CFR 1926.

C. Bedding. Do not place bedding material until the RE approves the depth of excavation and the material at the bottom of the excavation. If bedding is not shown, place pipe directly on the material at the bottom of the trench.

For Class A bedding, construct a concrete cradle. Place concrete according to the limitations specified in 504.03.02.C. Place concrete across the area to minimize rehandling. Ensure that concrete is not discharged into windrows or piles. Consolidate the concrete by hand spading or using internal mechanical vibrators. Protect concrete as specified in 504.03.02.I.

For Class B, Class C, and Class D bedding, place the bedding and provide recesses for pipe bells deep enough to ensure that the bell will not rest on the bottom of the recess. Ensure that the recess does not exceed 2 inches from the edge of the bell along the length of the pipe. Compact using the directed method as specified in 203.03.02.C.

D. Installing Pipe Before the installation of HDPE pipe and as directed by the RE, provide a technical representative from the pipe manufacturer on the work site for the first day of pipe installation to ensure proper installation procedures.

When installing pipe, use a laser system to control the alignment and grade of the pipe.

Use end sections of the same material as the adjoining pipe or pipe arch, except use concrete end sections for HDPE pipe.

Begin installing pipe at the lowest elevation of the pipeline. Ensure that the pipe is in firm contact with the bottom of the excavation or bedding throughout its full length. Place bell ends of pipe facing towards the highest elevation. When using perforated pipe, ensure that the perforations are at the bottom.

When installing pipe through concrete or masonry walls, provide a sufficient length of pipe outside of the wall to allow for connections, and cut the pipe flush with the inside face of the wall. Seal the connection using mortar. When pipe enters below the invert of existing structures, cut and shape the existing invert to form a new channel.

When constructing storm drains in stages, cover the end of the pipe after each stage to prevent material from entering the pipe. Do not cover the pipe if it is required to keep the pipe open for temporary drainage.

When using pipe for a stream diversion, install pipe outside of the existing stream bed while maintaining flow in the existing stream. When installing pipe within an existing stream channel, construct a temporary stream diversion while maintaining flow in the existing stream channel. Once the temporary channel is completed, divert the stream flow into the temporary channel while constructing the pipe system within the existing stream bed. When the pipe is completed, divert the stream flow into the pipe.

When using heavy construction equipment (100 kips axle load) over, or within 10 feet of HDPE pipe or corrugated aluminum alloy pipe, place the manufacturer recommended temporary compacted cover over the top of the pipe. Ensure that the temporary cover is free from stones larger than 1 inch.

E. Joining Pipe. Join rigid pipe using mortar or gaskets to form a watertight seal. With RE approval, the Contractor may use other types of joints that are recommended by the pipe manufacturer. Join corrugated metal pipe with coupling bands.

For mortar joints, clean the pipe ends and wet with water before placing stiff mortar. Place mortar in the lower half of the bell of the placed pipe section, and then place mortar on the upper half of the spigot of the section to be installed. Join the 2 pipe sections with their inner surfaces flush. Seal the exterior of the joint with mortar. Fill the lifting holes with mortar.

For circular pipe greater than 36 inches in diameter and elliptical pipe greater than 38 × 60 inches, ensure that the inside of the joint is finished smooth. For circular pipe smaller than 36 inches in diameter and elliptical pipe

greater than 38 × 60 inches, remove protruding mortar from the joint. If the completed mortar joints are not immediately backfilled with earth, protect the mortar joints against rapid drying. When the ambient temperature is below 40 °F, ensure that the mortar temperature is between 50 and 100 °F. Protect the mortar and maintain its temperature above 32 °F for 24 hours.

For gasket joints, install gaskets according to the manufacturer's recommendations.

Do not use split couplings to join field-cut HDPE pipe unless approved by the RE. Ensure that joints are bell and spigot type, or bell and spigot type with a gasket, according to ASTM F 477, to provide a silt-tight seal. Construct pipe connections according to the manufacturer's recommendations for assembly of joint components, lubrications, and making of joints. Ensure that the pipe fittings are free of inclusions and visible defects. Cut the ends of the pipe squarely so as not to adversely affect joining.

F. Backfilling. When using corrugated aluminum and HDPE pipe, backfill from the bottom of the trench to 2 feet above the top of the pipe with Class C bedding. When using pipe other than corrugated aluminum or HDPE, backfill from the bottom of the trench to 2 feet above the top of the pipe with suitable excavated material free from stones and rock larger than 2 inches in any dimension. For distances 2 feet above the top of the pipe, backfill using suitable excavated material.

Place backfill material symmetrically on each side of the pipe in lifts not exceeding 6 inches thick, loose measurement. Compact as follows:

1. If the backfill material is predominantly granular, use vibratory plate compactors.
2. If the backfill material is not predominantly granular, use vibratory rammer compactors.
3. For heights more than 2 feet above the pipe, the Contractor may use a roller.

The RE may direct compaction using the density control method as specified in 203.03.02.D.

Remove shoring, bracing, and sheeting as the backfilling proceeds.

The Contractor may use CLSM as alternate backfill material when backfilling trenches for drainage pipe. Do not use CLSM to replace pavement, base courses, or drainage layers that form the pavement structure. The RE will not allow combining other backfill materials in the same trench as CLSM. Place CLSM according to the limitations specified in 504.03.02.C. Place CLSM across the area to minimize rehandling. Protect CLSM as specified in 504.03.02.I.

601.03.02 Installing Pipe Using Alternate Methods

When installing pipe using methods other than as specified in 601.03.01, at least 30 days before installation, submit working drawings for approval that include the following:

1. Materials, including size and type of pipe.
2. Method of maintaining continuous operation of traffic on the Project.
3. Details for installing and removing sheeting, bracing, and shoring.
4. Method of ensuring horizontal and vertical alignment of the pipe.
5. Complete installation procedure.
6. Method of protecting pipe during installation.
7. Method of excavating and removing material during installation.
8. Method of sealing and finishing pipe joints.
9. Alternate method of pipe installation if original method becomes impossible due to obstructions.

601.03.03 Underdrains and Subbase Outlet Drains

A. Excavating. Maintain the existing drainage system during construction until the new drainage facilities are completed and placed into service.

Excavate the same distance on each side of the centerline of the pipe to ensure that the pipe is in the center of the trench. Do not excavate trenches more than 300 feet in advance of installation unless approved by the RE.

Obtain RE approval before finishing excavation. If the RE determines that the bottom of the trench is unstable, undercut as directed by the RE and backfill with Class B bedding.

If the material at the bottom of the trench is rock or other hard material, remove at least 6 inches of the material for RCP or at least 12 inches of the material below the bottom of the pipe for corrugated metal, steel, aluminum alloy pipe, or HDPE. Backfill the undercut with Class C bedding.

For trenches in the traveled way, shoulder, and within 30 feet of the outside edge of the shoulder, backfill and restore the pavement structure to match the surrounding pavement before opening to traffic. The Contractor may submit working drawings for approval for temporary protection instead of backfilling trenches.

Provide and maintain trench crossings where necessary. For trenches not in the traveled way and shoulder, do not leave trenches open overnight unless protected with fence. Maintain trenches according to 29 CFR 1926.

B. Installing. Begin constructing at the lowest elevation of the drain. Ensure that the perforations are at the bottom. Join underdrains according to the manufacturer's recommendations. Seal the dead ends of pipe underdrains with a pipe cap.

C. Backfilling. Backfill, using coarse aggregate, around the underdrains and subbase outlet drains and on top of stone backfill in rock areas. Compact the coarse aggregate with a vibratory pad compactor.

601.03.04 Video Inspection of Pipe

Perform video inspection of interior pipelines no sooner than 30 days after completing the pipe installation. Submit to the RE for approval the name and qualifications of the person performing the inspection.

Perform the video inspection in dry pipe conditions to ensure viewing of the entire pipe circumference. Ensure that a visual numerical registration of the distance the video camera is traveling from the starting point to the ending point within the pipe drainage structure is recorded on the footage tape at all times. Also, ensure that the name of the pipe run and the name of the structure is recorded on the footage tape at all times. Stop the video camera at all joints, lateral connections, breaks, and irregularities to ensure full view at these locations. Ensure that the videotape provides clear, sharply focused pictures. The Department will not accept blurred or out of focus footage. Submit a color VHS videotape, or equivalent digital media, of the inspection to the RE to become the property of the Department. Number the tapes sequentially and provide a corresponding index for all tapes, listing the location, date, size and type of pipe, cross or longitudinal drains, berm, slope, and similar identifying information.

If the pipe is found to be defective because of poor joints, deformation, breaks, poor connections, or irregularities, correct the defective pipe as directed by the RE. If the pipe cannot be corrected, remove and replace the defective pipe.

601.03.05 Deflection Inspection of HDPE Pipe

Test approximately 25 percent of the length of HDPE pipe for deflection no sooner than 30 days after installation. If testing produces a failure rate of 5 percent, increase the rate of testing to 100 percent. Perform the deflection testing using either electronic deflectometers, calibrated television or video cameras, properly sized "go, no-go" mandrel, direct measurement extension rulers and tape measures in pipe that allow safe entry, or another acceptable device. If mandrel testing is chosen, pull the mandrel through the pipe by hand.

Where deflection is more than 5 percent of the base inside diameter, submit a remediation plan to the RE for approval.

601.03.06 Cleaning Existing Pipe

At least 5 days before beginning the work, submit a plan to the RE detailing the proposed method and equipment to be used. Remove and collect silt debris and material of any kind and prevent material from being discharged into the drainage system. Dispose of materials removed from existing pipe as specified in 202.03.08.

601.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
___ " CORRUGATED ALUMINUM ALLOY PIPE	LINEAR FOOT
___ " CORRUGATED STEEL PIPE	LINEAR FOOT
___ " CORRUGATED METAL PIPE	LINEAR FOOT
___ " REINFORCED CONCRETE PIPE	LINEAR FOOT
___ " REINFORCED CONCRETE PIPE, CLASS___	LINEAR FOOT

___ " HIGH DENSITY POLYETHYLENE PIPE	LINEAR FOOT
___ " REINFORCED CONCRETE PIPE, USING ALTERNATE METHODS	LINEAR FOOT
___ " CORRUGATED ALUMINUM ALLOY END SECTION	UNIT
___ " CORRUGATED STEEL END SECTION	UNIT
___ " CORRUGATED METAL END SECTION	UNIT
___ " REINFORCED CONCRETE END SECTION	UNIT
SUBBASE OUTLET DRAIN	LINEAR FOOT
___ " CORRUGATED STEEL UNDERDRAIN PIPE	LINEAR FOOT
___ " CORRUGATED ALUMINUM ALLOY UNDERDRAIN PIPE	LINEAR FOOT
UNDERDRAIN, TYPE ___	LINEAR FOOT
___ "X ___ " CORRUGATED ALUMINUM ALLOY PIPE ARCH	LINEAR FOOT
___ "X ___ " CORRUGATED STEEL PIPE ARCH	LINEAR FOOT
___ "X ___ " CORRUGATED METAL PIPE ARCH	LINEAR FOOT
___ "X ___ " CORRUGATED ALUMINUM ALLOY END SECTION	UNIT
___ "X ___ " CORRUGATED STEEL END SECTION	UNIT
___ "X ___ " CORRUGATED METAL END SECTION	UNIT
___ "X ___ " REINFORCED CONCRETE END SECTION	UNIT
___ "X ___ " REINFORCED CONCRETE ELLIPTICAL PIPE, CLASS ___	LINEAR FOOT
VIDEO INSPECTION OF PIPE	LINEAR FOOT
DEFLECTION TESTING OF HIGH DENSITY POLYETHYLENE PIPE	LINEAR FOOT
CLEANING EXISTING PIPE, ___" TO ___" DIAMETER	LINEAR FOOT
CLEANING EXISTING PIPE, OVER ___" TO ___" DIAMETER	LINEAR FOOT
CLEANING EXISTING PIPE, ___" DIAMETER	LINEAR FOOT

When the RE directs undercutting of unstable material in a pipe trench, the Department will make payment, as specified in 104.03.03, for the additional excavation. The Department will also make payment, as specified in 104.03.03, for the additional bedding if there is not an excess of excavation available.

The Department will not include the distance between inner faces of inlet and manhole walls in the linear foot measurement of pipe. The Department will measure pipe with sloped or skewed ends along the invert.

The Department will include the length of end sections, measured along the bottom of the section, in the payment for CLEANING EXISTING PIPE, ___" TO ___" DIAMETER, CLEANING EXISTING PIPE, OVER ___" TO ___" DIAMETER and CLEANING EXISTING PIPE, ___" DIAMETER.

SECTION 602 – DRAINAGE STRUCTURES

602.01 DESCRIPTION

This Section describes the requirements for constructing, reconstructing, and cleaning inlets and manholes. This Section also describes the requirements for constructing and cleaning concrete culverts and concrete headwalls with a span of less than 5 feet.

602.02 MATERIALS

602.02.01 Materials

Provide materials as specified:

Coarse Aggregate (No. 57)	901.03
Soil Aggregate (I-3)	901.11
Concrete	903.03
Mortar	903.08.01
Curing Materials	903.10
Precast Inlet and Manhole	904.01
Reinforcement Steel	905.01
Castings	909.03
Epoxy Bedding Compound	909.03.5
Ladder Rung	909.03.6

Concrete Block 910.02
Concrete Brick 910.03
Preformed Joint Filler 914.01

602.02.02 Equipment

Provide equipment as specified:

Vibrator 1005.04
Concrete Batching Plant 1010.01
Concrete Trucks 1010.02

602.03 CONSTRUCTION

602.03.01 Culverts and Headwalls

Excavate as specified in 202.03.03. Shape and compact the underlying material to produce a firm, even surface.

1. **Precast.** Set precast culverts and headwalls on a 6-inch bed of compacted coarse aggregate. Remove handling devices and fill lifting holes with mortar.

2. **Cast-in-Place.** Construct cast-in-place culverts and headwalls as specified in 504.03.02.

602.03.02 Inlets and Manholes

Excavate as specified in 202.03.03. Obtain RE approval before finishing excavating. If the RE determines that the bottom of the excavation is unstable, undercut, backfill, and compact as directed by the RE.

When surrounding grade is below proposed grade, provide temporary drainage into the drainage structure as directed by the RE. Repair temporary openings as necessary. Construct inlet and manhole structures as follows:

1. **Precast.** The Contractor may use precast concrete inlets and manholes. If modifications to precast concrete inlets and manholes are required, obtain RE approval before installation. After installation, fill the lifting holes with mortar.

2 **Block and Brick Construction.** Lay concrete block and brick with staggered joints. Fill with mortar horizontal joints, brick vertical joints, and concrete block key ways. Ensure that horizontal joints and vertical joints in brick are not more than 3/8 inch wide. Coat the outside wall with at least a 1/2-inch thick layer of mortar and trowel smooth. When the ambient temperature is below 40 °F, ensure that the mortar temperature is between 50 and 100 °F. Cover the masonry and maintain its temperature above 32 °F for 24 hours. Ensure that the connection between drainage structures and pipe is leak-free.

Set castings in mortar beds or anchor castings to the masonry as shown before finishing adjoining Items of work with the same final elevation. Ensure that mortar attains a strength of 2500 pounds per square inch before opening to traffic.

Backfill and compact using the directed method as specified in 203.03.02.C.

Construct inverts with a smooth and uniform finish that minimizes resistance to flow. Ensure that the shape of the inverts conforms uniformly with the inlet and outlet pipe.

Set the manhole cover or inlet grate on the casting. If the manhole cover or inlet grate is loose or wobbles, grind to obtain a tight fit.

602.03.03 Setting Castings, Resetting Castings, and Reconstructing Inlets and Manholes

When modifying less than 1 foot of an inlet or manhole, set or reset the casting. When modifying 1 foot or more of an inlet or manhole, reconstruct the inlet or manhole.

Remove castings, damaged wall portions, and ladder rungs as directed by the RE. Reuse concrete as specified in 202.03.07.A. Dispose of other material as specified in 202.03.07.B.

Reconstruct the walls to the elevation shown, and, if necessary, install new ladder rungs. Set castings in mortar beds or anchor castings to the masonry as shown before finishing adjoining Items of work with the same final elevation. If excavation is required to reconstruct, backfill and compact using the directed method as specified in 203.03.02.C.

Set the manhole cover or bicycle safe grate on the casting. If the manhole cover or bicycle safe grate is loose or wobbles, grind to obtain a tight fit. Do not open to traffic until 3 days after the grout was set.

602.03.04 Converting Inlets into Manholes

Remove castings, unsound wall portions, and ladder rungs as directed by the RE. Reuse concrete as specified in 202.03.07.A. Dispose of other material as specified in 202.03.07.B.

Reconstruct the walls to the shown elevation and install new ladder rungs. Set castings in mortar beds or anchor castings to the masonry as shown before finishing adjoining Items of work with the same final elevation. If excavation is required to reconstruct, backfill and compact using the directed method as specified in 203.03.02.C.

Set the manhole cover on the casting. If the manhole cover is loose or wobbles, grind to obtain a tight fit. Ensure that mortar attains a strength of 2500 pounds per square inch before opening to traffic.

602.03.05 Extension Frames and Rings

If structures contain existing frames or rings, remove extension frames or rings. Use the minimum number of frames or rings necessary to achieve the proposed grades. Place the extension frame or ring in the casting and check for fit.

Before applying epoxy bedding compound, clean the surfaces that will receive the epoxy bedding compound, the lower bearing surfaces, and sides of the extension frames or rings. Clean by sand blasting or brushing with a mechanically-driven wire wheel to ensure that the epoxy bedding compound adheres to the surfaces. Wipe the prepared surfaces with a rapid-evaporating degreasing agent.

Apply extra epoxy bedding compound where there are gaps in the fit. Apply the epoxy bedding compound according to the manufacturer's recommendations, and immediately set the extension frame or ring into the epoxy bedding compound. Ensure that the frame or ring is in full contact with the casting and that the epoxy bedding compound fills the gaps.

Set the bicycle safe grate or manhole cover on the extension frame or ring. If the bicycle safe grate or manhole cover is loose or wobbles after being set in the extension frames or rings, grind to obtain a tight fit or replace as directed.

Repair damage to galvanized coatings according to ASTM A 780. Dispose of materials removed from the existing structure as specified in 201.03.09.

602.03.06 Manhole Covers and Bicycle Safe Grates

Set the manhole cover or bicycle safe grate on the casting. If the manhole cover or bicycle safe grate is loose or wobbles, grind to obtain a tight fit. Dispose of materials removed from the existing structure as specified in 201.03.09.

602.03.07 Curb Pieces

Remove curb pieces of existing inlets and install new curb pieces. Dispose of materials removed from existing structure as specified in 201.03.09.

Bolt the curb piece to the frame before setting the frame in concrete or mortar. Ensure that all castings are set firm and snug.

602.03.08 Cleaning Drainage Structures

At least 5 days before beginning the work, submit a plan to the RE detailing the proposed method and equipment to be used. Remove and collect silt, debris, and material. Ensure that the material is not discharged into the drainage system. Dispose of materials removed from the existing structure as specified in 202.03.08.

602.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
CONCRETE CULVERT	CUBIC YARD
CONCRETE HEADWALL	CUBIC YARD
INLET, TYPE___	UNIT
MANHOLE, ___' DIAMETER	UNIT
INLET, TYPE___, USING EXISTING CASTING	UNIT
MANHOLE, USING EXISTING CASTING	UNIT
INLET CONVERTED TO MANHOLE	UNIT
RESET EXISTING CASTING	UNIT
SET INLET TYPE ___, CASTING	UNIT
SET MANHOLE CASTING	UNIT
SET SQUARE FRAMED MANHOLE CASTING, CIRCULAR COVER	UNIT
RECONSTRUCTED INLET, TYPE ___, USING EXISTING CASTING	UNIT
RECONSTRUCTED INLET, TYPE ___, USING NEW CASTING	UNIT
RECONSTRUCTED MANHOLE, USING EXISTING CASTING	UNIT
RECONSTRUCTED MANHOLE, USING NEW CASTING	UNIT
EXTENSION FRAME FOR EXISTING INLET, TYPE ___	UNIT
EXTENSION RING FOR EXISTING MANHOLE, ___' DIAMETER	UNIT
MANHOLE COVER	UNIT
BICYCLE SAFE GRATE	UNIT
CURB PIECE	UNIT
CLEANING DRAINAGE STRUCTURE	UNIT

SECTION 603 – SLOPE AND CHANNEL PROTECTION

603.01 DESCRIPTION

This Section describes the requirements for constructing various kinds of slope and channel protection.

603.02 MATERIALS

603.02.01 Materials

Provide materials as specified:

Coarse Aggregate (No. 57)	901.03
Fine Aggregate	901.06.02
Riprap Stones	901.08
Concrete	903.03
Mortar	903.08.01
Curing Materials	903.10
Reinforcement Steel	905.01
Preformed Joint Filler	914.01
Joint Sealer	914.02
Stabilization Geotextile	919.01

For rock backfill, use 8 inch (d_{50}) riprap stone as specified in 901.08.

603.02.02 Equipment

Provide equipment as specified:

Vibrator	1005.04
Concrete Batching Plant	1010.01
Concrete Trucks	1010.02

603.03 CONSTRUCTION

603.03.01 Concrete Slope Gutters

Excavate as specified in 202.03.03. Shape and compact the underlying material to produce a firm, even surface.

Each time before using, ensure that the forms are thoroughly cleaned and treated with a material that will prevent adherence of the concrete to the forms without discoloring the concrete.

Construct 1/2-inch wide expansion joints, placed at intervals of approximately 20 feet, with preformed joint filler. Ensure that the expansion joint material extends for the full depth. Clean the top and ends of expansion joint material of all excess concrete, and trim the expansion joint material slightly below the surface of the concrete.

Place concrete according to the limitations specified in 504.03.02.C. Place concrete across the formed area to minimize rehandling. Ensure that concrete is not discharged into windrows or piles. Continuously place concrete between transverse joints without the use of intermediate bulkheads. To prevent bowing or misalignment of the transverse joints, place concrete simultaneously on both sides of transverse joints without disturbing the joints. Consolidate the concrete by hand spading or using internal mechanical vibrators. If a section is not completed from transverse joint to transverse joint, remove the incomplete section and replace. Terminate each day's placement at a transverse joint. If concrete becomes segregated during placement, cease operations and correct handling operations. Protect concrete as specified in 504.03.02.I.

Strike off the concrete to the required cross-section using a transverse template resting upon the side forms. Finish the concrete using floats and straightedges to obtain a smooth surface. When the surface of the concrete is free from water and just before the concrete attains its initial set, texture with a broom. Round edges using an edging tool with a 1/4-inch radius.

Cure concrete using curing compound as specified in 504.03.02.F.

Remove forms as specified in 504.03.02.G. After removing the side forms, backfill the spaces along the slope gutter with suitable material. Place this material in 5-inch lifts, and compact the layers until firm.

603.03.02 Concrete Slope Protection

Construct concrete slope protection as specified in 603.03.01. Place the welded wire mesh halfway between the top and bottom surfaces of the concrete. Construct edge beams and key beams monolithically with the slab.

Score 1/2-inch deep joints on a 6-foot grid pattern. Round scored edges to a 1/2-inch radius with an edging tool. Place a 1/2-inch, preformed joint filler where the concrete abuts any portion of a structure.

603.03.03 Riprap Stone Slope or Channel Protection

Excavate as specified in 202.03.03. Shape and compact the underlying material to produce a firm, even surface.

Place geotextile over the entire area where riprap is to be placed and extend it at least 12 inches on each side. Bury the geotextile that is extended outside of the riprap area a minimum of 6 inches into the soil. When joining sections of geotextile, overlap the geotextile by a minimum of 18 inches in the direction of flow.

Place a 6-inch layer of coarse aggregate without damaging or dislodging the geotextile.

Firmly bed the riprap stones into the coarse aggregate without damaging or displacing the geotextile. Use larger riprap stones in the lower courses. Fill spaces between the riprap stones with smaller stones of the same type and quality. Firmly ram the smaller stones into place. Provide an even, finished surface for the slope or channel protection.

603.03.04 Rock Backfill

Excavate as specified in 202.03.03. Shape and compact the underlying material to produce a firm, even surface.

Place geotextile over the entire area where riprap is to be placed and extend it at least 12 inches on each side. Bury the geotextile that is extended outside of the riprap area a minimum of 6 inches into the soil. When joining sections of geotextile, overlap the geotextile by a minimum of 18 inches in the direction of flow.

Firmly bed the riprap stones without damaging or displacing the geotextile.

603.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
CONCRETE SLOPE GUTTER, ___" THICK	SQUARE YARD
CONCRETE SLOPE PROTECTION, ___" THICK	SQUARE YARD
CONCRETE SLOPE PROTECTION, REINFORCED, ___ " THICK	SQUARE YARD
RIPRAP STONE SLOPE PROTECTION, ___ " THICK (D_{50}=___")	SQUARE YARD
RIPRAP STONE CHANNEL PROTECTION, ___ " THICK (D_{50}=___")	SQUARE YARD
ROCK BACKFILL	TON

SECTION 604 – GABION WALLS

604.01 DESCRIPTION

This Section describes the requirements for constructing gabion walls.

604.02 MATERIALS

Provide materials as specified:

Coarse Aggregate (No. 57) 901.03
Gabion Basket Stone 901.09
Stabilization Geotextile 919.01
Gabion Wire Basket 919.04

604.03 CONSTRUCTION

604.03.01 Gabion Walls

Excavate as specified in 202.03.03. Shape and compact the underlying material to produce a firm, even surface. Install the geotextile. If sections of geotextile need to be joined, overlap the sections a minimum of 18 inches. Permanently cover the geotextile within 48 hours of placement. Place and grade coarse aggregate without damaging the geotextile.

At least 10 days before beginning the work, submit the manufacturer's installation guide to the RE. Ensure that a representative from the manufacturer is at the work site during the first day of assembling the gabion basket and the first day of placing and filling the gabions. Install gabion walls according to the manufacturer's recommendations.

604.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
GABION WALL	CUBIC YARD

SECTION 605 – FENCE

605.01 DESCRIPTION

This Section describes the requirements for constructing fence and gates, removing and resetting fence, and repairing chain-link fence, including replacing damaged fabric.

605.02 MATERIALS

605.02.01 Materials

Provide materials as specified:

Concrete 903.03
Mortar 903.08.01
Chain-Link Fence 913.02.01

605.02.02 Equipment

Provide equipment as specified:

Vibrator 1005.04
Concrete Batching Plant 1010.01
Concrete Trucks 1010.02

605.03 CONSTRUCTION

605.03.01 Chain-Link Fence

Before constructing or placing fence, clear the site as specified in 201.03.01. Remove rock protruding above the ground surface in the fence line.

Where aluminum-coated fence or PVC-coated fence is not designated, the Contractor may use either kind.

Set terminal posts at the beginning and end of each continuous length of fence, at abrupt changes in vertical and horizontal alignment, and on each side of gate locations. Install posts to be set in concrete in dug or drilled holes. Place concrete as specified in 504.03.02.D and allow concrete to cure for at least 72 hours before stretching fence fabric.

If a concrete foundation is not required, the Contractor may drive posts to the required depth if ground conditions permit. When solid rock is encountered, install posts not required to be set in concrete by drilling the rock to the required depth and securing with mortar.

605.03.02 Gates

Install gates necessary for construction operations at selected locations. Set gates according to the manufacturer's recommendations. Provide gates equipped with locks and 2 sets of keys. Provide the keys to the RE. Keep gates padlocked, except when in use during working hours.

605.03.03 Repairing Chain-Link Fence

Provide and erect new fabric where required. Provide new fence fabric of the same type as existing fence. If the same fence fabric cannot be provided, obtain RE approval of equivalent. Straighten top rails and posts, or replace as necessary, as determined by the RE. Replace all tension wire and mend all vertical cuts.

Follow the construction requirements for new fence as specified in 605.03.01. Dispose of unusable materials as specified in 201.03.09.

605.03.04 Temporary Chain-Link Fence

Before beginning construction operations, erect temporary chain-link fence required to enclose construction areas. Construct temporary fence as specified in 605.03.01. The Contractor may reuse material as approved by the RE.

Maintain temporary fence as directed during construction, and properly dispose of fence as specified in 201.03.09 after it is no longer required on the Project.

605.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
CHAIN-LINK FENCE, ALUMINUM-COATED STEEL, ___ ' HIGH	LINEAR FOOT
CHAIN-LINK FENCE, PVC-COATED STEEL, ___ ' HIGH	LINEAR FOOT
CHAIN-LINK FENCE, ___ ' HIGH	LINEAR FOOT
GATE, CHAIN-LINK FENCE, ALUMINUM-COATED STEEL, ___ ' WIDE	UNIT
GATE, CHAIN-LINK FENCE, PVC-COATED STEEL, ___ ' WIDE	UNIT
GATE, CHAIN-LINK FENCE, ___ ' WIDE	UNIT
REPAIRING CHAIN-LINK FENCE	LINEAR FOOT
TEMPORARY CHAIN-LINK FENCE, ___ ' HIGH	LINEAR FOOT

The Department will measure chain-link fence along the bottom line of the fabric, deducting the width of gates.

The Department will measure TEMPORARY CHAIN-LINK FENCE, ___ ' HIGH by the linear foot, including gates.

The Department will measure REPAIRING CHAIN-LINK FENCE by the linear foot and will compute on the basis of the total length of fence fabric repaired plus the pro-rated quantity of top rails and posts straightened or replaced, tension wire replaced, and vertical cuts mended as follows:

Per linear foot of top rail replaced	1/5 linear foot
Per linear foot of top rail straightened	1/10 linear foot
Per unit of post replaced	10 linear feet
Per unit of post straightened	5 linear feet
Per linear foot of tension wire replaced	1/20 linear foot
Per linear foot of vertical cuts mended	1/20 linear foot

SECTION 606 – SIDEWALKS, DRIVEWAYS, AND ISLANDS

606.01 DESCRIPTION

This Section describes the requirements for constructing HMA sidewalks, driveways, and islands, and concrete sidewalks, driveways, and islands.

606.02 MATERIALS

606.02.01 Materials

Provide materials as specified:

DGA	901.10
HMA (9.5M64)	902.02
Concrete	903.03
Curing Materials	903.10
Reinforcement Steel	905.01
Welded Wire Reinforcement	905.01.03
Preformed Joint Filler	914.01
Hot-Poured Joint Sealer, Type 2	914.02
Sleeves	919.10
Detectable Warning Surface	919.14

For driveways, the Contractor may use Class E concrete, as specified in 903.04, in order to open the driveway to traffic in 3 days.

606.02.02 Equipment

Provide equipment as specified:

HMA Compactor	1003.05
Vibratory Drum Compactor	1003.06
Bituminous Material Distributor	1003.07
Sealer Application System	1003.08
Vibrator	1005.04
Straightedge	1008.02
Pavement Saw	1008.04
Hot-Air Lance	1008.06
HMA Plant	1009.01
HMA Trucks	1009.02
Concrete Batching Plant	1010.01
Concrete Trucks	1010.02

606.03 CONSTRUCTION

606.03.01 HMA Sidewalks, Driveways, and Islands

Excavate as specified in 202.03.03. Obtain RE approval before finishing excavation. If the RE determines that the bottom of the excavation is unstable, undercut, backfill, and compact as directed by the RE.

Place sleeves for signs and delineator posts at locations shown on the Plans. Ensure that sleeves are flush with the finished surface. Fill the sleeves with sand. Immediately before HMA placement, seal the top 1/2 inch with hot-poured joint sealer. Reseal the sleeves when sign or delineator posts are installed.

For sidewalks and islands, construct the base course using DGA. For driveways, construct the base course using DGA as specified in 302.03.01.

Construct the surface course, as specified in 401.03.03, using HMA. When compacting, use rollers that weigh at least 1/2 ton.

606.03.02 Concrete Sidewalks, Driveways, and Islands

A. Underlayer Preparation. Excavate as specified in 202.03.03. Obtain RE approval before finishing excavation. If the RE determines that the bottom of the excavation is unstable, undercut, backfill, and compact as directed by the RE.

B. Forms. Each time before using, ensure that the forms are thoroughly cleaned and treated with a material that will prevent adherence of the concrete to the forms without discoloring the concrete.

C. Sleeves. When signs or delineators are shown, place sleeves at locations shown on the Plans. Ensure that sleeves are flush with the finished surface. Fill the sleeves with sand. Seal the top 1/2 inch with hot-poured joint sealer immediately after curing concrete. Reseal the sleeves when sign or delineator posts are installed.

D. Welded Wire Mesh. When reinforcement is shown for sidewalks and driveways, ensure that the welded wire mesh is free of dirt, detrimental scale, paint, oil, or other foreign substances before placing. Ensure that the welded wire mesh is halfway between the top and bottom surfaces of the concrete.

E. Expansion Joints. Construct 1/2-inch wide expansion joints, placed at intervals of approximately 20 feet, with preformed joint filler. If the sidewalk, driveway, or island is constructed on a concrete surface, install expansion joints directly over the expansion joints in the underlying concrete surface. Construct expansion joints around all appurtenances, such as manholes and utility poles, and between new concrete and any fixed structure, such as a curb, walls, buildings, or bridges. Ensure that the expansion joint material extends for the full depth.

Clean the top and ends of expansion joint material of all excess concrete, and trim the expansion joint material slightly below the surface of the concrete.

F. Placing Concrete. Obtain RE approval of forms and joint placement before placing concrete. Place concrete according to the limitations specified in 504.03.02.C. Place concrete across the formed area to minimize

rehandling. Ensure that concrete is not discharged into windrows or piles. Continuously place concrete between transverse joints without the use of intermediate bulkheads. To prevent bowing or misalignment of the transverse joints, place concrete simultaneously on both sides of transverse joints without disturbing the joints. Consolidate the concrete by hand spading or using internal mechanical vibrators. If a slab is not completed from transverse joint to transverse joint, remove the incomplete slab and replace. Terminate each day's placement at a transverse joint. If concrete becomes segregated during placement, cease operations and correct handling operations. Protect concrete as specified in 504.03.02.I.

G. Finishing Concrete. Strike off the concrete using a transverse template resting upon the side forms to the required cross-section. Finish the concrete using floats and straightedges to obtain a smooth surface. When the surface of the concrete is free from water and just before the concrete attains its initial set, texture with a broom. Round edges using an edging tool with a 1/4-inch radius.

Divide the surface into blocks using a grooving tool. Ensure that groove lines coincide with expansion joints. Ensure that the grooves are cut to a depth of at least 1/2 inch. Finish the edges of the grooves using an edging tool with a 1/4-inch radius.

H. Protection and Curing. Cure concrete using curing compound as specified in 504.03.02.F. Remove forms as specified in 504.03.02.G. Ensure pedestrians do not use concrete sidewalks, islands, and driveways until 24 hours after finishing. Ensure vehicles and other loads are not placed on sidewalks, islands, and driveways until the concrete has concrete attained compressive strength of 3000 pounds per square inch, as determined from 2 concrete cylinders field cured according to AASHTO T 23.

I. Backfilling. After removing the side forms, backfill the spaces along the edges of sidewalks and driveways with suitable material. Place this material in 5-inch lifts, and compact the layers until firm.

606.03.03 Detectable Warning Surfaces

Clean and dry the designated area where the detectable warning surface will be installed. Install detectable warning surfaces according to the manufacturer's recommendations.

If the detectable warning surface is not integrally colored, apply the detectable warning surface coating according to the manufacturer's recommendation. Evenly broadcast 60 grit over the final wet coat at a rate of 0.07 pounds per square yard for skid resistance.

606.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
HOT MIX ASPHALT SIDEWALK, ___ " THICK	SQUARE YARD
CONCRETE SIDEWALK, ___ " THICK	SQUARE YARD
CONCRETE SIDEWALK, REINFORCED, ___ " THICK	SQUARE YARD
HOT MIX ASPHALT DRIVEWAY, ___ " THICK	SQUARE YARD
HOT MIX ASPHALT DRIVEWAY, VARIABLE THICKNESS	SQUARE YARD
CONCRETE DRIVEWAY, ___" THICK	SQUARE YARD
CONCRETE DRIVEWAY, REINFORCED, ___" THICK	SQUARE YARD
HOT MIX ASPHALT ISLAND, ___ " THICK	SQUARE YARD
CONCRETE ISLAND, ___" THICK	SQUARE YARD
DETECTABLE WARNING SURFACE	SQUARE YARD

When the RE directs undercutting of unstable material in the excavation area, the Department will make payment, as specified in 104.03.03, for the additional excavation. The Department will also make payment, as specified in 104.03.03, for the additional bedding if there is not an excess of excavation available.

SECTION 607 – CURB

607.01 DESCRIPTION

This Section describes the requirements for constructing concrete curb, granite curb, and HMA curb, and for resetting granite curb.

607.02 MATERIALS

607.02.01 Materials

Provide materials as specified:

HMA (9.5M64)	902.02
Concrete	903.03
Mortar	903.08.01
Curing Materials	903.10
Reinforcement Steel	905.01
Granite Curb	910.04
Flexible Delineators	911.03
Preformed Joint Filler	914.01
Joint Sealer, Hot-Poured	914.02

For concrete curb at driveways, the Contractor may use Class E concrete, as specified in 903.04, in order to open the driveway to traffic in 3 days.

607.02.02 Equipment

Provide equipment as specified:

HMA Curb Machine	1003.02
Bituminous Material Distributor	1003.07
Sealer Application System	1003.08
Vibrator	1005.04
Straightedge	1008.02
HMA Plant	1009.01
HMA Trucks	1009.02
Concrete Batching Plant	1010.01
Concrete Trucks	1010.02

607.03 CONSTRUCTION

607.03.01 Concrete Barrier Curb

A. Placing Footing. Excavate as specified in 202.03.03. Shape and compact the underlying material to produce a firm, even surface. Obtain RE approval before finishing excavation. If the RE determines that the bottom of the excavation is unstable, undercut, backfill, and compact as directed by the RE.

Place footing concrete according to the limitations specified in 504.03.02.C. Consolidate the concrete by hand spading or using internal mechanical vibrators. Insert the reinforcement steel into the concrete before initial set. Ensure that it remains perpendicular to the footing until the barrier curb is constructed. Protect concrete as specified in 504.03.02.I.

B. Constructing Forms. Each time before using, ensure that the forms are thoroughly cleaned and treated with a material that will prevent adherence of the concrete to the forms without discoloring the concrete. Construct concrete barrier curb in sections that correspond to the transverse joints in the existing or proposed pavement and at most 20 feet in length. Reduce this length where necessary for closures, but do not construct closure sections that are less than 6 feet. Where changes in the size or shape are necessary for variable height barrier curb, ensure that the transition between the sections is gradual.

C. Installing Joints. Place 1/2-inch preformed joint filler at the transverse joints and ensure that filler is flush with the top and face of the curb. Install 1/2-inch preformed joint filler between the curb and concrete pavement, and seal the joint with hot-poured joint sealer.

D. Placing Concrete. Obtain RE approval of forms and joint placement before placing concrete. Place concrete according to the limitations specified in 504.03.02.C. To place concrete between November 15 to March 1, submit to RE for approval a plan detailing the method of protecting the concrete from salt for at least 30 days after placing. Do not begin placing concrete until this plan is approved.

Place concrete across the formed area to minimize rehandling. Continuously place concrete between transverse joints without the use of intermediate bulkheads. To prevent bowing or misalignment of the transverse joints, place concrete simultaneously on both sides of transverse joints without disturbing the joints.

Consolidate the concrete using internal mechanical vibrators. When required, supplement vibrating by hand spading to ensure proper and adequate consolidation. Provide at least an additional standby vibrating unit for individual concrete placements in excess of 10 cubic yards.

Use vibrators to work the concrete around the reinforcement steel and embedded fixtures and into corners and angles of the forms. Ensure proper vibration of the concrete to avoid honeycombing and voids. Do not use vibrators to move or spread concrete into position. Do not over vibrate concrete.

Place reinforcement steel and sleeves for sign posts while placing concrete, and ensure that they remain in position until the concrete is set.

If a section is not completed from transverse joint to transverse joint, remove the incomplete section and replace. Terminate each day's placement at a transverse joint. Protect concrete as specified in 504.03.02.I.

Fill sleeves for sign or delineator posts installed in barrier curb with sand, and seal the sleeves with hot-poured joint sealer immediately after installation. Reseal the sleeves if and when posts are installed.

E. Finishing Concrete. Finish the top of the curb with a wood float and round the top edges. Remove the forms as soon as the concrete holds its shape, and immediately finish joint edges using an edging tool with a radius of 1/4 inch. Remove lips of mortar and irregularities caused by form joints. Using mortar from the barrier concrete placement, patch holes, depressions, voids, and honeycombs to produce a smooth, dense, uniform surface of concrete. Finish the surface of the barrier curb with a steel float and texture with a broom.

If a rigid type of construction is to be made against any exposed surface, leave the exposed surface smooth and uniform to allow free movement of the curb.

F. Protecting and Curing Concrete. Immediately after finishing the concrete, apply curing compound as specified in 504.03.02.F.1.

G. Installing Flexible Delineators. For delineators located on the right side when facing in the direction of traffic, ensure that the retroreflective sheeting is white. For delineators located on the left side when facing in the direction of traffic, ensure that the retroreflective sheeting is yellow.

Attach flexible delineators, according to the manufacturer's recommendations, 3 inches from the top of the barrier curb. Mount the first flexible delineator at the beginning of the concrete barrier curb section. Mount subsequent delineators every 80 feet. Position each delineator so that the plane face of the center of the reflective area is at an angle of 0 degrees with a line that is perpendicular to the direction of traffic. If the distance between the end of the concrete barrier curb and the adjacent delineator is greater than 40 feet, install a delineator on both sides of the barrier curb opening.

607.03.02 Concrete Vertical Curb and Concrete Sloping Curb

A. Underlayer Preparation. Excavate as specified in 202.03.03. Shape and compact the underlying material to produce a firm, even surface. Obtain RE approval before finishing excavation. If the RE determines that the bottom of the excavation is unstable, undercut, backfill, and compact as directed by the RE.

B. Constructing Forms. Construct forms as specified in 607.03.01.B.

C. Installing Joints. Install joints as specified in 607.03.01.C.

D. Placing Concrete. Obtain RE approval of forms and joint placement before placing concrete. Place concrete according to the limitations specified in 504.03.02.C. Place concrete across the formed area to minimize rehandling. Continuously place concrete between transverse joints without the use of intermediate bulkheads. Consolidate the concrete by hand spading or using internal mechanical vibrators. To prevent bowing or misalignment of the transverse joints, place concrete simultaneously on both sides of transverse joints without disturbing the joints.

If a section is not completed from transverse joint to transverse joint, remove the incomplete section and replace. Terminate each day's placement at a transverse joint. Protect concrete as specified in 504.03.02.I.

E. Finishing Concrete. Finish the top and front face of the curb as specified in 607.03.01.E.

F. Protecting and Curing Concrete. Immediately after finishing the concrete, apply curing compound as specified in 504.03.02.F.1.

G. Backfilling Curb. Backfill and compact using the directed method, as specified in 203.03.02.C, against the curb.

607.03.03 Concrete Barrier Curb, Dowelled

A. Underlayer Preparation. Remove dirt, bituminous material, and other loose or adhering matter from the surface. Drill holes in the concrete that are between 1/4 inch and 3/4 inch in diameter bigger than the diameter of the reinforcement steel dowel. Set the reinforcement steel dowels in the hole and grout into place.

B. Constructing Forms. Construct forms as specified in 607.03.01.B.

C. Installing Joints. Locate transverse joints in dowelled curb directly over the transverse joints in the concrete pavement, and over transverse pavement cracks wider than 1/4 inch. Locate additional joints as needed to divide the curb into approximately equal lengths of at most 20 feet. Place 1/2-inch preformed joint filler at transverse joint locations and ensure that it is flush with the top and faces of the curb. Place 1/2-inch preformed joint filler between the curb and concrete pavement, and seal the joint with hot-poured joint sealer.

D. Placing Concrete. Place concrete for barrier curb as specified in 607.03.01.D.

E. Finishing Concrete. Finish concrete as specified in 607.03.01.E.

F. Protecting and Curing Concrete. Immediately after finishing the concrete, apply curing compound as specified in 504.03.02.F.1. Protect the concrete as specified in 504.03.02.I.

G. Installing Flexible Delineators. Install flexible delineators as specified in 607.03.01.G.

607.03.04 Concrete Vertical Curb and Concrete Sloping Curb, Dowelled

A. Underlayer Preparation. Prepare the underlying surface as specified in 607.03.03.A.

B. Constructing Forms. Construct forms as specified in 607.03.01.B.

C. Installing Joints. Install joints as specified in 607.03.01.C.

D. Placing Concrete. Place concrete for vertical and sloping curb as specified in 607.03.01.D.

E. Finishing Concrete. Finish the top and front face of the curb as specified in 607.03.01.E.

F. Protecting and Curing Concrete. Immediately after finishing the concrete, apply curing compound as specified in 504.03.02.F.1.

G. Backfilling Curb. Backfill and compact using the directed method, as specified in 203.03.02.C, against the curb.

607.03.05 Granite Curb

Excavate as specified in 202.03.03. Shape and compact the underlying material to produce a firm, even surface. Obtain RE approval before finishing excavation. If the RE determines that the bottom of the excavation is unstable, undercut, backfill, and compact as directed by the RE.

Place footing concrete according to the limitations specified in 504.03.02.C. Consolidate the concrete by hand spading or using internal mechanical vibrators.

Set granite curb in concrete ensuring that the top surface is at the required grade. Ensure that joints are at most 1/4 inch wide for dressed and 3/8 inch wide for quarry-split curb. Point the joints using mortar. Place 1/2-inch preformed joint filler between the granite curb and concrete pavement. Seal with hot-poured joint sealer.

Backfill and compact using the directed method, as specified in 203.03.02.C, against the curb.

607.03.06 Reset Granite Curb

Remove granite curb without damaging the existing granite curb sections. Remove the existing foundation and concrete adhering to the granite curb sections to be reset. Reuse concrete as specified in 202.03.07.A.

Shape and compact the underlying material to produce a firm, even surface. Remove unstable material and replace it with suitable material. Once placed, compact the replacement underlying material.

Place footing concrete according to the limitations specified in 504.03.02.C. Consolidate the concrete by hand spading or using internal mechanical vibrators.

Reset granite curb. Ensure that joints are at most 1/4 inch wide for dressed and 3/8 inch wide for quarry-split curb. Point the joints using mortar. Place 1/2-inch preformed joint filler between the granite curb and adjacent concrete pavement. Seal with hot-poured joint sealer.

Backfill and compact using the directed method, as specified in 203.03.02.C, against the curb.

607.03.07 HMA Curb

Clean the surface where the HMA curb will be placed. Construct HMA curb using an HMA curb machine. Where the HMA curb is to be placed on an existing surface that does not have a smooth grade, use a method that provides the required curb line and grade. The Contractor may use side forms.

When short sections of HMA curb with short radii are required, the Contractor may use another method as long as the resulting HMA curb conforms to the curb as produced by the automatic machine.

Perform HMA curb construction in a continuous operation in 1 direction to eliminate curb joints. However, where conditions prevent a continuous operation, construct joints to ensure a continuous bond between the old and new sections of the HMA curb.

607.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
___"X___" CONCRETE BARRIER CURB	LINEAR FOOT
___"X___" CONCRETE VERTICAL CURB	LINEAR FOOT
___"X___" CONCRETE SLOPING CURB	LINEAR FOOT
___"X___" CONCRETE BARRIER CURB, DOWELLED	LINEAR FOOT
___"X___" CONCRETE VERTICAL CURB, DOWELLED	LINEAR FOOT
___"X___" CONCRETE SLOPING CURB, DOWELLED	LINEAR FOOT
___"X VARIABLE HEIGHT CONCRETE BARRIER CURB	LINEAR FOOT
___"X VARIABLE HEIGHT CONCRETE BARRIER CURB, DOWELLED	LINEAR FOOT
___"X VARIABLE HEIGHT CONCRETE VERTICAL CURB	LINEAR FOOT
___"X VARIABLE HEIGHT CONCRETE VERTICAL CURB, DOWELLED	LINEAR FOOT
GRANITE CURB	LINEAR FOOT
RESET GRANITE CURB	LINEAR FOOT
___" X___" HOT MIX ASPHALT CURB	LINEAR FOOT

The Department will measure curb along the face at the gutter line.

SECTION 608 – NON-VEGETATIVE SURFACES

608.01 DESCRIPTION

This Section describes the requirements for constructing non-vegetative surfaces of HMA.

608.02 MATERIALS

608.02.01 Materials

Provide materials as specified:

HMA (9.5M64) 902.02
Non-Vegetative Surface Coating 912.02.04

608.02.02 Equipment

Provide equipment as specified:

HMA Compactor 1003.05
Vibratory Drum Compactor 1003.06
HMA Plant 1009.01
HMA Trucks 1009.02

608.03 CONSTRUCTION

608.03.01 Non-Vegetative Surface, HMA

Excavate as specified in 202.03.03. Shape and compact the underlying material to produce a firm, even surface. Obtain RE approval before finishing excavation. If the RE determines that the bottom of the excavation is unstable, undercut, backfill, and compact as directed by the RE.

Construct non-vegetative surfaces before installing guide rail. Obtain RE approval for alternate methods of construction.

Deliver HMA as specified in 401.03.03.D. Construct non-vegetative surfaces 4 inches thick. Place and compact the material to produce a surface free of roller marks and ridges. Spread and grade the HMA as specified in 401.03.03.E. Ensure that the finished surface is smooth, even, and graded to drain away from the guide rail. Compact HMA as specified in 401.03.03.F. Spread, rake, and lute areas not accessible to pavers and rollers with hand tools and compact with dynamic compactors.

Repair non-vegetative surface damaged by guide rail installation with HMA. Use hand tampers around posts and other obstacles where mechanical compactors are not accessible.

608.03.02 Color-Coated Non-Vegetative Surface, HMA

Construct color-coated non-vegetative surfaces as specified in 608.03.01.

Uniformly apply the final color at a rate of 0.3 to 0.5 gallons per square yard by spraying, brushing, or squeegeeing over the HMA surface course. Ensure that the surface is clean and dry at the time of application. Reapply the coating to any missed spots or areas to obtain a uniform coating.

Avoid spilling the color coating on adjacent surfaces. If the color coating spills, immediately clean it with water before the coating dries. If the coating dries, repair as directed by the RE.

The RE will not allow traffic on the color-coated surface until it is dry.

608.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
NON-VEGETATIVE SURFACE, HOT MIX ASPHALT	SQUARE YARD
COLOR-COATED NON-VEGETATIVE SURFACE, HOT MIX ASPHALT	SQUARE YARD

When the RE directs undercutting of unstable material in the excavation area, the Department will make payment, as specified in 104.03.03, for the additional excavation. The Department will also make payment, as specified in 104.03.03, for the additional bedding if there is not an excess of excavation available for use as bedding.

SECTION 609 – BEAM GUIDE RAIL

609.01 DESCRIPTION

This Section describes the requirements for installing, resetting, or removing beam guide rail.

609.02 MATERIALS

Provide materials as specified:

Concrete	903.03
Reinforcement Steel	905.01
Adhesive Anchor System	908.01.04
Flexible Delineators	911.03
Rail Element	913.01.01
End Treatment	913.01.02
Posts	913.01.03
Blockouts	913.01.03
Rub Rail	913.01.04
Miscellaneous Hardware	913.01.05

609.03 CONSTRUCTION

609.03.01 Beam Guide Rail

Install beam guide rail, single or dual-faced, so that no unprotected end is exposed to approaching traffic. Within the same working day, replace all existing beam guide rail or cable guide rail that is removed. Where possible, install new beam guide rail exposed to approaching traffic before the removal of the existing system.

Before driving or mounting the posts, determine the location of utilities that may conflict with the posts. The Contractor may adjust post spacing by 6 inches, as approved, to eliminate such conflicts. After completing the wiring for each electrical system and before making connections, perform the following tests on each circuit using suitable equipment in the presence of the RE:

1. Tests for continuity.
2. Tests for ground.
3. Tests for insulation resistance between circuit wires and from circuit wires to ground. Verify that the insulation resistance is at least 150 megaohms between conductors, or between conductor and ground for circuits with a total single conductor length of 1500 feet or more, and at least 175 megaohms for circuits with a total single conductor length of less than 1500 feet.

The RE may require additional tests if it is suspected that conduit have been damaged. Locate and repair damage to the electrical conduit due to construction operations.

Drive beam guide rail posts to the required position. Ensure that posts are driven plumb, properly spaced, and to the line and grade shown.

Install the required bridge attachment type as shown on the Plans. Mount bridge beam guide posts as shown on the Plans.

Attach the beam guide rail element to the spacer at every post. Align the top edge of the beam guide rail element in a straight line or smooth curve, parallel to, or concentric with, the traveled way. Where a vertical transition is required, ensure that the top edge of the beam guide rail element forms the chords of a smooth vertical curve. If adjustments to the

rail element are necessary, obtain RE approval before punching, drilling, or reaming of the rail element. Do not cut or weld the rail element.

Install white delineators on the right side of the direction of traffic. Install yellow delineators on the left side of the direction of traffic. Mount flexible delineators on the spacer of beam guide rail using either a "U" channel base on the I-beam spacer or a flat base attached to a wood, polymer, or other solid top spacer. Attach the base to the spacer using an adhesive recommended by the manufacturer of the base and panel.

Mount the first delineator on the beam guide rail end treatment so that the plane face of the center of the reflective area is at an angle of 0 degrees with a line that is perpendicular to the direction of traffic. Mount subsequent delineators every 81.25 feet (13 sections of guide rail) along tangent mainline roadway, or every 43.75 feet (7 sections of guide rail) along curved mainline roadway with a radius of less than 1910 feet. If a parabolic flare in the beam guide rail exists, place the second delineator at the end of the flared section with subsequent delineators spaced as stated above. If the distance between the last delineator and the end of the beam guide rail is greater than 40 feet on tangent mainline roadways, or 20 feet on curved mainline roadways, mount a delineator on the last post or end treatment.

Repair damage to the galvanized coating according to ASTM A 780.

609.03.02 Rub Rail

When rub rail is required, bolt rub rail consisting of a steel channel or a bent plate to the beam guide rail posts.

609.03.03 Terminals and Anchorages

At least 10 days before beginning the work, submit the manufacturer's recommendations the RE. Install terminals and anchorages according to the manufacturer's recommendations.

Excavate for post holes and concrete anchorages as specified in 202.03.03. Backfill and compact using the directed method as specified in 203.03.02.C.

609.03.04 Beam Guide Rail Blockouts

Where required, attach blockout on existing beam guide rail between the steel posts and rail elements.

Where beam guide rail is attached to a structure, attach the blockout to the structure. Reset beam guide rail, as specified in 609.03.05, to provide a smooth transition to the existing structure.

609.03.05 Reset Beam Guide Rail

When the RE determines that the beam guide rail is suitable for resetting, dismantle, store, and protect the components until resetting. To ensure that the beam guide rail meets the current standards, replace existing components, replace damaged components, and provide necessary new components. Dispose of components not designated for resetting the beam guide rail as specified in 201.03.09.

When storage is required, remove the bolts, cables, and other hardware from beam guide rail element, posts, and other members. Sort the components and store until resetting. Stack rail elements and ensure that cables are free of kinks. Replace beam guide rail components that are damaged, lost, or missing in storage.

Reset the existing beam guide rail, as specified in 609.03.01, using the salvaged components. Use all the salvaged components before providing new components for resetting.

Where feasible, use existing rail elements in guide rail sections or portions thereof that are reset with existing posts, and use new rail elements in guide rail sections or in portions thereof where new guide rail posts are used. When it is necessary to use existing and new rail elements in the same guide rail section, install a continuous length of each.

609.03.06 Removal of Beam Guide Rail

After removing beam guide rail, backfill the post holes and compact the area to the elevation of the adjacent surface. Dispose of beam guide rail as specified in 201.03.09.

609.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
BEAM GUIDE RAIL	LINEAR FOOT
BEAM GUIDE RAIL, DUAL-FACED	LINEAR FOOT
MODIFIED THRIE BEAM GUIDE RAIL	LINEAR FOOT
MODIFIED THRIE BEAM GUIDE RAIL, DUAL-FACED	LINEAR FOOT
BEAM GUIDE RAIL, BRIDGE	LINEAR FOOT
BEAM GUIDE RAIL, DUAL FACED, BRIDGE	LINEAR FOOT
THRIE BEAM GUIDE RAIL, BRIDGE	LINEAR FOOT
THRIE BEAM GUIDE RAIL, DUAL FACED, BRIDGE	LINEAR FOOT
RUB RAIL	LINEAR FOOT
FLARED GUIDE RAIL TERMINAL	UNIT
TANGENT GUIDE RAIL TERMINAL	UNIT
TELESCOPING GUIDE RAIL END TERMINAL	UNIT
CONTROLLED RELEASE TERMINAL	UNIT
CONTROLLED RELEASE TERMINAL ANCHORAGE	UNIT
BEAM GUIDE RAIL ANCHORAGE	UNIT
BEAM GUIDE RAIL POST	UNIT
BEAM GUIDE RAIL POST, ___' LONG	UNIT
BEAM GUIDE RAIL ELEMENT	LINEAR FOOT
MODIFIED THRIE BEAM GUIDE RAIL ELEMENT	LINEAR FOOT
BEAM GUIDE RAIL BLOCKOUT	UNIT
RESET BEAM GUIDE RAIL WITH EXISTING POSTS	LINEAR FOOT
RESET BEAM GUIDE RAIL, DUAL-FACED, WITH EXISTING POSTS	LINEAR FOOT
RESET MODIFIED THRIE BEAM GUIDE RAIL WITH EXISTING POSTS	LINEAR FOOT
RESET MODIFIED THRIE BEAM GUIDE RAIL, DUAL-FACED, WITH EXISTING POSTS	LINEAR FOOT
REMOVAL OF BEAM GUIDE RAIL	LINEAR FOOT

The Department will measure the various guide rail items by the linear foot along the face of the rail, excluding anchorages and end terminals.

The Department will measure the various dual-faced rail items by the linear foot along the face of one rail excluding end terminals.

The Department will measure BEAM GUIDE RAIL ELEMENT and RUB RAIL by the linear foot along the face of the rail.

When installing BEAM GUIDE RAIL BLOCKOUT to an existing structure, the Department will make payment for the reset of the beam guide rail to provide a smooth transition under RESET BEAM GUIDE RAIL WITH EXISTING POSTS.

The Department will measure RESET BEAM GUIDE RAIL WITH EXISTING POSTS, RESET BEAM GUIDE RAIL, DUAL-FACED, WITH EXISTING POSTS, RESET MODIFIED THRIE BEAM GUIDE RAIL WITH EXISTING POSTS, and RESET MODIFIED THRIE BEAM GUIDE RAIL, DUAL-FACED, WITH EXISTING POSTS along the face of the rail, excluding anchorages and end terminals.

SECTION 610 – TRAFFIC STRIPES, TRAFFIC MARKINGS, AND RUMBLE STRIPS

610.01 DESCRIPTION

This Section describes the requirements for applying traffic stripes, traffic markings, and Raised Pavement Markers (RPMs) to HMA and concrete surfaces. This Section also describes the requirements for removing traffic stripes, traffic markings, and RPMs, removing and replacing RPM lenses, and constructing rumble strips.

610.02 MATERIALS

610.02.01 Materials

Provide materials as specified:

Flexible Delineators	911.03
Epoxy Traffic Stripes	912.03.01
Thermoplastic Traffic Markings	912.03.02
Raised Pavement Marker (RPM)	912.03.03
Epoxy Resin Adhesive	912.03.03.2
Lenses	912.03.03.3
Lens to Casting Adhesive	912.03.03.4

610.02.02 Equipment

Provide equipment as specified:

Grinding Machine	1006.08
Epoxy Striping Equipment	1007.01
Thermoplastic Applicator	1007.02
Traffic Stripe and Marking Removal Equipment	1007.03
Rumble Strip Cutting Machine	1007.04
Pavement Saw	1008.04

610.03 CONSTRUCTION

610.03.01 Long-Life Traffic Stripes

A. Striping Plan. At least 20 days before beginning the work, submit to the RE for approval a striping plan that includes:

1. Schedule of operations for applying traffic stripes.
2. Number and type of equipment.
3. Manufacturer's recommendations for use of the materials, including, but not limited to, mixing ratios and application temperatures.

B. Surface Preparation. Immediately before striping the pavement surface, clean the surface of dirt, oil, grease, and foreign material, including curing compound on new concrete. Clean the surface 2 inches beyond the perimeter of the stripes to be placed.

C. Striping Test Strip. Before beginning long-life traffic striping operations, construct 1 or more striping test strips as specified in 610.03.01.D. For each striping test strip, apply striping to approximately 500 linear feet of pavement with the same striping procedure that will be used for the Project. Construct a test strip for each applicator unit and long-life material used. Construct additional test strips when major equipment repairs or adjustments are made or when the traffic stripes are determined to be defective. When the test strip is in compliance, as determined by the RE, proceed with striping operations. Each test strip may remain in place and become part of the finished stripes subject to the requirements of 610.03.01.E.

D. Applying Striping. Mix epoxy resin with an automatic proportioning and mixing machine, and hot-spray the compound at a temperature of between 100 and 130 °F onto dry surfaces. Apply the compound with a wet film thickness of 20 ± 1 mil. Apply the material during dry weather conditions when the ambient temperature is a minimum of 45 °F and the surface temperature is a minimum of 50 °F. Adjust operations as required for the prevailing ambient and surface conditions to achieve a no-track drying time of 30 minutes or less.

Immediately after, or in conjunction with, the compound application, uniformly apply 12 pounds of large glass beads per gallon of epoxy resin to the compound. After applying the large glass beads, uniformly apply 12 pounds of small glass beads per gallon of epoxy resin to the compound.

Remove all compound that has been tracked or spilled outside of the intended placement areas.

E. Defective Stripes. Replace long-life traffic stripes that are determined by the RE before Acceptance to be defective or that are damaged due to sawcutting or sealing of joints in the HMA overlay. Remove defective stripes as specified in 610.03.08.

Replace the entire 10-foot skip line if the RE determines the line to have a deficiency.

If the RE determines, based upon calculated and measured yields, that the striping has a wet film thickness of less than 19 mils, restripe the entire length with 20 mils of new compound.

Replace the entire length of striping where improper curing or discoloration has occurred. Discoloration is localized areas or patches of brown or grayish colored compound. Where improper curing or discoloration occurs intermittently in intervals of 100 feet or less throughout the striping length, replace the entire length of striping from the beginning of the first occurrence until the end of the last occurrence, plus 5 feet on each end.

Replace the entire length of striping that has failed to bond to the pavement, or has chipped or cracked. Where more than 25 spots of chipping, cracking, or poor bonding have occurred within 1000 linear feet of striping, replace the entire 1000 foot length of striping.

Replace the entire area of striping where the glass bead coverage or retention is deficient, based on yield measurements made during application and on visual comparisons of the production traffic stripes with those of the test strips.

Replace the entire 1-mile length of striping where the initial retroreflectance values for 2 of 4 readings for that 1 mile length are less than 375 millicandelas per square meter per lux for white or 250 millicandelas per square meter per lux for yellow, as measured with a LTL-2000 Retroreflectometer.

F. Opening to Traffic. Complete each application of all types of traffic stripes and allow to thoroughly dry before opening to traffic. At a minimum, delineate center lines on undivided roadways and broken lines between lanes before the traveled way is opened. The RE will determine when the traveled way can be opened to traffic.

610.03.02 Thermoplastic Traffic Markings

A. Marking Plan. At least 20 days before beginning the work, submit to the RE for approval a marking plan that includes:

1. Schedule of operations for applying markings,
2. Number and type of equipment, and
3. Manufacturer's recommendations for use of the materials, including mixing ratios and application temperatures.

B. Surface Preparation. Immediately before marking the pavement surface, clean the surface of dirt, oil, grease, and foreign material, including curing compound on new concrete. Clean the surface 2 inches beyond the perimeter of the marking to be placed.

C. Applying Long-Life Traffic Markings. Place preformed thermoplastic or hot extruded thermoplastic traffic markings on thoroughly dry surfaces and during dry weather conditions. Apply using equipment and procedures that produce markings of the specified color, width, and thickness with well-defined edges, uniform retroreflectivity, and proper bonding to the pavement. Apply the thermoplastic material as follows:

1. Extruded Thermoplastic. Uniformly heat the thermoplastic material. When the ambient and surface temperatures are at least 50° F, apply the melted material at a temperature of between 400 and 425 °F. Extrude the thermoplastic traffic markings on the HMA or concrete pavement ensuring a thickness of 90 ± 1 mils.

Immediately after, or in conjunction with, the thermoplastic extrusion, uniformly apply glass beads to the wet material at a minimum rate of 10 pounds per 100 square feet of markings. Apply glass beads by mechanical means only.

2. Preformed Thermoplastic. Melt the preformed thermoplastic tape to bond the traffic markings permanently in position according to the manufacturer's recommendations.

Meet the minimum initial retroreflectance value, as specified in 610.03.01.D for thermoplastic tape, by applying additional glass beads to the hot-wet material in a uniform pattern as necessary.

D. Defective Markings. Replace long-life traffic markings that are determined by the RE before Acceptance to be defective or that are damaged due to sawcutting or sealing of joints in the HMA overlay. Remove defective markings as specified in 610.03.08.

Replace the entire area of traffic markings determined to be less than the required thickness, to have incorrect color or width, to have failed to bond to the pavement, or to have chipped or cracked. The minimum replacement area is an individual word or symbol, or entire length of longitudinal line from where the deficiency first occurs to where it no longer exists.

Replace the entire area of marking where the initial retroreflectance value is less than 375 millicandelas per square meter per lux for white or 250 millicandelas per square meter per lux for yellow. The RE will determine initial retroreflectance as follows:

1. The RE will perform visual inspections at night to identify defective traffic markings that appear to be below the specified minimum value.
2. The RE will perform retroreflectance measurements with a LTL-2000 Retroreflectometer on a clean, dry surface.
3. For word markings, the RE will make 3 random retroreflectance measurements on each letter. For symbols, the RE will make 9 random retroreflectance measurements over the symbol.
4. The RE will average all retroreflectance measurements for each letter or symbol to determine if the minimum retroreflectance requirement is met.

E. Opening to Traffic. Complete each application of traffic markings and allow to thoroughly dry before opening to traffic. The RE will determine when the traveled way can be opened to traffic.

610.03.03 Raised Pavement Markers (RPM)

Lay out the locations of all RPMs before installing to ensure proper placement. Place RPMs as follows:

1. Place RPMs on the travel lane side of solid paint lines at a distance of 2 inches from the near edge of the paint line to the near edge of the RPM.
2. Place amber RPMs between double yellow paint lines when there is no conflict with a longitudinal joint.
3. Place RPMs located along skip lines on the line's longitudinal center axis and at the midpoint of the unpainted gap between each dash.
4. When placing RPMs near longitudinal joints, place at least 2 inches from the joint.

Obtain RE approval of RPM locations before beginning sawcutting operations. If the pre-installation layout determines that a RPM is to be placed at a transverse joint or at a location that shows evidence of cracking, checking, spalling, or the failure of underlying base material, relocate the RPM longitudinally. Obtain RE approval of the proposed relocation. Ensure that the center-to-center RPM distance does not deviate from the specified distance by ±4 feet. If the center-to-center distance for the proposed relocation deviates from the specified center-to-center distance by ±4 feet, do not install the RPM.

When placing RPMs on bridge deck surfaces, locate reinforcement steel in the bridge decks using a pachometer. Do not place RPMs in any location that would expose the existing reinforcement steel. Repair damage to the reinforcement steel or bridge deck that is caused by the installation of RPMs.

Sawcut roadway grooves to the depth, width, and diameter specified by the RPM manufacturer. Sawcut only those grooves for RPMs that will be installed during the same workday.

Ensure that roadway grooves are free of dirt, dust, oil, grease, moisture, curing compounds, loose or unsound pavement, or other material that may interfere with bonding of the epoxy compound. Sand blast grooves where necessary. Ensure that the grooves are dry where installing RPMs.

Apply epoxy compound according to the manufacturer's recommendations. Do not apply epoxy compound when either the pavement surface or ambient air temperature is less than 50 °F at the time of application.

Install RPMs according to the manufacturer's recommendations. RPM leveling lugs shall rest on the pavement surface. Do not allow lugs to drop below the pavement surface. The tips of each RPM's snow plow deflecting surface must remain below the roadway surface.

Use reflector adhesive to bond each RPM lens to its casting. The RE will reject a RPM if visible buildup of epoxy compound or reflector adhesive affects its optical performance.

610.03.04 Removal of RPMs

Remove RPMs that are not installed to full depth or that have a raised end exposed above the pavement surface. Fill the hole with approved material and install a new RPM longitudinally within 2 feet.

Replace RPMs that have been damaged by traffic striping or marking material as a result of improperly located traffic stripes or markings.

Dispose of RPMs as specified in 201.03.09.

610.03.05 Removal and Replacement of RPM Lenses

Remove existing RPM lenses and install new mono-directional or bi-directional pavement reflector lenses using methods that do not damage the RPM castings.

Dispose of RPM lenses as specified in 201.03.09.

610.03.06 Ground Mounted Flexible Delineators

Use white for delineators located on the right side when facing in the direction of traffic. Use yellow for delineators located on the left side when facing in the direction of traffic.

Drive ground mounted flexible delineators vertically into the ground to a minimum depth of 18 inches. Position flexible delineators so that the plane face of the center of the reflective area is at an angle of 0 degrees with a line that is perpendicular to the direction of traffic.

610.03.07 Rumble Strips

At least 20 days before constructing rumble strips, submit a plan for the cutting and collection of the material to the RE for approval. Construct rumble strips after traffic striping operations have been completed.

Clean the shoulder area where rumble strips are to be installed. Construct rumble strips by cutting indentations into the pavement perpendicular to the edge of the shoulder without disturbing the surrounding pavement. Collect cuttings and reuse as specified in 202.03.07.A.

610.03.08 Removal of Traffic Stripes and Markings

Remove traffic stripes and traffic markings using methods that do not damage the underlying or adjacent pavement, and do not cause gouging or create ridges or grooves in the pavement. Before beginning removal operations, demonstrate to the RE the proposed method to remove at least 95 percent of stripes or markings without removing more than 1/16 inch of pavement thickness. Obtain RE approval before beginning removal operations.

The removal area includes the area of the stripe or marking plus 1 inch on all sides. Only remove traffic stripes or markings that will be replaced during the same workday.

Dispose of debris from the removal of stripes and markings as specified in 201.03.09.

610.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
TRAFFIC STRIPES, LONG-LIFE, EPOXY RESIN ___"	LINEAR FOOT
TRAFFIC MARKINGS, THERMOPLASTIC	SQUARE FOOT
RPM, MONO-DIRECTIONAL, WHITE LENS	UNIT
RPM, BI-DIRECTIONAL, WHITE LENS	UNIT
RPM, MONO-DIRECTIONAL, AMBER LENS	UNIT
RPM, BI-DIRECTIONAL, AMBER LENS	UNIT
REMOVAL OF RPM	UNIT
REMOVAL AND REPLACEMENT OF RPM LENS	UNIT

FLEXIBLE DELINEATOR, GROUND MOUNTED	UNIT
RUMBLE STRIP	LINEAR FOOT
REMOVAL OF TRAFFIC STRIPES	LINEAR FOOT
REMOVAL OF TRAFFIC MARKINGS	SQUARE FOOT

The Department will measure traffic stripes of the various types and materials by the linear foot for each specified width of stripe. The Department will not measure gaps in striping.

SECTION 611 – CRASH CUSHIONS

611.01 DESCRIPTION

This Section describes the requirements for providing and constructing inertial barrier systems and crash cushions.

611.02 MATERIALS

Provide materials as specified:

Sand.....901.06.02
Salt 919.09

Ensure that the sand has a dry density of 90 to 100 pounds per cubic foot and a 3 percent maximum allowable moisture content.

Use an inertial barrier system listed on the QPL.

611.03 CONSTRUCTION

611.03.01 Inertial Barrier System

Place each module in its location on the surface. Paint the outline of the base of the module on the surface and include the weight of the module inside the outline. Do not mix modules from different manufacturers in the same system. The RE may require the system manufacturer's representative to be present during the installation.

Fill each module with sand to the depth recommended by the manufacturer. Combine 5 to 7 percent of salt by weight and evenly disperse throughout the sand. Do not substitute calcium chloride ($CaCl_2$) for salt.

Place the lid on the module to ensure that no weather elements come in contact with the sand. Install 4 equidistant rivets or other fasteners, as recommended by the manufacturer and approved by the Department, on the periphery of the lid.

611.03.02 Crash Cushion

At least 10 days before beginning the work, submit the manufacturer's installation guide to the RE. Install crash cushions according to the manufacturer's recommendations. The RE may require the system manufacturer's representative to be present during the installation.

611.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
CRASH CUSHION, INERTIAL BARRIER SYSTEM, ___ MODULES	UNIT
CRASH CUSHION, ___	UNIT

SECTION 612 – SIGNS

612.01 DESCRIPTION

This Section describes the requirements for erecting signs and mounting sign panels.

612.02 MATERIALS

Provide materials as specified:

Concrete	903.03
Grout	903.08.02.A
Reinforcement Steel	905.01
Sign Panels	911.01.02.A
Steel "U" Post Sign Supports	911.02.01
Breakaway Sign Supports	911.02.02
Non-Breakaway Sign Supports	911.02.03
Mounting Material	911.02.05

Obtain Type GA Breakaway Couplings from the Department.

612.03 CONSTRUCTION

612.03.01 Regulatory and Warning Signs and Type GA "U" Post Support Guide Signs

If sign placement conflicts with existing conditions, obtain RE approval to adjust the sign location. Determine the sign post lengths based on the final grade.

Mount sign panels on breakaway steel "U" post sign supports. For signs located behind guide rails or other roadside barriers, mount sign panels on steel "U" post sign supports without the breakaway assembly.

After mounting sign panels, notify the RE. The RE will examine the sign panels at night for glare. If directed by the RE, adjust the sign panels to eliminate glare. Shim signs mounted on 2 posts either at all bolts on 1 of the posts, or at the proper upper or lower bolts on both posts. Shim signs mounted on a single post at either the upper or lower bolts, whichever best minimizes glare. Install shims between the back of the sign and the post. Ensure that the sign does not deform, and that the nuts and bolts are securely tightened.

612.03.02 Type GA Breakaway and Non-Breakaway Support Guide Signs

A. Working Drawings. At least 30 days before beginning work, submit working drawings for certification.

B. Excavating. Excavate as specified in 202.03.03. Shape and compact the underlying material to produce a firm, even surface. Obtain RE approval before finishing excavation. If the RE determines that the bottom of the excavation is unstable, undercut, backfill, and compact as directed by the RE.

C. Constructing Pedestals. Set anchor bolts into a template to maintain alignment and elevation. Secure in position to prevent displacement while placing concrete. Place reinforcement steel as specified in 504.03.01 before placing the concrete. Ensure that concrete placement complies with the limitations as specified in 504.03.02.C. Place concrete as specified in 504.03.02.D. Cure concrete as specified in 504.03.02.F.

D. Erecting Posts. Submit written request to the RE for the type and quantity of breakaway couplings required at least 10 days before erecting posts. Erect posts as specified in 512.03.01.G.

E. Mounting Sign Panels. Mount Type GA guide sign panels on sign support using mounting material.

612.03.03 Type GO and Type GOX Guide Sign Panels

Mount Type GO and Type GOX guide sign panels on sign support structures using mounting material.

After mounting sign panels, notify the RE. The RE will examine the sign panels at night for glare. If directed by the RE, adjust the sign panels to eliminate glare.

612.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
REGULATORY AND WARNING SIGN	SQUARE FOOT
GUIDE SIGN, TYPE GA, STEEL "U" POST SUPPORTS	SQUARE FOOT
GUIDE SIGN, TYPE GA, BREAKAWAY SUPPORTS	SQUARE FOOT
GUIDE SIGN, TYPE GA, NON-BREAKAWAY SUPPORTS	SQUARE FOOT
GUIDE SIGN PANEL, TYPE GO	SQUARE FOOT
GUIDE SIGN PANEL, TYPE GOX	SQUARE FOOT

The Department will make payment for sign support structures as specified in 512.04.

The Department will make payment for sign illumination as specified in 703.04.

DIVISION 650 – UTILITIES

SECTION 651 – WATER

651.01 DESCRIPTION

This Section describes the requirements for installing water pipe, resetting water valve boxes, connecting water services, installing, relocating, and resetting fire hydrant assemblies, and submitting as-built plans.

651.02 MATERIALS

Provide materials as specified:

Coarse Aggregate (No. 57)	901.03
Concrete	903.03
CLSM	903.09
Structural Steel	906.01
Bolts and Bolting Material	908.01
Class B Bedding	909.01.02
Class C Bedding	909.01.03
Ductile Iron Water Pipe	909.02.08

Provide gaskets according to the manufacturer's recommendations.

Provide steel pipe sleeves according to ASTM A 252, and galvanize according to ASTM A 123.

Provide galvanized channel supports, rods, bolts, nuts, washers, inserts, and other hardware required for the permanent installation according to ASTM A 123 or A 153.

See the Special Provisions for additional materials requirements.

651.03 CONSTRUCTION

651.03.01 Water Pipe

A. Scheduling of Work and Interruption to Water Service. Provide the RE and the Utility with a detailed schedule of the work. Notify the Utility in writing at least 15 days before beginning construction of water facilities. Do not perform work on water facilities that will result in water service interruptions from April 1 through September 30 without approval of the Utility. The Department may extend this period based on weather conditions and system demand requirements as determined by the Utility. Perform the work to minimize adverse impact to the Utility's operations.

Perform work in a manner that is acceptable to the Utility's inspector, and in coordination with the RE. Provide the Utility's inspector with access to the work.

B. Existing Utilities and Structures. Determine the location of surface and subsurface structures within the work site, including but not limited to underground electric, telecommunication, gas, and sewer facilities. Notify the RE when excavation is required within 10 feet of any existing utility, and submit a plan to the RE for approval, detailing the proposed methods of excavating around the existing utilities, and the proposed methods of protecting and supporting the existing utilities. Protect and support utility facilities encountered. Notify the RE and the Utility 3 days before crossing any existing utilities, so that the Utility may send a representative to the work site at the time of excavation or construction.

Remove and dispose of abandoned pipe, services, valves, boxes, thrust blocks, and appurtenances, unless otherwise shown on the Plans as specified in 201.03.09. Cap or plug pipe that is to be abandoned in a manner that is acceptable to the Utility.

C. Excavating. Before excavating, sawcut the full depth of the existing pavement and sidewalk. Excavate a trench for placing water pipe, valves, services, tees, or appurtenances. Obtain RE approval before finishing excavation. If

the RE determines that the bottom of the trench is unstable, undercut as directed by the RE and backfill with Class B bedding. If the material at the bottom of the trench is rock or other hard material, excavate an additional 6 inches of the material below the bottom of the pipe. Backfill the undercut with Class C bedding. Ensure that trenches are kept free of any standing water during the installation. Do not excavate for trenches in embankments until the embankment has been constructed to an elevation of at least 3 feet above the top of the pipe or to the top of the embankment, whichever is lower. Do not excavate trenches more than 300 feet in advance of installing the pipe unless approved by the RE.

Maintain trenches according to 29 CFR 1926. Provide and maintain trench crossings where necessary. For trenches in the traveled way, shoulder and within 30 feet of the outside edge of the shoulder, backfill and restore the pavement structure and match the surrounding condition before opening to traffic. The Contractor may use temporary protection instead of backfilling trenches in the traveled way and shoulder. If using temporary protection, submit working drawings for approval. For trenches not in the traveled way and shoulder, do not leave trenches open overnight unless protected with caution fence.

D. Handling of Pipe and Accessories. Lift pipe and other items using hoists. Do not drop pipe onto the ground or into a trench, and do not permit pipe to roll or skid against other pipe.

E. Installing Water Pipe. Identify areas where pipe will have less than 4 feet of cover. Provide the RE with a report of the identified areas in order to obtain the Utility's approval.

Use a laser system to control the alignment and grade of the pipe. Lay water pipe in straight lines. If deviations from a straight line are approved by the RE, ensure that the deflection at each pipe joint does not exceed the manufacturer's recommended maximum deflection.

Provide additional pipe or connections necessary to bypass obstructions or other utilities. Adjust the depth of the pipe to pass obstructions, as approved by the RE. When grade changes through curves are required, divide the curve among several joints. Install the pipe so that it is solidly supported by the subgrade or pipe bedding as required, over its full length except where recesses have been made for joints.

Ensure that the interior of the pipe is kept clean and free of intrusion by soil, or other foreign material. Ensure that the inside of the pipe is maintained clean and that valves and hydrants are in good working order when installed. Protect open ends of the pipe at all times and securely seal the openings with plugs approved by the Utility whenever work is stopped. Remove the plug, and inspect and clean the interior of the pipe before resuming pipe installation.

Join pipe according to the manufacturer's recommendations. Cut pipe according to the manufacturer's recommendations. Ensure cuts are clean and square. Install gate valves, inserting valves, tapping sleeves, tapping valves, valve boxes, blow-offs, and miscellaneous fittings. Set the fittings and valves true to the pipe lines. Ensure that valve stems are set plumb. Support the valves with concrete blocking set on firm ground that has been compacted using a mechanical plate tamper. Set valve boxes plumb, centered with respect to the valve stem, and flush with the finished grade.

Coordinate the installation of water mains with other work and prevent conflicts and interference with all existing facilities and proposed construction. Install tapping valves and insert valves as wet connections with no loss of water or interruption of flow. Notify the Utility 15 days before performing wet connections. Perform wet connections according to the equipment manufacturer's recommendations.

F. Hydrostatic Pressure Testing and Leakage Testing. After laying and joining a complete section of pipe between valves, and before backfilling, pressure-test the pipe line. Expel the air from the pipe line through blow-offs or taps, and ensure that the caps, plugs, and fittings are adequately braced and anchored. Perform pressure testing of the water main according to the AWWA Standard C600 in the presence of the Utility inspector using a minimum test pressure of 150 pounds per square inch. Maintain the pressure in the pipe for 120 minutes. Demonstrate that flanged, victaulic, or welded joint pipe lines exhibit no leaks under pressure. Demonstrate that the leakage for mechanical jointed pipe lines, or push-on joint pipe lines do not exceed the allowable leakage rate as computed by:

$$L = \frac{ND\sqrt{P}}{7400}$$

Where:
L = allowable leakage in gallons per hour
N = number of joints in length of pipe tested
D = nominal diameter of pipe in inches
P = average test pressure during the leakage test in pounds per square inch

Where it is impractical to maintain an open trench for the full length of any section between valves, provide test plugs and perform pressure testing and leakage testing to the satisfaction of the Utility

G. Backfilling. Symmetrically place backfill on each side of the pipe in lifts not exceeding 6 inches thick, loose measurement, and compact with a flat faced tamper using the directed method as specified in 203.03.02.C. Where bedding is not required, backfill with suitable excavated material that is free from rock larger than 2 inches in diameter. Reuse excess or excavated material as specified in 202.03.07.A. The Contractor may use CLSM as alternate backfill material when backfilling trenches. If using CLSM, install as specified in 601.03.01.F. Restore the existing pavement structure to the original condition or as shown on the Plans.

H. Disinfection/Bacteriological Testing. Before placing pipelines into service, disinfect the system according to the AWWA Standard C651 except if trench water has entered the main or if the water temperature is less than 41 °F, use the continuous feed method. Use hypochlorite or liquid chlorine according to AWWA Standards B-300 and B-301 respectively. Introduce and distribute the chlorine into the new lines using a minimum dosage of 50 parts per million. Maintain the chlorinated water in the system for a minimum of 24 hours. Contact the Utility inspector to verify the chlorine residual is 50 parts per million. Flush the pipe line in a manner approved by the Utility until the chlorine concentrations are no higher than generally prevailing in the system.

Retain a certified Testing Laboratory to sample and test the water for bacteriological and turbidity analysis according to the AWWA C651 and the Federal Safe Drinking Water Act (40 CFR, Parts 141 through 143). Ensure that the water conforms to the bacteriological standards specified in the New Jersey Safe Drinking Water Regulations (N.J.A.C. 7:10-1 *et seq.*) as well as the Federal Safe Drinking Water Act (40 CFR, Parts 141 through 143). Provide the test results to the Utility.

I. Thrust Blocks. Install thrust blocks at bends greater than 5 degrees, and at tees, plugs, and valves. Ensure thrust blocks are placed against firm, undisturbed ground. Ensure that thrust blocks do not come in contact with other utilities or structures without the approval of the RE. Place concrete as specified in 504.03.02.D.

651.03.02 Water Pipe, Bridge

Construct water mains on bridges as specified in the Special Provisions.

651.03.03 Water Service Connection

Before performing water service connections, check the condition of the meter pit, and determine if the enclosed meter is operational. Notify the Utility and water service customers at least 5 days in advance of water shut-off. Schedule the work as specified in 651.03.01.A. Determine the location of surface and subsurface structures as specified in 651.03.01.B. Excavate as specified in 651.03.01.C. Install the temporary and permanent water services required to maintain consistent service. Install the corporation stop. Install the continuous length of copper service pipe between the corporation stop and curb stop. Install the curb stop and curb box. Ensure the curb box is set to the proposed final grade. Install and connect customer water service pipe compatible with the existing customer water service pipe. If necessary, relocate the existing water meter and meter pit. Shut off existing services that are to be abandoned, install a plug in the existing curb stop, and remove the existing curb box. Backfill as specified in 651.03.01.G.

651.03.04 Fire Hydrant

Schedule the work as specified in 651.03.01.A. Determine the location of surface and subsurface structures as specified in 651.03.01.B. Excavate as specified in 651.03.01.C. Install the fire hydrant according to AWWA section C502-54. Install the branch connection to the main, including the standard tee, gate valve, and pipe from the main to the hydrant. Provide additional pipe or connections necessary to bypass obstructions or utilities. Place coarse aggregate around the

base. Ensure that the fire hydrant assembly is set plumb with the pumper nozzles normal to the face of the curb. Install thrust block as specified in 651.03.01.E. Backfill as specified in 651.03.01.G.

651.03.05 Relocate Fire Hydrant

Remove the existing fire hydrant. Cap the existing branch line. Install the existing fire hydrant as specified in 651.03.04 where shown on the Plans.

651.03.06 Reset Fire Hydrant

Adjust the height of the existing fire hydrant by adding to the vertical connection to the plug to meet the proposed grade. Do not move or disturb the location of the hydrant branch connection to the main.

651.03.07 Reset Water Valve Box

Adjust the height of the existing water valve boxes so that it is set flush with the proposed grade without disturbing the existing valve.

651.03.08 Water As-Built Plan

Upon completion of the water utility work, submit to the RE and to the Utility a scaled as-built plan noting the location of the Items of water utility construction except RESET FIRE HYDRANT and RESET WATER VALVE BOX. On the plan, show stationing, distance references to the curb line, and 3 ties for each valve box, curb box, and hydrant within 50 feet to above-ground physical features. On the plans, show the depth of the water pipe and service connection at a minimum of 100-foot increments along the line or connection. Provide the as-built plans in a format acceptable to the Utility.

651.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
___" DUCTILE IRON WATER PIPE, CLASS ___	LINEAR FOOT
___" DUCTILE IRON WATER PIPE BRIDGE, CLASS ___	LINEAR FOOT
WATER SERVICE CONNECTION	UNIT
FIRE HYDRANT	UNIT
RELOCATE FIRE HYDRANT	UNIT
RESET FIRE HYDRANT	UNIT
RESET WATER VALVE BOX	UNIT
WATER AS-BUILT PLAN	LUMP SUM

The Department will measure ___" DUCTILE IRON WATER PIPE by the linear foot including the lengths of tees, sleeves, and valves measured parallel to the water pipe outside the limit of a structure.

The Department will measure ___" DUCTILE IRON WATER PIPE BRIDGE by the linear foot measured parallel to the water pipe within the limits of a structure.

A unit of WATER SERVICE CONNECTION includes both temporary and permanent water service connections needed to provide continued service to a structure. The Department will make payment for each structure as a separate unit of WATER SERVICE CONNECTION.

The Department will make payment for restoring the existing pavement structure to the original condition or as shown on the Plans under the various Items the pavement structure is composed of.

SECTION 652 – SANITARY SEWERS

652.01 DESCRIPTION

This Section describes the requirements for installing sanitary sewer gravity and force mains, sewer lining, sanitary sewer manholes, sanitary sewer connections, miscellaneous fittings, and testing.

652.02 MATERIALS

Provide materials as specified:

Coarse Aggregate (No. 57)	901.03
Soil Aggregate (I-3)	901.11
Class B Bedding	909.01.02
Class C Bedding	909.01.03
Concrete	903.03
Mortar	903.08.01
CLSM	903.09
Curing Materials	903.10
Precast Manhole	904.01
Reinforcement Steel	905.01
Reinforced Concrete Sewer Pipe	909.02.01
PVC Sewer Pipe	909.02.03
Corrugated Steel Sewer Pipe	909.02.06
Ductile Iron Sewer Pipe	909.02.08
Castings	909.03
Epoxy Bedding Compound	909.03.5
Ladder Rung	909.03.6
Concrete Block	910.02
Concrete Brick	910.03
Preformed Joint Filler	914.01
Asphalt Cement Waterproofing	919.05

See the Special Provisions for additional materials requirements.

652.03 CONSTRUCTION

652.03.01 Sewer Pipe

A. Scheduling of Work. Schedule work as specified in 651.03.01.A.

B. Existing Utilities and Structures. Comply with 651.03.01.B.

C. Excavating. Before excavating, sawcut full depth existing pavement and sidewalk. Excavate a trench for placing sewer pipe and appurtenances. Remove any observable rock and boulders that are within 6 inches of the pipe. Obtain RE approval before finishing excavation. If the RE determines that the bottom of the trench is unstable, undercut as directed by the RE and backfill with Class B bedding. Ensure that trenches are kept free of standing water during the installation of sewer pipe. Do not excavate for trenches in embankments until the embankment has been constructed to an elevation of at least 3 feet above the top of the pipe. Do not excavate trenches more than 300 feet in advance of installing the pipe unless approved by the RE.

Maintain trenches according to 29 CFR 1926. Provide and maintain trench crossings where necessary. For trenches in the traveled way, shoulder and within 30 feet of the outside edge of the shoulder, backfill and restore the pavement structure and match the surrounding condition before opening to traffic. The Contractor may use temporary protection instead of backfilling trenches in the traveled way and shoulder. If using temporary protection, submit working drawings for approval. For trenches not in the traveled way and shoulder, do not leave trenches open overnight unless protected with caution fence.

D. Handling of Pipe and Accessories. Handle pipe and accessories as specified in to 651.03.01.D. Also store o-rings and gaskets in locations where air temperatures are maintained within the manufacturer's recommendations.

E. Installing Sanitary Sewer Gravity and Force Mains. Identify areas where pipe will have less than 3-1/2 feet of cover. Provide the RE with a report of the identified areas in order to obtain the Utility's approval.

Use a laser system to control the alignment and grade control of the pipe. Lay pipe with bell ends facing the opposite direction of flow. Lay sewer main pipe in straight lines except as approved by the RE. Adjust the depth of the pipe to pass obstructions, as approved by the RE. Install the pipe so that it is solidly supported by the underlying material over its full length except where recesses have been made for joints. Ensure that interior of the pipe is kept clean and free of intrusion by soil or other foreign material. Protect open ends of the pipe at all times and securely seal the openings with plugs approved by the Utility whenever work is stopped. Remove the plug, inspect, and clean the interior of the pipe before resuming pipe installation. Join pipe according to the manufacturer's recommendations. Cut pipe according to the manufacturer's recommendations. Ensure cuts are clean and square. Install plugs, vents, tapping sleeves, valves and miscellaneous fittings. Install tapping valves and insert valves as wet connections with no interruption of flow.

F. Thrust Blocks. For sewer force mains, install thrust blocks at bends greater than 5 degrees, and at tees, plugs, and valves. Ensure thrust blocks are placed against firm, undisturbed ground. Ensure that s blocks do not come in contact with other utilities or structures without the approval of the RE. Place concrete as specified in 504.03.02.D.

G. Sewer Pipe Testing. After laying and jointing a complete section of pipe between manholes and before backfilling, perform a visual inspection of the pipe by lamping with a light and mirror to show if alignment contains deflection between manholes. Perform the visual inspection in the presence of the Utility inspector and to the Utility's standards. Also test the pipe as follows:

1. Gravity Main Sewer Testing. Perform the leakage testing listed in the Special Provisions.

a. Infiltration Testing. At least 15 day before performing testing, submit a plan to the Utility for approval detailing the proposed method to construct weirs or otherwise measure infiltration, including installation of pipe plugs and methods of temporary pumping to maintain service as necessary. Submit the approved plan to the RE Perform the infiltration testing in the presence of the sanitary sewer inspector and according to the Utility's standards.

b. Exfiltration Testing. At least 15 day before performing testing, submit a plan to the Utility for approval detailing the proposed method to construct weirs or otherwise measure exfiltration, including installation of pipe plugs and methods of temporary pumping to maintain service as necessary. Submit the approved plan to the RE. Seal the low end of the section being tested and test the entire section of the system, including manholes, by filling the system with clean water to a minimum of 2 feet above the top of the pipe in the upstream manhole. Measure the amount of water necessary to maintain a constant head of pressure above the pipe for 4 hours. Perform the exfiltration testing in the presence of the sanitary sewer inspector and according to the Utility's standards.

2. Force Main Sewer Testing. At least 15 day before performing pressure testing, submit a plan to the Utility for approval detailing the testing. Submit the approved plan to the RE. Plug the force main at the tie-in manhole. Perform hydrostatic pressure testing of the water main according to AWWA Standard C600 in the presence of the Utility inspector using a minimum test pressure directed by the Utility. Maintain the pressure in the pipe for 120 minutes. Demonstrate, to the satisfaction of the Utility, that sanitary sewer force mains exhibit no leaks under pressure.

H. Backfilling. Symmetrically backfill on each side of the pipe in lifts not exceeding 6 inches thick, loose measurement, and compact with a flat faced mechanical tamper using the directed method as specified in 203.03.02.C. Where bedding is not required, backfill with suitable excavated material that is free from rock larger than 2 inches in diameter. Reuse excavated material as specified in 202.03.07.A. The Contractor may use CLSM as alternate backfill material when backfilling trenches. If using CLSM, install as specified in 601.03.01.F. Restore the existing pavement structure to the original condition or as shown on the Plans

652.03.02 Sanitary Sewer Pipe, Bridge

Construct sanitary sewer pipe on bridges as specified in the Special Provisions.

652.03.03 Sanitary Sewer Pipe Lining

At least 15 days before beginning the work, submit to the RE and the Utility for approval a plan detailing a method to temporarily transfer the wastewater flow around the section or sections of the sewer being lined. Divert the wastewater flow from an upstream access point and pump the flow to a downstream access point by providing a pump and bypass lines with adequate capacity to handle peak wastewater flow.

Perform sanitary sewer lining by entry from existing manholes. Modify existing manholes to permit sufficient access to perform the work as approved by the RE. Before beginning lining, internally clean new and existing pipe lines so that they are free from internal deposits. Remove pipe obstructions and sewer service projections into the sewer in a manner approved by the Utility. If an obstruction or sewer service connection projection can not be removed internally, perform the removal using an open-cut excavation, and make any necessary pipe repairs in a manner approved by the Utility.

Perform liner installation according to the manufacturer's recommendations. Ensure that the liner neatly fits the internal circumference of the sewer to be lined. Allow for circumferential stretching during insertions according to the manufacturer's recommendations. Perform the work to fully impregnate and cure the liner in-place, or to reform the folded liner to fully conform the liner to the pipe interior, depending upon the method used. Monitor the pressures and temperatures at both ends of the pipe where the liner is being reformed to ensure the recommended pressures and temperatures are available to fully form the liner over the entire length of the liner run. Cool the liner and relieve the pressure for the recommended time to maintain the optimum temperatures and pressures to fully form the liner.

Seal the annular space between the newly installed liner and the sewer pipe where the sewer pipe enters and exits each manhole. Finish the seal on the manhole interior with a non-shrink grout. Ensure that the finished liner connection into each manhole has a watertight seal. Reinstall existing sewer service connections into the newly lined pipe.

652.03.04 Sanitary Sewer Service Connections

Comply with 651.03.01.B. Notify the Utility at least 5 days in advance of performing sewer service connections. Where new sewer mains are shown to be constructed, determine the location of existing service connections. Where service connections are not immediately being reconnected, plug the existing service to provide a watertight seal.

Maintain uninterrupted wastewater flow from each existing service connection, and provide a temporary service bypass connection when necessary. Install sanitary sewer service connections using an approved wye, wye saddle, or manhole stub. Install sanitary sewer connections so that they are watertight, according to the manufacturer's recommendations and the Utility's standards. Make the connection to the main using an approved flexible adaptor. If connecting to a manhole, and a stub, or knockout bulkhead is not available, connect to the manhole using a coring machine.

652.03.05 Sanitary Sewer Manhole

Construct sanitary sewer manholes as specified in 602.03.02. Paint the outside surface of the manhole walls with 2 coats of asphalt cement waterproofing according to the manufacturer's recommendations.

Provide watertight manhole castings, unless use of existing castings is specified. The RE will not accept sanitary sewer manholes that are not watertight.

652.03.06 Reconstruct Sanitary Sewer Manhole

Reconstruct sanitary sewer manholes as specified in 602.03.02. Paint the outside surface of the manhole walls with 2 coats of asphalt cement waterproofing according to the manufacturer's recommendations.

Provide watertight manhole castings, unless using existing castings are specified. The RE will not accept sanitary sewer manholes that are not watertight.

652.03.07 Reset Sanitary Sewer Manhole

Reset sanitary sewer castings as specified in 602.03.03. Paint the outside surface of the manhole walls with 2 coats of asphalt cement waterproofing according to the manufacturer's recommendations.

Provide watertight manhole castings, unless using existing castings are specified. The RE will not accept sanitary sewer manholes that are not watertight.

652.03.08 Video Inspection of Sewer

Perform video inspection of interior pipelines as specified in 601.03.04. Provide an additional copy of the tape or digital media to the Utility.

652.03.09 Sewer As-Built Plan

Upon completion of the sewer utility work, submit to the RE and to the Utility scaled as-built plans noting the location of all Items of sewer utility construction except RESET MANHOLE, SANITARY SEWER, USING EXISTING CASTING and RESET MANHOLE, SANITARY SEWER, USING NEW CASTING. On the plans, show stationing, distance references to the curb line, and 3 ties for each wye connection, valve, vent, and service connection within 50 feet to above-ground physical features. For gravity sewer mains, show rim, invert elevations, and pipe slopes. On the plans, show the depth of the sewer pipe and service connection at a minimum of 100-foot increments along the line or connection. Provide the as-built plans in a format acceptable to the Utility.

652.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
___" DUCTILE IRON SEWER PIPE	LINEAR FOOT
___" REINFORCED CONCRETE SEWER PIPE	LINEAR FOOT
___" REINFORCED CONCRETE SEWER PIPE, CLASS___	LINEAR FOOT
___" POLYVINYL CHLORIDE SEWER PIPE	LINEAR FOOT
___" DUCTILE IRON SEWER PIPE, BRIDGE	LINEAR FOOT
___" CORRUGATED STEEL SEWER PIPE	LINEAR FOOT
SANITARY SEWER PIPE LINING	LINEAR FOOT
SANITARY SEWER SERVICE CONNECTION	UNIT
MANHOLE, SANITARY SEWER	UNIT
MANHOLE, SANITARY SEWER, USING EXISTING CASTING	UNIT
RECONSTRUCTED MANHOLE, SANITARY SEWER, USING EXISTING CASTING	UNIT
RECONSTRUCTED MANHOLE, SANITARY SEWER, USING NEW CASTING	UNIT
RESET MANHOLE, SANITARY SEWER, USING EXISTING CASTING	UNIT
RESET MANHOLE, SANITARY SEWER, USING NEW CASTING	UNIT
VIDEO INSPECTION OF SEWER	LINEAR FOOT
SEWER AS-BUILT PLAN	LUMP SUM

The Department will measure ___" REINFORCED CONCRETE SEWER PIPE, CLASS___ by the linear foot including the tees, valves and bends measured parallel to the sewer pipe outside the limit of a structure.

The Department will measure ___" REINFORCED CONCRETE SEWER PIPE BRIDGE, CLASS ___ by the linear foot measured parallel to the sewer pipe within the limits of a structure.

The Department will make payment for restoring the existing pavement structure to the original condition or as shown on the Plans under the various Items the pavement structure is composed of.

SECTION 653 – GAS

653.01 DESCRIPTION

The work describes the requirements for installing gas mains, valves, vents, service lines, and gas valve boxes, and resetting gas valve boxes.

653.02 MATERIALS

Provide materials as specified:

Coarse Aggregate (No. 57)..... 901.03
Soil Aggregate (I-3) 901.11
Concrete 903.03

CLSM 903.09
Structural Steel 906.01
Bolts and Bolting Material 908.01
Class A Bedding 909.01.01
Class B Bedding 909.01.02
Class C Bedding 909.01.03
Timber for Structures 915.04

Provide steel pipe sleeves as according to ASTM A 252 and galvanize according to ASTM A 123.

Provide hot-dip galvanize channel supports, rods, bolts, nuts, washers, inserts, and other hardware required for the permanent installation as according to ASTM A 123 or A 153.

653.03 CONSTRUCTION

653.03.01 Gas Main

A. Prequalification. Only a pre-qualified contractor approved by the Utility may construct or relocate gas mains and appurtenances. The Department will list pre-qualified contractors for this work in the Special Provisions. The work restricted to pre-qualified contractors does not preclude the Contractor from performing sawcutting, pavement removal, removal of excess gas, and temporary or final pavement restoration associated with the work of constructing gas mains. Ensure that the work is performed according to the Utility's General Specifications.

B. Scheduling Work. Schedule work as specified in 651.03.01.A and according to 49 CFR 192.

C. Handling and Storing. The Utility will provide and deliver pipe in minimum 20 foot lengths, large fittings, and gas protective steel plate. Transport materials within the Project Limits. Coordinate delivery with the Utility

Pick up other gas main or service specific materials such as pipe, pipe sleeves, pipe hanger assemblies, expansion joints, and seals between the pipe and sleeves from the Utility at the location specified in the Special Provisions. Store and protect the pipe, and other materials received from the Utility. Support polyethylene pipe every 10 feet during storage and while being transported.

Return and deliver excess pipe, fitting, and other miscellaneous materials provided by the Utility to the Utility at the location specified in the Special Provisions.

Obtain material receipts from the Utility when material is being delivered by the Utility or returned to Utility and provide a copy to the RE

D. Existing Utilities and Structures. Comply with 651.03.01.B.

E. Excavating. Before excavating, sawcut the full depth of the existing pavement and sidewalk. Excavate a trench for placing gas pipe, valves, services, tees, and appurtenances. Obtain RE approval before finishing excavation. If the RE determines that the bottom of the trench is unstable, undercut as directed by the RE and backfill with Class B bedding. If the material at the bottom of the trench is rock or other hard material, excavate an additional 6 inches of the material below the bottom of the pipe. Ensure that trenches are kept free of standing water during the installation. Do not excavate for trenches in embankments until the embankment has been constructed to an elevation of at least 3 feet above the top of the pipe. Do not excavate trenches more than 300 feet in advance of installing the pipe unless approved by the RE.

Maintain trenches according to 29 CFR 1926. Provide and maintain trench crossings where necessary. For trenches in the traveled way, shoulder and within 30 feet of the outside edge of the shoulder, backfill and restore the pavement structure and match the surrounding condition before opening to traffic. The Contractor may use temporary protection instead of backfilling trenches in the traveled way and shoulder. If using temporary protection, submit working drawings for approval. For trenches not in the traveled way and shoulder, do not leave trenches open overnight unless protected with caution fence.

F. Installing Gas Mains. Identify areas where pipe will have less than 3 feet of cover. Provide the RE with a report of the identified areas in order to obtain the Utility's approval. Use a laser system to control the alignment and grade control of the pipe. Place Class B or C bedding and compact with a mechanical tamper using the directed method as specified in 203.03.02.C. Install the pipe so that it is solidly supported by the bedding over its full length except where recesses have been made at joint locations. Ensure that interior of the pipe is kept clean and free of

all intrusion by bedding, soil, or other foreign material. Install elbows and associated fittings. Cut standard elbows of 45 or 90 degrees to match the required elbow shown on the Plans or as required by field conditions. Install insulating joints, valves, valve risers, valves boxes, miscellaneous fittings, insulated locating wire, pipeline markers, and test stations. Maintain a 1-foot minimum clearance between utilities. Coordinate the installation of gas main with other work, and prevent conflicts and interference with existing facilities and proposed construction. Join pipe as follows:

1. **Welding Steel Pipe.** At least 15 days before installing gas mains, submit to the RE and to the Utility a copy of the welders' Performance Qualification Record showing the welder has been tested and approved by the Utility. Perform welding according API Standard 1104. Perform welding in a manner that is acceptable to the Utility.

   Do not tack ground clamps or other devices to the pipe. Repair arc burn damage to the pipe when the depth of the defect is less than 8 percent of the nominal wall thickness by grinding smooth. When the depth of the arc burn physical defect is greater than 8 percent of the nominal wall thickness, remove the defect and the adjacent firth weld. Do not perform welding repairs on gouges, scratches, arc burns or other defects of the pipe. The Contractor may make field repairs of gouges and groves in the parent metal of the pipe by grinding. Do not grind more than 8 percent of the nominal wall thickness of the pipe. Remove dents that contain stress concentrations, such as scratches, gouges, groves, or arc burns by cutting out the damaged portion of the pipe.

   Provide an examination of welds by radiographic (X-ray) inspection by a qualified inspection company approved by the Utility. Deliver the X-ray films and 1 copy of the radiographic inspection report to the RE and to the Utility. Apply or repair pipe coating so that pipe coating passes a holiday detector test. Seal field welds and fittings with Raychem Unisleeve or with a double layer of cold applied, 4-inch-wide, corrosion protective tape as directed by the Utility inspector. Install cathodic protection, including pipe coating, anodes and rectifiers, insulating joints, and test stations. Install the anodes at the lower elevation of the pipe (in or below the water table where possible) and offset the anodes as far as practical from the pipe. Do not place the anodes where other metallic structures such as conduit, cable or pipe is between the main and the anode. Provide temporary blocking to exposed end of gas mains to be abandoned in place using combination beam and column method. Do not backfill around the anodes with Class B bedding. Use excavated material for backfill around the anodes.

2. **Fusing Plastic Pipe.** At least 15 days before installing plastic gas mains, submit to the RE and the Utility the names and training qualifications of personnel intended to perform fusing on the work site for approval. Ensure that personnel fusing and inspecting butt fusion joints are certified according to 49 CFR 192. Before fusing plastic pipe, obtain the approval of the Utility for the heat fusion equipment. Fabricate steel to plastic transition fittings using an electric arc welder.

3. **Thrust Restraints and Bell Joint Encapsulation.** Install thrust restraints and bell joint encapsulation devices as directed by the Utility before excavating other areas around the main. The number of thrust restraints and bell joint encapsulations is dependent upon field conditions and the location of the tie-in and live gas excavations.

4. **Hot Tap Preparation.** When hot taps are performed by the Utility, in the presence of the Utility's representative, weld a spherical tee, 3-way tee, line stop fitting or other fitting on the existing steel main, or install a split sleeve collar, line stop fitting or other fitting on the existing cast iron main.

G. Backfilling. Symmetrically backfill on each side of the pipe using Class B bedding in lifts not exceeding 6 inches thick, loose measurement. Compact with a flat faced mechanical tamper using the directed method specified in 203.03.02.C. When the height of 1 foot above the pipe is achieved, place caution tape. Backfill the remainder of the trench with suitable excavated material that is free from rock larger than 2 inches in diameter in lifts not exceeding 6 inches thick, loose measurement. Compact with a flat faced mechanical tamper using the directed method as specified in 203.03.02.C.

For plastic mains with less than 2 feet cover, enclose with steel pipe or protect with a steel plate. If the pipe is in an area not subject to vehicular traffic, the Department will not require a steel plate. Reuse excess excavated material as specified in 202.03.07.A. Restore the existing pavement structure to the original condition or as shown on the Plans.

H. Line Stop and Tie-in Assistance. Excavate pits as required to provide access to the Utility for line stops, flow stops, bypass insertions, bagging and venting, hot tops, thrust restraints, purging, and tie-ins. Protect using temporary fencing or steel plates as directed. Maintain the excavation until the Utility has completed its work. Construct a concrete support pad under the pipe at locations requiring a line stop before the arrival of the Utility's line stop crew. Assist the Utility in handling the pipe by providing sufficient labor and equipment.

I. Tie-in and Gas Out. Perform cutouts and tie-ins at both ends of the pipe simultaneously. The Utility will purge and cut the pipeline. Once started, continue the work of tie-ins until completed. Keep tie-in excavations open or plated as required until the Utility has completed its work. As necessary, modify standard tie-in pieces to fit connection requirements.

J. Air-Pressure Test. Perform an air-pressure test on new pipeline including tie-in pieces under the direction and supervision of the Utility. Perform the test according to the pressures and durations provided in the Special Provisions. Locate and repair leaks in a manner that is approved by the Utility. Pig steel gas mains using a scraper barrel pig or a poly pig when testing plastic mains. Ensure that the pig is in a like new condition that is acceptable to the Utility. If using caps or expansion joints, anchor the pipe in a manner that is acceptable to the Utility to prevent any movement during the test.

653.03.02 Installing Gas Mains on Bridges

Install expansion joints in the main as instructed by the Utility representative. Comply with the requirements of 506.03.01 for structural shapes and plates for utility supports. Adjust hangers to provide uniform support of the pipe across the bridge and to align it in the abutment sleeves. Clean and paint the hanger supports as directed by the Utility.

653.03.03 Gas Service Connection

Comply with 651.03.01.B. Perform work associated with the transfer of service including the excavation of 1 tie-in hole for direct burial and transfer installations and 2 tie-in holes for insert installations. Submit to the RE and the Utility the names and training qualifications of personnel intended to install fused or mechanical connections for approval.

Turn off the gas at the service tee using pressure control equipment before cutting the existing service pipe. Disconnect the service pipe inside the building before the meter. Support the meter to avoid stressing the house piping. Install services either by inserting plastic tubing in the existing service or by directly burying plastic tubing or pipe.

1. **Installing Services with Direct Burial of Plastic Pipe.** Excavate as specified in 651.03.01.E.

   Install the direct burial plastic service including location wire from the main to the building, fuse the pipe, and assist the Utility to tie the connection into the gas main.

   Backfill above the pipe with Class B bedding in lifts not exceeding 6 inches thick, loose measurement. Compact with a flat faced mechanical tamper. When the height of backfill reaches 2 feet above the service connection, backfill the remainder of the trench with suitable excavated material that is free from rock larger than 2 inches in diameter in lifts not exceeding 6 inches thick, loose measurement. Compact with a flat faced mechanical tamper using the directed method as specified in 203.03.02.C.

   Install a curb shut-off valve and install a meter shut-off valve at the head of the service. Seal the hole in the foundation wall and surround the service pipe with cement or grout. Electrofuse or weld the self tapping tee to the main and connect it to the service using Electrofuse or mechanical fittings.

2. **Installing Services by Plastic Tubing Insertion.** Excavate and remove any curb shut-off, offset, swing or service drip that may impede the insertion of the plastic pipe. Ream the existing service from the building to the main. After reaming, air-blow the existing service from the building to the main. Insert the plastic tubing from the main to the building. Install a curb shut-off valve and install meter shut-off valve at the head of the service. Leave the meter shut off valve open with the plug installed. Electrofuse or weld the self tapping tee to the new main and connect it to the new plastic service using Electrofuse or mechanical fittings.

Pressure test the service as required and soap test all fuses and mechanical connections. Perform pressure and soap tests in the presence of the Utility inspector. Release the pressure, tap a self tapping tee, and gas out service through the hose from the meter shut off to the outside of the building until a gas reading of greater than 95 percent is obtained using a combustible gas indicator. Install a tee cap and soap test the cap.

653.03.04 Reset Gas Valve Boxes

Adjust the height of the existing valve box so that it is set flush with the proposed grade without disturbing the existing valve.

653.03.05 Gas As-Built Plan

Upon completion of the work, submit to the RE and to the Utility as-built drawings in a CADD format acceptable to the Utility.

653.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
___" GAS MAIN	LINEAR FOOT
___" GAS MAIN, BRIDGE	LINEAR FOOT
GAS SERVICE CONNECTION	UNIT
RESET GAS VALVE BOX	UNIT
GAS AS-BUILT PLAN	LUMP SUM

The Department will make payment for ___" GAS MAINS by the linear foot including the length projecting into the rear face of the abutment.

A unit of GAS SERVICE CONNECTION includes the permanent installation and any required temporary installation for each property.

The Department will make payment for restoring the existing pavement structure to the original condition or as shown on the Plans under the various Items the pavement structure is composed of.

DIVISION 700 – ELECTRICAL

SECTION 701 – GENERAL ITEMS

701.01 DESCRIPTION

This Section describes the requirements for constructing or installing various electrical Items.

701.02 MATERIALS

701.02.01 Materials

Provide materials as specified in:

Coarse Aggregate (No. 57)	901.03
Concrete	903.03
Grout	903.08.02.A
CLSM	903.09
Precast Concrete	904.01
Reinforcement Steel	905.01
Anchor Bolts	908.01.03
Miscellaneous Hardware	908
Pipe Bedding	909.01
Junction Box Frames and Covers	909.03
Coal Tar Epoxy Paint	912.01.03
Conduit and Fittings	918.01
Cable and Wire	918.02
Multiple-Lighting and Service Wire	918.02.03
Bonding and Grounding Materials	918.03
Resin Splicing Kits	918.05
Electrical Tape	918.06
Cable Racks	918.07
Cast Boxes and Fittings	918.08

Provide materials as specified in the Contract and in the New Jersey Electrical Materials Specifications that are available on the Department's website. A listing of pre-qualified materials is also available from the Department's website.

The Department will allow the use of pre-qualified materials provided the materials meet the requirements of the Contract. Submit materials for approval on a Materials Questionnaire as specified in 106.04. Include working drawings for certification with the Materials Questionnaire for materials not pre-qualified.

Follow the accepted standards of ANSI, NEMA, UL, NEC, ITE, and ASTM for materials not specified in the Contract.

Provide nylon cable ties with a tensile strength of 120 pounds.

Provide true tape with a tensile strength of 130 pounds.

701.02.02 Equipment

Provide equipment as specified in:

Vibrator	1005.04
Concrete Batching Plant	1010.01
Concrete Trucks	1010.02

701.03 CONSTRUCTION

701.03.01 Existing Systems

Follow the accepted standards of ANSI, NEMA, UL, NEC, ITE, and ASTM for construction operations not specified in the Contract. Ensure that the work complies with the requirements of the Utilities having jurisdiction at the device location.

At least 30 days before starting work on an existing system, submit a plan to the RE for approval that includes the proposed construction methods and describes how the existing systems will be maintained, modified, or operated during the performance of the work.

Systems are comprised of 1 or more new or existing Items to provide a fully functional operation. At least 20 days before starting work on an existing system, provide notification, as specified in 105.07, and arrange a meeting with the Department to verify the operational status of the existing systems and responsibilities for maintenance. Document the findings of the meeting and forward a written summary to the attendees. If work is performed on or damage occurs to an electrical system before the meeting with the Department, the Contractor assumes maintenance responsibility for that electrical system.

Do not interfere with the operation of existing systems that are not designated for modification or removal.

If modifying existing systems, salvage the existing above-ground materials for use in the modified system, or for alternative use, as specified by the Department. Store salvaged materials at or near the Project Limits as specified in 108.04. As directed, deliver salvaged materials to the nearest Department electrical maintenance yard or to the location specified in the Special Provisions and unload the materials where directed. Dispose of unused or unsalvaged materials from the Project Limits as specified in 201.03.09.

Provide connections and coordination with utility services as specified in 701.03.15.C.

701.03.02 Rigid Metallic Conduit (Earth)

A. Excavation. Comply with the requirements specified in 701.03.01. Excavate as specified in 202.03.02. Excavate trenches only for distances to be installed and backfilled during the same day. Prepare the trench bottom to eliminate lumps, ridges, and hollows.

B. Installation. Do not use aluminum conduit, and do not embed aluminum conduit in structural concrete.

Do not use disc grinders to cut conduit. Cut conduit square and true and ensure they butt together over their full circumference. Ream rigid metallic conduit ends, whether shop or field cut, to remove burrs and rough edges.

Thread rigid metallic conduit ends according to NEMA standards, and provide the free ends with grounded-type insulated bushings. For rigid metallic conduit with a diameter less than 1 inch, the Contractor may provide impact-resistant plastic, insulating bushings and bond lock nuts. Thread bonding bushings on the free ends of the conduit and lock bushings in place with set screws.

Coat ungalvanized threads on rigid metallic conduit resulting from field cuts and places where the galvanizing on the conduit or fittings has been damaged with a compound that is electrically conductive and prevents oxidation.

Construct a conduit run with at least 10-foot sections. The Contractor may use a shorter section to complete a conduit run into a foundation or junction box. Cap conduit that does not terminate in a junction box at the end of the workday.

If unable to use a standard coupling, use a UL-approved, concrete-tight compression coupling with a permanent stop. Do not use reducing couplings, except for expansion joints on bridges if necessary, to adapt a service conduit to the meter cabinet. Do not use couplings that use set screws. Do not use slip joints or running threads to couple rigid metallic conduit.

Make field bends to rigid metallic conduit with an industry-accepted hydraulic conduit bender. Provide a radius of at least 9 times the inside diameter of the conduit. Do not install more than two 90-degree bends between junction boxes, pull boxes, and foundations.

Ensure that bends and elbows used in service conduit conform to the Utility requirements. Ensure that conduit used for fiber optic cables meets the minimum bend and radius requirements as specified in the Contract and as required by the fiber optic cable manufacturer.

When installing rigid metallic conduit in structures, rigidly support the conduit before placing concrete. Install expansion joint fittings at structure expansion joints.

If installing conduit in existing junction boxes, cut additional holes in the junction boxes to admit the conduit. Grout around conduit installed in junction boxes before installing wire or cables.

If unable to install conduit with sufficient grade to provide drainage, install T-drains consisting of standard pipe tee and nipple for conduit at the lowest point of the conduit run.

Seal the underground conduit entrance to the meter cabinet and the wire entrance to the controller cabinet with a sealing compound.

Clean conduit runs, including existing conduit to be used. After cleaning, test each conduit by pulling through a metal ball with a diameter at least 85 percent of the nominal inside diameter of the conduit, to ensure that the conduit is free of any obstruction or foreign material. If the ball fails to pass through the conduit, repair or replace the defective conduit.

Install a 130-pound average breaking strength true tape marked in 1-foot increments for the length of the conduit. Cap and seal the conduit leaving the tape inside.

C. Backfilling. Ensure that conduit is centered in the trench and is held firmly in place while the trench is backfilled. Backfill with suitable excavated material that is free from rock larger than 2 inches in diameter in lifts not exceeding 6 inches thick, loose measurement. If the excavations do not provide sufficient material of the quality required for backfilling, provide and place the material necessary to make up the deficiency. Compact the backfill using the directed method as specified in 203.03.02.C. Restore the disturbed areas to original conditions, the conditions specified in the Contract, or as directed by the RE.

701.03.03 Rigid Metallic Conduit (Roadway)

Comply with the requirements specified in 701.03.01. Submit working drawings for approval, detailing the proposed method of jacking or directional drilling. Ensure that jacking or drilling and receiving pits are not within 2 feet from the edge of the pavement. Excavate the pits as specified in 202.03.02. Ensure that the force of the jacks is transmitted uniformly to the end face of the end pipe. Replace end sections of pipe that are damaged during jacking.

If obstructions are encountered during conduit installation, submit a new working drawing for approval detailing an alternate method of installation. This may include moving the location (horizontally and vertically).

If the alternate method is unsuccessful, the RE may allow the Contractor to use the open-cut method to excavate as specified in 701.03.02.A except sawcut the pavement full depth and no wider than 2 inches greater than the proposed conduit diameter. Excavate the trench, place and maintain the conduit in the center of the trench and fill the trench with CLSM to the bottom of the pavement structure. Replace the existing pavement structure in kind. Remove unsuccessful conduit and grout any voids left by the jacking or drilling operations as directed by the RE. The Contractor may leave the unsuccessful conduit in place if approved by the RE. Note these sections of conduit on the as-builts as abandoned. Restore disturbed areas to original conditions, the conditions specified in the Contract, or as directed by the RE.

701.03.04 Rigid Metallic Conduit (Exposed)

Comply with the requirements specified in 701.03.01. Install rigid metallic conduit as specified in 701.03.02.B. Also, install expansion joint fittings at structure expansion joints and provide necessary mounting hardware and fittings for the conduit run. Install and support exposed rigid metallic conduit parallel with or at right angles to the lines of the structure. Install and rigidly support concealed rigid metallic conduit in as direct a line as possible.

Ensure the following:

1. Aluminum conduit connected to steel conduit is separated by a stainless steel coupling.
2. Aluminum flexible conduit connected to a steel coupling is separated by a stainless steel nipple and coupling.
3. Aluminum conduit connected to steel or cast iron boxes is separated by a short stainless steel nipple with stainless steel couplings.

4. Aluminum resting on or against concrete surfaces has the contact surfaces painted with coal tar epoxy paint.

701.03.05 Rigid Nonmetallic Conduit

A. Excavation. Comply with the requirements specified in 701.03.01. Excavate as specified in 202.03.02. Excavate trenches only for distances to be installed and backfilled during the same day. Prepare the trench bottom to eliminate lumps, ridges, and hollows.

B. Installation. Install conduit on Class C bedding material and compact as specified in 202.03.02.

Do not use disc grinders to cut conduit. Cut rigid nonmetallic conduit square and true and ensure they butt together over their full circumference.

Construct rigid nonmetallic with at least 10-foot sections. The Contractor may use a shorter section to complete a conduit run into a foundation and junction box. Cap conduit that does not terminate in a junction box at the end of the workday.

Make rigid nonmetallic conduit connections according to the manufacturer's directions using manufacturer-recommended solvents. If connecting nonmetallic conduit to metallic conduit or other existing conduit, use a manufacturer's recommended adapter.

When installing rigid nonmetallic conduit in concrete, use a UL-approved, concrete-tight compression coupling with a permanent stop. Do not use reducing couplings, except for expansion joints on bridges if necessary, to adapt a service conduit to the meter cabinet.

Make field bends to rigid nonmetallic with an industry-accepted flameless heater designed to distribute heat evenly over the section of conduit being bent. Provide internal supports to prevent deformation of the conduit during bending. The Contractor may also use manufactured bends and elbows of material identical to the conduit. Do not install more than two 90-degree bends between junction boxes, pull boxes, and foundations.

Ensure that bends and elbows used in service conduit conform to the Utility's requirements. Ensure that conduit used for fiber optic cables meets the minimum bend and radius requirements as specified in the Contract and as required by the fiber optic cable manufacturer.

The Contractor may cut off damaged ends of rigid nonmetallic conduit, and use the remainder of the undamaged conduit on the Project, provided at least a 9-foot length remains. The RE will not allow other repairs to rigid nonmetallic conduit.

Do not repair rigid nonmetallic fittings. Remove broken, chipped, cracked, or impaired fittings, and replace with new fittings.

If installing 2 or more rigid nonmetallic, use impact-resistant plastic spacers. Install the spacers a maximum of 8 feet on center to provide a separation between conduit equal to at least 65 percent of the diameter of the conduit.

If installing conduit in existing junction boxes, cut additional holes in the junction boxes to admit the conduit. Grout around conduit installed in junction boxes before installing wire or cables.

If unable to install rigid nonmetallic conduit with sufficient grade to provide drainage, install T-drains consisting of standard pipe tee and nipple for conduit at the lowest point of the conduit run.

Seal the underground rigid nonmetallic entrance to the meter cabinet and the wire entrance to the controller cabinet with a sealing compound.

Clean rigid nonmetallic conduit runs, including existing conduit to be used. After cleaning, test each rigid nonmetallic conduit by pulling through a metal ball with a diameter at least 85 percent of the nominal inside diameter of the rigid nonmetallic conduit, to ensure that the conduit is free of any obstruction or foreign material. If the ball fails to pass through the conduit, repair or replace the defective conduit.

Install true tape marked in 1-foot increments for the length of the conduit. Cap and seal the conduit leaving the tape inside.

C. Backfilling. Ensure that conduit is centered in the trench and is held firmly in place while the trench is backfilled. Fill the trench sides around the conduit with Class C bedding material to the top of the conduit. If more than 1 conduit is in the trench, then also center fill. Place additional bedding material over the conduit to a depth of 6

inches and compact using a vibratory pad-type compactor. Above this depth, backfill with suitable excavated material that is free from rock larger than 2 inches in diameter in lifts not exceeding 6 inches thick, loose measurement, with a flat faced mechanical tamper. If the excavations do not provide sufficient material of the quality required for backfilling, provide and place the material necessary to make up the deficiency. Restore disturbed areas to original conditions, the conditions specified in the Contract, or as directed by the RE.

701.03.06 Flexible Metallic Conduit

Install according to NEC requirements.

701.03.07 Flexible Nonmetallic Conduit

A. Excavation. Comply with the requirements specified in 701.03.01. Excavate as specified in 202.03.02. Excavate trenches only for distances to be installed and backfilled during the same day. Prepare the trench bottom to eliminate lumps, ridges, and hollows.

B. Installation. Install nonmetallic conduit on Class C bedding material and compact as specified in 202.03.02.

Cut flexible nonmetallic conduit according to with manufacturer's recommendations.

Construct flexible nonmetallic conduit runs so that there are no joints or splices in the conduit between junction boxes. Ensure flexible nonmetallic conduit runs are terminated in the junction boxes at the end of the workday.

Ensure that conduit used for fiber optic cables meets the minimum bend and radius requirements as specified in the Contract and as required by the fiber optic cable manufacturer.

If installing flexible nonmetallic conduit in existing junction boxes, cut additional holes in the junction boxes to admit the conduit. Grout around conduit installed in junction boxes before installing wire or cables.

Seal the underground conduit entrance to the meter cabinet and the wire entrance to the controller cabinet with a sealing compound.

Clean flexible nonmetallic conduit runs, including existing conduit to be used. After cleaning, test each flexible nonmetallic conduit by pulling through a metal ball with a diameter at least 85 percent of the nominal inside diameter of the flexible nonmetallic conduit, to ensure that the conduit is free of any obstruction or foreign material. If the ball fails to pass through the flexible nonmetallic conduit, repair or replace the defective conduit.

Install true tape marked in 1-foot increments for the length of the flexible nonmetallic conduit. Cap and seal the flexible nonmetallic conduit leaving the tape inside.

C. Backfilling. Backfill as specified in 701.03.05.C.

701.03.08 Junction Box

Comply with the requirements specified in 701.03.01. Excavate as specified in 202.03.02. Place precast junction boxes on 6 inches of course aggregate No. 57. With each junction box, provide 4 cable racks, inserts and fasteners, and a ground rod and clamp. Do not provide the cable racks with the circular 20-inch junction boxes.

1. **Precast.** With RE approval, use precast junction boxes in areas where the slope is less than 22H:1V. Submit working drawings for approval for those locations approved.
2. **Cast-in-Place.** Construct cast-in-place junction boxes or junction box foundations as specified in 504.03.02. Keep forms in place for at least 24 hours after placing concrete. Neatly finish exposed portions of junction boxes with a wood float followed by brushing with a wet, soft-haired brush. Set junction box covers to grade with the surrounding area.
3. **Fabricated.** With RE approval, the Contractor may use fiberglass or polymer concrete junction boxes in areas where the slope is less than 22H:1V.

Backfill and compact using the directed method as specified in 203.03.02.D. Restore disturbed areas to original conditions, the conditions specified in the Contract, or as directed by the RE.

701.03.09 Metal Junction Boxes

Comply with the requirements specified in 701.03.01. Install on structures with mounting attachments according to the manufacturer's recommendations.

701.03.10 Junction Box Foundation

Comply with the requirements specified in 701.03.01. Excavate as specified in 202.03.02. Place cast-in-place junction box foundations on 6 inches of course aggregate. With each junction box foundation, provide 4 cable racks, inserts and fasteners, and a ground rod and clamp.

1. **Precast.** With RE approval, use precast junction box foundations in areas where the slope is less than 22H:1V. Submit working drawings for approval for those locations approved.
2. **Cast-in-Place.** Construct cast-in-place junction box foundations as specified in 504.03.02. Keep forms in place for at least 24 hours after placing concrete. Neatly finish exposed portions of junction box foundations with a wood float followed by brushing with a wet, soft-haired brush. Set junction box covers to grade with the surrounding area.

Backfill and compact using the directed method as specified in 203.03.02.D. Restore disturbed areas to original conditions, the conditions specified in the Contract, or as directed by the RE.

701.03.11 Junction Box Frame and Cover

Remove the existing junction box frame and cover, and the damaged portion of the wall as directed by the RE. Reuse concrete as specified in 202.03.07.A. Dispose of other material as specified in 201.03.09. Obtain RE approval to reuse the cover.

Reconstruct the walls to the elevation shown on the Plans. Ensure that the junction box frame is set to the correct elevation and held firmly in place. Place concrete, as specified in 504.03.02.D, and in accordance with the limitations specified in 504.03.02.C. Set the cover on the junction box frame. If the cover wobbles, grind to obtain a tighter fit.

701.03.12 Foundations

Comply with the requirements specified in 701.03.01. Excavate as specified in 202.03.02.

Set or finish the top of foundations to a level elevation 1 inch above curb or sidewalk. Where curbs or sidewalks are not constructed or do not exist, finish the top of foundations to an elevation 2 inches above the surrounding lawn or earth. For foundations used with lighting, finish the top of foundations to grade when installed with curb or sidewalk. Where curbs or sidewalks are not constructed or do not exist, finish the top of foundations to an elevation 1 inch above the surrounding lawn or earth.

1. **Precast Foundations.** With approval, the Contractor may use precast foundations for lighting standards in areas where the slope is less than 22H:1V. Submit working drawings for approval for those locations approved.
2. **Cast-in-Place Foundations.** Construct cast-in-place concrete foundations as specified in 504.03.02.

   Terminate conduit with a coupling flush with the surface of structural concrete, and provide the conduit with a close nipple. Provide pipe caps for the conduit during concrete placement. When the foundation finishing is complete, remove the pipe caps and install insulated grounding bushings. If not immediately installing wiring, install the bushings with push-penny plugs.

   Ensure that foundations are completely formed. Pour foundations monolithically on firm ground. Place conduit and anchor bolts in proper and plumb position and hold in place using a template until the concrete sets. Keep forms in place for at least 24 hours after placing concrete. Neatly finish exposed portions of foundations with a wood float followed by brushing with a wet, soft-haired brush.

   Allow foundations to cure for at least 3 days before installing poles, standards, or other equipment.

Place backfill as specified in 203.03.02.C. Restore disturbed areas to original conditions, the conditions specified in the Contract, or as directed by the RE.

701.03.13 Cable Rack

A cable rack consists of a cable rack, including inserts or fasteners. When pulling cable and wire through existing junction boxes not equipped with cable racks, install cable racks as directed by the RE. In addition, provide bonding bushings and bonding wire on metallic conduit ends within these junction boxes.

701.03.14 Meter Cabinet

Install cabinets, meters, control and distribution systems, including the grounding of all materials, the photoelectric control, and internal wire and wiring. Install the metering systems as required by the Utility.

701.03.15 Cable and Wire

A. Installing. Install cable and wire in the conduit system. Pull cable and wire through junction boxes to allow racking and connection to cabinets, standards, mast arms, and other Items.

Identify the circuit number of the cables and wires by attaching cable identification tags to each of the cables or wires in all junction boxes and in the cabinets of the load centers or controller. Secure tags to the cable or wire using nylon cable ties.

When pulling wires and cables through conduit, do not overstress or stretch, and take precautions not to score, twist, or damage the protective covering or insulation. Ensure wire lubricant is used or an industry approved wire pulling machine. Except for ground wire, provide all wires and cables in junction boxes, pull boxes and enclosures with adequate slack placed on the cable racks. Include a minimum length of slack as follows:

Table 701.03.15-1 – Minimum Length of Slack

Item	Length of Slack
Rectangular Junction Box	
Rigid Metallic Conduit	7 feet
Rigid Nonmetallic Conduit	9 feet
20-inch Junction Box (Circular)	5 feet[1]
Standard Base and Cabinet	3 feet

1. Secure slack with nylon cable ties, and place slack in the bottom of the box.

After installing cables and pending permanent splicing, seal the end of each section of cable jacket in junction boxes and service panels or cabinets with rubber tape, and then paint the ends with a waterproof sealing compound.

Secure conductors to the cable racks using nylon cable ties. Group and identify new and existing conductors in standard bases, junction boxes, meter cabinets, and controller cabinets using cable identification tags.

B. Bonding and Grounding. Bond and ground electrical circuits, metallic conduit, junction boxes, junction box foundations, above-ground material, and all other materials as specified in the NEC and as required by the Utility.

Ensure bare ground wire is used when installing a bonding wire in junction boxes and ITS Items. Secure it to the conduit bushings and to the ground rod.

For traffic signal systems, install an insulated, color-coded green, ground wire continuously throughout. Secure the ground wire to all ground rods and all materials requiring grounding.

For lighting systems, use either an insulated or bare ground wire.

C. Connection and Coordination with Utility Services. Install underground conduit and electrical conductors that extend from a meter cabinet or junction box to a point on the service pole or manhole, and supply a sufficient length of conductors to extend to the overhead utility service as required by the Utility and subject to its approval. Ensure the Utility completes the extensions of the conductors from this point on the pole and connections to overhead utility service, or the connection inside a service manhole.

Service points shown on the Plans are approximate only. Contact the serving Utility to determine the exact locations. Install the service conduit as required by the Utility. Notify the Utility and complete the required applications for inspection. Provide permits, fees, and access for inspections.

If the meter socket is not provided by the Utility, obtain the meter socket as required by the Utility's regulations. Verify the dimensions of the socket and meter to ensure proper installation in the cabinet and conformance with Utility's requirements.

Obtain and provide for utility services required for testing and operation of the electrical systems until Substantial Completion or as directed by the RE.

D. Testing. After completing the wiring for each electrical system and before making connections, perform the following tests on each circuit using suitable equipment in the presence of the RE:

1. Tests for continuity.
2. Tests for ground.
3. Tests for insulation resistance between circuit wires and from circuit wires to ground. Verify that the insulation resistance is at least 150 megaohms between conductors, or between conductor and ground for circuits with a total single conductor length of 1500 feet or more, and at least 175 megaohms for circuits with a total single conductor length of less than 1500 feet.

Complete the electrical system, including connections, and repeat continuity, ground, and insulation resistance testing starting from the control cabinet. Record the observed readings with their respective circuits. Submit 4 copies of the wiring test results to the RE. Record on the test results the Project title, the date of the test, and the atmospheric conditions.

Energize each electrical system, with the exception of traffic signals, for a minimum of 10 consecutive periods of normal operation.

In addition, test traffic signal and system loop detectors by checking the complete loop wire and detector lead for continuity using a suitable tester.

Before placing the sealant, perform an insulation resistance test on the loop and lead wire to ensure that the resistance to ground is 10 megaohms or greater. If the resistance to ground is less than 10 megaohms, perform corrective measures, as necessary, to obtain the desired readings.

Perform an inductance test on the loop using a loop inductance meter. Provide a tabulation of the results for the loops.

Replace defective material discovered during testing and retest as required.

701.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
___" RIGID METALLIC CONDUIT	LINEAR FOOT
___" RIGID NONMETALLIC CONDUIT	LINEAR FOOT
___ - ___" FLEXIBLE NONMETALLIC CONDUIT	LINEAR FOOT
___" FLEXIBLE METALLIC CONDUIT	LINEAR FOOT
___" JUNCTION BOX	UNIT
___" X ___" JUNCTION BOX	UNIT
___" X ___" X ___" METAL JUNCTION BOX	UNIT
JUNCTION BOX FOUNDATION	UNIT
JUNCTION BOX FRAME AND COVER	UNIT
FOUNDATION, TYPE ___	UNIT
CABLE RACK	UNIT
METER CABINET, TYPE ___	UNIT
GROUND WIRE, NO. ___ AWG	LINEAR FOOT
MULTIPLE LIGHTING WIRE, NO. ___ AWG	LINEAR FOOT
SERVICE WIRE, NO. ___ AWG	LINEAR FOOT

The Department will make payment for TEST PITS as specified in 202.04.

The Department will include the payment for bonding wire under GROUND WIRE.

The Department will make payment for each conduit when multiple conduits are installed in a run for RIGID METALLIC CONDUIT, RIGID NONMETALLIC CONDUIT, and FLEXIBLE METALLIC CONDUIT.

SECTION 702 – TRAFFIC SIGNALS

702.01 DESCRIPTION

This Section describes the requirements for providing and installing a complete traffic signal system, including temporary and interim traffic signal systems.

Terms used are according to NEMA Standard Publication No. TS-1, Section 1, entitled Traffic Control Systems.

702.02 MATERIALS

702.02.01 Materials

Provide materials as specified in:

Coal Tar Epoxy Paint 912.01.03
Loop Detector Lead 918.02.01
Loop Wire 918.02.02
Traffic Signal Cable 918.02.04
Cabinets 918.09
Panel Boards and Circuit Breakers 918.10
Standard and Mast Arms 918.12
Lamps 918.14

Provide materials as specified in the Contract and in the New Jersey Electrical Materials Specifications that are available on the Department's website. A listing of pre-qualified materials is also available from the Department's website.

The Department will allow the use of pre-qualified materials provided the materials meet the requirements of the Contract. Submit materials for approval on a Materials Questionnaire as specified in 106.04. Include working drawings for approval with the Materials Questionnaire for materials not pre-qualified.

Follow the accepted standards of ANSI, NEMA, UL, NEC, ITE, and ASTM for materials not specified in the Contract

When signs are mounted on traffic signal mast arms, use vertical mounted type, high-strength aluminum alloy, swing sign brackets with stainless steel materials; heavy duty stainless steel straps adaptable to any pole diameter; and removable stainless steel damper springs. Use adjustable swing sign brackets for leveling.

Use LED modules for all signals.

For fittings and mounting hardware not specified, follow the manufacturer's recommendations.

702.02.02 Equipment

Provide equipment as specified in:

Pavement Saw 1008.04
Hot-Air Lance 1008.06

702.03 CONSTRUCTION

Before working on an existing traffic signal system, meet the requirements of 701.03.01.

702.03.01 Controller

Before delivery of a controller to the Project Limits, bench test the controller as a complete unit according to the timing schedule for each location. At least 20 days before the bench testing, notify the Department for approval of the bench testing location. The Department may choose to witness part of the bench test. The Department will approve the controller only after 168 hours of continuous trouble-free operation. If unsatisfactory performance of the controller occurs, correct the problem and repeat the entire bench test. Provide the certified results of bench testing at the time of delivery on forms provided by the Department.

Securely bolt the controller cabinet to the foundation in a vertical position using stainless steel hardware. If temporarily installing a controller cabinet on top of a meter cabinet, fasten it in a vertical position using stainless steel hardware. Seal the joint between the cabinets with a neoprene gasket and seal the wireway with sealing compound.

702.03.02 Standards

Leave the factory wrapping on standards for as long as the manufacturer recommends. Install the standard with the wrapping in place, and maintain the standard and other material in original factory appearance. When erecting the standard and other material, use methods that prevent scratching or abrasion.

1. **Traffic Signal Standard.** Bolt the standard securely to the foundation, and erect the standard with sufficient rake to assume a vertical position after all attachments and appurtenances are in place. For aluminum standards, the Contractor may install leveling shims to a maximum height of 1/4 inch. Provide and install the standard with ground studs either in the base for aluminum or in the standard for steel. Install a ground wire that extends to the ground rod from the standard.
2. **Pedestrian Signal Standard.** Bolt the pedestrian signal standard to the foundation securely in a vertical position, using stainless steel hardware.

If signs are to be mounted to a standard, provide the necessary mounting hardware.

702.03.03 Traffic Signal Mast Arm

Leave the factory installed wrapping on the arm for as long as the manufacturer recommends. Install the arm with the wrapping in place, and maintain it in original factory appearance. Erect mast arms with methods that prevent scratching or abrasions. Install a traffic signal arm on a traffic signal standard with a pole clamp (as required), mast arm hanger, grommet, safety chains, swing sign brackets (as required), and miscellaneous fittings and hardware. Provide for all modifications or adjustments that may be required for staged construction.

702.03.04 Traffic Signal Cable

Install multi-conductor cable and cable identification tags. Individually wire each push button, traffic signal face and pedestrian signal face using the specified colors for each with an insulated locking spade terminal. Perform splices at the bottom of the standard.

Attach the terminations in meter cabinets or controller cabinets to barrier type terminal blocks. Ensure that the terminal blocks are clearly identified. Terminate and clearly identify spare wires.

Provide slack cable in standards, mast arms, and cabinets as specified in Table 701.03.15-1.

Color code traffic signal circuits and wire as follows:

Table 702.03.04-1 Conductor Cable Assignments

	Function	Color	Number
Two-Conductor Cable	Pedestrian Push Button	Black	1
	Neutral	White	2
Five-Conductor Cable (Traffic Signal)	Spare	Black	1
	Neutral	White	2
	Red	Red	3
	Green	Green	4
	Yellow	Orange	5

Table 702.03.04-1 Conductor Cable Assignments			
	Function	**Color**	**Number**
Five Conductor Cable (One Pedestrian Signal)	Spare	Black	1
	Neutral	White	2
	Don't Walk	Red	3
	Walk	Green	4
	Spare	Orange	5
Five Conductor Cable (Two Pedestrian Signal)	Walk (2)	Black	1
	Neutral	White	2
	Don't Walk	Red	3
	Walk	Green	4
	Don't Walk (2)	Orange	5
Ten-Conductor Cable (Traffic Signal)	Green Arrow (spare)	Black	1
	Neutral (1)	White	2
	Red (1)	Red	3
	Green (1)	Green	4
	Yellow (1) or Yellow Arrow	Orange	5
	Arrow Neutral (spare)	Blue	6
	Neutral (2)	White-Black	7
	Red (2)	Red-Black	8
	Green (2)	Green-Black	9
	Yellow (2)	Orange-Black	10

If splices are required above ground, use a compression solderless connector, and mechanically and electrically secure them with the proper tool. Clean the conductors with a minimum of the insulation removed. Insulate splices located in standards using insulating tape to provide 1-1/2 times the insulation rating of the original conductor. Coat the taped splices with an electrical grade sealant and bonding compound.

If splices are required below ground in junction boxes or junction box foundations, use a compression solderless connector, and mechanically and electrically secure them with the proper tool. Before splicing, clean the conductors with a minimum of the insulation removed. Complete splice with a resin splicing kit.

702.03.05 Traffic Signal Head

Assemble traffic signal faces using a wrench designed for that purpose. Use mounting fittings designed to function with the unit and that provide the proper clearance to aim and adjust the traffic signal head. If directed by the Department, install dull black louvers of the specified cut-off angle inside the signal visor using stainless steel sheet-metal screws. When attaching the visors, backplates, or adaptors, ensure that they conform and readily fasten to existing mounting surfaces without affecting the water and light integrity of the traffic signal head. Make field adjustments of louvers and optically programmed traffic signal heads as directed by the Department. Install cable from the traffic signal head to the foundation and make connections. If replacing an existing traffic signal head, remove the existing head and cable and dispose of as specified in 201.03.09.

702.03.06 Pedestrian Signal Head

Install a pedestrian signal head with pole clamp mounting, miscellaneous fittings and hardware, and grommet including drilling the standard as required. Install cable from the pedestrian signal head to the foundation and make connections. If replacing an existing pedestrian signal head, remove the existing head and cable and dispose of as specified in 201.03.09.

702.03.07 Push Button

Install a push button that operates on logic ground including its housing, and instruction signage. Install cable from the push button to the foundation and make connections. Install the instruction sign and ensure that it conforms to the MUTCD.

If replacing an existing push button, remove the existing head and cable and dispose of as specified in 201.03.09.

702.03.08 Image Detector

Install a camera mounted to a mast arm, with an automatic control unit, a pointing device, and all materials needed to provide accurate vehicle detection at the specified location. Mount and install according to the manufacturer's recommendation, including all cable and cable connections from the camera to the control unit without splices.

702.03.09 Loop Detector

Sawcut the pavement as shown on the Plans. After sawcutting, immediately collect the slurry from the sawcut cavity and surrounding pavement surface and dispose of as specified 201.03.09. Clean sawcuts with a 150-pounds-per-square-inch water blast to remove remaining debris in the sawcut cavity, and then blow sawcuts with a hot-air lance to provide a dry surface. If not immediately installing the loop wire, install a filler to prevent the sawcut from collapsing.

Place a continuous length wire in the sawcut. Install wire by laying turns of the wire in the sawcut so there are no kinks or curls. Do not strain or stretch the wire insulation around the corners of the sawcut or in the junction box. When seating the wire in the bottom of the sawcut, do not damage the wire. Do not splice the wire. Twist the 2 wires that form the lead-in wires together in the trench and in the conduit to the nearest junction box. Extend the wire from the sawcut to the nearest junction box.

Connect the loop wire to the loop detector cable using a compression solderless connector, and mechanically and electrically secure them with the proper tool. Clean the conductors with a minimum of insulation removed. Insulate the joints and splices using a resin splicing kit. After placing the wire, recheck the wire for slack, raised portions, or tightness. Correct slack, raised portions, and tightness in the wire.

After testing the loop for continuity, seal the sawcut with a joint sealant applied according to the manufacturer's recommendation. If installing a loop on a grade steeper than 3 percent, use Type 1 joint sealant. Do not place the joint sealant in the sawcut at temperatures below 45 °F or during precipitation. Completely fill the sawcut with the joint sealant so there are no air bubbles below the surface. Prevent joint sealant from running out of the trench and on to the roadway. Remove joint sealant applied to the roadway. Allow the joint sealant to harden before allowing opening to traffic.

When the roadway in the area of the loop detector is to be resurfaced, or when constructing a new section of roadway, install the loop detector immediately below the top layer of pavement. Ensure that the joint sealant is hardened before the installation of the pavement.

702.03.10 Loop Detector Cable

Install loop detector cable continuously from the controller to the junction box nearest to the loop. Do not splice the loop detector cable.

702.03.11 Temporary and Interim Traffic Signal Systems

After placing the temporary or interim traffic signal system into operation, inspect the traffic signal system every 2 months. Fill out a Contractor Maintenance Traffic Signal Inspection Report (Form EL-16C) when the temporary or interim traffic signal system becomes operational, when the temporary or interim traffic signal system is modified, and at every 2-month inspection.

Maintain as-built drawings of each signal modification. Place copies of the as-built drawings for each traffic signal system modification, Forms EL-16C, and Forms EL-11C in a plastic pocket mounted inside the cabinet door of each controller cabinet. Also provide a copy of all forms and as-built drawings to the RE.

If the temporary or interim traffic signal system fails or becomes damaged, repair and restore the temporary or interim traffic signal system to normal operation. Begin repair of the temporary or interim traffic signal system within 2 hours of

receiving notice of damage or malfunction from the Department, State police, or local authorities. Ensure that workers assigned to such repair work continuously until the traffic signal resumes normal signal operation.

For each response to a system failure or damage, fill out a Contractor Maintenance Emergency Call Record (Form EL-11C) and place it in a plastic pocket mounted inside the cabinet door of each controller cabinet.

If the Contractor fails to respond to a failure or damage notification and begin work within 2 hours of notification, or does not continue to work until the temporary or interim traffic signal system resumes normal operation, the Department, in the interest of safety, will respond with its own forces to restore normal operation. If the Department mobilizes its forces to effect repairs, the Contractor agrees to pay the Department a sum of $3000 for costs of mobilizing its forces and equipment. In addition, the Contractor must pay the Department the actual cost of material used for the repair and pay the actual costs of police traffic protection. The Department will recover the total amount as specified in 107.16.

Perform requirements that are specific to temporary or interim traffic signal systems as follows:

1. **Temporary Traffic Signal System.** A temporary traffic signal system includes, but is not limited to, temporary wiring, span and tether wire, signal heads, relamping, mast arms, poles, traffic signal cables, junction boxes, foundations, conduit, detectors, controllers and timing sequences, cabinets, associated lighting units, providing and maintaining electric services, and necessary hardware.

   If the Plans do not specify the design, at least 30 days before starting the installation, submit working drawings for approval. Prepare and design the system according to the Department design manuals. Include complete structural design calculations signed and sealed by a Professional Engineer.

   Before energizing the temporary traffic signal system, provide the RE with the contact information of the Contractor's personnel should a failure occur. Provide only individuals who are familiar with traffic signal construction and operation.

2. **Interim Traffic Signal System.** Install a modification to an existing traffic signal system to provide the timing and operation as shown on the Plans. An interim traffic signal system includes, but is not limited to, temporary wiring, span and tether wire, signal heads, relamping, mast arms, poles, traffic signal cables, junction boxes, foundations, conduit, detectors, controllers and timing sequences, cabinets, associated lighting units, obtaining electric services, and necessary hardware.

   The Contractor may use above-ground traffic signal materials designated for removal in interim traffic signal systems with the RE's approval.

   Maintain an interim traffic signal system from the first alteration of the existing traffic signal installations until the work of revising the existing traffic signal installations is fully operational, inspected, and partially accepted by the Department.

   Before modifying the existing traffic signal system, provide the RE with the contact information of the Contractor's personnel should a failure occur. Provide only individuals who are familiar with traffic signal construction and operation.

   Upon removal of the interim traffic signal system, salvage existing above-ground material for Department use. Salvaged material becomes property of the Department. Store salvaged material near or within the Project Limits. As directed, deliver salvaged material to the nearest Department electrical maintenance yard and unload the material as directed.

702.03.12 Controller Turn On

Controller turn-on consists of supplying a technician authorized by the controller manufacturer at the work site when each controller is placed into flash mode and into final operation. Provide the RE a letter, from the controller manufacturer, stating the technician is authorized and qualified to perform the work. Ensure that the technician is available at all times during flash mode testing. Ensure that traffic signals complete a successful flash period for 3 consecutive days as part of the required testing.

702.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
CONTROLLER, ___ PHASE	UNIT
TRAFFIC SIGNAL STANDARD, ALUMINUM	UNIT
TRAFFIC SIGNAL STANDARD, STEEL	UNIT
PEDESTRIAN SIGNAL STANDARD	UNIT
TRAFFIC SIGNAL MAST ARM, ALUMINUM	UNIT
TRAFFIC SIGNAL MAST ARM, STEEL	UNIT
TRAFFIC SIGNAL CABLE, ___ CONDUCTOR	LINEAR FOOT
TRAFFIC SIGNAL HEAD	UNIT
PEDESTRIAN SIGNAL HEAD	UNIT
PUSH BUTTON	UNIT
IMAGE DETECTOR	UNIT
LOOP DETECTOR	LINEAR FOOT
LOOP DETECTOR CABLE	LINEAR FOOT
TEMPORARY TRAFFIC SIGNAL SYSTEM, LOCATION NO. ___	LUMP SUM
INTERIM TRAFFIC SIGNAL SYSTEM, LOCATION NO. ___	LUMP SUM
CONTROLLER TURN-ON	UNIT

The Department will measure a unit of CONTROLLER TURN-ON for each controller that the technician turns on unless the controller does not function as specified.

The Department will make payment for LOOP DETECTOR measured by linear foot of sawcut in which the wire is installed.

SECTION 703 – HIGHWAY LIGHTING

703.01 DESCRIPTION

This Section describes the requirements for providing and installing complete highway lighting systems, temporary and interim highway lighting systems, sign lighting, underdeck lighting, and complete tower lighting systems.

703.02 MATERIALS

703.02.01 Materials

Provide materials as specified in:

Concrete	903.03
Grout	903.08.02.A
Reinforcement Steel	905.01
Anchor Bolts	908.01.03
Miscellaneous Pole Hardware	908.04
Coal Tar Epoxy Paint	912.01.03
Cable Connectors	918.04
Panel Boards and Circuit Breakers	918.10
Photoelectric Controls	918.11
Standard Lighting Mast Arm	918.12
Tower Poles	918.13
Lamps	918.14

Provide materials as specified in the Contract and in the New Jersey Electrical Materials Specifications that are available on the Department's website. A listing of pre-qualified materials is also available from the Department's website.

The Department will allow the use of pre-qualified materials provided the materials meet the requirements of the Contract. Submit materials for approval on a Materials Questionnaire as specified in 106.04. Include working drawings with the Materials Questionnaire for materials not pre-qualified.

Follow the accepted standards of ANSI, NEMA, UL, NEC, ITE, and ASTM for materials not specified in the Contract.

For fittings and mounting hardware not specified, follow the manufacturer's recommendations.

Include with each shipment and its invoice a list of all the parts on that specific shipment. Either box or bundle bolts, nuts, and other hardware, and identify each by the packing list.

703.02.02 Equipment

Provide equipment as specified in:

Vibrator	1005.04
Concrete Batching Plant	1010.01
Concrete Trucks	1010.02

703.03 CONSTRUCTION

Before working on an existing highway lighting system meet the requirements of 701.03.01.

703.03.01 Lighting Standard

Leave the factory installed wrapping on the standard for as long as the manufacturer recommends. Install the standard with the wrapping in place, and maintain the standard and other material in original factory appearance. When erecting the standard and other material, use methods that prevent scratching or abrasion. Repair abrasions and scratches.

Bolt the standard securely to the foundation, and erect the standard with sufficient rake to assume a vertical position after all attachments and appurtenances are in place. For aluminum standards, the Contractor may install leveling shims to a maximum height of 1/4 inch. Provide and install the standard with ground studs either in the base for aluminum or in the standard for steel. Install a ground wire that extends to the ground rod from the standard.

703.03.02 Lighting Mast Arm

Leave the factory installed wrapping on the arm for as long as the manufacturer recommends. Install the arm perpendicular to centerline of roadway, and attach to the standard. When mounting the arm and other materials, use methods that prevent scratching or abrasions. Repair abrasions and scratches. Provide modifications or adjustments that may be required for staged construction.

703.03.03 Luminaire

Attach the luminaire plumb to the end of the arm or on the standard. Ensure proper and accurate placement of the luminaire reflector.

Provide and install lamp, ballast terminals, cable connectors (fused and nonfused), and 2 No. 10 AWG color-coded, multiple-lighting wires extending from the ballast terminals to the distribution wires in the base of the standard or in the adjacent junction box.

Tag lighting wire by identifying the area, circuit, and luminaire number.

Use color-coded, single-conductor, multiple-lighting wire for lighting circuits. Pull conductors through conduit and junction boxes to allow racking and connection to luminaire and meter cabinet. Seal the underground conduit entrance to meter cabinets or transformer enclosures with a sealing compound.

Except for neutral and ground circuits, color-code lighting wire with plastic, colored tape overlapped from duct edge to duct edge within each junction box. Clearly identify neutral (white) and ground (green) circuits with continuous color compound along their entire lengths within the junction box.

Identify the circuit number of conductors by attaching cable identification tags to each conductor in all junction boxes and at the meter cabinets of the load centers. Secure tags to the conductor using nylon cable ties.

If pulling multiple-lighting wire through existing junction boxes not equipped with cable racks, install cable racks.

For cable splices in boxes, use a Type C copper pressure connector, and mechanically and electrically secure splices with the proper tool. Clean the conductors with a minimum of insulation removed.

For multiple-lighting wire splices, use a resin splicing kit as follows:

1. Use an in-line type splicing kit for joining a single conductor to another to form 1 continuous through conductor.
2. Use a tap or wye-type splicing kit where it is necessary to obtain a tap connection at a through conductor or where it is necessary to join together more than 2 conductors.

Keep the conductors and splicing connector centered within the mold, so an even amount of resin surrounds the splice.

If fastening electrical boxes to masonry with expansion fasteners, provide fasteners of sufficient size and strength to provide adequate support. Use stainless steel mounting bolts and anchors. If not using a boss, secure conduit entering electrical boxes to the box using lock nuts on the inside and outside of the box.

When a luminaire is shown on the Plans as being replaced, install a luminaire and cable connectors (fused and nonfused). Also install 2 No. 10 AWG, color-coded, multiple-lighting wires extending from the ballast terminals to the cable connectors in the base of the standard or to the mounting box for wall mounted replacements.

703.03.04 Sign Lighting

Securely bolt sign luminaires to the sign support perpendicular to the sign face.

Seal underground conduit entering sign service cabinets, meter cabinets, or transformer enclosures with sealing compound.

Install color-coded, single-conductor multiple-lighting wire for sign circuits. Ensure conductors run through the conduit and are properly trained through the junction boxes to permit racking and connection to sign service cabinets and to meter cabinet installations. Ensure splices form continuous circuits that are complete and ready for operation. Splice cables as specified in 703.03.03.

Use at least 2 circuits for each sign panel, and ensure fixtures are distributed alternately among the circuits.

Place wire for luminaires from the fixture to sign service cabinet.

Install an electrical outlet, junction, pull, and device boxes where required to facilitate the pulling, supporting, or connecting of wires and cables.

Ensure conduit entering metal boxes, except threaded boxes, exposed to the weather, is installed with 2 lock nuts, 2 flat washers, a lead washer, and bushing. When boxes are aluminum, ensure the lock nuts and flat washers are stainless steel. Ensure ground bushings are the insulated bushing type. Ensure bushing caps remain in place until just before conductors are installed. Secure continuous ground by bonding where required.

Install exposed rigid metallic conduit parallel with or at right angles to the lines of the structure and ensure that they are supported. Install concealed rigid metallic conduit in as direct a line as possible and ensure that they are supported.

Ensure aluminum conduit to be installed exposed on tubular aluminum sign structures are supported with clamps or bands with stainless steel saddles.

703.03.05 Underdeck Lighting

Install an underdeck luminaire, lamp, and 2 No. 10 AWG, color-coded, multiple-lighting wires extending from the ballast terminals in the luminaire to the distribution cables in the adjacent junction box for both new and replacement underdeck lighting.

703.03.06 Tower Lighting

Construct the foundation as specified in 504.03.02. Place reinforcement steel as specified in 504.03.01.

Install the tower structure on the foundation according to the manufacturer's requirements, including anchor bolts, base plate, pole, head frame assembly, luminaire support ring, lowering device including the winch assembly, circuit breaker

panel, power receptacles, terminal box, structural and power cables, secondary wiring, and luminaires. Install cable and wire from the lighting to the foundation and make connections.

Do not blast or finish the surface of the poles.

Either permanently stamp or weld a beam plate to each pole base plate indicating the manufacturer's name, date, and pole design reference number.

703.03.07 Temporary Highway Lighting System

At least 30 days before beginning the work, submit working drawings for approval that include the following:

1. Structural design calculations signed and sealed by a Professional Engineer.
2. Calculations in IES electronic format that are signed and sealed by a Professional Engineer, Electrical with 3 years experience in design of lighting systems according to the Department's design manuals.
3. Luminaires and ballasts.
4. Lighting mast arms and standards.
5. Temporary, lighting, ground, and tether wire.
6. Method of splicing cable and wire.
7. Method of tagging and clearly identifying items.
8. Junction boxes and foundations.
9. Conduit.
10. Meter cabinets and lighting circuitry.
11. Method of electrifying the system.
12. Other items necessary to provide a complete system for the Project.

Ensure that the lighting system is designed according to the Department's design manuals. Ensure the temporary highway lighting system is operational before removing existing lighting.

The Contractor may use the existing above-ground highway lighting material designated for removal for the temporary highway lighting system.

Obtain and pay electric current cost for new temporary electric service if required to maintain the existing highway lighting system in operation during construction.

Obtain electric service for the temporary system from the Utility in the name of the Contractor. Before energizing the temporary highway lighting system, provide the RE with the contact information of the Contractor's personnel should a failure occur. Provide only individuals who are familiar with highway lighting construction and operation.

Ensure that the as-built drawings of each lighting unit modification are maintained at the Project Limits. Place copies of the as-built drawings in a plastic pocket mounted inside the cabinet door of each lighting cabinet and also provide copies of the as-built drawings to the RE.

Upon removal of the temporary highway lighting system, salvage existing above-ground materials for Department use. Salvaged materials becomes the property of the Department. Deliver the salvaged materials to the nearest Department electrical maintenance yard, or to the location specified in the Special Provisions and unload the materials where directed. If storage is necessary, store salvaged materials within the Project Limits.

If the temporary lighting system fails or becomes damaged, repair and restore the system to normal operation. Begin repair of the temporary signal system within 2 hours of receiving notice of damage or malfunction from the Department, State police, or local authorities. Ensure workers assigned to such repair work continuously until the lighting system is restored to normal operation.

For each response to a system failure or damage, fill out a Contractor Maintenance Emergency Call Record (Form EL-11C) and place it in a plastic pocket mounted inside the cabinet door of each controller cabinet.

If the Contractor fails to respond to a failure or damage notification and begin work within 2 hours of notification, or does not continue to work until the temporary lighting system is restored to normal operation, the Department, in the interest of safety, will respond with its own forces to restore normal operation. If the Department mobilizes its forces to effect repairs, the Contractor agrees to pay the Department a sum of $3000 for costs of mobilizing its forces and equipment. In addition, the Contractor must pay the Department the actual cost of material used for the repair and pay the actual costs of police traffic protection. The Department will recover the total amount as specified in 107.16.

703.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
LIGHTING STANDARD ALUMINUM	UNIT
LIGHTING STANDARD STEEL	UNIT
LIGHTING STANDARD FIBERGLASS	UNIT
LIGHTING MAST ARM ALUMINUM	UNIT
LIGHTING MAST ARM STEEL	UNIT
LUMINAIRE	UNIT
SIGN LIGHTING, STRUCTURE NO. ___	LUMP SUM
UNDERDECK LIGHTING TYPE ___	UNIT
TOWER LIGHTING	UNIT
TEMPORARY HIGHWAY LIGHTING SYSTEM	LUMP SUM

SECTION 704 – INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

704.01 DESCRIPTION

This Section describes the requirements for providing, installing, configuring, calibrating, testing and placing into operation Advanced Traveler Information Systems (ATIS) and Advanced Traffic Management Systems (ATMS).

704.02 MATERIALS

704.02.01 Materials

Provide materials as specified in:

Coarse Aggregate (No. 57)..... 901.03
Concrete 903.03
Grout 903.08.02.A
Precast Concrete..... 904.01
Reinforcement Steel 905.01
Anchor Bolts 908.01.03
Miscellaneous Hardware 908
Coal Tar Epoxy Paint 912.01.03
Conduit and Fittings..... 918.01
Cable and Wire..... 918.02
Loop Detector Lead..... 918.02.01
Loop Wire 918.02.02
Bonding and Grounding Materials 918.03
Resin Splicing Kits..... 918.05
Electrical Tape 918.06
Cable Racks..... 918.07
Cabinets..... 918.09
Panel Boards and Circuit Breakers..... 918.10
Standards..... 918.12

Follow the accepted standards of ANSI, NEMA, UL, NEC, ITE, and ASTM for materials not specified in the Contract.

For fittings and mounting hardware not specified, follow the manufacturer's recommendations.

Provide materials as specified in the Contract and in the New Jersey Electrical Materials Specifications that are available on the Department's website. A listing of pre-qualified materials is also available on the QPL.

Submit electrical material information, including any materials selected from the pre-qualified materials, in a complete package with the working drawings for approval for each system Item. Electrical materials must be approved in the

working drawings before use on the Contract. After approval of the working drawings, submit the materials in a Material Questionnaire form as specified in 106.04.

Label ITS electronic components with machine printed, laminated, self-adhesive labels using the industry standard format and nomenclature described in the Common Language Equipment Identification (CLEI) publication GR-485-CORE for communications and electronic devices.

For materials provided and installed, provide a minimum 2-year warranty from the date of Substantial Completion or Partial Acceptance against any imperfections in workmanship or materials. Submit a warranty certificate to the RE from each material manufacturer, with the Department named as holder of the certificate.

704.02.02 Equipment

Provide equipment as specified in:

Vibrator 1005.04
Pavement Saw 1008.04
Hot-Air Lance 1008.06
Concrete Batching Plant 1010.01
Concrete Trucks 1010.02

704.03 CONSTRUCTION

704.03.01 General System (GS)

A. Components. A GS consists of the specified Items needed to modify an existing system or construct a proposed system. The system includes, but is not limited to, electronic and electrical devices, cabinets, wiring, programming, configuration, communication and electric service connections, service charges, utility software, grounding, and surge protection

B. Installation. Before beginning the work and during the work, comply with the requirements of 701.03.01. The allowable time frame for existing system shutdown and the cost of damages for exceeding the allowable time frames is specified in the Special Provisions. The Department will recover the cost as specified in 107.16.

Construct components as follows:

1. **Junction Box ITS.** Excavate as specified in 202.03.02. Install junction boxes only in areas where the slope is not less than 22H: 1V. Place junction boxes on 10 inches of coarse aggregate No. 57. With each junction box, provide 6 coiling brackets, inserts and fasteners, and a ground rod and clamp. A ground rod is only required for locations where electrically conductive material is present. Backfill and compact using the directed method as specified in 203.03.02.D. Restore disturbed areas to the original conditions, the conditions specified in the Contract, or as directed by the RE.

2. **Communication Cable.** Install communication cable from the utility pole or manhole to the controller. Provide and install the material necessary to provide a complete installation, including a weather-tight terminal block enclosure on the utility pole as required by the Utility, cable ties, cable tags, labels, clamps, jumpers, and connectors. Ensure that there are no splices in the section of cable between the terminal block and the devices.

   Provide the standard allowable slack for cable and wire, as specified in 701.03.15.A, within the in-ground rectangular junction boxes. Provide 3 feet of slack with an appropriate connector in the cabinet for connection to devices and utility service. Provide 10 feet of slack to allow for the Utility to make their connections in the manholes or on utility poles.

3. **Foundation ITS.** Construct the foundation as specified in 701.03.12.

4. **Controller ITS.** At least 30 days before beginning the work, submit working drawings for approval that include a block wiring diagram illustrating the interconnections of the system components from the field location to the designated control center. Identify each component by manufacturer, model, and CLEI number.

Securely bolt the controller, equipped with communications and electronic devices for a fully functional and operational system, to the foundation in a vertical position using stainless steel hardware.

5. **Communication Hub.** Submit working drawings for approval that include a block wiring diagram illustrating the interconnections of the system components from the field location to the designated control center. Identify each component by manufacturer, model, and CLEI number.

   Install system alarms with communications back to the designated control center central software system. Ensure alarms are operational to monitor the following: humidity (high and low), smoke, temperature (high and low), door open and power failure.

6. **Control Center System.** Submit working drawings for approval that include a block wiring diagram illustrating the interconnections of the system components from the field location to the designated control center. Identify each component by manufacturer, model, and CLEI number.

C. Testing. Perform wiring and cable testing, as specified in 701.03.15.D, before performing any other system testing. Record the results of the testing on Department provided forms. Within 5 days of completing the testing, submit the forms to the RE for approval. Do not begin subsequent testing until the previous testing has been approved by the RE.

1. **Device Testing.** Before beginning system testing, complete all individual device testing as follows:

   a. **Level A.** Demonstrate that the individual devices at each work site are fully operational.

   b. **Level B.** Demonstrate that each device is full operational from the designated control center to the work site with the original equipment manufacturer's software. The Department will operate and monitor the device for a minimum of 7 days to observe its functionality.

   c. **Level C.** Demonstrate that each device is fully operational from the designated control center to the device work site after integration into the designated control center software management systems. Conduct a test to verify that the device and communications meet the specified requirements of the Contract. After the Contractor's verification test, the Department will conduct a 14-day observational and functional test period. Provide support as needed during this testing, including adjustments to or replacements of any of the equipment and materials installed, modified, or otherwise disturbed until the full 14-day observation period is completed without failure as determined by the Department.

2. **Project Testing.** After completion of device testing, verify the operation of the individual devices from all locations interconnected and functioning as a complete and integrated system by exercising control with the central control software of Level C. In the presence of the RE, ensure that the manufacturer's authorized technician is present to assist with installation, configuration, and testing of system hardware and software.

   After the Contractor's verification test, the Department will conduct a 14-day observational and functional test period. Provide support including adjustments to or replacements of equipment and materials until the 14-day observation and functional test period is completed.

   In the event of a failure as determined by the RE, the RE will suspend the observation and functional test period until corrective action is completed. After the corrective action is completed, the RE will resume the observation and functional test period.

D. Maintenance. Perform maintenance as follows:

1. **Regular Maintenance.** Perform regular maintenance and repairs as specified in 108.09 and as follows:

   1. Troubleshoot malfunctioning equipment within 48 hours of failure notification by the RE.
   2. If the Contractor cannot complete the repairs in the time specified by the RE, the Department may repair the equipment and recover the cost as specified in 107.16. The Department will assess liquidated damages at a minimum of $1000 per hour.
   3. Record the work performed and submit the record to the RE. Include an explanation of the exact repairs made and identification of parts replaced by part number and circuit number.

   If the Contractor fails to respond to a failure or damage notification and begin work within 2 hours of notification, the Department may respond with its own forces to restore normal operation. If the Contractor begins the work but does not finish the work within a reasonable time period as determined by the RE, the

Department will also respond with its own forces to restore normal operation. If the Department mobilizes its forces to perform repairs, the Contractor agrees to pay the Department's cost of performing the work including the cost of material and labor used for the repair and the actual costs for police traffic protection and maintenance and protection of traffic.

2. Operational Maintenance. If an Item has completed system device testing before Substantial Completion, perform operational maintenance in 6 month intervals as follows:

1. Exercise the equipment functionality, including uploads, downloads, fans, lights, and sensors.
2. Replace filters, clean lenses, and check communications.
3. Run diagnostics.
4. Record all work and submit it to the RE.

E. Final Documentation. Submit 2 sets of the complete schematics and maintenance manuals of the equipment for each type of device provided. Include a complete sub-component parts list with each maintenance manual.

Submit as-built documentation showing the function and detail of each individual fiber and termination connection installed. Submit as-built drawings for each subsystem, including wiring and set up configurations, and software versions.

Provide drawings and diagrams in the Department's CADD format in accordance with the file structure and standards of the Department. Provide reports in MS Word format.

At a minimum, also include the following documentation:

1. Controller equipment layout and wiring.
2. System wiring diagram that illustrates the connections and cross-connections between equipment components from the field device through to the designated control center equipment and rack profiles. Include work site and designated control center set up configurations and firmware versions installed.
3. Licensed copies of the software needed for complete operation and testing of the system. Include software necessary to read the electronic files of the test results and documentation and needed to program and configure devices for any software not covered by an existing Department license. Ensure software is compatible with the Department's current operating software.
4. Controller communication protocol and System Development Kit.
5. As-Built (GPS) Inventory Report on forms provided by the Department and in the required format.
6. Provide the original signature certification from an independent laboratory that the devices have been tested and comply with the NTCIP protocol requirements of this Contract.
7. Supply 2 CD-R copies of the final documentation and 2 paper copies. Compile and organize the test results in 3-ring binders.
8. Provide troubleshooting guidelines that identify symptoms, rank their possible causes in order of highest probability, and recommend remedial actions and the required testing equipment.
9. Installation, operation, configuration, programming, maintenance, data, and schematic manuals.

F. Equipment Training. Provide, for use by the Department, equipment necessary for proper instruction, demonstration, and testing of the system materials. Submit software used for testing to the Department for use in equipment maintenance. The software will become the property of the Department.

Provide training for installation, control, testing, and maintenance of the systems for 10 Department personnel. Schedule the training with the designated control center personnel to avoid interruption of daily Department operations. If necessary, conduct the training over several sessions or in multiple groups.

704.03.02 Camera Surveillance System (CSS)

A. Components. CSS consists of the specified Items in order to provide a complete system capable of processing video and control data to and from the designated control center. The system also includes but is not limited to wiring, communication and power connections, service charges, software, grounding, and surge protection.

B. Installation. Before beginning the work and during the work, comply with the requirements of 701.03.01. The allowable time frame for existing system shutdown and the cost of damages for exceeding the allowable time frames is specified in the Special Provisions. The Department will recover the cost as specified in 107.16.

Construct components as follows:

1. **Foundation CSS.** Construct the foundation as specified in 701.03.12.

2. **Camera Standard.** Bolt the standard securely to the foundation, and erect the standard with sufficient rake to assume a vertical position after all attachments and appurtenances are in place. Install a ground wire that extends to the ground rod from the standard.

3. **Camera.** Mount the camera housing and camera according to the manufacturer's recommendation. Ensure that the camera's field of view is unobstructed. Perform tree trimming and site clearing to provide an unobstructed field of view as directed by the RE. Set up 4 preset views for each camera and establish a proposed system of pan and tilt zones. Title each zone as specified by the Department.

   Ensure the camera is equipped with video and control cables that have weatherproof connectors and strain relief. Ensure cables are factory assembled and tested according to the camera manufacturer's recommendations. Make all wire and cable camera connections to the camera controller.

   Apply a polymer spray recommended by the camera manufacturer to enhance rainwater sheeting and runoff on the dome and positional housing.

   If directed by the RE, provide a bucket truck with safety equipment that can reach the height of the camera. Operate the bucket truck for the Department to use to determine the camera's final location and orientation, and for testing.

4. **Controller, Camera.** Submit working drawings for approval that include a block wiring diagram illustrating the interconnections of the CSS components from the field location to the designated control center. Identify each component by manufacturer, model, and CLEI number.

   Mount the camera controller cabinet to a foundation as specified in 704.03.01.B.4. Ensure that the conduit entry points are properly closed off with duct sealing compound. Install the controller according to the manufacturer's recommendations.

C. Testing. Perform testing as specified in 704.03.01.C.

D. Maintenance. Perform maintenance as specified in 704.03.01.D.

E. Final Documentation. Provide the documentation specified in 704.03.01.E.

F. Equipment Training. Provide training as specified in 704.03.01.F and in the Special Provisions.

704.03.03 Fiber Optic Cable

A. Components. When installing fiber optic cable, provide a complete communications path between 2 or more ITS devices. Installing fiber optic cable includes, but is not limited to, providing and installing conduit, junction boxes, cables, splicing, communication and power connections, service charges, terminations, software, and grounding.

At least 30 days before beginning work, submit to the RE for approval a fiber optic installation plan that lists the following items and includes a brief narrative on each:

1. Cable layout with splice locations and linear distances between splice points.
2. Fiber specific connection assignments to devices.
3. Catalogue cut of the cable lubricant.
4. The manufacturer's minimum allowable cable and fiber strand bending radii.
5. Pulley wheel sizes.
6. Manufacturer's maximum outer jacket pulling tensions and monitoring device.
7. If using an air pressure system, list the blowing pressures applied to each cable size and conduit type.
8. Provide certifications from the fiber optic splice unit, OTDR, and power meter equipment manufacturer that verify the qualifications of each individual employed to perform the work.

B. Installation. Before beginning the work and during the work, comply with the requirements of 701.03.01. The allowable time frame for existing system shutdown and the cost of damages for exceeding the allowable time frames is specified in the Special Provisions. The Department will recover the cost as specified in 107.16.

Provide and install the material necessary for a complete, functional installation including cables, cable ties, jumpers, cable identification tags, pigtails, breakout kits, connectors, patch panels, splices, splice enclosures,

testing, end caps, consumables, attenuators, and related documentation. Ensure that cable tags follow the industry standard CLEI GR-485-CORE format and nomenclature for communications and electronic components.

After the connections are completed, provide the minimum amount of slack for each cable that enters a junction box or termination enclosure as specified in Table 701.03.15-1. Provide additional slack as required to meet the proposed installation as follows:

1. For an ITS Junction Box provide 30 feet of slack
2. For a Hub provide 10 feet of slack
3. For a Cabinet provide 3 feet of slack

Attach cable tags to cables at junction boxes that contain multiple cables and at all cabinets. Secure them with nylon cable ties.

For armored cables, install a ground rod, ground and bond all armor casings at any existing or proposed junction box at which electrical power conductors are also present.

Before installing the tracer wire, obtain RE approval of the installation locations of the tracer wire. Install a continuous tracer wire in the conduit. Do not splice tracer wire in the conduit. Provide 10 feet of slack in each junction box. If approved by the RE, the Contractor may splice the tracer wire in the junction box. If more than one conduit is installed in a single trench, the Contractor may install the tracer wire in only one conduit.

Ensure that splices are fusion splices. Install splices only in ITS junction boxes or ITS cabinets. Use splice enclosures for splices made in junction boxes. Cut only those individual fiber strands needed for connection to the devices. For those fibers designated for trunk line communications, do not cut the fibers or install cables that require splices at lengths less than 2500 feet.

Splice a fiber optic breakout kit with ST type connectors to each end of the strands for a cable that terminates at a device cabinet. Label each strand using machine-printed, laminated, self-adhesive labels. Fully document the connections and individual splices in the as-built drawings.

C. Testing. Perform wiring and cable testing as specified in 701.03.15.D before performing any other testing. The Department will provide forms detailing the testing requirements for the following tests:

1. Level 1. Test each splice with the fusion splicing unit at the time the splice is made. Record each splice decibel value electronically with the splicing machine at 1310 nanometers. Provide 2 paper copies and 1 electronic copy of the results immediately to the RE for review and approval. Clearly identify each fiber on the report. Ensure that the maximum splice loss does not exceed 0.05 decibels. If the 0.05-decibel value cannot be reached in 3 attempts, the RE may employ a third party vendor to re-do the work with the costs deducted from the Contract. Provide the RE with certification from the equipment manufacturer that the splice machine was calibrated within 3 months of its use on the Contract. Recalibrate the splice machine at 6-month intervals.

2. Level 2. Perform the following Level 2 tests:

a. OTDR. Test each individual fiber after completion of all splicing and connections. Perform the testing at 1310 and 1550 nanometers in both directions. Ensure that the maximum decibel loss for any single event is not greater that 0.3 decibels at 1310 nanometers; however, ensure that the OTDR machine threshold is set to record all events greater than or equal in absolute value to 0.05 decibels along the positive and negative axes. Events revealed by the OTDR machine bi-directional trace average to exceed 0.3 decibels are cause for the rejection of the cable. If directed, remove and replace the cable.

Ensure that the net result of the bi-directional trace average at 1310 nanometers across a splice event is not greater than 0.15 decibels. Redo splices revealed by the OTDR machine to be greater than 0.15 decibels up to 2 additional times in order to achieve 0.15 decibels or less. If the 0.15-decibels value cannot be reached in 3 attempts, the RE may employ a third party vendor to re-do the work. The Department will recover the cost as specified in 107.16.

Ensure that reflectance at each connector is better than −55 decibels.

Ensure the fiber loss across each fiber segment is not greater than 0.4 decibels per kilometer when tested at 1310 nanometers.

Also test, and include in the report, the dark fiber segments that are not being utilized by the signal transmission equipment. Provide connectors as necessary to test unterminated fibers.

Provide 2 paper copies and 1 electronic copy of the results immediately to the RE for review and approval. Clearly identify each fiber on the report. Provide RE with certification from the equipment manufacturer that the OTDR was calibrated within 3 months of its use on the Contract. Recalibrate the OTDR at 6-month intervals.

b. Power Meter. Measure and record all fiber segment optical budgets including each end connector, according to the meter manufacturer instructions. Compile the test results in a binder and submit 2 copies with the final documentation. Perform power meter tests at 1310 nanometers and 1550 nanometers in both directions after completion of all cable and connector splicing. Ensure that the maximum connector loss tested at 1310 nanometers is 0.8 decibels with the average of all connectors in the tested fiber segment being 0.5 decibels.

Provide 2 paper copies and 1 electronic copy of the results immediately to the RE for review and approval. Clearly identify each fiber on the report and the work site location of the end points. Provide the RE with a certification from the equipment manufacturer that the power meters were calibrated within 3 months of their use on the Contract. Recalibrate at 6-month intervals.

Record the results of the testing on the Department provided forms. Within 5 days of completing the testing, submit the forms to the RE for approval. Do not begin subsequent testing until the previous testing has been approved by the RE.

D. Maintenance. Perform maintenance as specified in 704.03.01.D.

E. Final Documentation. Provide the following:

1. Individual splice connection as-built drawings in the format specified by the Department.
2. Splice machine, OTDR, and power meter readings with manufacturer's software disks to read the test results. Include power meter test results for each individual fiber section showing the optical budget between the termination point connectors. Include all unused fibers. Include OTDR electronic trace files and computer software so that the user can set any threshold values desired for all parameters and can view all ranges of events.
3. Cable identification key sheet.
4. Spreadsheets that identify the file names of the same fiber shot in both directions. Identify the individual common events and calculate the true event loss by averaging the point value of the fiber traces from each direction. Include this calculation in the spreadsheet tables. Supply 2 CD-R copies of the final documentation and 2 paper copies. Compile and organize the test results in 3-ring binders.
5. Licensed copies of splice and test equipment software. Ensure that the software is compatible with Windows XP operating system.
6. Communications system equipment fiber optic interconnections, including patch panel cross connections.
7. Inventory Report on the form provided by the Department.

F. Equipment Training. Provide training as specified in 704.03.01.F and in the Special Provisions.

704.03.04 Controlled Traffic Signal System (CTSS)

A. Components. CTSS consists of the Items needed to provide a complete system that is capable of controlling a series of interconnected signalized intersections and processing control data to and from the designated control center. The system also includes, but is not limited to, electronic and electrical devices, cabinet, wiring, programming, configuration, communication and electric service, service charges, connections, software, grounding, and surge protection.

B. Installation. Before beginning the work and during the work, comply with the requirements of 701.03.01. The allowable time frame for existing system shutdown and the cost of damages for exceeding the allowable time frames is specified in the Special Provisions. The Department will recover the cost as specified in 107.16.

Construct components as follows:

1. **Controller, CTSS.** Submit working drawings for approval that include a block wiring diagram that illustrates the interconnections of the CTSS components from the field location to the designated control center. Identify each component by manufacturer, model, and CLEI number.

   Construct as specified in 702.03.01.

2. **CTSS Controller Unit.** Submit working drawings that include a block wiring diagram that illustrates the interconnections of the CTSS components from the field location to the designated control center. Identify each component by manufacturer, model, and CLEI number.

   Provide and install a traffic controller unit, NEMA "D" panel and harness to maintain compatibility in the existing traffic signal controller cabinet: perform all wiring; configuration, programming and testing; and remove the existing controller unit from the traffic signal control cabinet. Clean dust, dirt, and debris from the inside of the cabinet and replace air filters and light fixtures. Employ a manufacturer's certified representative to program and configure the controllers with the timing plan directive parameters. Place the intersection into cabinet flash during installation of the CTSS controller unit.

3. **Controller, CTSS Turn On.** Provide an authorized representative that is trained and certified by the controller manufacturer and is on the work site when the CTSS controller is being placed into operation.

C. Testing. Perform testing as specified in 704.03.01.C.

Also, before delivery to the Project Limits, perform a 168-hour burn in test period for the assembled, programmed and configured CTSS controller and CTSS controller unit following the requirements of 702.03.01 for continuous operation without failure.

D. Maintenance. Perform maintenance as specified in 704.03.01.D.

E. Final Documentation. Provide the documentation specified in 704.03.01.E and the following:

1. For CTSS controller, provide a detailed drawing of all controller backpanel and subpanel wiring and equipment layout. For CTSS controller unit, provide the detailed "D" harness wiring drawing and the connections to the back panel.
2. Original signature certification of the CTSS controller and CTSS controller unit to verify that the equipment has been programmed, configured, wired, functions, and operates as specified in the Contract.

F. Equipment Training. Provide training as specified in 704.03.01.F and in the Special Provisions.

704.03.05 Travel Time Systems (TTS)

A. Components. A TTS consists of the specified Items needed to provide a complete system that is capable of measuring traffic speed, time, and volume, can process data to and from the designated control center and is integrated into the central control system for the purpose of determining and reporting travel time information. The system also includes, but is not limited to, the electronic and electrical equipment, wiring, central system database configurations, communication and electric service connections, service charges, software, grounding, and surge protection.

B. Installation. Before beginning the work and during the work, comply with the requirements of 701.03.01. The allowable time frame for existing system shutdown and the cost of damages for exceeding the allowable time frames is specified in the Special Provisions. The Department will recover the cost as specified in 107.16.

Construct components as follows:

1. **Foundation, TTS.** Construct the foundation as specified in 701.03.12.

2 **Detector Standard.** Bolt the standard securely to the foundation, and erect the standard with sufficient rake to assume a vertical position after all attachments and appurtenances are in place. Install a ground wire that extends to the ground rod from the standard.

3 **Controller, TTS.** Submit working drawings for approval that include a block wiring diagram that illustrates the interconnections of the TTS components from the field location to the designated control center. Identify each component by manufacturer, model, and CLEI number.

Securely bolt the controller cabinet to the foundation in a vertical position using stainless steel hardware. Seal the underground conduit entrance to the controller with a sealing compound.

4 TTS Detector. Submit working drawings for approval that include a block wiring diagram that illustrates the interconnections of the TTS components from the field location to the designated control center. Identify each component by manufacturer, model, and CLEI number.

Install the detector according to the manufacturer's recommendations.

Mark all wire and cable detector connections to the controller.

C. Testing. Perform testing as specified in 704.03.01.C.

D. Maintenance. Perform maintenance as specified in 704.03.01.D.

E. Final Documentation. Provide the documentation specified in 704.03.01.E, including configuration data and parameters with channel assignments per traveled lane.

F. Equipment Training. Provide training as specified in 704.03.01.F and in the Special Provisions.

704.03.06 Road Weather Information System (RWIS)

A. Components. A RWIS consists of the specified Items needed to provide a complete system that is capable of processing sensor and control data to and from the designated control center for wind speed and direction, gusts, precipitation, visibility, humidity, pavement surface, and subsurface temperature. The system also includes, but is not limited to, the electronic and electrical equipment, cabinet, wiring, configuration, communication and power connections, service charges, software, grounding, and surge protection.

B. Installation. Before beginning the work and during the work, comply with the requirements of 701.03.01. The allowable time frame for existing system shutdown and the cost of damages for exceeding the allowable time frames is specified in the Special Provisions. The Department will recover the cost as specified in 107.16.

Construct components as follows:

1. Weather Station. Construct the foundation as specified in 701.03.12.

Submit working drawings for approval that include a block wiring diagram that illustrates the interconnections of the RWIS components from the field location to the designated control center. Identify each component by manufacturer, model number, and CLEI number.

Install RWIS devices and materials, including cabinet enclosure, camera, electric power devices, remote microprocessor controlled unit, software, back panel, main power disconnect, surge suppression, communication modems, atmospheric sensors, road, subsurface and bridge sensors, sensor leads, grounding, and all wires and incidental material. Aim the camera for proper functioning of the system. Follow the manufacturer's recommended installation, calibration, and configuration instructions.

Install sensors embedded in the pavement according to the manufacturer's recommendations. Sawcut the pavement, pressure wash, and dry the sawcut before installing the sensors. Install each cable from the sensor in a separate individual saw cut to the conduit at the curb leading to the nearest junction box. Install bridge sensors according to the manufacturer's recommendations.

Do not splice cables and sensor leads.

If not connected into the fiber optic network, obtain and provide communications with a utility service provider from the field microprocessor to the existing Department RWIS designated control center.

2. Weather Station, Roadway Devices. Install sensors embedded in the pavement and on bridges according to the manufacturer's requirements for connections into existing weather stations. Sawcut the pavement, pressure wash, and dry the sawcut before installing the sensors.

Install each cable from the sensor in a separate individual saw cut to the conduit at the curb leading to the nearest junction box. Do not splice cables and sensor leads.

C. Testing. Perform testing as specified in 704.03.01.C.

D. Maintenance. Perform maintenance as specified in 704.03.01.D.

E. Final Documentation. Provide the documentation specified in 704.03.01.E and the following:

1. Configuration data and parameters, port and channel assignments for each traveled lane.
2. Calibration coefficient data for each sensor.

F. Equipment Training. Provide training as specified in 704.03.01.F and in the Special Provisions.

704.03.07 Dynamic Message System (DMS)

A. Components. DMS consists of the specified Items needed to provide a complete system that is capable of processing control data to and from the designated control center. The system also includes, but is not limited to, wiring, communication and power connections, service charges, software, grounding, and surge protection.

B. Installation. Before beginning the work and during the work, comply with the requirements of 701.03.01. The allowable time frame for existing system shutdown and the cost of damages for exceeding the allowable time frames is specified in the Special Provisions. The Department will recover the cost as specified in 107.16.

Construct components as follows:

1. Foundation DMS. Construct the foundation as specified in 701.03.12.

2. DMS Standard. Bolt the standard securely to the foundation, and erect the standard with sufficient rake to assume a vertical position after all attachments and appurtenances are in place. Install a ground wire that extends to the ground rod from the standard.

3. DMS Sign. At least 30 days before beginning construction, submit working drawings for approval that include sign mounting and lifting calculations. Ensure the calculations are signed and sealed by a Professional Engineer. Mount the sign on the standard or structure and install the controller according to the manufacturer's recommendations.

Ensure control cables are factory assembled and tested according to the sign manufacturer's recommendations. Make all wire and cable connections to the DMS sign controller according to the sign manufacturer's recommendations.

Perform tree trimming and site clearing to provide an unobstructed field of view up to 1000 feet from the sign as directed by the RE.

4. DMS Sign with Controller. At least 30 days before beginning construction, submit working drawings for approval that include sign mounting and lifting calculations. Identify each component by manufacturer, model, and CLEI number. Ensure the calculations are signed and sealed by a Professional Engineer. Mount the sign with controller on the standard.

Ensure control cables are factory assembled and tested according to the sign manufacturer's recommendations. Make all wire and cable connections to the DMS sign controller according to the sign manufacturer's recommendations.

Perform tree trimming and site clearing to provide an unobstructed field of view up to 1000 feet from the sign as directed by the RE.

5. DMS Sign Install and DMS Sign With Controller Install. Submit working drawings that include sign mounting and lifting calculations. Pick up as specified in the Special Provisions the type of DMS signs shown on the Plans for installation. Before transport, test and confirm the functionality of the DMS material. Provide a manufacturer's representative to be present during the tests. Mount the sign on the standard, and install the controller.

Perform tree trimming and site clearing to provide an unobstructed field of view up to 1000 feet from the sign as directed by the RE.

6. Controller DMS. Submit working drawings for approval that include a block wiring diagram that illustrates the interconnections of the DMS components from the field location to the designated control center. Identify each component by manufacturer, model, and CLEI number.

Securely bolt the controller to the foundation in a vertical position using stainless steel hardware. Seal the underground conduit entrance to the controller with a sealing compound.

Install cables and wire connections between the sign and controller according to the manufacturer's recommendations. Ensure that the conduit entry points are properly closed off with duct sealing compound.

C. Testing. Perform testing as specified in 704.03.01.C.

D. Maintenance. Perform maintenance as specified in 704.03.01.D.

E. Final Documentation. Provide the documentation specified in 704.03.01.E.

F. Equipment Training. Provide training as specified in 704.03.01.F and in the Special Provisions.

704.03.08 Weigh in Motion System (WIMS)

A. Components. A WIMS consists of the specified Items needed to provide a complete system that is capable of processing pavement sensor and control data to and from the control center in Trenton. The WIMS is composed of electronic and electrical equipment, pavement sensors, cables, wiring, control cabinet, site processor, remote communication modems, operating software, and software used to process and generate reports on the collected raw vehicle record files. The system also includes, but is not limited to, wiring, cabinet, foundation, communication and power connections, service charges, software, grounding, and surge protection.

B. Installation. Before beginning the work and during the work, comply with the requirements of 701.03.01. The allowable time frame for existing system shutdown and the cost of damages for exceeding the allowable time frames is specified in the Special Provisions. The Department will recover the cost as specified in 107.16.

If not connected into the fiber optic network, obtain and provide communications with a Utility service provider from the field microprocessor to the Department WIMS control center in Trenton.

Make operational electronic and electrical components to monitor volume, speed, length, gap, headway, vehicle type classification by axle configuration, and axle weights. The roadway sensors are composed of inductive loop detectors, loop leads, weight sensors, and temperature sensor. The WIMS electronics are installed at each work site with electrical power and communications for remote station programming, monitoring and failure diagnosis, and data retrieval.

Construct components as follows:

1 Controller, WIMS. Construct the foundation as specified in 701.03.12.

At least 30 days before beginning construction, submit working drawings for approval that include a block wiring diagram that illustrates the interconnections of the WIMS components from the field location to the control center in Trenton. Identify each component by manufacturer, model, and CLEI number.

Securely bolt the controller cabinet to the foundation in a vertical position using stainless steel hardware. Seal the underground conduit entrance to the controller with a sealing compound.

2. WIM Roadway Devices. Install the devices according to the manufacturer's requirements. Pressure wash and dry the sawcut as recommended by the manufacturer. Ensure that sensors, loop detector wires, and cables are installed in separate conduit per type of device and that conduit is waterproofed and sealed. Ensure that the temperature sensor is installed in a schedule 80 PVC conduit in the shoulder of the roadway. Maintain at least 3 feet of space between the saw cut loops and the sensors. After completion of the HMA, re-establish the location of each loop edge to facilitate and mark for cutting of the slot for the axle weight sensor. Ensure that the lengths of weight sensors do not exceed the width of the lanes. Do not splice cables. Grind the top of the encapsulation material flushed with the road.

Ensure that the piezoelectric sensors are installed perpendicular to the flow of traffic and are without twists or curls. Shorter sensors (6 feet length) are positioned to one side in a wheel path, not in the center of the lane; longer sensors are typically centered in the lane. Cut a slot for the sensor that is 8 inches longer than the sensor. Do not mix or place the epoxy until the RE has approved all cleaning operations.

C. Testing. Perform testing as specified in 704.03.01.C, except do not perform Level B as specified in 704.03.01.C.1.b. Also perform the testing as follows:

Use an LCR Meter to measure the capacitance, resistance, and dissipation factor of each sensor. When the lane is opened to traffic, perform a functional test on the sensor using an oscilloscope.

Provide a 5-axle tractor-trailer combination (3-axle tractor and 2-axle semi-trailer) and driver for calibration of the WIM system. Weigh the calibration truck on a certified, multi-draft public scale. Also weigh the steering axle, drive tandem axles, and trailer tandem axles. Record and provide the weight data to the RE at the start of the test. Include the total gross weight of the combination. Ensure that the truck has an air-ride suspension and is in good mechanical condition. Ensure that the trailer is a dry van type and loaded with a non-shifting load so that the gross weight of the tractor-trailer combination is between 75,000 and 80,000 pounds. Ensure that the axle-loads do not exceed New Jersey Title 39 limits, and do not violate the Federal Bridge Formula.

Drive the truck over each lane a minimum of 5 times and record the axle and gross weights as determined by the WIM system by each sensor for each pass. Use the average values among the 5 passes to calculate a calibration factor for each sensor. Perform this test twice.

After the calibration, ensure that the average values recorded by the WIM system are within 10 percent of each axle weight (average axle weight of each axle group) and within 5 percent of the gross weight of the combination of the weights recorded at the public scale.

If the system cannot be properly calibrated after 3 attempts, the RE may employ a third party vendor to re-do the work. The Department will recover the cost as specified in 107.16.

D. Maintenance. Perform maintenance as specified in 704.03.01.D.

E. Final Documentation. Provide the documentation specified in 704.03.01.E and the following:

1. Configuration data and parameters, port and channel assignments for each traveled lane.
2. Calibration coefficient data for each sensor.

F. Equipment Training. Provide training as specified in 704.03.01.F and in the Special Provisions.

704.03.09 Traffic Volume System (TVS)

A. Components. A TVS consists of the specified Items needed to provide a complete system that is capable of processing traffic control data to and from the control center in Trenton including pavement loop and vehicle detectors, electronic devices to measure and record vehicle volume, speed, length, gap, and headway in each lane connected to the respective monitoring devices in a cabinet. The system also includes wiring, cabinet, foundation, communication and power connections, service charges, software, grounding, and surge protection.

B. Installation. Before beginning the work and during the work, comply with the requirements of 701.03.01. The allowable time frame for existing system shutdown and the cost of damages for exceeding the allowable time frames is specified in the Special Provisions. The Department will recover the cost as specified in 107.16.

If not connected into the fiber optic network, obtain and provide communications with a Utility service provider from the field microprocessor to the Department TVS control center in Trenton.

Construct components as follows:

1. Controller, TVS. Construct the foundation as specified in 701.03.12.

Submit working drawings for approval that include a block wiring diagram that illustrates the interconnections of the TVS components from the field location to the control center in Trenton. Identify each component by manufacturer, model, and CLEI number.

Make operational electronic and electrical components to monitor volume, speed, length, gap, and headway. The roadway sensors are composed of inductive loops and loop leads. The TVS electronics are installed at each work site with electrical power and communications for remote station programming, monitoring and failure diagnosis, and data retrieval.

Securely bolt the controller cabinet to the foundation in a vertical position using stainless steel hardware. Seal the underground conduit entrance to the controller with a sealing compound.

2. TVS Roadway Devices. Sawcut the pavement. Pressure wash then dry the sawcut according to the manufacturer's recommendations. Ensure that sensors, loop detector wires, and cables are installed in

separate conduit per type of device and that the conduit is waterproofed and sealed. Maintain at least 3 feet of space between the saw cut loops and the sensors. Do not splice cables. Grind the top of the encapsulation material flush with the road.

C. Testing. Perform testing as specified in 704.03.01.C, except do not perform Level B as specified in 704.03.01.C.1.b. Also perform the testing as follows:

Use an LCR Meter to measure the capacitance, resistance, and dissipation factor of each sensor. When the lane is opened to traffic, perform a functional test on the sensor using an oscilloscope.

Measure the ratio of loop inductance to lead inductance and ensure it is within the requirements of the sensor manufacturer.

D. Maintenance. Perform maintenance as specified in 704.03.01.D.

E. Final Documentation. Provide the documentation specified in 704.03.01.E and the following:

1. Configuration data and parameters, port and channel assignments.
2. Calibration data for each sensor.

F. Equipment Training. Provide training as specified in 704.03.01.F and in the Special Provisions.

704.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
JUNCTION BOX ITS TYPE ___	UNIT
COMMUNICATION CABLE	LINEAR FOOT
FOUNDATION ITS TYPE ___	UNIT
CONTROLLER, ITS	UNIT
COMMUNICATION HUB	UNIT
CONTROL CENTER SYSTEM, LOCATION ___	LUMP SUM
FOUNDATION CSS TYPE ___	UNIT
CAMERA STANDARD TYPE ___	UNIT
CAMERA	UNIT
CONTROLLER, CAMERA	UNIT
FIBER OPTIC CABLE TYPE ___	LINEAR FOOT
CONTROLLER, CTSS	UNIT
CTSS CONTROLLER UNIT	UNIT
CONTROLLER, CTSS TURN ON	UNIT
FOUNDATION TTS TYPE ___	UNIT
DETECTOR STANDARD	UNIT
CONTROLLER, TTS	UNIT
TTS DETECTORS TYPE _____	UNIT
WEATHER STATION	UNIT
WEATHER STATION ROADWAY DEVICES ____ LANES	UNIT
FOUNDATION DMS TYPE ___	UNIT
DMS STANDARD TYPE ___	UNIT
DMS SIGN	UNIT
DMS SIGN WITH CONTROLLER	UNIT
DMS SIGN INSTALL	UNIT
DMS SIGN WITH CONTROLLER INSTALL	UNIT
CONTROLLER, DMS	UNIT
CONTROLLER, WIM	UNIT
WIM ROADWAY DEVICES ____ LANES	UNIT
CONTROLLER, TVS	UNIT
TVS ROADWAY DEVICES ____ LANES	UNIT

The Department will make payment for each item, except for FIBER OPTIC CABLE, TYPE___, STANDARDS, JUNCTION BOXES, and FOUNDATIONS, as follows:

Work Completed	**Payment**
Installing the Item	70% of Total Contract Price
Successful completion of Level A testing	10% of Total Contract Price
Successful completion of Level B testing	10% of Total Contract Price
Successful completion of Level C testing	10% of Total Contract Price

If a level of testing is not required, the Department will include the percentage specified for that level of payment in the Installing the Item percentage.

The Department will make payment for FIBER OPTIC CABLE, TYPE___, as follows:

Work Completed	**Payment**
Installing the fiber optic cable	80% of Total Contract Price
Successful completion of Level 1 testing	10% of Total Contract Price
Successful completion of Level 2 testing	10% of Total Contract Price

DIVISION 800 – LANDSCAPING

SECTION 801 – SELECTIVE VEGETATION REMOVAL

801.01 DESCRIPTION

This Section describes the requirements for removing live and dead trees, both standing and fallen, shrubs, and other vegetation and debris; to produce irregular foliage lines; to create a natural transition between the artificial edge of the woods to create bays in wooded areas; to establish new vegetation limits along roadsides; and to open views.

801.02 MATERIALS

Provide materials as specified:

Topsoil	917.01
Fertilizer, 1-2-1 Ratio	917.03
Grass Seed Mixture (Type A-3)	917.05.01
Mulch	917.06
Herbicide	917.11.03

801.03 CONSTRUCTION

801.03.01 Selective Thinning

A. Site Preparation. Notify the RE 3 days before beginning work. The Department will designate trees, shrubs, and other vegetation to be removed within the designated areas. Ensure that work is supervised by a skilled person. At least 7 days before beginning the work, submit the name and qualifications to the RE for approval.

B. Selective Thinning. Fell trees to prevent damage to adjacent vegetation, structures, utility wires, and property. Remove trees, stumps, and all debris in a manner that does not compact or disturb the soil.

In open areas, remove stumps to at least 6 inches below the existing ground surface. Backfill stump holes with topsoil, as specified in 804.03.01, and fertilize, seed, and mulch the area as specified in 806.03.01. In wooded areas and on slopes of 2H:1V or steeper, cut off stumps at the existing ground surface. Treat live stumps with herbicide immediately after cutting. If suckering occurs, apply herbicides or perform mechanical operations to ensure that regrowth does not occur.

Remove dead, dying, diseased, interfering, objectionable, and weak branches up to a height of 16 feet.

C. Site Clean Up. Dispose of cleared material, stumps, and resulting debris as specified in 201.03.09.

Repair damage to remaining trees and vegetation as directed by the RE. Repair damaged turf areas as specified in 806.03.01.

801.03.02 Selective Clearing

A. Site Preparation. Prepare the site as specified 801.03.01.A.

B. Selective Clearing. Fell trees to prevent damage to adjacent vegetation, structures, utility wires, and property. Remove stumps of trees, shrubs, and vines to at least 6 inches below the existing ground surface. Backfill stump holes with topsoil, as specified in 804.03.01, to eliminate depressions. The RE may direct the area to be fertilized, seeded, and mulched as specified in 806.03.01. In wooded areas and on slopes of 2H:1V or steeper, cut off stumps at the existing ground surface. Treat live stumps with herbicide immediately after cutting. If suckering occurs, apply herbicides or perform mechanical operations to ensure that regrowth does not occur.

C. Site Clean Up. Clean up the site as specified in 801.03.01.C.

801.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
SELECTIVE THINNING	ACRE
SELECTIVE THINNING	SQUARE YARD
SELECTIVE CLEARING	ACRE
SELECTIVE CLEARING	SQUARE YARD

The Department will measure the area of SELECTIVE THINNING and SELECTIVE CLEARING using the perimeter defined by the edge of the existing canopy.

SECTION 802 – TRIMMING AND REMOVING TREES

802.01 DESCRIPTION

This Section describes the requirements for removing trees and defective or undesirable limbs and for repairing injuries or wounds on existing trees.

802.02 MATERIALS

Provide materials as specified:

Topsoil 917.01
Fertilizer, 1-2-1 Ratio 917.03
Grass Seed Mixture (Type A-3) 917.05.01
Mulch 917.06
Disinfectant 917.11.01
Herbicide 917.11.03

802.03 CONSTRUCTION

802.03.01 Trimming Existing Trees

Notify the RE 3 days before beginning work. The Department will designate trees to be trimmed. Ensure that tree trimming is supervised by a skilled person. At least 7 days before beginning the work, submit the name and qualifications to the RE for approval.

Remove all dead, dying, diseased, interfering, objectionable, and weak branches. Do not remove healthy low branches unless directed. When removing the lower bottom branches of trees for underclearance, ensure a symmetrical appearance and minimize cuts to ensure normal sap flow.

Make clean cuts as close as possible to the trunk or parent limb, without cutting into the branch collar or leaving a protruding stub, so that closure can start. Cut branches that are too heavy to handle in multiple sections to prevent splitting or peeling of the bark. Where necessary, lower branches to the ground by ropes or equipment to prevent tree or property damage.

On trees known to be diseased, disinfect tools after each cut when there is a danger of transmitting the disease on tools.

Inspect old injuries, and trace those not closing properly and where callus growth is not already completely established.

Reuse waste material and debris resulting from trimming existing trees as specified in 202.03.07.A.

802.03.02 Removing Existing Trees

Notify the RE 3 days before beginning work. The Department will designate trees to be removed. Ensure that tree trimming is supervised by a person skilled in the work. At least 7 days before beginning the work, submit the name and qualifications to the RE for approval.

Fell trees to prevent damage to adjacent vegetation, structures, utility wires, and property. Remove trees and their stumps to at least 6 inches below the existing ground surface. Backfill stump holes with topsoil, and fertilize, seed, and mulch the area as specified in 806.03.01. In wooded areas and on slopes of 2H:1V or steeper, cut off stumps at the existing ground surface. Treat live stumps with herbicide immediately after cutting. If suckering occurs, apply herbicides or perform mechanical operations to ensure that regrowth does not occur.

Repair damage to remaining trees and vegetation as directed by the RE. Repair damaged turf areas as specified in 806.03.01.

Reuse waste material and debris resulting from tree removal as specified in 202.03.07.A.

802.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
TRIMMING EXISTING TREE, OVER ___" TO ___" DIAMETER	UNIT
TRIMMING EXISTING TREE, OVER 36" DIAMETER	UNIT
TREE REMOVAL, OVER ___" TO ___" DIAMETER	UNIT
TREE REMOVAL, OVER 36" DIAMETER	UNIT

The Department will determine the quantity of TRIMMING EXISTING TREES, OVER ___" TO ___" DIAMETER and TREE REMOVAL, OVER ___" TO ___" DIAMETER by the number of trees in each diameter category. The Department will measure the diameter of the tree 4-1/2 feet above the ground.

SECTION 803 – PREPARATION OF EXISTING SOIL

803.01 DESCRIPTION

This Section describes the requirements for preparing existing soil for seeding.

803.02 MATERIALS

Provide materials as specified:

Soil Aggregate (I-14) 901.11

803.03 CONSTRUCTION

803.03.01 Preparing Existing Soil

Clear the surface of the existing soil of all stumps, brush, weeds, and debris. Cultivate the soil to a depth of 3 to 4 inches to prepare a seed bed. Where depressions exceed 8 inches in depth, backfill with I-14 soil aggregate and cover with 4 inches of topsoil. Bring the entire area to a smooth grade, free from any depressions that would collect water. If necessary, use additional topsoil to fill depressions.

Dispose of waste material and debris resulting from preparation of existing soil as specified in 201.03.09.

803.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
PREPARATION OF EXISTING SOIL	ACRE
PREPARATION OF EXISTING SOIL	SQUARE YARD

The Department will make payment for ___ SOIL AGGREGATE as specified in 203.04.

SECTION 804 – TOPSOILING

804.01 DESCRIPTION

This Section describes the requirements for preparing and placing topsoil.

804.02 MATERIALS

Provide materials as specified:

Topsoil 917.01

804.03 CONSTRUCTION

804.03.01 Topsoiling

Store topsoil in stockpiles as specified in 202.03.03.B.

Scarify the area to be topsoiled to improve the bond between slope and topsoil. Remove from the scarified area stones 2 inches or larger in any dimension and other debris such as wires, cables, tree roots, pieces of concrete, clods, and lumps. For slopes of 2H:1V or steeper, create ridges (such as by a dozer track) in the subsoil surface parallel to the bottom of the slope.

After the RE has approved the prepared surface elevations, spread topsoil and smooth to grade to produce the required thickness. For slopes of 2H:1V or steeper, create ridges (such as by a dozer track) in the topsoil surface parallel to the bottom of the slope to hold the seed in place and to retain moisture.

Ensure that ground areas are not damaged by the delivery, handling, or storage of materials; by washouts due to drainage diversion; by workers; or by equipment. Repair such damage by grading, fertilizing, seeding, and mulching as specified in 806.03.01.

804.03.02 Borrow Topsoil

Provide borrow topsoil from off-site sources. Store borrow topsoil in stockpiles as specified in 202.03.03.B.

804.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
TOPSOILING, ___ " THICK	SQUARE YARD
BORROW TOPSOIL	CUBIC YARD

The Department will include areas designated for planting pits in the measured area for TOPSOILING, ___ " THICK.

The Department will determine the quantity of BORROW TOPSOIL by the average end area method as specified in 109.01.

SECTION 805 – TURF REPAIR STRIP

805.01 DESCRIPTION

This Section describes the requirements for regrading and repairing the area immediately adjacent to the shoulder.

805.02 MATERIALS

Provide materials as specified:

Topsoil 917.01
Fertilizer, 1-2-1 Ratio 917.03
Pulverized Limestone 917.04

Grass Seed Mixture, Type A-3 ..... 917.05.01
Wood Cellulose Fiber Mulch 917.06.02

805.03 CONSTRUCTION

805.03.01 Turf Repair Strip

Remove soil and vegetation immediately adjacent to the edge of existing pavement. If necessary, form a windrow adjacent to the pavement. After completing resurfacing, restore the soil and add topsoil as required. Fertilize and seed as specified in 806.03.01. Apply fiber mulch at the minimum rate of 2000 pounds per acre.

805.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
TURF REPAIR STRIP	LINEAR FOOT

SECTION 806 – FERTILIZING AND SEEDING

806.01 DESCRIPTION

This Section describes the requirements for providing and placing pulverized limestone, fertilizer, and seed mixtures; and for preparing, seeding, and mulching wildflower seed beds.

806.02 MATERIALS

Provide materials as specified:

Fertilizer, 1-2-1 Ratio 917.03
Pulverized Limestone 917.04
Grass Seed Mixture 917.05.01
Wildflower Seed Mixture 917.05.02
Straw Mulch 917.06.01
Tackifiers 917.07

806.03 CONSTRUCTION

806.03.01 Turf Seeding

A. Optimal Seeding Seasons. Seed from March 1 to May 15 and from August 15 to October 15. When weather and soil conditions are suitable, the RE may allow seeding at other times for soil erosion and sediment control. Notify the RE 24 hours before the seeding operation.

B. Soil Preparation. When the topsoil to be seeded has a pH value of less than 5.8, incorporate sufficient pulverized limestone to increase the soil pH value to 6.5.

Recommended quantities of total oxides (calcium and magnesium) to raise the pH of a 4-inch layer of soil to approximately 6.5 as specified in Table 806.03.01-1.

Table 806.03.01-1 Recommended Quantities of Total Oxides per Soil Class (Pounds per Acre)

Soil (pH)	Loamy Sand	Sandy Loam	Loam	Silty Loam
5.7	300	600	900	1200
5.3 to 5.6	600	1035	1500	1800
4.9 to 5.2	900	1500	2100	2400
4.5 to 4.8	1200	1800	2700	3000
4.1 to 4.4	1500	2100	3300	3600

Ensure that the quantity of pulverized limestone required is in proportion to its total oxide content.

Cultivate areas to be seeded to provide a reasonably firm but friable seedbed to a depth of 3 to 4 inches. On slopes steeper than 3H:1V, the RE may reduce the depth of cultivation. Remove all vegetation, stones 2 inches or larger in any dimension, and other debris from areas to be seeded.

C. Seed and Fertilizer Application. Sow grass seed mixtures at the rate of 100 pounds per acre. Use only 1 type of fertilizer to establish turf throughout the Project Limits. At the time of seeding, apply fertilizer at the rate necessary to yield 30 pounds of nitrogen per acre.

Place seed and fertilizer by either of the following methods:

1. **Hydraulic Method.** Mix the seed and fertilizer in water, and then apply under pressure at the specified rates. Retreat all areas inadequately covered.

2. **Dry Method.** Spread fertilizer in dry form separately from seed at the specified rates. Use mechanical spreaders to achieve even distribution. For areas inaccessible to mechanical spreaders, use hand-operated spreaders. Smooth finished seeded areas to the grades shown on the Plans.

D. Mulching. Mulch seeded areas as specified in 809.03.01.

E. Turf Establishment. Protect and maintain seeded areas. Repair damage to seeded areas caused by pedestrian or vehicular traffic or other causes.

If the initial application of fertilizer was performed between January and June, repeat the fertilizer application the following September. If the initial application of fertilizer was performed between July and December, repeat the fertilizer application the following March.

If a stand of grass, practically weed free and containing plants in reasonable proportion to the various kinds of seed in the grass seed mixture, is not established on areas of seeding, prepare a viable seed bed, refertilize, reseed, and remulch until a satisfactory stand of grass is established.

806.03.02 Wildflower Seeding

A. Seeding Seasons. Seed wildflowers from August 15 to October 1 and from April 1 to May 31 inclusive.

B. Bed Layout. Stake bed outlines at a maximum spacing of 25 feet using 2 × 2 × 36-inch wood stakes driven 1 foot into the ground. The staking defines the limits for seed protection from mowing, overspray of herbicides, and other potential damage.

C. Soil Preparation. Do not fertilize or seed grass mixes in the wildflower seed areas. Spray existing vegetation within the areas proposed for wildflowers during the active growing season with glyphosate at the manufacturer's recommended rates for total control of all plant material. Where necessary, reapply glyphosate 10 days after the first application. Mow the dead vegetation as close as possible to the existing ground, and then cultivate to a depth of 1 to 2 inches.

D. Preparation of Seed Mixtures. Provide wildflower seed mixture as specified in 917.05.B. In the presence of the RE, combine the mixture with a carrier of clean, dry, salt-free sand at a volume ratio of 2 parts sand to 1 part wildflower seed mixture.

E. Seed Application. Evenly spread the prepared blend of seed and sand using a hand-operated, hand-held, broadcast spreader. Lightly drag the seeded area with a piece of chain-link fence to mix the seed into the soil surface.

F. Mulching. Mulch seeded areas within 7 days of wildflower seeding. Uniformly spread straw mulch in a layer 1 to 1-1/2 inches thick, loose measurement. Bind in place with a tackifier as specified in 809.03.01.

G. Wildflower Establishment. Protect and maintain seeded areas. Repair damage to seeded areas caused by pedestrian or vehicular traffic or other causes.

If a stand of wildflowers, practically weed free and containing plants in reasonable proportion to the various kinds of seed in the wildflower seed mixture, is not established on areas of seeding, reseed, and remulch until a satisfactory stand of wildflowers is established.

806.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
FERTILIZING AND SEEDING, TYPE ___	SQUARE YARD
WILDFLOWER SEEDING	SQUARE YARD

The Department will not make payment for fertilizing and seeding areas disturbed by construction operations, beyond the specified grading limits in islands and medians, and between specified grading limits and the ROW.

The Department will not include payment for mulch under FERTILIZING AND SEEDING, TYPE ___ and WILDFLOWER SEEDING. The Department will make payment for mulching under the various Items in 809.04.

SECTION 807 – TOPSOIL STABILIZATION

807.01 DESCRIPTION

This Section describes the requirements for providing and placing jute and excelsior mats, erosion control mulch blankets, turf reinforcement mats, and mechanically bonded fiber matrices on prepared topsoiled surfaces.

807.02 MATERIALS

Provide materials as specified:

Fertilizer, 1-2-1 Ratio	917.03
Pulverized Limestone	917.04
Grass Seed Mixture	917.05.01
Wildflower Seed Mixture	917.05.02
Straw Mulch	917.06.01
Tackifiers	917.07
Type 1 Mat	917.08.01
Type 2 Mat	917.08.02
Type 3 Mat	917.08.03
Type 4 Mat	917.08.04

Provide staples that are made of 12-inch lengths of No. 25 plain iron wire.

807.03 CONSTRUCTION

807.03.01 Installing Topsoil Stabilization Matting

Before placing erosion control mats, ensure that topsoil is smooth, friable, and free of depressions, clods, mounds, stones, or other debris that may prevent the matting from making complete contact with the topsoil.

1. **Type 1.** After grading topsoil, fertilize, seed, and mulch the area as specified in 806.03.01. Lay the mats and anchor them with staples to ensure the matting is in full contact with the topsoil. Ensure that there are no voids between the topsoil and the matting. Place staples 12 inches apart across the matting and blankets at 50-foot intervals and at critical locations such as at inlets, check slots if required, overlapping joints, and ends. Drive staples at an uphill angle of approximately 30 degrees from the perpendicular surface of the slope. When jute or excelsior matting is required in swales or medians, the Contractor may install the matting in multiple widths.

   When laying excelsior matting, unroll the material in the direction of the flow of water. Snugly butt seams. Cut bulging seams in the matting material.

   When laying jute matting, unroll parallel to the primary direction of flow. Bury the uphill end 6 inches vertically in a trench, and overlap the downhill end over the next roll. Overlap side seams.

2. **Type 2 Mat.** After grading topsoil, fertilize and seed as specified in 806.03.01.C. Use erosion control mulch blanket instead of mulch. Lay and anchor erosion control mulch blanket as specified in 807.03.01.1.

3. **Type 3 Mat.** After grading topsoil, lay the mat parallel to the direction of flow on unseeded topsoil. Anchor and overlap mat as specified in 807.03.01.1. Infill the 3-dimensional matrix with topsoil to the thickness of the mat, then fertilize, seed, and mulch the area as specified in 806.03.01.

4. **Type 4 Mat.** After grading topsoil, fertilize and seed as specified in 806.03.01.C. Install mechanically bonded fiber matrix according to the manufacturer's recommendations, applying at least 4000 pounds of dry product per acre. Use mechanically bonded fiber matrix instead of mulch. Use approved hydro-spraying machines with fan-type nozzle (50-degree tip). To achieve optimum topsoil surface coverage, apply to the topsoil surface from opposing directions.

   Mix 50 pounds of mechanically bonded fiber matrix per 125 gallons of water; confirm loading rates with the equipment manufacturer.

807.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
TOPSOIL STABILIZATION, TYPE ___ MAT	SQUARE YARD

SECTION 808 – SODDING

808.01 DESCRIPTION

This Section describes the requirements for providing and placing topsoil and sod.

808.02 MATERIALS

Provide materials as specified:

Topsoil	917.01
Fertilizer, 1-2-1 Ratio	917.03
Pulverized Limestone	917.04
Sod	917.09
Pegs	917.09

808.03 CONSTRUCTION

808.03.01 Placing Sod

Before placing sod, place 4 inches of topsoil as specified in 804.03.01. Incorporate fertilizer, applied at a rate that yields 50 pounds of nitrogen per acre. Incorporate pulverized limestone, if necessary, to adjust the pH of the topsoil to 6.5 as specified in 806.03.01.B.

With each delivery of sod, submit to the RE a delivery slip, indicating the time and date of harvest and the quantity of sod, and a New Jersey Department of Agriculture certification. Within 36 hours of harvesting, deliver and lay the sod. Lay sod with staggered joints pressed closely together. Match the ends of sod strips so that the ends and sides always lie flush with each other. Press sod into the underlying soil by hand tamping and rolling to produce an even surface.

On slopes, start placing sod at the bottom. At the top of slopes, turn the upper edge of the sod strips into the soil and cover with topsoil. On slopes steeper than 3H:1V, hold sod in place with pegs driven flush with the surface of the sod. Do not space the pegs more than 1 foot apart. Use at least 2 pegs for each strip of sod.

Water until infiltration occurs through the root zone and into the topsoil zone in a manner that provides equal distribution and coverage to all areas sodded. Rewater as necessary until a firm root mass is established.

Do not place sod when the moisture content of the topsoil may adversely affect the sod. If the upper 1/2-inch of topsoil is dry, moisten the soil immediately before laying the sod.

Immediately replace sod that is dead or unhealthy.

After a firm root mass is established and before the turf reaches the height of 3 to 4 inches, mow the turf to a height of 1-1/2 to 2 inches with a machine that does not produce ruts, contribute to soil compaction, or damage the sod. Subsequently mow as directed.

808.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
SODDING	SQUARE YARD

The Department will make payment for mowing as specified in 810.04.

SECTION 809 – MULCHING

809.01 DESCRIPTION

This Section describes the requirements for providing and spreading mulch, and for tacking straw mulch.

809.02 MATERIALS

Provide materials as specified:

Grass Seed Mixture, Type F 917.05.01
Mulch 917.06
Tackifiers 917.07

809.03 CONSTRUCTION

809.03.01 Straw Mulching

Uniformly spread straw mulch in 3/4 to 1-1/2-inch loose layers over turf areas within 7 days of seeding. Bind the mulch in place using 1 of the following tackifiers:

1. **Fiber Mulch.** Mix fiber mulch with water, and apply using hydraulic pressure equipment. Apply fiber mulch as recommended by the manufacturer, except do not apply less than 400 pounds of the dry product per acre. Evenly distribute the mixture over the straw mulch.
2. **Synthetic Plastic Emulsion.** Apply synthetic plastic emulsion using hydraulic pressure equipment at a rate of 30 gallons (264 pounds) of undiluted material per acre. Dilute the synthetic plastic emulsion with water at a ratio of 1:15. Do not apply synthetic plastic emulsion in precipitation or in freezing weather.
3. **Vegetable-Based Gels.** Mix vegetable-based gels with water, and apply using hydraulic pressure equipment. Apply vegetable-based gels as recommended by the manufacturer, except thoroughly mix at least 40 pounds of the dry material with 750 gallons of water per acre. Do not apply vegetable-based gels in precipitation or in freezing weather.

When immediate protection of newly graded slopes is necessary at times other than during optimum seeding seasons, apply straw mulch with a temporary seed mixture.

Leave straw mulch in place and allow to disintegrate. If straw mulch is displaced before the grass reaches a height of 1-1/2 inches, refertilize, reseed, and remulch the area.

809.03.02 Fiber Mulching

The Contractor may only use fiber mulch during the optimum seeding seasons and with the approval of the Department. Apply fiber mulch over turf areas within 7 days of seeding. Mix fiber mulch with water, and apply using hydraulic pressure equipment. Following the manufacturer's recommendations, apply at least 2000 pounds of dry fiber mulch per acre.

Leave fiber mulch in place and allow to disintegrate. If fiber mulch is displaced before the grass is 1-1/2 inches high, refertilize, reseed, and remulch the area.

809.03.03 Mulching Plants

Mulch the specified plant pits of individual trees or shrubs, including the saucer to its outer edge and the entire area where material is planted in beds, with a 3 to 4-inch layer of wood chips, stone, gravel, or shredded hardwood bark, as specified. For *Hemerocallis* and perennial beds, mulch the entire area with a 2-inch layer of wood mulch. In naturalized areas, individually mulch each *Hemerocallis* plant with a 2-inch layer of wood mulch. Mulch plants within 10 days of installation. Replace mulch that is displaced.

809.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
STRAW MULCHING	SQUARE YARD
FIBER MULCHING	SQUARE YARD
STONE MULCHING	SQUARE YARD
GRAVEL MULCHING	SQUARE YARD
SHREDDED HARDWOOD BARK MULCHING	SQUARE YARD
WOOD MULCHING	SQUARE YARD
WOOD MULCHING, 2" THICK	SQUARE YARD

SECTION 810 – MOWING

810.01 DESCRIPTION

This Section describes the requirements for mowing new and existing turf within the ROW.

810.02 MATERIALS

(Intentionally Blank)

810.03 CONSTRUCTION

810.03.01 Mowing Seeded Areas

Mow, to a height of 3 to 4 inches, designated seeded turf areas when vegetation reaches a height of 6 to 8 inches. Use hand mowing methods and light equipment in areas where the use of heavy equipment may damage the turf or soil or cause soil compaction.

Before beginning mowing operations, pick-up and remove litter and debris in the areas of seeded turf to be mowed. Dispose of waste material and debris as specified in 201.03.09. Remove excessive cuttings as specified in 201.03.09.

810.03.02 Mowing Existing Turf

Mow, to a height of 3 to 4 inches, designated existing turf areas when vegetation reaches a height of 10 to 12 inches. Use hand mowing methods and light equipment in areas where the use of heavy equipment may damage the turf or soil or cause soil compaction.

Before beginning mowing operations, pick-up and remove litter and debris in the areas of existing turf to be mowed. Dispose of waste material and debris as specified in 201.03.09. Remove excessive cuttings as specified in 201.03.09.

810.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
MOWING	ACRE
MOWING	SQUARE YARD
MOWING EXISTING TURF	ACRE
MOWING EXISTING TURF	SQUARE YARD

SECTION 811 – PLANTING

811.01 DESCRIPTION

This Section describes the requirements for furnishing, delivering, and installing plants.

811.02 MATERIALS

Provide materials as specified:

Topsoil 917.01
Fertilizer, 1-2-1 Ratio 917.03
Pulverized Limestone 917.04
Mulch 917.06
Plant Materials 917.10
Antidesiccant 917.11.02
Herbicide 917.11.03
Water 919.08

811.03 CONSTRUCTION

811.03.01 Planting

A. Furnishing, Delivering, Installing, and Caring for Plants. Submit to the RE the current Materials Questionnaire Form for landscaping material, as specified in 106.04, 30 days before delivery with a copy to the Bureau of Landscape Architecture and Environmental Solutions.

Handle and pack plants to prevent injuries during transit. Do not dump or drop plants while unloading. Protect the roots of all plants from freezing or desiccating by heeling-in, watering, covering or keeping shaded, or placing in a climate controlled building or trailer.

Coordinate work to prevent delays in planting that may expose the root systems of plants to the air, sun, or freezing conditions.

B. Optimal Planting Seasons.

Table 811.03.01-1 Optimal Planting Season

Type of Plant	Season
Broad leaf and coniferous evergreen trees, shrubs, vines, and ground covers	March 1 to May 15 August 15 to December 1
Deciduous trees, shrubs, vines, ornamental grasses, and perennials	March 1 to May 15 October 15 to December 1
Container grown plant materials	March 1 to May 15 August 15 to December 1
Narcissus	October 15 to December 1
Hemerocallis	March 1 to May 15

When planting outside the optimal planting seasons, ensure that plants installed are kept watered and protected from freezing and desiccation.

C. Layout. Before planting, stake plant locations and bed outlines and obtain Department approval. Immediately notify the RE to arrange for Departmental guidance if existing conditions prevent planting at the exact locations shown on the Plans. The Department may adjust plant locations to meet field conditions.

D. Planting Beds. Spray existing vegetation within proposed planting beds during the growing season with glyphosate at the manufacturer's recommended rates. The Department may direct the reapplication of glyphosate 10 days after the first application. Mow the dead vegetation as closely as possible to existing ground, or turn it into the soil.

If the use of glyphosate is ineffective, mechanically remove existing vegetation from the bed area and cultivate to a depth of 6 inches.

Cultivate perennial planting beds to a depth of 6 to 8 inches, and grade beds smooth immediately before planting. Plant Narcissus bulbs to a depth of 8 inches.

E. Excavation for Plant Pits and Beds. Before excavating for plant pits and beds, ensure that the areas conform to the specified lines and grades. On slopes steeper than 4H:1V, excavate pits no more than 5 days in advance of planting.

Excavate pits for balled and burlapped plants to a minimum of 2 times the width of the root ball and no deeper than the root ball as measured from the bottom of the trunk flare to the bottom of the ball. Excavate pits for containerized plants to a minimum of 2 times the width of the container and no deeper than the actual height of the root mass within the container. Ensure that side slopes of all pits taper down from the rim of the pit to the outer edge of the bottom of the ball. Ensure that the sides of the pits are loosened and roughened to promote root penetration. Obtain RE approval before reusing topsoil from the excavated pits

For seedlings, vines, ground covers, and perennials, excavate pits to a minimum 12-inch diameter and 12-inch depth.

Reuse excavation as specified in 202.03.07.A. Dispose of sod, weeds, roots, and other objectionable material as specified in 201.03.09.

If the Contractor does not plan to plant excavated pits before the end of the working day, provide a plan, to the RE for approval, 5 days before planting that details the measures to ensure safety.

F. Pruning. Prune according to ANSI A 300 to preserve the natural character of each plant. Limit pruning at the time of planting to the removal of dead, conflicting, and broken branches. Do not prune the leaders of trees. Ensure that experienced personnel, using properly conditioned equipment and methods in keeping with accepted horticultural practice, perform all pruning.

G. Setting Plants. Set plants plumb and at the same depth at which they were grown in the nursery, except set trees with a trunk flare 1/2 to 1 inch above the surrounding grade to allow for settling. Set roots for the various conditions as follows:

1. **Balled and Burlapped Plants.** Handle and move plants only by the ball. Either remove, or loosen and fold back the burlap from the upper 1/2 of the ball. When balled and burlapped plants are in wire baskets, remove the entire wire basket, preserving the integrity of the ball.

2. **Containerized Plants.** Immediately before planting, remove the container, and make 3 vertical cuts equidistantly spaced around the perimeter of the root mass. Make each cut 1/2 inch deep from the top of the root-earth mass to the bottom.

H. Backfilling. Backfill with topsoil around the root system. Hand-tamp the topsoil and water at the rate of 15 gallons per square yard of pit area to settle the topsoil and to remove air pockets. Ensure that the topsoil is not frozen at the time of backfilling. Where necessary, backfill areas that have settled with topsoil. Form a 4-inch high compacted berm using topsoil around individual plants to a diameter equal to that of the pit. Ensure that the berm functions properly throughout the plant establishment period.

I. Watering. Water plants with sufficient frequency and quantity to ensure that the soil surrounding the root system remains moist but not saturated

J. Staking and Guying. Immediately after planting, stake or guy trees either 1 inch or more in caliper or more than 3 feet in height. Ensure that guy wires allow for normal sway. Ensure that trees remain plumb.

K. Tree Protection. Install tree protectors to a height of 2 feet above the ground surface on all planted *Malus* and *Crataegus* species to prevent damage from bark consuming rodents.

L. Mulching. Treat all beds with a pre-emergent herbicide before placing mulch. Mulch plants as specified in 809.03.02. Neatly edge the beds to produce a smooth, flowing edge line.

M. Caring for Plants. Maintain plants in a healthy growing condition during the life of the Contract by watering, weeding, spraying with pesticides, pruning, remulching, maintaining guys and stakes, and other operations as necessary.

N. Restoration and Cleanup. Where existing turf areas have been damaged during planting operations, restore the disturbed areas as specified in 806.03.01. Dispose of debris as specified in 201.03.09.

811.03.02 Plant Establishment Period

Upon completion of all plantings, request that an inspection be made by the Department to determine if the plants are alive and healthy. The Department will inspect plantings between May 1 and October 1st. Replace plants as specified in 811.03.01 that are missing or not alive and healthy. If replacing plants outside of the optimal planting season as specified in Table 811.03.01-1, only use containerized or balled and burlapped plants that are certified as being dug dormant. The plant establishment period will begin when the Department determines that 100 percent of the plants are alive and healthy.

Ensure the plantings are cared for during the plant establishment period by keeping the plants in a healthy growing condition by watering, weeding, spraying with pesticides, pruning, remulching disturbed areas, maintaining guys and stakes, and by other operations as horticulturally necessary.

The Department will reinspect the plants approximately 1 year after the start of the plant establishment period. If the Department determines that plants need to be replaced, replant plants as specified in 811.03.01 within 3 weeks. If replanting outside of the optimal planting season as specified in Table 811.03.01-1, only use containerized or balled and burlapped plants that are certified as being dug dormant.

The Department will reinspect the plants approximately 2 years after the start of the plant establishment period. If the Department determines that plants need to be replaced, replant plants as specified in 811.03.01 within 3 weeks. If replacing outside of the optimal planting season as specified in Table 811.03.01-1, only use containerized or balled and burlapped plants that are certified as being dug dormant.

Remove stakes, guys, and guy wires within the last month of the conclusion of the plant establishment period. At the conclusion of the plant establishment period, remove and dispose of weeds, debris, and damaged plant material as specified in 201.03.09. Treat planting beds with a pre-emergence herbicide.

When the establishment period extends beyond Completion, provide the Department's Bureau of Landscape Architecture and Environmental Solutions with the following for the remaining duration of the establishment period:

1. **Highway Occupancy Permit.** Obtain a Highway Occupancy Permit from the NJDOT Regional Operations permits office. Provide 2 copies of the approved permit to the Department's Bureau of Landscape Architecture and Environmental Solutions. Include the following in the permit:

    1. Project description, location, and copy of the landscape plans, details, and specifications.
    2. Description of the establishment care work during the establishment period.
    3. Work Schedule describing when the establishment care work will occur.

2. **Maintenance Bond.** Provide a bond to the Department in the amount specified in the Special Provisions.

811.04 MEASUREMENT AND PAYMENT

The Department will measure and make payment for Items as follows:

Item	*Pay Unit*
LARGE DECIDUOUS TREE, ___	UNIT
LARGE DECIDUOUS TREE, SEEDLING ___	UNIT
SMALL DECIDUOUS TREE, ___	UNIT
EVERGREEN TREE, ___	UNIT
EVERGREEN TREE, SEEDLING ___	UNIT
DECIDUOUS SHRUB, ___	UNIT
EVERGREEN SHRUB, ___	UNIT
GROUND COVER OR VINE, ___	UNIT
PERENNIAL, ___	UNIT
BULB	UNIT
CORM	UNIT
TUBER	UNIT
ROOT	UNIT
RHIZOME	UNIT
PLANT ESTABLISHMENT PERIOD	LUMP SUM

DIVISION 900 – MATERIALS

SECTION 901 – AGGREGATES

901.01 SOURCE

Use aggregates from a single source and geological classification in any 1 construction item unless otherwise authorized. Use only sources of aggregate that are listed on the QPL.

The ME may allow aggregates from different sources if they are of the same geological classification and have similar specific gravities and aggregate properties.

Use test methods for gradation according to the appropriate provisions of AASHTO T 11 or T 27, unless otherwise noted. Gradations of aggregates in the various tables of this and other Sections are the percentages passing by weight.

The aggregate producer shall submit annually, to the ME for approval, a quality control plan for the aggregate products. The aggregate producer may obtain guidelines for developing the quality control plan from the ME upon request.

901.02 STOCKPILES

Provide an area for each stockpile of adequate size, reasonably uniform in cross-section, well drained, and cleared of foreign materials.

At concrete and HMA mixing plants, stockpile a sufficient quantity of aggregate to provide for a minimum of 1 day's operations. Place the aggregate stockpiles on a firm, hard surface, such as a compacted aggregate, HMA, or concrete surface. Construct the stockpile by placing the aggregates in layers of not more than 3 feet thick.

Locate the piles so that there is no contamination by foreign material and no intermingling of aggregates from adjacent piles. Do not use steel-tracked equipment on the stockpiles.

Do not store aggregates from different sources, geological classifications, or of different gradings in stockpiles near each other unless a bulkhead is placed between the different materials. If blending aggregates of different gradings and from different sources, proportion through weigh hoppers. The ME may allow loader blending of aggregate stockpiles if included in the approved aggregate producer's quality control plan. The Department will reject aggregates found segregated or contaminated. If a stockpile is rejected for segregation, the Contractor may reconstruct it for further evaluation. Use methods that prevent segregation when charging aggregates from stockpiles.

Do not use washed aggregates sooner than 24 hours after washing or until the surplus water has drained out and the material has a uniform moisture content.

Do not stockpile RAP higher than 15 feet. Cover or otherwise protect stockpiles of RAP for use in HMA to prevent buildup of moisture.

901.03 COARSE AGGREGATE

Obtain coarse aggregate as specified in 901.01. Use coarse aggregate that is broken stone or washed gravel graded as specified Table 901.03-1. Stockpile coarse aggregate as specified in 901.02. The ME will sample coarse aggregate as specified in Table 901.03-2.

Table 901.03-1 Standard Sizes of Coarse Aggregate

		Amounts finer than each laboratory sieve, percentage by weight													
No.	**Nominal Size**	**4"**	**3-1/2"**	**3"**	**2-1/2"**	**2"**	**1-1/2"**	**1"**	**3/4"**	**1/2"**	**3/8"**	**No. 4**	**No. 8**	**No. 16**	**No. 50**	**No. 100**
1	**3-1/2" - 1-1/2"**	100	90-100		25-60		0-15		0-5							
2	**2-1/2" - 1-1/2"**			100	90-100	35-70	0-15		0-5							
3	**2" - 1"**				100	90-100	35-70	0-15		0-5						
4	**1-1/2" - 3/4"**					100	90-100	20-55	0-15		0-5					
5	**1" - 1/2"**						100	90-100	20-55	0-10	0-5					
57	**1" - No. 4**						100	95-100		25-60		0-10	0-5			
67	**3/4"- No. 4**							100	90-100		20-55	0-10	0-5			
7	**1/2" - No. 4**								100	90-100	40-70	0-15	0-5			
8	**3/8" - No. 8**									100	85-100	10-30	0-10	0-5		
9	**No. 4 - No. 16**										100	85-100	10-40	0-10	0-5	
10	**No. 4 - No. 200**										100	85-100				10-30

Table 901.03-2 Coarse Aggregate Sampling

Coarse Aggregate, No.	Sample Size (pounds)	Frequency
1	150	1000 tons or 830 cubic yards
2	100	1000 tons or 830 cubic yards
3	90	1000 tons or 830 cubic yards
4	70	1000 tons or 830 cubic yards
5 & 57	50	500 tons or 415 cubic yards
67	30	500 tons or 415 cubic yards
7	20	250 tons or 200 cubic yards
8, 9, & 10 (stone sand)	10	250 tons or 200 cubic yards

901.03.01 Broken Stone

Use broken stone that is uniform in texture and quality and that conforms to the requirements specified in Table 901.03.01-1.

Table 901.03.01-1 Requirements for Broken Stone

Aggregate Property	Test Method	Maximum Percent
Weathered and deleterious stone	NJDOT A-3	5
Broken stone other than that classification approved for use	NJDOT A-3	5
Flat and elongated pieces for graded material No. 67 and larger (length greater than 5 times the thickness or width)	ASTM D 4791	10
Absorption in cold water:		
No. 9 and larger	AASHTO T 85	1.8
Stone sand only (No. 10)	AASHTO T 84	2.0
Sodium sulfate soundness, loss	AASHTO T 104	10
Adherent fines in coarse aggregates:		
HMA	NJDOT A-4	1.5
Concrete	NJDOT A-4	1.0
Percentage of wear (Los Angeles Abrasion Test):		
HMA surface course	AASHTO T 96	40
HMA intermediate or base course	AASHTO T 96	45
Concrete surface course and bridge decks	AASHTO T 96	40
Concrete, other	AASHTO T 96	50
Dense-graded aggregate base course	AASHTO T 96	50

The geologic classifications are as follows:

1. **Argillite.** A thoroughly indurated and cohesive rock composed predominantly of silt size or smaller particles of clay, quartz, and feldspar or the fine-grained thermal recrystallization products of this assemblage (hornfels). Ensure rock is bedded thickly enough so as not to break into thin pieces at planes of stratification.
2. **Carbonate Rock.** A thoroughly indurated and cohesive rock composed predominantly of calcite and dolomite, bedded thickly enough so as not to break into thin pieces at planes of stratification. Minerals insoluble in hot hydrochloric acid are discrete grains of quartz, clay, and mica.
3. **Gneiss.** A metamorphic rock consisting principally of quartz and feldspar. Ensure rock has a dense structure, with a uniform distribution of minerals that will not break into thin pieces at lines of stratification.
4. **Granite.** An equigranular or porphyritic igneous rock consisting principally of quartz and feldspar.
5. **Quartzite.** A metamorphic rock composed principally of quartz. Quarry rock so that only the nonarkosic, uniformly compacted quartzites are included in the graded products. Ensure quartzite is not schistose in structure.
6. **Trap Rock.** An igneous rock, locally, either basalt or diabase, with a uniform distribution of constituent minerals. Amygdaloidal or vesicular basalt is not considered trap rock and is considered a deleterious material for testing purposes.

901.03.02 Washed Gravel

Use washed gravel that is either crushed or uncrushed as specified and that conforms to the requirements specified in Table 901.03.02-1.

Table 901.03.02-1 Requirements for Washed Gravel

Aggregate Property	Test Method	Maximum Percent
Weathered and deleterious gravel	NJDOT A-3	5
Sodium sulfate soundness, loss	AASHTO T 104	10
Soft particles as determined by scratch hardness test	NJDOT A-5	5
Absorption in cold water:		
No. 9 and larger	AASHTO T 85	1.8
Stone sand only (No. 10)	AASHTO T 84	2.0
Clay lumps, organic material, coal and other foreign or deleterious matter (Percent by weight or volume, whichever is greater)	AASHTO T 112	0.5
Chloride content	AASHTO T 260	0.06
Crushed gravel material with at least 1 fractured face (Nicked gravel is not considered crushed)	ASTM D 5821	60
Adherent fines in coarse aggregates:		
HMA	NJDOT A-4	1.5
Concrete	NJDOT A-4	1.0

Quartz gravel is composed of natural pebbles, of which the majority is coarsely crystalline quartz. Ensure that the individual crystals within each pebble are intergrown into a tenacious, nonporous, interlocking texture that fractures as a single unit. Ensure that the percent of wear determined according to the Los Angeles Abrasion Test is as specified for the various uses, except that the percent maximum loss for quartz gravel is 50 percent.

When the sodium sulfate soundness and scratch hardness tests total 10 percent or more, the ME will perform a petrographic analysis to determine the amount of unsound and weathered material.

901.04 BLAST FURNACE SLAG

Obtain blast furnace slag as specified in 901.01. Use as blast furnace slag the air-cooled residue resulting from the production of pig iron. Ensure that the blast furnace slag consists of tough, durable, angular fragments that are uniform in density, absorption, and quality, and are free from flux stone, dirt, or other objectionable material. Stockpile blast

furnace slag as specified in 901.02. Ensure that blast furnace slag conforms to the requirements specified in Table 901.04-1.

Table 901.04-1 Requirements for Blast Furnace Slag

Aggregate Property	Test Method	Requirement
Weight per cubic foot (loose measure), pounds	AASHTO T 19	60 minimum
Percentage of wear, Los Angeles Abrasion Test	AASHTO T 96	50 maximum
Sulfur, percentage by weight	ASTM C 563	2 maximum

901.05 AGGREGATES FOR HMA

901.05.01 Coarse Aggregate

Use coarse aggregate for HMA that is broken stone conforming to 901.03.01, except that the Contractor may use carbonate rock for the surface course only in shoulder areas, parking areas, or driveways.

901.05.02 Fine Aggregate

For HMA surface course, use fine aggregate that is manufactured stone sand or natural sand.

Manufacture stone sand from aggregates conforming to 901.03, with not more than 15 percent passing the No. 200 sieve. When the percent passing the No. 200 sieve exceeds 15 percent, blend the stone sand with another approved sand so that the combination contains no more than 15 percent passing the No. 200 sieve, based on stockpile samples theoretically combined. Feed each sand source into the plant through a separate cold feed hopper.

Use natural sand consisting of material composed of predominantly angular particles of quartz or other hard durable minerals conforming to the quality and gradation requirements specified in Table 901.05.02-1 and Table 901.05.02-2, respectively.

Table 901.05.02-1 Quality Requirements for Fine Aggregate used in HMA

Aggregate Property	Test Method	Maximum Percent
Mica	NJDOT A-2	2.0
Absorption, cold water	AASHTO T 84	2.0
Sodium sulfate soundness, loss	AASHTO T 104	5.0
Clay and clay lumps	AASHTO T 88	5.0

Table 901.05.02-2 Gradation Requirements for Fine Aggregate used in HMA

Sieve Size	Percent Passing
3/8"	100
No. 4	95 - 100
No. 8	80 - 100
No. 200	0 - 5

For HMA surface course, wash and grade the natural sand. Natural sand does not need to be washed if it conforms to the requirements of 901.06.02, except that the allowable percent passing the No. 200 sieve is 0 to 5 percent.

The ME will sample fine aggregate at a frequency of 10 pounds for each 500 tons.

901.05.03 Mineral Filler

Use mineral filler for HMA that is free from lumps and foreign materials. Produce mineral filler from broken stone conforming to 901.03.01, fly ash conforming to 903.02.03.A, kiln dust from cement manufacture, or baghouse fines from an HMA plant. Produce baghouse fines from a consistent geological source of coarse and fine aggregate.

Ensure that a HMA mixture containing the filler retains 70 percent of its initial strength after an immersion cycle of 14 days when prepared according to AASHTO T 167 and tested according to AASHTO T 165.

Use mineral filler that, when tested according to AASHTO T 37, conforms to the gradation requirements specified in Table 901.05.03-1.

Table 901.05.03-1 Gradation Requirements for Mineral Filler

Sieve Size	Percent Passing
No. 50	95 - 100
No. 200	70 - 100

901.05.04 Reclaimed Asphalt Pavement (RAP)

Process RAP for HMA through screening and crushing operations to ensure that it is 100 percent passing the maximum aggregate size for the mixture.

Use RAP containing asphalt binder that is free from solvents or other contaminating substances. Ensure that the coarse aggregate contained in the RAP conforms to the requirements of 901.03.01 for broken stone and to the requirements of 901.03.02 for gravel. Ensure that the fine aggregate contained in the RAP conforms to the quality requirements in 901.05.02.

901.05.05 Crushed Recycled Container Glass (CRCG)

Use container glass that is derived from items such as bottles. Use glass that when crushed does not produce thin sliver and flake-like fragments. Ensure that no more than 5 percent of the material is glass derived from thin walled items, such as test tubes and other laboratory glassware, which are not considered to be container glass. Use CRCG that is 100 percent passing a 3/8-inch sieve.

Ensure that the CRCG contains no more than the maximum allowable percent of foreign materials specified in Table 901.05.05-1.

Table 901.05.05-1 Allowable Percentages of Foreign Materials in CRCG

Foreign Material	Maximum Percent[1]
Paper	2.5
Metal	3.0
Plastic	0.3
Other	0.5

1. Determine the percent by dividing the weight of a foreign material retained on the No. 4 sieve by the total weight of material retained on the No. 4 sieve.

901.05.06 Ground Bituminous Shingle Material (GBSM)

Use GBSM that is derived from pre-consumer roofing shingles and is 100 percent passing a 3/4-inch sieve and that conforms to the composition requirements specified in Table 901.05.06-1.

Table 901.05.06-1 Components of GBSM

Material	Composition by Weight
Petroleum asphalt	30 - 40%
Fibers	10% Maximum
Mineral matter	50 - 65%

Submit a certificate of compliance, as specified in 106.07, for the GBSM. Submit test methods and results along with the certification.

Add the GBSM to the mixture through a feed system that individually proportions the GBSM and is approved by the ME.

901.05.07 Remediated Petroleum Contaminated Soil Aggregate (RPCSA)

For use as a coarse aggregate, fine aggregate, or both in HMA base course, the Contractor may use a maximum of 20 percent remediated ID-27 petroleum contaminated soil, produced by a NJDEP approved “Class B” recycling center

operating pursuant to N.J.A.C 7:26A, provided it conforms to all quality requirements specified in 901.05.01 and 901.05.02.

901.06 AGGREGATES FOR CONCRETE, MORTAR, AND GROUT

The ME will test aggregates used in concrete according to AASHTO T 303 for potential expansion due to alkali-silica reactivity. The ME will classify aggregates that produce expansion of 0.1 percent or more after 14 days in solution as potentially reactive. Use potentially reactive aggregate in concrete only in conjunction with remedial agents such as fly ash, slag, or low alkali cement at the minimum addition rates specified in 903.03.01.

901.06.01 Coarse Aggregate

Use coarse aggregate that is broken stone or washed gravel conforming to 901.03.01 or 901.03.02, respectively, except do not use carbonate rock for concrete surface courses, bridge approach, or bridge decks. Use coarse aggregate that is the size or sizes shown in Table 903.03.06-1 and Table 903.03.06-2. Wash the coarse aggregate at least 24 hours before use.

901.06.02 Fine Aggregate

For all classes of concrete and mortar, use fine aggregate that is washed and sized through a sand classifier plant and composed of quartz or other hard, durable particles. Ensure that the fine aggregate is subangular to angular in shape and free of soft particles. Derive fine aggregate from either a natural sand deposit resulting from glacial or water action, or produce a manufactured stone sand from the mechanical crushing of quarried rock or gravel that conforms to 901.03. Ensure that the fine aggregate also conforms to 901.01 and 901.02 and the gradation specified in Table 901.06.02-1.

Table 901.06.02-1 Gradation Requirements for Fine Aggregate used in Concrete, Mortar, and Grout

Sieve Size	Percent Passing
3/8"	100
No. 4	95 - 100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 65
No. 50	10 - 30
No. 100	1 - 10
No. 200	0.0 - 3.4

Ensure that the fine aggregate does not have more than 45 percent passing any sieve and retained on the next sieve and that the fineness modulus according to AASHTO M 6 is from 2.3 to 3.1 for concrete. Ensure that the fine aggregate conforms to the quality requirements specified in Table 901.06.02-2.

Table 901.06.02-2 Quality Requirements for Fine Aggregate used in Concrete, Mortar, and Grout

Aggregate Property	Test Method	Minimum Percent	Maximum Percent
Mica	NJDOT A-2		2.0
Absorption, cold water	AASHTO T 84		2.0
Sodium sulfate soundness, loss	AASHTO T 104		5.0
Chloride content	AASHTO T 260		0.06
Lightweight pieces	AASHTO T 113		0.25
7-Day mortar strength	NJDOT A-1	75	

The ME will test the fine aggregate for organic impurities and will reject it if it produces a color darker than the standard. Ensure that the mortar-making properties of the fine aggregate for concrete and mortar are not less than 100 percent of those of standard Ottawa sand.

The ME will sample fine aggregate at a frequency of 10 pounds for each 500 tons.

901.06.03 Lightweight Aggregate

Manufacture lightweight aggregate by expanding or sintering material such as slate or shale by the rotary kiln process. Grade the lightweight aggregate to the size designation requirements for 3/4-inch to No. 4 sieves of Table 1 of ASTM C 330. Ensure that the lightweight aggregate producer has at least 5 years experience and a record of successful production and use of such product. Submit to the ME a certification of compliance as specified in 106.07. Ensure that the lightweight aggregate conforms to ASTM C 330 and the following requirements:

1. **Sodium Sulfate Soundness.** Use a lightweight aggregate that has a sodium sulfate soundness loss of weight that does not exceed 10 percent after 5 immersion and drying cycles when tested according to AASHTO T 104. Use a sample of sufficient size to provide the amounts specified in Table 901.06.03-1 of the various sieve sizes:

Table 901.06.03-1 Sampling for Sodium Sulfate Soundness Testing

Sieve Size	Weight
1" to 3/4"	2.20 pounds
3/4" to 1/2"	1.65 pounds
1/2" to 3/8"	1.10 pounds
3/8" to No. 4	0.66 pounds

2. **Percentage of Wear.** Use a lightweight aggregate with a loss that does not exceed 40 percent when tested according to AASHTO T 96.

901.07 GRIT

Use grit for spreading over the epoxy waterproofing that is a subangular, natural, 98 percent silica sand. Ensure that 90 percent of the total sample by weight falls between the No. 4 and No. 30 sieves, with 0 percent passing the No. 30 sieve.

901.08 RIPRAP STONES

Use riprap stones that consist of a uniformly graded mixture of rock conforming to 901.03.01, such that 50 percent of the mixture by weight is equal to or larger than the designated median stone size (d_{50}). Ensure that the stones are a well-graded mixture composed primarily of the larger stone sizes, but with a sufficient quantity of other sizes to fill the progressively smaller voids between the stones. Ensure that the diameter of the largest stone size is less than 1.5 times d_{50}.

901.09 GABION BASKET STONE

To fill gabion baskets, use crushed stone consisting of trap rock, granite, or gneiss and conforming to the requirements of 901.03.01. To prevent breakdown after placement, use aggregate that is free of cracks due to jointing, faulting, or other causes. Ensure that the aggregate conforms to the size requirements specified in Table 901.09-1.

Table 901.09-1 Gabion Basket Stone Size Requirements

Basket Height	Minimum	Maximum
Less than 24 inches	3 inch	5 inch
Greater than or equal to 24 inches	4 inch	8 inch

901.10 DENSE-GRADED AGGREGATE (DGA)

Use a DGA that is listed on the QPL. For gradation acceptance, the ME will sample DGA according to AASHTO T 2 for each 500 cubic yards. The ME will apply the gradation requirements to the material after it has been placed and compacted on the Project.

901.10.01 Virgin

Produce virgin DGA from broken stone conforming to 901.03.01, crushed gravel conforming to 901.03.02, or blast furnace slag conforming to 901.04, except that at least 90 percent of all fragments shall contain at least 1 fractured face. Ensure that the DGA conforms to the following requirements and gradation:

1. **Moisture Content.** Ensure that the moisture content of DGA immediately before placement is 6 ± 2 percent based on dry weight. If dense-graded aggregate is to be paid for on a weight basis, do not deliver DGA to the Project with the moisture content exceeding 8 percent.

2. **Plasticity and Gradation.** When tested according to AASHTO T 90, ensure that the portion passing the No. 40 sieve is non-plastic. Ensure that the gradation conforms to the requirements specified in Table 901.10.01-1.

Table 901.10.01-1 Gradation Requirements for DGA

Sieve Size	Percent Passing
1-1/2"	100
3/4"	55 - 90
No. 4	25 - 50
No. 50	5 - 20
No. 200	3 - 10

901.10.02 Recycled Concrete Aggregate (RCA)

The Contractor may produce DGA from recycled concrete aggregate that conforms to the gradation and plasticity requirements specified in 901.10.01 and to the following:

1. **Composition.** Ensure that the composition, as determined according to NJDOT A-3, conforms to the requirements specified in Table 901.10.02-1.

Table 901.10.02-1 Composition Requirements for RCA

Aggregate Property	Minimum Percent	Maximum Percent
Concrete[1]	90	
HMA		10
Brick, cinder block, schist, concrete washout, and other friable material		4
Reactive material		0
Wood		0.1

1. To meet the minimum requirement for concrete, the Contractor may add broken stone, vitreous china, or crushed gravel. Use broken stone conforming to 901.03.01 or crushed gravel conforming to 901.03.02, except that it need not be washed.

2. **Percentage of Wear.** Ensure that the loss does not exceed 50 percent when tested according to AASHTO T 96.

3. **Reporting of Recycled Materials Usage.** Report the tonnage of concrete aggregate being recycled to the Solid Waste Management District of origin, according to N.J.A.C 7:26A.

901.10.03 Virgin and RAP Mixture

The Contractor may also produce DGA by mixing a maximum of 50 percent RAP conforming to 901.05.04 with previously approved virgin DGA.

Use a method of mixing that will ensure that the blended mixture is homogeneous with regard to particle size and composition. Ensure that the blended mixture meets the following requirements:

1. **Composition.** Ensure that the composition, as determined according to NJDOT A-3, conforms to the requirements specified in Table 901.10.03-1.

Table 901.10.03-1 Composition Requirements for Virgin DGA and RAP Mixture	
Aggregate Property	**Percent by Weight Maximum**
RAP	50
Concrete	5
Brick, schist, and other friable material	4
Reactive material	0
Wood	0.1

2. **Plasticity and Gradation.** Use a blended material that is non-plastic when the portion passing the No. 40 sieve is tested according to AASHTO T 90. Ensure that the DGA containing RAP conforms to the gradation for DGA as specified in 901.10.01, except that the percent passing the No. 200 sieve is 0 to 10 percent when tested according to NJDOT A-6.

3. **Density Control.** Perform density control as specified in 302.03.01, except for the method for determining the dry density. After determining the wet density according to AASHTO T 310 (Direct Transmission Mode), the ME will take a 1000-gram sample of the DGA for subsequent weighing, drying, and reweighing in the laboratory to determine the moisture content. The ME will calculate the dry density using the wet density measured according to AASHTO T 310 and the moisture content measured from the lab tested sample. The ME will use the dry densities to determine the Q statistic for acceptance of the density.

901.11 SOIL AGGREGATE

Use soil aggregates that are natural or prepared mixtures consisting predominately of hard, durable particles of stone, gravel, or sand. Mixtures may contain some silt, clay, or stone dust. Ensure that stone conforms to 901.03.01, and that gravel is crushed or uncrushed and conforms to 901.03.02. Use sand that is either natural sand resulting from the weathering process or stone sand produced by grinding or crushing of rock. Ensure that stone sand is manufactured from an aggregate source as specified in 901.03. Provide natural sand consisting of material composed of predominantly angular particles of quartz or other hard, durable minerals.

The Contractor may use soil aggregate produced from RPCSA produced by a NJDEP approved "Class B" recycling center operating pursuant to N.J.A.C 7:26A.

Do not place soil aggregate obtained from subaqueous sources until the ME has determined that its moisture content is not excessive.

Ensure that soil aggregate conforms to the following:

1. **Composition of Soil Aggregate.** Ensure that the soil aggregate is free from elements or chemicals which, in the presence of water, would produce detrimental effects to pavements, structures, or utility lines, and is free of organic matter, garbage, metal, debris, lumps of clay, or other deleterious matter.

   Produce Designations I-1, I-2, I-3, I-4, I-9, I-10, I-11, I-12, I-13, and I-15 from sand, gravel, or stone.

   Produce Designation I-5 from hard, durable gravel or stone mixed with sand or stone dust so that it can be compacted into a hard, dense mass. Ensure that the coarse aggregate fraction of the I-5 is composed of at least 85 percent by weight of hard, durable aggregate of a geologic type conforming to 901.03, as determined by lithologic analysis performed according to NJDOT A-3.

   Ensure that Designations I-6, I-7, and I-8 consist of clean, free-draining sand, gravel, or stone.

   For Designation I-14, use material that is composed of soil aggregate and rock. The material may also contain recycled concrete or HMA. Ensure that the proportion of soil aggregate is sufficient to fill all voids in the rock and larger pieces of recycled material.

2. **Gradation.** Use soil aggregate that conforms to the gradation specified in Table 901.11-1 for the various designations. The gradation requirements shall apply to the material after it has been placed and compacted on the Project. Where compaction is not prescribed, the requirements for any given type shall apply to the material at the time of placement. Should the source contain oversize material, the RE may require the Contractor to eliminate such oversize material.

For Designation I-14, ensure that the portion of material passing the 4-inch sieve contains no more than 35 percent by weight of material passing the No. 200 sieve. Ensure that the proportion of soil aggregate is sufficient to fill all voids in the rock and larger pieces of recycled material. When embankments are constructed outside the ROW in areas where the State has purchased slope rights to construct embankments, use material that is 100 percent passing the 2-inch sieve to construct the top 2-1/2 feet. When driving piles through the embankment, use material that is 100 percent passing the 2-inch sieve.

Table 901.11-1 Standard Soil Aggregate Gradations

Gradation Designations, percentage by weight passing square mesh sieves													
	6"	**4"**	**2"**	**1-1/2"**	**1"**	**3/4"**	**1/2"**	**No. 4**	**No. 8**	**No. 16**	**No. 50**	**No. 100**	**No. 200**
I-1		100	70-100			50-95		30-60			5-25		0-7
I-2			100			65-100		40-75			5-30		0-7
I-3				100		60-90		40-80			10-35		0-8
I-4			100		60-100		40-100	25-100	20-100	15-85	8-45		5-10
I-5			100			70-100		30-80			10-35		5-12
I-6					100		80-100		45-100	30-90	0-20	0-3	
I-7					100		80-100		35-100	25-90	5-50	0-8	0-2
I-8							100	95-100		45-70	5-25		0-5
I-9		100	80-100			60-100		40-100		20-70	5-35	0-20	0-8
I-10		100	80-100			60-100		40-100		20-70	5-40	0-30	0-20
I-11		100	80-100			60-100		40-100			0-75		0-9
I-12		100				70-100					0-75		0-5
I-13		100						30-100					0-12
I-14	See Text.												
I-15	100	80-100						30-80			0-25		0-10

3. **Combining and Mixing.** If bank-run or other materials conforming to the requirements are not available, the Contractor may produce materials that conform to requirements by combining and mixing, or by washing. The Contractor may combine materials and mix on the grade only with RE approval. Do not blend Designation I-9 to meet gradation requirements. Perform blending on the grade using a traveling high-speed rotor mixer capable of cutting and thoroughly mixing to a minimum depth of 6 inches.

4. **Electrochemical Requirements for Designation I-15.** Ensure that Designation I-15 conforms to the electrochemical requirements specified in Table 901.11-2.

Table 901.11-2 Electrochemical Requirements for Designation I-15

Property	Test Method	Requirement
Resistivity, ohm-cm	AASHTO T 288	Greater than 3000
pH	AASHTO T 289	Acceptable Range of 5 - 10
Organic Content	AASHTO T 267	1.00% Maximum
Chloride	AASHTO T 291	Less than 100 ppm
Sulfates	AASHTO T 290	Less than 200 ppm

If the resistivity is greater than or equal to 5000 ohm-cm, the Department will waive the chloride and sulfates requirements.

Test Designation I-15 at a rate of once for every 1000 cubic yards of material placed to ensure conformance to the electrochemical limits specified in Table 901.11-2. Whenever the appearance or behavior of the material changes, the ME may require additional samples.

Ensure that the material has a sodium sulfate loss of less than 15 percent after 5 cycles as determined according to AASHTO T 104.

Provide the RE with a certification of compliance, as specified in 106.07, certifying that the Designation I-15 conforms to the requirements of this Section. Attach a copy of the test results representative of material used on the Project.

The ME will sample soil aggregate as specified in Table 901.11-3.

Table 901.11-3 Soil Aggregate Sampling

Soil Designation	Sampling/Frequency
I-1, I-2, I-3, I-4, I-5, I-6, I-7, I-8, I-9, & I-10	According to AASHTO T 2 for each 500 cubic yards
I-11, I-12, I-13, & I-15	According to AASHTO T 2 for each 500 cubic yards[1]
I-14	According to AASHTO T 2 for each 2000 cubic yards

1. After initial 10,000 cubic yards have been sampled, the ME will take 1 sample for each 2000 cubic yards, except if any sample fails or is borderline, then the ME will revert to 1 sample for each 500 cubic yards. The ME will continue with the 1 sample for each 500 cubic yards sampling frequency until the ME determines that the gradation requirements are consistently being met.

The ME may sample stockpiles before placement, but the Department will make the final and governing determination of conformance or nonconformance based on sampling and testing of the materials after they have been placed as specified in the Contract. Remove materials that do not conform and replace with conforming materials, or correct the deficiencies of the non-conforming materials. If corrective action has been taken, the ME will take an additional sample, and if necessary, one check sample. If the materials still do not conform after corrective action, the ME will not perform further testing until the Contractor tests and certifies that the rejected material has been corrected. After this certification, the ME will analyze an additional sample, and if this sample does not meet the requirements, the Contractor shall remove and replace the material.

SECTION 902 – ASPHALT

902.01 BITUMINOUS MATERIALS

Use the following temperature-volume correction (TVC) factors to convert the volume of bituminous materials, measured at the temperature at the point of use, to the volume at 60 °F:

1. For PG Binder and MC 800, use the following equation:

$$TVC = 1.0211326242 - 3.548988118 \times 10^{-4} [T (°F)] + 4.49881 \times 10^{-8} [T (°F)]^2$$

2. For all other cutbacks, use the following equation:

$$TVC = 1.02413769 - 4.0641418 \times 10^{-4} [T (°F)] + 6.79176 \times 10^{-8} [T (°F)]^2$$

3. For emulsified asphalts, use Table 902.01-1.

Table 902.01-1 TVC Factors for Emulsified Asphalt Material

Temp (°F)	Factor	Temp (°F)	Factor	Temp (°F)	Factor	Temp (°F)	Factor
40	1.0050	75	0.9953	110	0.9876	145	0.9792
41	1.0048	76	0.9960	111	0.9874	146	0.9790
42	1.0045	77	0.9958	112	0.9872	147	0.9787
43	1.0043	78	0.9955	113	0.9869	148	0.9785
44	1.0040	79	0.9953	114	0.9867	149	0.9782
45	1.0038	80	0.9950	115	0.9864	150	0.9780
46	1.0035	81	0.9948	116	0.9862	151	0.9778
47	1.0033	82	0.9945	117	0.9860	152	0.9775
48	1.0030	83	0.9943	118	0.9857	153	0.9773
49	1.0028	84	0.9940	119	0.9855	154	0.9770
50	1.0025	85	0.9938	120	0.9852	155	0.9768
51	1.0023	86	0.9935	121	0.9850	156	0.9766
52	1.0020	87	0.9933	122	0.9847	157	0.9763
53	1.0018	88	0.9930	123	0.9845	158	0.9761
54	1.0015	89	0.9928	124	0.9843	159	0.9758
55	1.0013	90	0.9925	125	0.9840	160	0.9756

Table 902.01-1 TVC Factors for Emulsified Asphalt Material							
Temp (°F)	**Factor**	**Temp (°F)**	**Factor**	**Temp (°F)**	**Factor**	**Temp (°F)**	**Factor**
56	1.0010	91	0.9923	126	0.9838	161	0.9754
57	1.0008	92	0.9920	127	0.9835	162	0.9751
58	1.0005	93	0.9918	128	0.9833	163	0.9749
59	1.0003	94	0.9915	129	0.9830	164	0.9747
60	1.0000	95	0.9913	130	0.9828	165	0.9744
61	0.9998	96	0.9910	131	0.9826	166	0.9742
62	0.9995	97	0.9908	132	0.9823	167	0.9739
63	0.9993	98	0.9905	133	0.9821	168	0.9737
64	0.9990	99	0.9903	134	0.9818	169	0.9735
65	0.9988	100	0.9901	135	0.9816	170	0.9732
66	0.9985	101	0.9899	136	0.9814	171	0.9730
67	0.9983	102	0.9896	137	0.9811	172	0.9728
68	0.9980	103	0.9884	138	0.9809	173	0.9725
69	0.9978	104	0.9891	139	0.9806	174	0.9723
70	0.9975	105	0.9889	140	0.9804	175	0.9721
71	0.9973	106	0.9886	141	0.9802	176	0.9718
72	0.9970	107	0.9884	142	0.9799	177	0.9716
73	0.9968	108	0.9881	143	0.9797	178	0.9713
74	0.9965	109	0.9879	144	0.9794	179	0.9711

902.01.01 Asphalt Binder

Use asphalt binder that conforms to AASHTO M 320, Table 1. Use Grade 64-22, except the ME may direct that an asphalt of softer grade be used when the mixture contains a high percentage of RAP and except where otherwise specified.

When specified, use PG 76-22 asphalt binder that is a storage-stable, pre-blended, homogeneous, polymer modified asphalt binder using styrene-butadiene or styrene-butadiene-styrene formulations. Ensure that the binder's rolling thin film oven test (AASHTO T 240) residue has a minimum elastic recovery (ASTM D 6084, Procedure A) of 60 percent when tested for at 25 °C.

The asphalt binder producer shall provide the asphalt binder quality control plan annually to the ME for approval. Ensure that the quality control plan conforms to AASHTO R 26.

Submit to the ME a certification of compliance, as specified in 106.07, for the asphalt binder. The ME will perform quality assurance sampling and testing of each asphalt binder lot as defined in the approved quality control plan.

902.01.02 Cutback Asphalts

Use cutback asphalt of the rapid-curing types conforming to AASHTO M 81 and cutback asphalt of the medium-curing types conforming to AASHTO M 82.

For cutback asphalt that will not be used as a penetrating prime coat, use and store according to N.J.A.C 7:27-16 *et seq.*, which includes a limitation for use only between October 15 and April 15.

The cutback asphalt producer shall provide the cutback asphalt quality control plan annually to the ME for approval.

Submit to the ME a certification of compliance, as specified in 106.07, for the asphalt binder. The ME will perform quality assurance sampling and testing of each cutback asphalt lot as defined in the approved quality control plan.

902.01.03 Emulsified Asphalts

Use emulsified asphalts of the rapid-setting (RS), medium-setting (MS), and slow-setting (SS) types conforming to AASHTO M 140. Use cationic emulsified asphalts of the rapid-setting (CRS), medium-setting (CMS), and slow-setting (CSS) types conforming to AASHTO M 208.

The emulsified asphalt producer shall provide the emulsified asphalt quality control plan annually to the ME for approval.

Submit to the ME a certification of compliance, as specified in 106.07, for the asphalt binder. The ME will perform quality assurance sampling and testing of each emulsified asphalt lot as defined in the approved quality control plan.

902.01.04 Polymer Modified Tack Coat

Use a tack coat consisting of homogeneous cationic emulsified asphalt modified using styrene-butadiene, styrene-butadiene-styrene, natural latex, or synthetic latex and conforming to the requirements specified in Table 902.01.04-1.

Table 902.01.04-1 Requirements for Polymer Modified Tack Coat

Tests on Emulsion	Test Method	Minimum	Maximum
Elastic Recovery on Residue @10 °C, %	AASHTO T 301	58	
Total Residue by Distillation, %	AASHTO T 59[1]	63	
Viscosity @ 25 °C, SSF	AASHTO T 72	20	100
Particle Charge	AASHTO T 59	Positive	
Storage Stability Test, 1 day, %	AASHTO T 59		1
Sieve Test, % mass (850 µm)	AASHTO T 59		0.10
Demulsibility, %	AASHTO T 59[2]	55	

1. AASHTO T 59 modified to maintain a temperature of 177 ± 5 °C for 15 minutes. Use an ASTM 16C thermometer to monitor the temperature of the emulsion during distillation.
2. For demulsibilty testing, use 35 mL of 0.8 percent dioctyl sodium sulfosuccinate solution.

902.02 HOT MIX ASPHALT (HMA)

902.02.01 Mix Designations

The requirements for specific HMA mixtures are identified by the abbreviated fields in the Item description as defined as follows:

HOT MIX ASPHALT 12.5H64 SURFACE COURSE

1. **"HOT MIX ASPHALT"** "Hot Mix Asphalt" is located in the first field in the Item description for the purpose of identifying the mixture requirements.
2. **"12.5"** The second field in the Item description designates the nominal maximum size aggregate (in millimeters) for the job mix formula (sizes are 4.75, 9.5, 12.5, 19, 25, and 37.5 mm).
3. **"H"** The third field in the Item description designates the design compaction level for the job mix formula based on traffic forecasts as listed in Table 902.02.03-2 (levels are L=low, M=medium, and H=high).
4. **"64"** The fourth field in the Item description designates the high temperature (in °C) of the performance-graded binder (options are 64, 70, and 76 °C). All binders shall have a low temperature of –22 °C, unless otherwise specified.
5. **"SURFACE COURSE"** The last field in the Item description designates the intended use and location within the pavement structure (options are surface, intermediate, or base course).

902.02.02 Composition of Mixtures

Provide materials as specified:

Aggregates for Hot Mix Asphalt 901.05
Asphalt Binder 902.01.01

Mix HMA in a plant that is listed on the QPL and conforms to the requirements for HMA Plants as specified in 1009.01.

Composition of the mixture for HMA surface course is coarse aggregate, fine aggregate, and asphalt binder, and may also include mineral filler and up to 15 percent Reclaimed Asphalt Pavement (RAP). Ensure that the finished mix does not contain more than a total of 1 percent by weight contamination from Crushed Recycled Container Glass (CRCG).

The composition of the mixture for HMA base or intermediate course is coarse aggregate, fine aggregate, and asphalt binder, and may also include mineral filler and up to 35 percent of recycled materials. The 35 percent of recycled materials may consist of a combination of RAP, CRCG, Ground Bituminous Shingle Material (GBSM), and RPCSA, with the following individual limits:

Table 902.02.02-1 Use of Recycled Materials in HMA Base or Intermediate Course

Recycled Material	Maximum Percentage
RAP	25
CRCG	10
GBSM	5
RPCSA	20

Combine the aggregates to ensure that the resulting mixture meets the grading requirements specified in Table 902.02.03-1. In determining the percentage of aggregates of the various sizes necessary to meet gradation requirements, exclude the asphalt binder.

Ensure that the combined coarse aggregate, when tested according to ASTM D 4791, has less than 10 percent flat and elongated pieces retained on the No. 4 sieve and larger. Measure aggregate using the ratio of 5:1, comparing the length (longest dimension) to the thickness (smallest dimension) of the aggregate particles.

Ensure that the combined fine aggregate in the mixture conforms to the requirements specified in Table 902.02.02-2. Ensure that the material passing the No. 40 sieve is non-plastic when tested according to AASHTO T 90.

Table 902.02.02-2 Additional Fine Aggregate Requirements for HMA

Mix Compaction Level	Course	Uncompacted Void Content of Fine Aggregate[1] Minimum Percent	Sand Equivalent[2] Minimum Percent
L	Surface/Intermediate	40	45
L	Base	40	45
M, H	Surface/Intermediate	45	45
M, H	Base	40	45

1. According to AASHTO T 304, Method A.
2. According to AASHTO T 176.

902.02.03 Mix Design

Submit a mix design including a job mix formula (JMF) for each mixture on forms supplied by the ME. Include a statement naming the source of each component and a report showing that the results conform to the criteria specified in Table 902.02.03-1, Table 902.02.03-2, and Table 902.02.03-3. If a change in sources or properties of materials occur, the ME may require the HMA producer to establish a new mix design and to obtain approval before production can continue.

To establish the JMF for each mix design, determine the percentage of dry weight of aggregate passing each required sieve size and an optimum percentage of asphalt binder based upon the weight of the total mix. Determine the optimum percentage of asphalt binder according to AASHTO M 323 and R 35. Combine the aggregates to ensure that the resulting mixture conforms to the grading requirements specified in Table 902.02.03-1. In determining the percentage of aggregates of the various sizes necessary to conform to gradation requirements, exclude the asphalt binder.

Table 902.02.03-1 HMA Mixtures Nominal Maximum Size of Aggregate – Grading Of Total Aggregate

Sieve Size	Nominal Maximum Aggregate Size – Control Point (Percent Passing)											
	37.5 mm		25 mm		19 mm		12.5 mm		9.5 mm		4.75 mm	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
2"	100	–	–	–	–	–	–	–	–	–	–	–
1-1/2"	90	100	100	–	–	–	–	–	–	–	–	–
1"	–	90	90	100	100	–	–	–	–	–	–	–
3/4"	–	–	–	90	90	100	100	–	–	–	–	–
1/2"	–	–	–	–	–	90	90	100	100	–	100	–
3/8"	–	–	–	–	–	–	–	90	90	100	95	100
No. 4	–	–	–	–	–	–	–	–	–	90	90	100
No. 8	15	41	19	45	23	49	28	58	32	67	–	–
No. 16	–	–	–	–	–	–	–	–	–	–	30	60
No. 200	0	6	1	7	2	8	2	10	2	10	6	12

Table 902.02.03-2 Gyratory Compaction Effort for HMA Mixtures

Compaction Level	ESALs[1] (millions)	N_{des}	N_{max}
L	< 0.3	50	75
M	0.3 to < 3	75	115
H	≥3	100	160

1. Design ESALs (Equivalent (80kN) Single-Axle Loads) refer to the anticipated traffic level expected on the design lane over a 20-year period.

Table 902.02.03-3 HMA Requirements for Design

Compaction Levels	Required Density (% of Theoretical Max. Specific Gravity)		Voids in Mineral Aggregate (VMA), % (minimum)						Voids Filled With Asphalt (VFA)1 %	Dust-to-Binder Ratio
			Nominal Max. Aggregate Size, mm							
	@N_{des}[2]	@N_{max}	37.5	25.0	19.0	12.5	9.5	4.75		
L	96.0	≤ 98.0	11.0	12.0	13.0	14.0	15.0	16.0	70 - 80	0.6 - 1.2
M	96.0	≤ 98.0	11.0	12.0	13.0	14.0	15.0	16.0	65 - 78	0.6 - 1.2
H	96.0	≤ 98.0	11.0	12.0	13.0	14.0	15.0	16.0	65 - 75	0.6 - 1.2

1. For 37.5-mm nominal maximum size mixtures, the specified lower limit of the VFA is 64 percent for all design traffic levels.
2. As determined from the values for the maximum specific gravity of the mix and the bulk specific gravity of the compacted mixture. Maximum specific gravity of the mix is determined according to AASHTO T 209. Bulk specific gravity of the compacted mixture is determined according to AASHTO T 166. For verification, specimens must be between 95.0 and 97.0 percent of maximum specific gravity at N_{des}.

For mix designs that include RAP or GBSM, also include the following based on the weight of the total mixture:

1. Percentage of RAP or GBSM.
2. Percentage of asphalt binder in the RAP or GBSM.
3. Percentage of new asphalt binder.
4. Total percentage of asphalt binder.
5. Percentage of each type of virgin aggregate.

At the ME's request, test the mix design to ensure that it meets a minimum tensile strength ratio of 80 percent, when tested according to AASHTO T 283. The ME will require tensile strength ratio testing for new aggregate sources and for aggregates suspected of stripping susceptibility.

For each mix design, submit with the mix design forms 2 gyratory specimens and 1 loose sample corresponding to the composition of the JMF. The ME will use these to verify the properties of the JMF. Compact the specimens to the design number of gyrations (N_{des}). For the mix design to be acceptable, all gyratory specimens must comply with the

requirements specified in Table 902.02.03-1 and Table 902.02.03-3. The ME reserves the right to be present at the time the gyratory specimens are molded.

The ME's may verify a mix on an annual basis rather than on a project-to-project basis if the properties and proportions of the materials do not change. If written verification is submitted by the HMA supplier that the same source and character of materials are to be used, the ME may waive the requirement for the design and verification of previously approved mixes.

902.02.04 Sampling and Testing

A. General Acceptance Requirements. The RE or ME may reject and require disposal of any batch or shipment that is rendered unfit for its intended use due to contamination, segregation, improper temperature, lumps of cold material, or incomplete coating of the aggregate. For other than improper temperature, visual inspection of the material by the RE or ME is considered sufficient grounds for such rejection.

For PG 64-22 or PG 70-22, ensure that the temperature of the mixture at discharge from the plant or surge and storage bins is at least 290 °F when the ambient temperature is less than 50 °F or is at least 275 °F when the ambient temperature is greater than or equal to 50 °F. For PG 76-22, ensure that the temperature of the mixture at discharge from the plant or surge and storage bins is at least 10 °F above the manufacturer's recommended laydown temperature. Do not allow the mixture temperature to exceed 330 °F at discharge from the plant.

Combine and mix the aggregates and asphalt binder to ensure that at least 95 percent of the coarse aggregate particles are entirely coated with asphalt binder as determined according to AASHTO T 195. If the ME determines that there is an on-going problem with coating, the ME may obtain random samples from 5 trucks and will determine the adequacy of the mixing on the average of particle counts made on these 5 test portions. If the requirement for 95 percent coating is not met on each sample, modify plant operations, as necessary, to obtain the required degree of coating.

B. Sampling. The ME will take 5 stratified random samples of HMA for volumetric acceptance testing from each lot of approximately 3500 tons of a mix. When a lot of HMA is less than 3500 tons, the ME will take samples at random for each mix at the rate of one sample for each 700 tons. The ME will perform sampling according to AASHTO T 168, NJDOT B-2, or ASTM D 3665.

Use a portion of the samples taken for volumetric acceptance testing for composition testing, unless composition is determined by hot bin analysis. If using hot bin analysis at a fully automated batch plant, take 5 samples from each lot corresponding to the volumetric acceptance samples, under the supervision of the ME.

C. Quality Control Testing. The HMA producer shall provide a quality control (QC) technician who is certified by the Society of Asphalt Technologists of New Jersey as an Asphalt Technologist, Level 2. The QC technician may substitute equivalent technician certification by the Mid-Atlantic Region Technician Certification Program (MARTCP). Ensure that the QC technician is present during periods of mix production for the sole purpose of quality control testing and to assist the ME. The ME will not perform the quality control testing or other routine test functions in the absence of, or instead of, the QC technician.

The QC technician shall perform sampling and testing according to the approved quality control plan, to keep the mix within the limits specified for the mix being produced. The QC technician may use acceptance test results or perform additional testing as necessary to control the mix.

To determine the composition, perform ignition oven testing according to AASHTO T 308. For fully automated plants, the QC technician may determine composition using hot bin analysis according to NJDOT B-5. Use only one method for determining composition within a lot.

For each acceptance test, perform maximum specific gravity testing according to AASHTO T 209 on a test portion of the sample taken by the ME. Sample and test coarse aggregate, fine aggregate, mineral filler, and RAP according to the approved quality control plan for the plant.

When using RAP, ensure that the supplier has in operation an ongoing daily quality control program to evaluate the RAP. As a minimum, this program shall consist of the following:

1. An evaluation performed to ensure that the material conforms to 901.05.04 and compares favorably with the design submittal.

2. An evaluation of the RAP material performed using a solvent or an ignition oven to qualitatively evaluate the aggregate components to determine conformance to 901.05.
3. Quality control reports as directed by the ME.

D. Acceptance Testing and Requirements. The ME will determine volumetric properties at N_{des} for acceptance from samples taken, compacted, and tested at the HMA plant. The ME will compact HMA to the number of design gyrations (N_{des}) specified in Table 902.02.03-2, using equipment according to AASHTO T 312. The ME will determine bulk specific gravity of the compacted sample according to AASHTO T 166. The ME will use the most current QC maximum specific gravity test result in calculating the volumetric properties of the HMA.

The ME will determine the dust-to-binder ratio from the composition results as tested by the QC technician.

Ensure that the HMA mixture conforms to the requirements specified in Table 902.02.04-1, and to the gradation requirements in Table 902.02.03-1. If 2 samples in a lot fail to conform to the gradation or volumetric requirements, immediately initiate corrective action.

The ME will test a minimum of 1 sample per lot for moisture, basing moisture determinations on the weight loss of an approximately 1600-gram sample of mixture heated for 1 hour in an oven at 280 ± 5°F. Ensure that the moisture content of the mixture at discharge from the plant does not exceed 1.0 percent.

Table 902.02.04-1 Hot Mix Asphalt Requirements for Control

Compaction Levels	Required Density (% of Theoretical Max. Specific Gravity)	Voids in Mineral Aggregate (VMA), % (minimum)						Dust-to-Binder Ratio
		Nominal Max. Aggregate Size, mm						
	@Ndes[1]	37.5	25.0	19.0	12.5	9.5	4.75	
L, M, H	95.0 – 97.0	11.0	12.0	13.0	14.0	15.0	16.0	0.6 - 1.3

1. As determined from the values for the maximum specific gravity of the mix and the bulk specific gravity of the compacted mixture. Maximum specific gravity of the mix is determined according to AASHTO T 209. Bulk specific gravity of the compacted mixture is determined according to AASHTO T 166.

E. Plants Producing for Multiple Projects. When a plant is producing HMA for 2 or more Department projects at the same time, the ME will establish 1 common lot for each mix and will use the sample results for the lot to represent the HMA for each Contract on which a part of that lot was used.

902.03 OPEN-GRADED FRICTION COURSE (OGFC) AND MODIFIED OPEN-GRADED FRICTION COURSE (MOGFC)

902.03.01 Composition of Mixtures

Mix OGFC and MOGFC in a plant that is listed on the QPL and conforms to the requirements for HMA plants as specified in 1009.01.

Composition of mixture for OGFC and MOGFC is coarse aggregate, fine aggregate and asphalt binder. Ensure that the mixture conforms to the following requirements:

1. Use aggregate for OGFC and MOGFC that conforms to 901.10, except, for coarse aggregate, use broken stone of gneiss, granite, quartzite, or trap rock. Do not use RAP, CRCG, GBSM, or RPCSA.
2. Use asphalt binder for OGFC and MOGFC that is PG 76-22 as specified in 902.01.01.
3. For MOGFC, add a stabilizing additive consisting of mineral fiber or cellulose fiber to the mix. Use a stabilizing additive that conforms to the requirements for stabilizing additives in AASHTO MP 8. Use only 1 type per mix design. If using mineral fibers, use a dosage rate of 0.4 percent by weight of total mix. If using cellulose fibers, use a dosage rate of 0.3 percent by weight of total mix. The dosage rate may be increased, as necessary, to prevent draindown as measured by the visual draindown determination of asphalt content in NJDOT B-8. Accurately control proportioning the fibers into the mixture within ±10 percent of the required weight, and use equipment that ensures uniform dispersion of the fibers. Store fibers in a dry location with a storage temperature not to exceed 120 °F. The supplier of the cellulose or mineral fibers shall provide a certification of compliance, as specified in 106.07, that the material supplied conforms to AASHTO MP 8. Ensure that a technical representative from the additive supplier is at the work site for the first full day of construction for technical assistance.

902.03.02 Mix Design

Submit a mix design including JMF for each mixture on forms supplied by the Department. Include a statement naming the source of each component and a report with the results for the criteria specified in Table 902.03.03-1. Design the mix to meet the criteria in Table 902.03.03-1.

In the JMF for each mixture, establish the percentage of dry weight of aggregate passing each required sieve size and an optimum percentage of asphalt binder based upon the weight of the total mix. Determine the optimum asphalt binder content for OGFC as specified in NJDOT B-7. Determine the optimum asphalt binder content for MOGFC as specified in NJDOT B-8. Ensure that the JMF is within the master range specified in Table 902.03.03-1.

Prepare compacted test specimens for submittal to the ME at least 30 days before the initial production date. Prepare these specimens from material mixed according to the final JMF, using 50 gyrations of the Superpave gyratory compactor according to AASHTO T 312.

The ME will test 2 specimens to verify that the final JMF produces a mixture that has a minimum void content as specified in Table 902.03.03-1. The ME will determine percent air voids according to AASHTO T 209, and either NJDOT B-6 or AASHTO TP 69.

The ME will test 6 specimens according to AASHTO T 283, except for the following:

1. No specific air void level is required.
2. Compact specimens with 50 gyrations using the Superpave gyratory compactor.
3. Apply a vacuum of 26 inches of mercury for 10 minutes to saturate the compacted specimen. No specific saturation level is required.
4. Submerge the specimen in water during 1 freeze/thaw cycle.

If the tensile strength ratio falls below 80 percent, adjust the mixture to satisfy the minimum requirement. Adjustments may include the use of anti-stripping agents.

For MOGFC only, the ME will test 2 test specimens for abrasion and impact resistance using a modified L.A. Abrasion Test according to NJDOT B-8. The maximum allowable loss as calculated by this method is 30 percent.

Do not modify the JMF unless the ME approves the modification.

902.03.03 Sampling and Testing

Perform and meet requirements for quality control testing as specified in 902.02.04.C.

During production, the ME will take one random acceptance sample from each 500 tons of production to verify composition. Conduct air voids and draindown tests as directed by the ME.

If the composition testing results are outside of the production control tolerances specified in Table 902.03.03-2 for an acceptance sample, determine if a plant adjustment is needed and immediately run a quality control sample. If the quality control sample is also outside of the control tolerances in Table 902.03.03-2, immediately take corrective action to bring the mix into compliance. Take additional quality control samples after the corrective action to ensure that the mix is within the production control tolerances. If 2 consecutive acceptance samples are outside the tolerances specified in Table 902.03.03-2, immediately stop production. Obtain ME approval of a plant correction plan before resuming production. Upon restarting production, do not transport mixture to the Project Limits before the results of a QC sample from the mixture indicate that the mixture meets JMF tolerances. The ME will reject mixture produced at initial restarting that does not meet tolerances.

The ME will perform sampling according to NJDOT B-2 or ASTM D 3665, and will perform testing for composition according to AASHTO T 308 or NJDOT B-5. Perform testing for air voids and draindown according to NJDOT B-7 or NJDOT B-8.

Table 902.03.03-1 JMF Master Ranges and Mixture Requirements Open-graded Friction Course			
	Mixture Designations (% Passing[1])		
Sieve Sizes	**OGFC – 9.5 mm**	**MOGFC – 12.5 mm**	**MOGFC – 9.5 mm**
3/4"		100	
1/2"	100	85 - 100	100
3/8"	80 - 100	35 - 60	85 - 100
No. 4	30 - 50	10 - 25	20 - 40
No. 8	5 - 15	5 - 10	5 - 10
No. 200	2.0 - 5.0	2.0 - 5.0	2.0 - 4.0
Minimum asphalt binder, %[1]	5.5	5.7	6.0
Minimum % Air Voids, design	15%	20%	18%
Minimum lift thickness, design	3/4"	1-1/4"	3/4"

1. Aggregate percent passing to be determined based on dry aggregate weight. Asphalt binder content to be determined based on total weight of mix.

Table 902.03.03-2 Production Control Tolerances for OGFC and MOGFC Mixtures	
Sieve Sizes	**Production Control Tolerances from JMF[1]**
1/2"	±6.0
3/8"	±5.5
No. 4	±5.5
No. 8	±4.5
No. 200	±2.0
Asphalt binder, % (AASHTO T 308)	±0.40
Asphalt binder, % (NJDOT B-5)	±0.15
Minimum % Air Voids	1.0% less than design requirement

1. Production tolerances may fall outside of the wide band gradation limits in Table 902.03.03-1.

902.04 ULTRA-THIN HMA

902.04.01 Composition of Mixture

Mix ultra-thin HMA in a plant listed on the QPL conforming to the requirements for HMA plants specified in 1009.01.

Use ultra-thin HMA that consists of coarse aggregate, fine aggregate, and polymer modified asphalt binder and that may contain mineral filler. Do not add RAP, CRCG, GBSM, or RPCSA. Combine the material in such proportions that the total aggregate and asphalt binder conform to the composition percentages specified in Table 902.04.02-1.

To produce the ultra-thin HMA, use aggregates and asphalt binder that conforms to the following:

1. For asphalt binder, use PG 76-22 conforming to the requirements of 902.01.01.
2. For fine aggregate, use stone sand conforming to 901.05.02. Ensure that the combined gradation with coarse aggregate conforms to Table 902.04.02-1.
3. Use coarse aggregate that conforms to 901.05.01 and Table 902.04.01-1. Permissible geologic classifications for coarse aggregate are argillite, gneiss, granite, quartzite, or trap rock. Ensure that the combined gradation with fine aggregate conforms to Table 902.04.02-1.

Table 902.04.01-1 Coarse Aggregate Properties		
Tests	**Test Method**	**Maximum Percent**
Percentage of wear, Los Angeles Abrasion Test	AASHTO T 96	25
Micro Deval	AASHTO T 327	18

4. Use mineral filler, if necessary, that conforms to 901.05.03.

902.04.02 Mix Design

At least 30 days before the initial production date, submit a JMF, within the limits of Table 902.04.02-1, to the ME for approval on forms supplied by the Department. Include in the submission a statement naming the source of each component and the results of all applicable tests.

If the source of any component material changes, submit a new JMF and obtain ME approval before using the new material. When unsatisfactory results or other conditions make it necessary, the ME may require a new JMF.

Design the ultra-thin HMA so that it has a draindown of less than 0.1 percent when tested according to AASHTO T 305.

When tested for moisture sensitivity according to AASHTO T 283, ensure that the ultra-thin HMA has a tensile strength ratio of at least 80 percent. Prepare specimens according to AASHTO T 312, and test according to T 283 except for the following:

1. Before compaction, condition the mixture for 2 hours according to AASHTO R 30, Section 7.1.
2. Compact specimens with 100 gyrations.
3. Extrude specimens as soon as possible without damaging.
4. Use AASHTO T 269 to determine void content.
5. Record the void content of the specimens.
6. If less than 55 percent saturation is achieved, repeat the procedure, unless the difference in tensile strength between duplicate specimens is greater than 25 pounds per square inch.
7. If visual stripping is detected, modify or readjust the mix.

Size, uniformly grade, and combine aggregate fractions in proportions so that the grading of total aggregate and asphalt binder in the JMF conform to the composition by mass percentages specified in Table 902.04.02-1.

Table 902.04.02-1 JMF Requirements for Ultra-Thin Friction Course

Sieve Size	Total % Passing By Mass	Production Control Tolerances from JMF
1/2"	100	±6.0
3/8"	75-100	±5.5
No. 4	23-38	±5.5
No. 8	19-31	±4.5
No. 16	15-23	±4.0
No. 30	10-18	±4.0
No. 50	8-14	±4.0
No. 100	5-10	±3.0
No. 200	4.0-7.0	±2.0
Asphalt %	4.5 - 5.7	Ignition Oven ±0.40 Hot Bins ±0.15

902.04.03 Sampling and Testing

Maintain the temperature of the mix between 300 °F and 360 °F. Perform and meet requirements for quality control tested as specified in 902.02.04.C.

During production, the ME will take one random acceptance sample from each 500 tons of production to verify composition. Conduct draindown tests as directed by the ME.

If the composition testing results are outside of the production control tolerances specified in Table 902.04.02-1 for an acceptance sample, determine if a plant adjustment is needed and immediately run a quality control sample. If the quality control sample is also outside of the control tolerances in Table 902.04.02-1, immediately take corrective action to bring the mix into compliance. Take additional quality control samples after the corrective action to ensure that the mix is within the production control tolerances. If 2 consecutive acceptance samples are outside the tolerances specified in Table 902.04.02-1, immediately stop production. Obtain ME approval of a plant correction plan before resuming production. Upon restarting production, do not transport mixture to the Project Limits before the results of a QC sample

from the mixture indicate that the mixture meets JMF tolerances. The ME will reject mixture produced at initial restarting that does not meet tolerances.

The ME will perform sampling according to NJDOT B-2 or ASTM D 3665, and will perform testing for composition according to AASHTO T 308, or NJDOT B-5. Perform testing for draindown according to NJDOT B-7 or NJDOT B-8.

902.05 STONE MATRIX ASPHALT (SMA)

902.05.01 Composition of Mixture

Mix SMA in a plant that is listed on the QPL and conforms to the requirements for HMA plants as specified in 1009.01.

The composition of the SMA mixture is coarse aggregate, fine aggregate, mineral filler, mineral fibers or cellulose fibers, and polymer modified asphalt binder.

Use asphalt binder for SMA that is PG 76-22 as specified in 902.01.01.

For coarse aggregate in SMA, use crushed stone conforming to 901.05.01 and Table 902.05.01-1.

Table 902.05.01-1 Coarse Aggregate Properties for SMA

Tests	Test Method	Maximum Percent
Percentage of wear, Los Angeles Abrasion Test	AASHTO T 96	30
Flat and Elongated, 5 to 1 (Material Retained on the No. 4 Sieve)	ASTM D 4791	5
Flat and Elongated, 3 to 1 (Material Retained on the No. 4 Sieve)	ASTM D 4791	20

For fine aggregate, use stone sand conforming to 901.05.02. Ensure that the combined fine aggregate in the mixture conforms to the requirements for compaction level H as specified in Table 902.02.02-1.

For mineral filler, use rock dust or crushed limestone conforming to AASHTO M 17. Ensure that the mineral filler has a plasticity index of less than 4 percent when tested according to AASHTO T 90.

Do not add RAP, CRCG, GBSM, or RPCSA to the mixture.

Add stabilizing fibers consisting of mineral fiber or cellulose fiber conforming to AASHTO MP 8. Use only one type per mix design. If using mineral fibers, use between 0.4 and 0.6 percent by weight of total mix. If using cellulose fibers, use between 0.3 and 0.4 percent by weight of total mix. Provide control to accurately proportion the fibers into the mixture within ±10 percent of the required weight, and use equipment that ensures uniform dispersion of the fibers. If using pre-packaged bags of fibers added to the pugmill during the dry mix cycle, follow the manufacturer's recommendations for the dry and wet mixing time. Store fibers in a dry location with a storage temperature not to exceed 120 °F. The supplier of the cellulose or mineral fibers shall provide a certification of compliance, as specified in 106.07, for the fibers. Ensure that a technical representative from the fiber supplier is at the HMA plant for the first full day of production for technical assistance.

902.05.02 Mix Design

Design the SMA to meet the requirements in Table 902.05.02-1 and Table 902.05.02-2. Prepare the JMF according to AASHTO PP 41. Determine the JMF at 4 percent air voids and 100 gyrations of the Superpave gyratory compactor.

Table 902.05.02-1 SMA Specification Band (% passing) nominal-maximum aggregate size				
Production Control Tolerances[1]	**Sieve Size**	**19 mm % Passing**	**12.5 mm % Passing**	**9.5 mm % Passing**
0%	1"	100	100	100
±5%	3/4"	90-100	100	100
±5%	1/2"	50-88	90-100	100
±5%	3/8"	25-60	50-80	70-95
±4%	No. 4	20-28	20-35	30-50
±4%	No. 8	16-24	16-24	20-30
±4%	No. 16	–	–	0-21
±3%	No. 30	–	–	0-18
±3%	No. 50	–	–	0-15
±2%	No. 200	8.0-11.0	8.0-11.0	8.0-12.0
	Coarse Aggregate Fraction	Portion Retained on No. 4 Sieve	Portion retained on No. 4 Sieve	Portion retained on No. 8 Sieve
	Minimum Lift Thickness	2 inches	1-1/2 inch	1 inch

1. Production tolerances may fall outside of the wide band gradation limits.

Table 902.05.02-2 SMA Mixtures Volumetrics For Design and Plant Production		
Property	**Production Control Tolerances**	**Requirement**
Air Voids	±1%	4.0%
Voids in Mineral Aggregate (VMA)	–	17.0% minimum
VCA_{mix}	–	Less than VCA_{dry}
Draindown @ production temperature	–	0.30% maximum
Asphalt Binder Content (Bin Analysis)	±0.15%	6% minimum
Asphalt Binder Content (Ignition Oven)	±0.40%	6% minimum
Tensile Strength Ratio	–	70% minimum

902.05.03 Sampling and Testing

Perform quality control testing as specified in 902.02.04.C.

During production at the plant, the ME will take a sample from each 600 tons of production to verify composition and air voids. Conduct draindown, VCA_{mix}, VCA_{dry}, and VMA testing as directed by the ME. Perform tests according to AASHTO PP 41.

If the testing results are outside of the production control tolerances specified in Table 902.05.02-1 and Table 902.05.02-2 for an acceptance sample, determine if a plant adjustment is needed and immediately run a quality control sample. If the quality control sample is also outside of the control tolerances in Table 902.05.02-1, immediately take corrective action to bring the mix into compliance. Take additional quality control samples after completing the corrective action to ensure that the mix is within tolerances. If 2 consecutive acceptance samples are outside the tolerances specified in Table 902.05.02-1 and Table 902.05.02-2, immediately stop production. Obtain ME approval of a plant correction plan before resuming production. Upon restarting production, do not transport mixture to the Project Limits before the results of a QC sample from the mixture indicate that the mixture meets JMF tolerances. The ME will reject mixture produced at initial restarting that does not meet tolerances.

The ME will perform sampling according to NJDOT B-2 or ASTM D 3665, and will perform testing for composition according to AASHTO T 308, or NJDOT B-5. Perform testing for draindown according to NJDOT B-7 or NJDOT B-8.

902.06 ASPHALT-STABILIZED DRAINAGE COURSE (ASDC)

902.06.01 Composition

Mix ASDC in a plant that is listed on the QPL and conforms to the requirements specified in 1009.01.

The mixture shall consist of asphalt binder and aggregate. Use asphalt binder that is PG 64-22 as specified in 902.01.01. Use aggregate that conforms to 901.05 and the gradation requirements specified in Table 902.06.01-1.

Table 902.06.01-1 Gradation Requirements and Tolerances for ASDC

Production Tolerance (Variation From JMF)	Sieve Size	JMF (Percent Passing)
±0.0	1"	100
±6.0	3/4"	95 - 100
±5.5	1/2"	85 - 100
±5.5	3/8"	60 - 90
±5.5	No. 4	15 - 25
±4.5	No. 8	2 - 10
±2.0	No. 200	2 - 5

Design the mixture to have an asphalt binder content of 3 ± 1/2 percent by weight of dry aggregate.

902.06.02 Mix Design

Submit to the ME for approval, a JMF for the material that includes the source of each component.

Establish with the JMF the percentage of dry weight of aggregate passing each required sieve size and the optimum percentage of asphalt binder based upon the weight of the total mix. Ensure that the design values of percent passing each sieve size are within the gradation band specified in Table 902.06.01-1. Design the mix to have a permeability of 2000 ± 500 feet per day.

At least 45 days before the production of the asphalt-stabilized drainage course, submit a mix design for approval. In addition, submit samples of the component materials to the ME for verification. Submit the following quantities:

Table 902.06.02-1 Verification Samples for Asphalt-Stabilized Drainage Course

Component	Quantity
Each Aggregate Component	35 pound
Asphalt Binder	1 gallon
Anti-Stripping Agent, if needed	0.264 gallon

The ME will perform gradation testing according to AASHTO T 27 on the submitted aggregate sample. The ME will prepare the specimens for permeability testing according to AASHTO T 167. The ME will compact specimens at 260 °F. The ME will determine permeability according to NJDOT B-1.

At the ME's option, verification may be done on an annual basis for a mix rather than on a project-to-project basis, provided the properties and proportions of the materials do not change. If written verification is submitted by the HMA supplier that the same source and character of materials are to be used, the ME may waive the requirement for the design and verification of previously approved mixes.

902.06.03 Sampling and Testing

Perform quality control testing as specified in 902.02.04.C.

During production, the ME will take one random acceptance sample from each 600 tons of production to verify composition. Conduct draindown tests as directed by the ME.

If the composition testing results are outside of the production control tolerances specified in Table 902.06.01-1 for an acceptance sample, determine if a plant adjustment is needed and immediately run a quality control sample. If the quality control sample is also outside of the control tolerances specified in Table 902.06.01-1, immediately take

corrective action to bring the mix into compliance. Take additional quality control samples after the corrective action to ensure that the mix is within tolerances. If 2 consecutive acceptance samples are outside the tolerances specified in Table 902.06.01-1, immediately stop production. Obtain ME approval of a plant correction plan before resuming production. Upon restarting production, do not transport mixture to the Project before the results of a QC sample from the mixture indicate that the mixture meets JMF tolerances. The ME will reject mixture produced at initial restarting that does not meet tolerances.

The ME will perform sampling according to NJDOT B-2 or ASTM D-3665 and will perform testing for composition according to AASHTO T 308 or NJDOT B-5. If directed by the ME, perform testing for draindown according to AASHTO T 305.

SECTION 903 – CONCRETE

903.01 CEMENT

Use cement, listed on the QPL, that is either portland cement or blended hydraulic cement and conforms to the following:

Portland Cement, Type I, II, and Type III	ASTM C 150
Blended Hydraulic Cement, Type IS and IP	ASTM C 595

The Contractor may only use Type III portland cement for class V concrete, prestressed Items, or precast Items.

For blended hydraulic cement, the Contractor may use portland cement pre-blended with a maximum of 25 percent fly ash, by weight, or a maximum of 5 percent silica fume by weight, or with a maximum of 50 percent slag by weight. If more than 30 percent slag is used, ensure that a scaling test according to ASTM C 672 is completed on the mix design and the concrete has a visual rating less than 3 after 50 cycles.

When blended hydraulic cement is used, do not add additional mineral admixtures at the concrete plant unless approved by the ME.

Do not mix different brands of cement, the same brand of cement from different mills, or different types of cement.

Provide suitable means for storing and protecting the cement against dampness. The ME will reject cement that has become partially set or that contains lumps of caked cement. Ensure that the temperature of the cement at the time of delivery to the mixer does not exceed 160 °F.

903.02 CONCRETE ADMIXTURES

903.02.01 Air-Entraining Admixtures

Use air-entraining admixtures for concrete that are listed on the QPL and conform to AASHTO M 154, except that the tests for bleeding and volume change are not required.

The ME will test for uniformity through the use of infrared spectrophotometry, pH values, specific gravity, and solids content.

Keep all bulk storage tanks inside a heated area with an ambient temperature of not less than 32 °F. Do not reuse air-entraining admixture that has been allowed to freeze until it has been agitated and retested.

903.02.02 Chemical Admixtures

Use chemical admixtures for concrete that are listed on the QPL and conform to AASHTO M 194.

Use chemical admixtures of the following types:

1. Type A – Water-reducing admixtures
2. Type B – Retarding admixtures
3. Type C – Accelerating admixtures
4. Type D – Water-reducing and retarding admixtures

5. Type E – Water-reducing and accelerating admixtures
6. Type F – Water-reducing, high range admixtures
7. Type G – Water-reducing, high range, and retarding admixtures

Do not use chemical admixtures that contain calcium chlorides or any other chlorides that may initiate or promote corrosion of the reinforcement steel.

Locate all bulk storage tanks for chemical admixtures inside a heated area with an ambient temperature of not less than 32 °F. Do not use chemical admixtures that have been allowed to freeze until they have been agitated and retested.

The ME may require certification from the manufacturer stating that the material is identical to that originally approved and has in no way been changed or altered. The ME will test for uniformity through the use of infrared spectrophotometry, pH values, specific gravity, and solids content.

903.02.03 Mineral Admixtures

A. Fly Ash. Ensure that fly ash for use as a pozzolan in concrete is listed on the QPL and conforms to ASTM C 618, Class C or Class F, except that the loss on ignition shall not exceed 3 percent. Use Class F fly ash to control alkali-silica reactivity.

The supplier shall determine conformance to the requirements for loss on ignition and fineness for each truck load of fly ash delivered to the mixing site and shall include the test values on the delivery ticket.

Submit certificate of compliance as specified in 106.07.

B. Slag. Slag for use as a cementitious material is ground, granulated blast furnace slag. Use slag that is listed on the QPL and conforms to the requirements of AASHTO M 302, Grade 120. The Contractor may use Grade 100 with the written permission of the ME.

The Contractor may use slag as a replacement for cement as specified in 903.01, up to a maximum replacement level of 50 percent by weight of the total cementitious material. If more than 30 percent of cement is replaced, test the concrete mix design for scaling as specified in ASTM C 672, and ensure that it complies with a visual rating less than 3.

Submit certificate of compliance, as specified in 106.07, indicating that the slag conforms to the requirements of AASHTO M 302, Grade 120.

C. Silica Fume Admixture. Ensure that silica fume admixture for use in concrete is listed on the QPL and conforms to AASHTO M 307. Use only 1 brand of silica fume admixture for the entire duration of the Contract. The Contractor may supply silica fume admixture either in dry or in slurry form. If the slurry form is used, ensure that it is homogeneous and agitated to prevent separation.

Submit certificate of compliance as specified in 106.07.

903.02.04 Viscosity Modifying Admixture

If needed for self-consolidating concrete, use a viscosity modifying admixture that is listed on the QPL and that, when evaluated according to the test methods and mix design proportions in AASHTO M 194, conforms to the following physical requirements:

1. For initial and final set times, the allowable deviation of the test concrete from the reference concrete is not more than 1.0 hour earlier or 1.5 hours later.
2. For compressive and flexural strengths, the minimum allowable strength of the test concrete is 90 percent of the reference concrete strength at 3, 7, and 28 days.
3. The maximum allowable length change of the test concrete is 135 percent of the reference concrete. However, if the length change of the reference concrete is less than 0.030 percent, the maximum allowable length change of the test concrete is 0.010 percentage units more than the reference concrete.
4. The minimum allowable relative durability factor of the test concrete is 80 percent.

903.02.05 Corrosion Inhibitor Admixture

When required, use a calcium nitrite based corrosion inhibitor admixture to reduce the potential of corrosion of embedded steel. Use the following guidelines for calcium nitrite:

1. Ensure that the calcium nitrite does not contact other admixtures before entering the concrete mix. Use air entraining, water reducing, and retarding admixtures that are compatible with the calcium nitrite solution. Thoroughly mix the calcium nitrite solution before incorporating it into the concrete mix.
2. Strictly adhere to the manufacturer's written recommendations regarding the use of the calcium nitrite admixture including storage, transportation, and method of mixing. The manufacturer of the calcium nitrite admixture shall have a representative available to assist the Contractor.
3. The ME will test for the presence of the calcium nitrite admixture in the plastic concrete as specified in NJDOT C-3. Provide the test kit that is required to perform the plastic test to the ME.
4. Use admixture that is 30 ± 2 percent calcium nitrite by weight of solution. Include a high range water reducing chemical admixture in the concrete when using a calcium nitrate admixture.
5. Add the calcium nitrite at a rate of 3 gallons per cubic yard of concrete.
6. Use a calcium nitrite admixture listed on the QPL.

903.03 CONCRETE

903.03.01 Composition

Compose concrete of cement, coarse aggregate, fine aggregate, admixtures, and water. Concrete may include fly ash, slag or silica fume. Provide materials as specified:

Aggregates 901.06
Cement 903.01
Admixtures:
Air-Entraining 903.02.01
Chemical 903.02.02
Mineral 903.02.03
Corrosion Inhibitor 903.02.05
Water 919.08

Use chemical admixtures according to the admixture manufacturer's recommendation for the mix design and anticipated field conditions, including the admixture dosage rate and the location and method for introducing it into the mixture.

If fly ash is added to control alkali-silica reactivity, use at least 15 percent fly ash by weight of the total cementitious material. If AASHTO T 303 testing results in an expansion greater than 0.40 percent, use at least 20 percent fly ash. If slag is used to control alkali-silica reactivity, use at least 25 percent slag by weight of the total cementitious material. If a low alkali cement is used to control alkali-silica reactivity, use cement with equivalent alkali of less than 0.60 percent.

Use the combined weight of fly ash, slag, silica fume, and cement content to determine compliance with the minimum cement content and water-cement ratio requirements specified in Table 903.03.06-3. Include free water from the aggregates and the water in the admixtures and additives along with the mixing water when calculating the water-cement ratio.

903.03.02 Mix Design and Verification

Design at least 1 mix to equal or exceed the required verification strengths specified in Table 903.03.06-3 for each class of concrete included on the Project. A single mix design may satisfy the requirements for more than 1 class of concrete. Compute and set up the designs according to ACI Standard 211.1 or 211.2, as applicable.

At least 45 days before the start of concrete placement, submit each mix design on concrete mix design forms provided by the ME. Identify the sources of materials and test data on the forms.

The ME will be present at the time of verification batching to confirm that the proportions and ingredients batched are according to the proposed mix designs. If directed by the ME, mix at least 3 cubic yards of concrete in a central mix plant or transit truck for verification. The ME will direct that the verification batch be mixed in the top half of the allowable slump and air content ranges. Test for and report the slump and air content of the trial batch. The ME will reject the verification batch if the slump, air content, or yield is not acceptable. Prepare at least six 4×8-inch test

cylinders from each acceptable batch and cure according to AASHTO T 23 or AASHTO R 39. Between 2 and 5 days after molding, deliver the cylinders to the ME for testing. The ME will test 3 cylinders at 7 days and 3 cylinders at 28 days to determine the 7-day and 28-day compressive strengths, respectively.

At the ME's option, verification may be done on an annual basis for a concrete plant rather than on a project-to-project basis, provided the properties and proportions of the materials do not change. If the Contractor submits written verification that the same source and character of materials are to be used, the ME may waive the requirement for the design and verification of previously approved mixes.

Provide concrete conforming to the approved mix design. If using a previously approved mix design, notify the ME at least 1 day before making the change. Do not change the source, type, or proportions of materials until approved and the requirements for design and verification have been satisfied.

903.03.03 Mixing for Central-Plant and Transit Mixing

A. Handling, Measuring, and Batching Materials. Mix concrete at a concrete plant that is listed on the QPL and conforms to the requirements specified in 1010.01. Ensure that the plant's location, layout, equipment, and provisions for transporting material will ensure a continuous supply of concrete to the work.

Stockpile aggregates as specified in 901.02. Separately weigh the fine aggregate and each size of coarse aggregate into hoppers according to the amounts in the job mix design.

Measure cement by weight, using separate scales and hoppers with a device to indicate the complete discharge of the batch of cement into the batch box or container. Ensure that the weighing hopper and scale are of adequate size, completely encased, and have provisions for locking. Operate the weighing hopper discharge gate so as to not affect the scale balance. Suspend the discharge chute, boot, or other such device from the encasement, not from the weighing hopper. Discharge the cement so that it does not lodge in the weighing hopper and there is no loss of cement by air currents. Ensure that the required cement content is added to each batch.

Store mineral admixtures, unless pre-blended cement is supplied, at the batching plant in a separate storage facility. Batch mineral admixtures to tolerances equivalent to those specified for cement. When mineral admixtures are weighed cumulatively with the cement, add the mineral admixtures last in the batching sequence.

When silica fume and dyes are added, demonstrate, prior to production, that the batching sequence will produce a uniform mix. If using mineral admixtures packaged in bags, empty the bag into the mix. Do not put degradable bags in the mix.

Add chemical, air-entraining, and corrosion inhibiting admixtures to the mixing water or sand. Use a water measuring device that automatically registers and stops the flow of the water when the designated quantity has been delivered into the mixing drum.

B. Batch Tolerances. For individual batches, conform to the following tolerances based on the required scale reading:

1. Cement and Mineral Admixtures: ±1.0 percent of the required weight of material or ±0.3 percent of scale capacity, whichever is greater.
2. Aggregates 1-1/2 inches or smaller: ±2.0 percent of the required weight of material or ±0.3 percent of the scale capacity, whichever is greater.
3. Aggregates larger than 1-1/2 inches: ±3.0 percent of the required weight of material or ±0.3 percent of scale capacity, whichever is greater.
4. Water: ±1.0 percent of the required weight of material.
5. Chemical, Air-entraining, and Corrosion Inhibiting Admixtures: ±3.0 percent of the required weight of material or ±1 ounce, whichever is greater.

C. Delivery Tickets. Supply a delivery ticket for each load of concrete. Ensure that the delivery ticket contains the following information:

1. Use tickets that are serially numbered and bear the printed heading of the supplier and the location of the batch plant.
2. Show the name of the Project, the name of the Contractor, the quantity and class of concrete, the batch time as imprinted on the ticket by an automatic clock, the date, and the truck number.

3. After the truck has been discharged, fill in the time when the concrete was completely discharged, the amount of mixing water and the amount of tempering water, if used, and the total number of mixing revolutions for transit mix.
4. An authorized representative of the supplier shall sign each ticket and give copies to the ME and the RE.

In addition, for each truck or batch, provide a batching ticket to the ME, indicating the amount, brand name, and type of cementitious material; the amount and source of the fine aggregate; the amount, sizes, and sources of the coarse aggregates; the amount of mixing water; and the amounts, brand names, and types of admixtures.

D. Mixing Requirements. Do not allow the elapsed time from batching to the discharge of all the concrete from the mixer to exceed 90 minutes, except that under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is above 85 °F, the time limit is changed to 60 minutes. Under very severe conditions, the RE may further reduce the time limits. Measure batching time from the time cement is introduced to the mixer.

If the concrete cannot be entirely discharged within 10 minutes, keep the concrete in the drum plastic and workable by revolving the truck drum at the manufacturer's designated speed for agitation for at least 2 minutes in each 10 minute period.

Use one of the following mixing methods unless mixing on the Project as specified in 903.03.04:

1. Mixing at a Central-Mixing Plant. For central-mix concrete, proportion and mix concrete at a central plant and transport to the point of use in an agitator approved by the ME. If approved by the ME, non-agitating vehicles may be used to transport concrete at precast/prestressed concrete fabricators. Use central-mixing plant mixers that are of the type and capacity capable of combining the required materials into a thoroughly mixed and uniform mass within the specified mixing time and of discharging the mixture with a satisfactory degree of uniformity. Operate the plant according to N.J.A.C 7:27-6.1 *et seq*.

Mix for at least 1 minute, with mixing time measured from the time all cement and aggregates are in the drum. Charge the batch into the mixer so that sufficient water enters in advance of cement and aggregates to prevent caking. Ensure that all water is in the drum by the end of the first quarter of the mixing time.

When the temperature of the mixing water exceeds 100 °F, modify the loading sequence by mixing all the water and the aggregates and then the cement. Begin mixing immediately following the complete charging of the drum, and continue for not less than 1 minute.

Restrict the volume of mixed concrete in the agitating truck to not exceed the manufacturer's rating or 80 percent of the gross drum volume, whichever is less.

Before acceptance testing, the Contractor may add mixing water, air entraining agent, or chemical admixture incrementally in order to achieve the proper slump or air content range as specified in Table 903.03.06-1 or Table 903.03.06-2.

2. Transit Mixing. For transit mix concrete, proportion materials, including water, into a truck mixer from a 1-stop or 2-stop batching plant and mix in the truck. A one-stop batching plant is a plant where the dry ingredients for each batch of concrete are loaded into the mixer truck while water is being introduced. A 2-stop batching plant is a plant where the ingredients for each batch of concrete are loaded into the mixer truck at 2 separate locations.

When loaded for mixing concrete, restrict the volume of concrete to no more than 63 percent of the gross drum volume of the transit truck mixer.

Immediately begin mixing after the complete charging of the drum and continue for not less than 50 or more than 100 revolutions of the drum at the mixing speed recommended by the manufacturer of the transit truck mixer. After completing the minimum number of mixing revolutions at the plant, reduce the speed of the drum to the agitation speed recommended by the manufacturer. When using Type F or G admixtures, mix the load at the minimum specified number of mixing revolutions as recommended by the manufacturer.

Before acceptance testing, the Contractor may add mixing water, air entraining agent, or chemical admixture incrementally in order to achieve the proper slump or air content range as specified in Table 903.03.06-1 or Table 903.03.06-2.

E. Rejection Criteria. The RE will reject concrete for any of the following reasons:

1. The information for batching and delivery tickets is not complete, does not agree with the mix design, or is not supplied to the ME.
2. The mixer fails to maintain the manufacturer's stated speed of rotation for both mixing and agitation, or is not able to properly discharge the concrete.
3. The RE observes improper batching, lack of uniform distribution of constituents throughout the load, or balling of the cement and aggregates.
4. Water has been added while the truck is en route to the work site.
5. The concrete is not discharged within the specified time limit, or if the revolution counter shows a total of more than the 300 revolutions. However, if the load has been partially discharged and if the concrete yet to be discharged conforms to the specified ranges for slump and entrained air without further addition of water or admixtures, then the RE may allow the use of the concrete.
6. The slump or air content does not comply with requirements specified in 903.03.05.C.
7. The concrete has been tempered after the ME has performed the final acceptance testing.
8. Water is added after the truck has partially discharged regardless of ME testing.
9. The indicator on the revolution counter shows that the instrument has been turned off or tampered with.
10. The temperature of the concrete does not comply with requirements.
11. The water-cement ratio of the load is greater than the allowable maximum water-cement ratio for the class of concrete.

903.03.04 Mixing on the Project

A. Mobile Mixers. Mix the concrete in a mixing unit that is part of the truck carrying the dry ingredients and conforms to the requirements for a mobile mixer as specified in 1010.03. Use a mixing unit that is an auger type incorporated in the truck's discharge chute or other approved mixing mechanism. Produce concrete of uniform consistency and discharge the mix without segregation.

Provide a means for storing the additives on the truck and incorporating them into the mix. Include a way to check the rate of flow of the additive into the mix and a meter to register the total volume of additive incorporated into the mix during each mixing operation. The ME will not allow use of trucks not having functional meters on the Project.

Handle, measure, and batch materials according to the following:

1. Stockpile aggregates as specified in 901.02.
2. Proportion, measure, and batch cement and aggregates by a volumetric weight equivalent method. Mix the materials in the continuous-mixing-type truck mixer.
3. Provide delivery tickets to the ME for each truckload of ingredients. On the delivery tickets, show the brand name and type of cement, the calibrated cement constant of the mixer in terms of the indicator revolution count, the source of aggregates, and the size of the coarse aggregate. A responsible officer or employee of the concrete supplier shall sign the delivery tickets. For each class of concrete and for each separate mixing operation, the mixer operator shall enter on the tickets the name of the Project, the name of the Contractor, the revolution counter indicator readings indicating the volumetric weight equivalent of cement discharged during that mixing operation, the concrete additive meter reading indicating the total volume of additive discharged into the mix during that mixing operation, the aggregate dial settings, the water and concrete additive flow rates, and the class of concrete delivered. The operator shall sign each completed ticket and provide a copy to the ME.

B. Small Mixers. With the RE's approval, use small mixers only for small quantities of concrete that must be mixed on the Project. Unless provisions are made for accurately weighing bulk cement, use full bags of cement in each batch. Only use pre-blended mineral admixtures. Proportion aggregates and water by weight unless a calibrated volumetric method has been approved by the RE. Use accurate volumetric measuring devices to proportion chemical and air-entraining admixtures.

Charge the mixer with the aggregates and part of the mixing water, and begin mixing. Add cement and admixtures with another portion of the mixing water. Mix until uniform. Temper with the remaining allowable mixing water to obtain the necessary consistency. Do not exceed the quantity of water required by the mix design.

903.03.05 Control and Acceptance Testing Requirements

A. Sampling and Testing Methods. Use the sampling and testing methods for concrete as specified in Table 903.03.05-1.

Table 903.03.05-1 Sampling and Testing Methods

Designation	Test Method
AASHTO T 22[1]	Compressive Strength of Cylindrical Concrete Specimens (Including the Annex providing for use of neoprene caps)
AASHTO T 23[2]	Making and Curing Concrete Test Specimens in the Field
AASHTO T 24[3]	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
AASHTO T 97	Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
AASHTO T 119	Slump of Hydraulic Cement Concrete
AASHTO T 121	Weight Per Cubic Foot, Yield and Air Content (Gravimetric) of Concrete
AASHTO T 141[4]	Sampling Fresh Mixed Concrete
AASHTO T 152	Air Content of Freshly Mixed Concrete by the Pressure Method
AASHTO T 196	Air Content of Freshly Mixed Concrete by the Volumetric Method
AASHTO T303	Accelerated Detection of Potentially Deleterious Expansion of Mortar Bars Due to Alkali-Silica Reaction.
AASHTO R 39	Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 567	Unit Weight of Structural Lightweight Concrete
ASTM C 311[5]	Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete.
NJDOT C-1	Determination of Yield of Concrete Produced by Mobile Truck Mixers

1. Use 4 × 8-inch (diameter × height) compression test cylinders, except use 6 × 12-inch (diameter × height) test cylinders for concrete mixes containing coarse aggregate sizes exceeding a nominal maximum size of 1 inch.
2. Cure compression test cylinders for strength acceptance according to the Standard Cure Method in AASHTO T 23. For determining early strength for form removal, early loading of members, or opening to traffic, cure compression test cylinders according to the Field Cure Method in AASHTO T 23.
3. Obtain and prepare cores for compressive strength testing according to AASHTO T 24, except for the provisions for moisture conditioning. For moisture conditioning, soak cores in a lime bath at 73.4 ± 3 °F for at least 40 hours immediately prior to testing. After making any necessary corrections to the core results for ratio, the ME will divide each core result by 0.85 before reporting the final compressive strength.
4. Sample according to AASHTO T 141, except do not take a composite sample to represent a truck. Take the sample after approximately 1 cubic yard of concrete has been discharged from the truck to be sampled.
5. The Department may modify the sampling rate for individual and composite samples.

B. Quality Control. The concrete supplier shall have a quality control plan approved annually by the ME. The producer shall ensure that the plan conforms to the "Requirements for a Portland Cement Concrete Plant Quality Control Plan", which may be obtained from the ME. During production of concrete for the Project, the supplier shall perform quality control testing as required in the approved plan. If a concrete supplier does not have an approved plan or does not follow the approved plan, the ME will remove the supplier from the QPL.

Ensure that the QC technician, certified by ACI as a Concrete Field Technician, Grade 1, is present at the plant or the Project Limits during production. During production of concrete for the Project, perform quality control testing as required in the approved plan and as needed to ensure compliance with the requirements for the concrete.

C. Acceptance Testing Procedures for Slump and Air Entrainment. The ME will perform sampling and testing for slump (AASHTO T 119) and air entrainment (AASHTO T 152 or T 196), except for precast, prestressed concrete Items, for which the Contractor shall perform sampling and testing for slump and air entrainment. For pumped concrete, take the sample of concrete at the point of discharge and deliver it to the ME.

At a minimum, the ME will perform slump and air-entrainment tests at the rate specified for strength tests in Table 903.03.06-4 and on the same samples of material from which the compressive tests cylinders are molded. The ME will perform additional slump and air-entrainment tests as necessary to ensure the quality of the concrete. While these tests are being performed, halt discharge from the truck. Discharge from other trucks not scheduled for testing may proceed unless otherwise directed by the ME.

If the measured value of either slump or air entrainment exceeds the upper limit, the ME will perform a second test on a different portion of material from the same load. If the average of the 2 test results for either slump or air entrainment exceeds the upper limit, the ME will reject the load. Remove rejected loads from the Project Limits.

If neither of the measured values of the slump or air entrainment exceeds the upper limit, the Contractor may temper the concrete once, prior to discharge into the work. Temper by addition of water, air entraining agent, or any chemical admixture included in the mix design as recommended by the manufacturer. Ensure that quantities added will result in slump and percent air entrainment within the specified ranges throughout the duration of discharge of the load. After tempering, rotate the drum at the recommended mixing speed for a minimum of 30 revolutions. Meet the specified maximum water-cement ratio and comply with the time and revolution limits specified in 903.03.03. Report quantities added to the ME.

Following any allowed tempering, the ME will disregard the original test results and perform a single test for slump and air entrainment. If the measured values for slump and air-content are not within the ranges specified in Table 903.03.06-1 or Table 903.03.06-2, the RE will reject the load of concrete.

Do not make additions to the load after the acceptance testing has been completed. For loads not scheduled for acceptance testing, make additions as specified in 903.03.03 before discharge into the work.

D. General Acceptance Testing Requirements for Strength. The ME will perform sampling and testing for strength, except for precast, prestressed concrete Items for which the Contractor shall perform sampling and testing for strength. For pumped concrete, take the sample of concrete at the point of discharge and deliver it to the ME.

Provide, for the sole use of the ME, a sufficient number of curing facilities for the storage and curing of concrete test cylinders within the Project Limits for the first 24 hours according to AASHTO T 23. Ensure that the curing facilities are provided with minimum-maximum thermometers and are securable with lock and key. During the period from May 1 through October 31, provide water tanks or tubs of sufficient capacity and rigidity to hold the cylinders in an upright position, fully submerged and without contact between cylinders. During the remaining months of the year, or as directed by the RE, provide securable, insulated boxes, of similar capacity and rigidity. During the initial 24 hours, ensure that the test specimens are undisturbed and maintained within the specified temperature range. If, within 10 days of the RE's request, the facilities are not provided, do not place any concrete.

The ME will cure concrete test specimens that are to be used for determination of early strengths for removing forms, opening to traffic, or otherwise placing the concrete into service according to the field curing provisions in AASHTO T 23.

An initial strength test result is defined as the average strength of two 4 × 8-inch compression test cylinders, cured for 28 days, and tested by the ME. The Contractor may have cylinders for precast concrete tested at the fabricator's plant under the supervision of the ME. The ME will sample and test at the rate specified in Table 903.03.06-4. If either of the cylinders comprising a test shows definite evidence (other than low strength) of improper sampling, molding, handling, curing, or testing, the ME will discard it and use the strength of the remaining cylinder as the test result. If the difference in compressive strength between 2 cylinders comprising a test equals or exceeds 600 pounds per square inch, the ME will disregard the lower value and use the higher value as the test result. If both cylinders comprising a test are discarded, the ME will evaluate the lot on the basis of the reduced number of tests.

If the ME takes additional unscheduled compression cylinders, as specified in 106.05, the ME will include the results with the regularly scheduled compression cylinder results and will evaluate the lot on the basis of the increased number of tests.

E. Acceptance Testing for Strength for Pay-Adjustment Items. The Special Provisions will identify the concrete Items, if any, that are subject to pay adjustment and their base prices.

The ME will test the cylinders in the lot of concrete and compute the pay adjustment in the following steps:

1. **Compute Average Lot Strength (ALS) and Standard Deviation (S).** If only a single test result is available, the standard deviation (S) is assumed to equal 200 pounds per square inch.

$$ALS = \frac{\sum X_i}{N}$$

$$S = \sqrt{\frac{\sum (X_i - ALS)^2}{N-1}}$$

Where:
$\sum$ = Summation
X_i = Individual test result (average strength of a test cylinder pair)
N = Number of test results for the lot

2. Compute Quality Index (Q).

$$Q = \frac{ALS - CDS}{S}$$

Where:
CDS = Class design strength in pounds per square inch from Table 903.03.06-3 for the specified class of concrete.

3. Determine Percent Defective (PD). Using NJDOT ST for the appropriate sample size, the ME will determine PD associated with Q calculated in the previous step.

4. Compute Percent Pay Adjustment (PPA).

	Quality	Percent Pay Adjustment
Equation 1	PD < 50	PPA = 3.0 − 0.3 PD
Equation 2	PD ≥ 50	PPA = 26.0 − 0.76 PD

The amount of pay-adjustment in dollars is the product of the Item base price times the lot quantity times the percent pay-adjustment (expressed as a decimal) given by Equation 1 or 2.

For lots having percent defective (PD) levels less than 10 percent, Equation 1 provides positive adjustments to the contract price. For lots having exactly 10 percent defective, there is no adjustment to the contract price. For lots having greater than 10 percent defective, Equations 1 or 2, as appropriate, subtract progressively larger amounts from the contract price.

If, based on the initial series of tests, the lot quality of a pay-adjustment item is estimated to be PD = 50 or greater, the ME may reevaluate by coring or other suitable means. When this provision is applied to precast/prestressed concrete, the ME will evaluate each item in the bed separately.

If the re-evaluation is accomplished by a method other than coring, the ME will use the results only to determine what further action is to be taken. If all non-core test results equal or exceed the class design strength, the ME may elect to accept the lot at 100 percent payment.

If the Department elects not to core, the Contractor may accept the PPA calculated by Equation 1 or 2, as appropriate, or, when approved by the Department, the Contractor may take cores as specified in Table 903.03.06-4. Take the cores within 90 days from the date of concrete placement. If electing to core, perform the coring as directed by the ME, and provide the cores to the ME for testing.

If cores are taken, the Department will use the core results to determine the final disposition of the lot. If, based on the core results, the lot is determined to be at a quality level of PD < 75, the Department will compute the pay-adjustment by Equation 1 or 2, as appropriate. If the lot is confirmed to be at a quality level of PD ≥ 75, the ME will reject the lot and the RE may do one of the following:

1. Require the Contractor to remove and replace the defective lot.
2. Allow the Contractor to leave the defective lot in place and receive a PPA computed by Equation 2.
3. Allow the Contractor to submit a plan, to the RE for approval, for corrective action.

F. Acceptance Testing for Strength for Non-Pay-Adjustment Items. Non-pay-adjustment Items are those concrete Items not specifically designated as pay-adjustment Items, as specified in 903.03.05.E, but may be accepted by pay-adjustment under certain circumstances. Such an item is eligible for 100 percent payment (PPA = 0) if each individual test result in a lot meets the retest limit specified in Table 903.03.06-4.

If any individual test value (average of a cylinder pair) falls below the retest limit for non-pay-adjustment concrete in Table 903.03.06-4, the ME may reevaluate by coring or other suitable means. When this provision is applied to precast/prestressed concrete, the ME will evaluate each item in the bed separately.

If the re-evaluation is accomplished by a method other than coring, the ME will use the results only to determine what further action is to be taken. If all non-core test results equal or exceed the class design strength, the ME may elect to accept the lot at 100 percent payment.

If the Department elects not to core, the Department may allow the Contractor to take cores as specified in Table 903.03.06-4. Take the cores within 90 days from the date of concrete placement. If electing to core, perform the coring as directed by the ME, and provide the cores to the ME for testing.

If cores are taken, the Department will use the core results to determine the final disposition of the lot. If, based on the core results, the lot is determined to be at a quality level of PD < 75, the Department will compute the pay-adjustment as specified in 903.03.05.E. If the lot is confirmed to be at a quality level of PD ≥ 75, the ME will reject the lot and the RE may do one of the following:

1. Require the Contractor to remove and replace the defective lot
2. Allow the Contractor to leave the defective lot in place and receive a PPA computed by Equation 2.
3. Allow the Contractor to submit a plan, for approval, for corrective action.

If retesting is not performed by the Department or the Contractor, the Department will calculate the PPA as for a pay-adjustment item as specified in 903.03.05.E, except that the Department will use the item bid price instead of an item base price in the computation of the pay-adjustment.

When computing a pay-adjustment for any of the Items listed in Table 903.03.05-2, which are only partially composed of concrete, the ME will multiply the amount of pay-adjustment, if any, by the Estimated Percentage of Concrete (expressed as a decimal) as shown in Table 903.03.05-2.

Table 903.03.05-2 Estimated Percentage of Concrete in Items

Item	Estimated Percentage of Concrete
INLET, TYPE ___	30
INLET, TYPE ___, USING EXISTING CASTING	30
MANHOLE, ___' DIAMETER	30
MANHOLE, USING EXISTING CASTING	30
MANHOLE, SANITARY SEWER	30
MANHOLE, SANITARY SEWER, USING EXISTING CASTING	30
GRANITE CURB	25
RESET GRANITE CURB	25
BEAM GUIDE RAIL TERMINALS AND ANCHORAGES	25
CHAIN-LINK FENCE, ___' HIGH	25
CHAIN-LINK FENCE, ALUMINUM-COATED STEEL, ___' HIGH	25
CHAIN-LINK FENCE, PVC-COATED STEEL, ___' HIGH	25
GATE, CHAIN-LINK FENCE, ___' WIDE	25
GATE, CHAIN-LINK FENCE, ALUMINUM-COATED STEEL, ___' WIDE	25
GATE, CHAIN-LINK FENCE, PVC-COATED STEEL, ___' WIDE	25
TEMPORARY CHAIN-LINK FENCE, ___' HIGH	25
GUIDE SIGN, TYPE GA, BREAKAWAY SUPPORTS	20
GUIDE SIGN, TYPE GA, NON-BREAKAWAY SUPPORTS	20

The amount of pay-adjustment for Items not listed in Table 903.03.05-2 is the product of the unit bid price times the lot quantity times the percent pay-adjustment determined according to Equation 1 or 2.

903.03.06 Tables

Table 903.03.06-1 Requirements for Roadway Concrete Items

	Concrete Class	Slump[1] (inch)	Percent Air Entrainment for Coarse Aggregate[1]	
			No. 57 and No. 67	No. 8
Cast-in-Place Items				
Surface Course, Base Course	B	2 ± 1	6.0 ± 1.5	7.0 ± 1.5
Inlets, Manholes, Headwalls, Sidewalks, Driveways, Islands	B	3 ± 1	6.0 ± 1.5	7.0±1.5
Slope Gutters, Vertical Curb, Sloping Curb, Barrier Curb, Concrete Islands	B	4 ± 1	6.0 ± 1.5	7.0 ± 1.5
Foundations for: Inlets, Manholes and Electrical Items	B	3 ± 1	7.5 max	8.5 max
Signs	B	3 ± 1	6.0 ± 1.5	7.0 ± 1.5
Footings for: Fence Post, Beam Guide Rail Terminals, and Anchorages	B	3 ± 1	7.5 max	8.5 max
Culverts	A	3 ± 1	6.0 ± 1.5	7.0 ± 1.5
Monuments	A	3 ± 1	7.5 max	8.5 max
Slope Protection	B	2 ± 1	6.0 ± 1.5	7.0 ± 1.5
Pipe Bedding, Thrust Blocks, Pipe Plugs, Encasements, Saddles	B	3 ± 1	7.5 max	8.5 max
Precast Items				
Culverts	P	3 ± 1	6.0 ± 1.5	7.0 ± 1.5
Inlets, Manholes, Junction Boxes, Headwalls, Reinforced Concrete End Sections	B	3 ± 1	6.0 ± 1.5	7.0 ± 1.5
Concrete Barrier Curb	B	3 ± 1	7.0 ± 2.0	8.0 ± 2.0
Slip-Form Items				
Surface Course, Base Course	B	1-1/2 ± 1	6.0 ± 1.5	7.0 ± 1.5

1. When using a Type F or G admixture, change the requirements for Slump and Air Content for the given concrete item as follows:
   1.1 Slump: 6 ± 2 inches
   1.2 Air Content: Increase both the target value and tolerance percentages by 0.5.

Table 903.03.06-2 Requirements for Structural Concrete Items

	Concrete Class	Slump[1] (inches)	Percent Air Entrainment for Coarse Aggregate[1]	
			No. 57 & No. 67	No. 8
Cast-in-Place Items				
Bridge Approach	A	3 ± 1	6.0 ± 1.5	7.0 ± 1.5
Footings, Piles	B	3 ± 1	7.5 max	8.5 max
Abutments, Wing Walls, Pier Shafts, Retaining Walls	B	3 ± 1	6.0 ± 1.5	7.0 ± 1.5
Drilled Shafts[2]	A	7 ± 1[2]	–	7.5 ± 1.5
Concrete Barrier Curb, Bridge	B	4 ± 1	7.0 ± 2.0	8.0 ± 2.0
Pier Columns and Pier Caps, Arch Spans, Culverts	A	3 ± 1	6.0 ± 1.5	7.0 ± 1.5
Decks, Sidewalks, Curbs, Parapets, Concrete Patch	A	3 ± 1		7.0 ± 1.5
Seal (Tremie) Concrete	S	7 ± 2	7.5 max	8.5 max
Prestressed Items				
Beams	P, P-1,& P-2	2 ± 1	5.0 ± 1.5	5.0 ± 1.5
Piles	P	2 ± 1	6.0 ± 1.5	7.0 ± 1.5
Precast Items				
Piles	B	3 ± 1	6.0 ± 1.5	7.0 ± 1.5

Table 903.03.06-2 Requirements for Structural Concrete Items

	Concrete Class	Slump[1] (inches)	Percent Air Entrainment for Coarse Aggregate[1]	
			No. 57 & No. 67	No. 8
Culverts, Parapet	P	3 ± 1	6.0 ± 1.5	7.0 ± 1.5
Modular Bin Units, MSE Wall Panels, Leveling Pads	P	2 ± 1	6.0 ± 1.5	7.0 ± 1.5
Slip-Form Items				
Parapet	A	1 ± 1/2	6.0 ± 1.5	7.0 ± 1.5

1. When using a Type F or G admixture, change the requirements for Slump and Air Content for the given concrete item as follows:
   1.1 Slump: 6 ± 2 inches
   1.2 Air Content: increase both the target value and tolerance percentages by 0.5.
2. For drilled shaft concrete, use Type F or G admixture to achieve the required slump. If concrete in the drilled shaft is placed under a drilling fluid, the required slump is changed to 8±1.

Table 903.03.06-3 Mix Design Requirements

	Class A	Class B	Class S	Class P	Class P-1	Class P-2
Class Design Strength[2] (28 days, psi)	4600	3700	2000	5500	6000	6500
Verification Strength[2] (28 days, psi)	5400	4500	–	6000	6500	7000
Maximum Water-Cement Ratio[3] (lb/lb)	0.443	0.488	0.577	0.400	0.400	0.400
Minimum Cement Content (lb/cy)	611	564	658	[1]	[1]	[1]

1. According to *PCI MNL-116*.
2. Record all concrete test results to the nearest 10 psi.
3. When a Type F or G water-reducing, high range admixture is used as specified in Table 903.03.06-1 and Table 903.03.06-2, reduce the maximum water-cement ratio by 0.043 for all classes of concrete except for Classes P, P-1 and P-2.

Table 903.03.06-4 Lot Sizes, Sampling Rates, and Retest Limits

	Class A	Class B	Class S	Class P	Class P-1	Class P-2
Lot Size[1, 2] (maximum)	Day's Production			Day's Production of a Single Steam Bed		
Pay-Adjustment Items						
Initial Sampling Rate[3, 4]	5/Lot	5/Lot	–	5/Lot	5/Lot	5/Lot
Retest Sampling Rate[5] (minimum)	5/Lot	5/Lot	–	5/Unit or Load Test		
Non-Pay-Adjustment Items						
Initial Sampling Rate [3, 4]	3/Lot	2/Lot	1/Lot	5/Lot	5/Lot	5/Lot
Retest Limit (psi)	4400	3600	2000	5400	5900	6400
Retest Sampling Rate[5]	5/Lot	5/Lot	5/Lot	5/Lot	5/Lot	5/Lot

1. The lot sizes are maximums. The ME may subdivide a lot into 2 or more smaller lots. When a subdivision is made, the specified sampling rate applies to each of the smaller lots.
2. The ME will not include more than 1 class of concrete in a lot.
3. An initial sample is defined as 2 cylinders taken from a concrete sample.
4. The ME will sample at the specified sampling rates except that no more than 1 test per truckload or batch of concrete will be required (except for air and slump tests when retempering). The ME may accept nonstructural concrete lots consisting of 20 cubic yards or less without strength tests.
5. A retest sample is defined as 1 core.

903.04 PAVEMENT REPAIR MIXES CLASS V AND E

903.04.01 Composition

Use Class V or E concrete for concrete pavement repair and replacement. Ensure that the composition of Class V and E concrete complies with 903.03.01 except that Class V concrete is required to use an accelerating admixture and a high range water-reducing admixture.

Ensure that the composition of Class V or E concrete conform to the composition requirements specified in 903.03.01, except use an accelerating admixture and a high range water-reducing admixture for Class V concrete.

903.04.02 Mix Design and Verification

Design and verify Class V and E concrete as specified in 903.03.02, except for the following:

1. Design Class V and E concrete to conform to the requirements in Table 903.04.02-1.
2. Include 6.5-hour flexural beam testing in the verification testing for Class V concrete. Test two 6 × 6 × 21-inch flexural beams according to AASHTO T 97. The ME will witness the flexural beam testing. The ME will approve the mix design if both beams meet the verification strength.
3. Include 72-hour compressive strength testing in the verification testing for Class E concrete.

Table 903.04.02-1 Mix Design Requirements

	Class V	Class E
Class Design Strength		
28-day Compressive Strength, psi	3700	3700
6.5-Hour Flexural Strength, psi	350	–
72-Hour Compressive Strength, psi	–	3000
Verification Strength		
28-day Compressive Strength, psi	4500	4500
6.5-Hour Flexural Strength, psi	390	–
72-Hour Compressive Strength, psi	–	3700
Maximum Water-Cement Ratio (lb/lb)	.40	.40
Minimum Cement Content (lb/cy)	611	611

903.04.03 Mixing

Mix Class V and E concrete as specified in 903.03.03 or 903.03.04.

903.04.04 Control and Acceptance Testing Requirements

A. Sampling and Testing Methods. Use the sampling and testing methods specified in 903.03.05.A.

B. Acceptance Testing Procedures for Slump and Air Entrainment. The ME will perform acceptance testing for slump and air entrainment as specified in 903.03.05.C.

C. Acceptance Testing Procedures for Strength. The ME will test Class V and E concrete to ensure conformance to the requirements specified in 903.03.05.D and 903.03.05.F for control and acceptance testing of non-pay adjustment Class B concrete for 28-day compressive strength.

For each day's production of Class V concrete, the ME will field cure two 6 × 6 × 21-inch beams according to AASHTO T 23 and will test the beams' 6.5-hour flexural strength according to AASHTO T 97. If either beam is below the required strength of 350 pounds per square inch at 6.5 hours, the ME will perform a retest on 2 beams at 8 hours. If either beam is below the required strength of 350 pounds per square inch at 8 hours, the ME will reject the day's production.

For Class E concrete, the ME will field cure cylinders according to AASHTO T 23 for use in 72-hour compressive strength testing. The ME will sample for 72-hour compressive strength testing at the same rate as for the 28-day compressive strength. The ME will perform compressive strength testing to ensure that the required 72-hour compressive strength of 3000 pounds per square inch is in compliance. Each test is comprised of 2 cylinders.

903.05 HIGH PERFORMANCE CONCRETE (HPC)

903.05.01 Composition

Produce HPC conforming to the composition requirements specified in 903.03.01, except for the following:

1. When using more than 1 admixture, ensure that they are compatible. If using admixtures from different manufacturers, submit letters from each manufacturer certifying that their admixtures are compatible with all others in the mix design.
2. Pozzalonic material maximum percentage limitations specified in 903.01 and 903.02.03 are waived for HPC mix designs.
3. In the design of HPC, in order to achieve the desired resistance to chloride penetration, provide an appropriate pozzalonic or other cementitious material, such as silica fume, fly ash, or slag in the mix design.
4. Do not use silica fume as a sole material to achieve the desired resistance to chlorides. Do not use more than 5 percent of silica fume by weight of the total cementitious material. If using fly ash in conjunction with silica fume, use 10 to 15 percent fly ash by weight of the total cementitious materials. If using slag in conjunction with silica fume, use up to 40 percent slag by weight of the total cementitious materials.

903.05.02 Mix Design and Verification

Design an HPC mix that conforms to the requirements in Table 903.05.02-1. Submit a report documenting these results to the ME. Obtain the results of these standard tests from an AASHTO accredited testing agency that is accredited for the test being performed. Design mixes according to the HPC-1 criteria for use in bridge decks, parapets, and bridge sidewalks. Design mixes meeting the HPC-2 criteria for use in pier column protection.

Table 903.05.02-1 Design and Verification Requirements for HPC

Performance Characteristic	Test Method	Requirements	
		HPC-1	HPC-2
Scaling Resistance[1] @ 50 cycles (visual rating of the surface, maximum)	ASTM C 672	3	–
Abrasion Resistance (average depth of wear in inches, maximum)	ASTM C 944	–	0.04
Freeze-Thaw Durability (relative dynamic modulus of elasticity after 300 cycles, minimum)	ASTM C 666 Proc. A	80%	80%
Chloride Permeability[2] @56-days (coulombs, maximum)	AASHTO T 277	1000	1000
Compressive Strength[3] @ 56-days (pounds per square inch, minimum)	AASHTO T 22	5400	5400
Water-Cement Ratio (maximum)	–	0.40	0.40

1. For the scaling resistance testing, moist cure specimens for 14 days and then air cure for 14 days.
2. If the chloride permeability requirement has been achieved in 28 days, consider the chloride permeability acceptable. If the required chloride permeability is not achieved in 28 days, test the HPC sample at 56 days.
3. If the compressive strength requirement has been achieved in 28 days, consider the strength acceptable. If the required compressive strength is not achieved in 28 days, test the HPC samples at 56 days.

At least 90 days before the planned start of the concrete placement, submit the mix design to the ME for approval and verification as specified in 903.03.02. Include the results of the required performance testing in the submission.

In addition to verifying the compressive strength of the HPC mix, the ME will verify the chloride permeability testing according to AASHTO T 277. Submit 4 additional cylindrical samples, having a 4-inch diameter and a length of at least 8 inches, to the ME for this verification testing. The ME will average the values of tests on 2 specimens for each mix design.

903.05.03 Mixing

Mix HPC concrete as specified in 903.03.03. During production, do not change the components of the mix in any way from the approved mix design. If the components must be changed, redesign and re-verify the mix.

903.05.04 Control and Acceptance Testing Requirements

With the exception that the ME may perform compression testing at 56 days, the ME will enforce the requirements specified in 903.03.05 for control and acceptance testing of non-pay adjustment Class A concrete in the fabrication of the HPC elements.

Produce HPC that conforms to the acceptance testing criteria in Table 903.05.04-1.

Table 903.05.04-1 Acceptance Requirements for HPC

Performance Characteristic	Test Method	Requirement
Percent Air Entrainment[1]	AASHTO T 152	6.0 ± 1.5 (No. 57/67 Aggregate) 7.0 ± 1.5 (No. 8 Aggregate)
Slump (inches)[1, 2]	AASHTO T 119	3 ± 1
Chloride Permeability @ 56-days[3, 4] (coulombs, maximum)	AASHTO T 277	2000
Compressive Strength @ 56-days[5] (pounds per square inch, minimum)	AASHTO T 22	4400

1. If using a Type F or G admixture, change the Slump and Air Content values for the HPC as follows:
   1.1 Slump: 6 ± 2 inches
   1.2 Air Content: increase both the target value and tolerance percentages by 0.5
2. For slip-formed parapet, design and produce a mix with a slump of 1 ± 1/2 inch.
3. The ME will not test for the chloride permeability requirements for HPC used for Items other than bridge decks.
4. For chloride permeability testing, the ME will mold 4 additional cylinders, taking 2 cylinders each from 2 randomly selected delivery trucks for testing at 28-day and 56-day intervals.
5. For compressive strength testing, the initial rate for the HPC is 6 per lot. The retest limit is 4400 pounds per square inch.

The ME will test 2 specimens for chloride permeability and will average the results of the 2 specimens to determine the test result. The ME will perform 2 tests on each lot from samples taken from 2 randomly selected delivery trucks. The lot is eligible for 100 percent payment provided that the test results are equal to or below 2000 coulombs.

Whenever 1 or more individual test results exceed 2,000 coulombs at 28 days, the ME will re-evaluate the lot at the same testing rate at 56 days. If, upon testing at 56 days, 1 or more individual test results exceed 2000 coulombs, the RE may:

1. Require that the Contractor remove and replace the defective lot, or
2. Allow the Contractor to submit a corrective action plan for approval.

903.06 SELF-CONSOLIDATING CONCRETE (SCC)

903.06.01 SCC for Drilled Shafts

A. Composition. Produce SCC conforming to the composition requirements specified in 903.03.01, except use a Type F admixture and a viscosity modifying admixture (VMA). Use Type F and VMA admixtures, as specified in 903.02.02 and 903.02.04, at a dosage to produce a flowable concrete that does not require vibration for consolidation. Proportion the aggregates so that the fine aggregate is less than 50 percent by weight of the total aggregate.

B. Mix Design and Verification. Design the mix as specified in 903.03.02 to conform to the strength requirements, water-cement ratio, and cement content for a Class A concrete and the requirements specified in Table 903.06.01-1.

Table 903.06.01-1 Requirements for SCC for Drilled Shafts		
Property	**Test Method**	**Requirement**
Air Content		
Coarse Aggregate No. 57	AASHTO T 152	6.5 ± 2.0 percent
Coarse Aggregate No. 67		6.5 ± 2.0 percent
Coarse Aggregate No. 8		7.5 ± 2.0 percent
Slump Flow	NJDOT C-4	21 ± 3 inches
Visual Stability Index		
Plastic Concrete	NJDOT C-4	1 maximum
Hardened Concrete	NJDOT C-5	1 maximum

Perform mix design verification as specified in 903.03.02. For the verification batch, ensure that the air content is in the top half of the allowable range and the slump flow is between 21 and 24 inches. Perform air content, slump flow, and visual stability index (plastic concrete) testing on the verification batch. Make concrete cylinders for compression testing as specified in 903.03.02 and make 2 additional 4 × 8-inch cylinders for evaluation of the visual stability index of the hardened concrete. Saw the additional cylinders length-wise according to NJDOT C-5. The ME will perform the compressive strength testing and the visual evaluation to assign a visual stability index in order to approve the mix.

C. Verification of Pumpability. Verify pumpability at least 10 days before pouring the SCC concrete in the drilled shaft. Demonstrate the pumpability of the SCC to the ME by pumping a trial batch through the pump proposed for placing the SCC into the drilled shaft. Use the proposed methods for mixing the concrete including any anticipated time delays. The ME will test the SCC before and after pumping to verify that the SCC meets the requirements of Table 903.06.01-1 after pumping.

D. Mixing. Mix SCC as specified in 903.03.03.

E. Control and Acceptance Testing. Perform quality control testing as specified in 903.03.05.

The ME will perform acceptance testing as specified in 903.03.05 for a non-pay adjustment Class A concrete, except that the provisions for slump testing are replaced with requirements for slump flow testing and visual stability index on the plastic concrete. The ME will perform the slump flow testing and the visual stability index according to NJDOT C-4, at the sampling rate specified for slump testing of Class A concrete. The ME will perform visual stability index on the hardened concrete according to NJDOT C-5 at a rate of at least 1 per day. If the visual stability index on the hardened concrete does not conform to the criteria in Table 903.06.01-1, the ME will require redesign of the mix.

In the performance of quality control or acceptance testing, fill cylinder molds, slump flow cones, and air buckets in one lift. Do not vibrate, rod, or tap to consolidate the SCC.

903.06.02 SCC For Precast Concrete

A. Composition. Produce SCC conforming to the composition requirements specified in 903.03.01, except use a Type F admixture or a combination of a Type F and a viscosity modifying admixture (VMA). Use Type F and VMA admixtures, as specified in 903.02.02 and 903.02.04, at a dosage to produce a flowable concrete that does not require vibration for consolidation. Proportion the aggregates so that the fine aggregate is less than 50 percent by weight of the total aggregate.

B. Mix Design and Verification. Design the mix, as specified in 903.03.02 or 903.05.02, to conform to the strength, water-cement ratio, cement content, and air content requirements for the specified class of concrete for the item that is being cast. In addition, ensure that the SCC conforms to the requirements specified in Table 903.06.02-1.

Table 903.06.02-1 Requirements for SCC for Precast Concrete		
Property	**Test Method**	**Requirement**
Slump Flow	NJDOT C-4	24 to 28 inches
Visual Stability Index		
Plastic Concrete	NJDOT C-4	1 maximum
Hardened Concrete	NJDOT C-5	1 maximum

Perform mix design verification as specified in 903.03.02 or 903.05.02. For the verification batch, ensure that the air content is in the top half of the allowable range and the slump flow is between 26 and 28 inches. Perform air content, slump flow, and visual stability index (plastic concrete) testing on the verification batch. Make concrete cylinders for compression testing as specified in 903.03.02 or 903.05.02 and make 2 additional 4 × 8 inch cylinders for visual stability index on the hardened concrete. Saw the additional cylinders length-wise according to NJDOT C-5. The ME will perform the compressive strength testing and the visual evaluation to assign a visual stability index in order to approve the mix.

C. Mixing. Mix SCC as specified in 903.03.03.

D. Control and Acceptance Testing. Perform quality control testing as specified in 903.03.05.

The ME will perform acceptance testing as specified in 903.03.05 for specified class of concrete for the item, except that the provisions for slump testing are replaced with requirements for slump flow testing and visual stability index on the plastic concrete. The ME will perform the slump flow testing and the visual stability index according to NJDOT C-4, at the sampling rate specified for slump testing for the specified class of concrete. The ME will perform visual stability index on the hardened concrete according to NJDOT C-5 at a rate of at least one per day. If the visual stability index on the hardened concrete does not conform to the criteria specified in Table 903.06.02-1, the ME will require redesign of the mix.

In the performance of quality control or acceptance testing, without remixing the sample, fill cylinder molds, slump flow cones, and air buckets in one lift. Do not vibrate, rod, or tap to consolidate the SCC.

903.07 QUICK-SETTING PATCH MATERIALS

Use quick-setting patch material that is listed on the QPL and is ready for mixing according to the manufacturer's recommendations. Follow the manufacturer's recommendations regarding the required water demand for the patching material. Use patching material that is concrete gray in color and contains no calcium chloride or other ingredients that cause corrosion to steel reinforcement. If adding coarse aggregate to patching material, use broken stone conforming to 901.03.01. Ensure that the material is quick-setting for use in concrete patching where fast setting, rapid strength gain, non-shrink, and high bond strength characteristics are needed. The ME will add products to the QPL only after testing and evaluation in the field, after service for 1 year.

The classifications for quick-setting patch materials are as follows:

1. **Type 1.** Suitable for use above water. Type 1 products are used neat or with up to 15 pounds of coarse aggregate size No. 8 added to a 50-pound bag of material. The ME will test the patch material neat. At the work site, the Contractor may add up to 15 pounds of coarse aggregate size No. 8 to a 50-pound bag of the patch material to increase yield, provided that the product properties are not adversely affected.

2. **Type 1A.** Suitable for use above water. Type 1A products have manufacturer specified mix proportions with aggregates that would preclude it from being classified as a Type 1. The ME will approve the mix proportions before adding the material to the QPL. The manufacturer shall provide mixing proportions, including the required type and size of aggregate and the proportion of patching material, aggregate/sand, and water. At least 10 days before the start of placement, propose aggregates for verification trial batching based on the manufacturer's pre-approved proportions. The ME will verify that the proposed quick setting patch mixture meets the required physical properties.

3. **Type 1B.** Suitable for use above water. Type 1B products are those products that have course aggregate, sand, or both pre-packaged with the cementitious material. The ME will test this material, including a field trial, prior to adding it to the QPL. The manufacturer shall designate the amount of aggregate and shall maintain the total aggregate within ±10 percent of this stated amount. The ME will randomly test the

aggregate to ensure that the overall percentage of aggregate is within ±10 percent of the total and that the gradation on individual sieves does not vary more than ±10 percent from the gradation of the originally approved sample. The manufacturer shall use an aggregate supplier that is listed on the QPL. The ME will disapprove quick-setting patch material that fails to comply with the aggregate consistency requirements. If the manufacturer makes any changes to the formulation, the ME will require that the material be resubmitted for approval. Do not add additional aggregate in the field.

4. **Type 2.** Suitable for vertical and overhead repairs that are not formed and poured. The ME will test the patch material neat.

If liquid activator, other additives, adhesive, or bonding agents are integral to the performance of the patch material, the manufacturer shall provide the material so that 1 package of additive, activator, adhesive or bonding agent is required for 1 package of patch material. Mix patch material as specified in 903.03.04.

Use quick setting patch material that meets the requirements in Table 903.07-1 when tested according to NJDOT C-2. Mix quick-setting patch according to the manufacturer's recommendations.

Table 903.07-1 Requirements for Quick Setting Patch Material

	Type 1, 1A, 1B	Type 2
Bond Strength		
7-day (minimum)	1000 psi	1000 psi
28-day (minimum)	2000 psi	2000 psi
Expansion/Shrinkage		
Cured in Water (maximum)	+0.20%	+0.20%
Cured in Air (maximum)	−0.20%	−0.20%
Difference (maximum)	0.30%	0.30%
Durability		
Retained strength at 50 cycles (minimum)	90%	90%
Visual condition rating at 50 cycles (maximum)	3	3
Permeability (maximum chloride content at 2 inches)	2.5 lbs/yd^3	2.5 lbs/yd^3
Compressive Strength		
3-hour (minimum)	2000 psi	–
1-day (minimum)	3000 psi	1000 psi
7-day (minimum)	4000 psi	2000 psi
28-day (minimum)	4500 psi	3000 psi
Time of Set in minutes (minimum)	15	15

903.08 MORTAR AND GROUT

903.08.01 Mortar

To produce mortar, mix 1 part cement to 2 parts fine aggregate. Add water to form the proper consistency. Do not temper or use mortar after it has begun to set.

Provide materials as specified:

Fine Aggregate 901.06.02
Cement 903.01
Water 919.08

903.08.02 Grout

A. Non-Shrink Grout. Use non-shrink grout of a plastic consistency that is listed on the QPL and conforms to ASTM C 1107 with the following amendments:

1. Ensure that the grout has a working time of at least 30 minutes from the time the water is added.
2. Match the color of the hardened grout, where visible, to the color of the adjacent hardened concrete.

3. Include 1-day strength tests as part of the performance requirements of ASTM C 1107.
4. Ensure that the grout contains no more than 0.05 percent chlorides or 5.0 percent sulfates by weight.

B. Epoxy Grout. Use epoxy grout that is listed on the QPL and conforms to the requirements of ASTM C 881, Type 1, Grade 3, Class B or C.

903.08.03 Grout for Undersealing of Concrete Pavement

A. Pozzolan Grout. Provide materials as specified:

Cement, Type I, II, III 903.01
Chemical Admixtures 903.02.02
Fly Ash 903.02.03.A
Water 919.08

Ensure that the mix for grout conforms to the following proportions by volume:

1. 1 part cement
2. 3 parts fly ash
3. Water to achieve required fluidity
4. Admixtures as needed to obtain required grout characteristics

Submit materials proposed for use to the RE for approval. Include in the submittal the mill certification for cement, physical and chemical analysis of fly ash, and tests of the pozzolan grout by an AASHTO accredited testing laboratory. Ensure that the laboratory report includes the 1-day, 3-day, and 7-day compressive strengths; flow cone time; shrinkage/expansion; and time of initial set. Ensure that the grout conforms to the requirements specified in Table 903.08.03-1.

Table 903.08.03-1 Requirements for Pozzolan Grout

Property	Test Method	Requirements
Compressive Strength, 7-Day (psi)	AASHTO T 106	600 minimum
Flow Cone Time (s)	ASTM C 939	9 - 16

B. High-Density Polyurethane Grout. Submit to the RE for approval all materials proposed for use. Include in the submittal a certification of physical and chemical analysis by an AASHTO accredited testing laboratory. Provide certification that the materials will not shrink or deteriorate for a period of 10 years from the date of injection.

Ensure that the high-density polyurethane conforms to the requirements specified in Table 903.08.03-2.

Table 903.08.03-2 Requirements for High-Density Polyurethane Grout

Property	Test Method	Requirements
Density (pcf)	ASTM D 1622	5.65 to 5.90
Compressive Strength (psi)[1]	ASTM D 1621	65 to 95
Tensile Core (psi)	ASTM D 1623	70 to 100
Shear Strength (psi)	ASTM C 273	40 to 85
Closed Cell Content %	ASTM D 2858	85 to 95
Percent Volume Change		
Humid - 28 Days (158 °F, 95% Humidity)	ASTM D 2126	+5.0 to +11.0
Freeze - 5 Days (−20° F, Dry)		−0.1 to −0.9

1. Ensure high-density polyurethane grout reaches 90 percent of the full compressive strength within 15 minutes of injection.

903.09 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

Provide materials as specified:

Fine Aggregate 901.06.02
Cement 903.01

CheSWmical Admixtures 903.02.02
Water 919.08

Use CLSM that consists of a mixture of cement, water, fine aggregate, and admixtures. Proportion the CLSM mixture to provide a backfill material that is self-compacting and capable of being excavated with hand tools at a later date. Proportion the CLSM to produce a 28-day compressive strength of 50 to 150 pounds per square inch. If fast-setting CLSM is required, use an accelerating admixture to produce a fast setting flowable mixture. Ensure that the CLSM for backfilling of conduit and piping has a permeability of $1.7 \times 10^{-3} \pm 0.2 \times 10^{-3}$ centimeters per second when tested according to ASTM D 5084.

At least 45 days before the start of any CLSM placement, prepare trial batches of CLSM of the same materials and proportions proposed for use in the Contract. Submit each mix design on concrete mix design forms provided by the Department, naming the sources of materials and test data.

The ME will be present at the time of verification batching to confirm that the proportions and materials batched conform to the proposed mix designs. Prepare at least six 6 × 12-inch compression test cylinders for each batch to be tested according to ASTM D 5971 for 28-day strengths except for fast setting mixes. Test fast-setting CLSM at the specified cure time. If fly ash is used in the CLSM, the ME will take an additional set of cylinders to ensure that the strength of the CLSM does not exceed 150 pounds per square inch in 90 days.

For acceptance testing, the ME will take 1 sample per day but may waive the testing if less than 20 cubic yards is placed in a day. If strength does not comply, the ME may require a new mix design for the CSLM.

903.10 CURING MATERIALS

903.10.01 Burlap Cloth

Use burlap cloth made from jute or kenaf conforming to AASHTO M 182, Class 4. The ME may sample 1 square yard of burlap cloth from each source for testing. If requested by the RE, submit a certification of compliance as specified in 106.07.

903.10.02 Liquid Membrane-Forming Compound

Use liquid membrane-forming compounds conforming to AASHTO M 148, Type 1-D, clear or translucent with fugitive dye. The ME may sample 1 quart of liquid membrane-forming compound from each lot for testing. If requested by the RE, submit a certification of compliance as specified in 106.07.

903.10.03 White Polyethylene Sheeting

Use white polyethylene sheeting conforming to AASHTO M 171 for white opaque polyethylene film. The ME may sample a 1-foot strip (cut across full width) from each source for testing. If requested by the RE, submit a certification of compliance as specified in 106.07.

SECTION 904 – PRECAST AND PRESTRESSED CONCRETE

904.01 NON-STRUCTURAL PRECAST CONCRETE

904.01.01 Component Materials

Provide materials as specified:

Concrete 903.03
Self-Consolidating Concrete (SCC) 903.06.02
Mortar 903.08.01
Curing Materials 903.10
Reinforcement Steel 905.01

Welded steel wire fabric used for reinforcement need not be galvanized.

904.01.02 Fabrication

Fabricate precast concrete at a plant as specified in 1011.01.

1. **Placing Reinforcement Steel.** Before placing the concrete, place reinforcement steel in position as shown on the approved working drawings and as specified in 504.03.01. Firmly tie the reinforcement to prevent displacement during placing of the concrete.

2. **Placing Concrete.** Place concrete as specified in 504.03.02.D and 504.03.02.E. Before placing concrete, ensure that reinforcement steel and any other embedded materials are free of loose rust, frost, dirt, oil, or contaminants that may prevent a bond with the concrete. Consolidate concrete with internal vibrators. The fabricator may use external vibration to supplement internal vibration. If using SCC, minimize or eliminate the use of vibrators is to prevent segregation.

904.01.03 Curing

Cure according to the *PCI MNL-116*, except for steam curing. Do not strip forms until the piece has attained a stripping strength of 2000 pounds per square inch.

If steam curing, delay the application of steam within the enclosure for 4 hours or until the concrete has attained an initial set as determined according to ASTM C 403. Maintain an ambient temperature between 50 °F and 90 °F during the delay. Ensure that the maximum rate of temperature increase in the enclosure is 40 °F per hour. Monitor the temperature in the enclosure using recording thermometers placed at a minimum of 2 locations. Ensure that the enclosure temperature is maintained between 90 °F and 150 °F until 2 concrete test cylinders, field cured according to AASHTO T 23, have attained the stripping strength.

904.01.04 Removing Forms and Finishing

Ensure that items remain in forms for the duration of the curing operation. Remove forms when concrete has attained the stripping strength. If handling devices are used, remove and fill the holes with concrete or mortar. Provide a Class 1 finish as specified in 504.03.02.H.1. Complete surface finishing operations before placing the piece in storage.

904.01.05 Shipping and Handling

Store, stack, and transport the pieces using methods that do not cause the development of cracks or other damage. Do not ship pieces until the class design strength as specified in Table 903.03.06-3 has been attained.

904.01.06 Quality Control and Acceptance Requirements

Notify the ME before start of production.

For quality control, keep applicable records according to PCI Division 1, Quality Control, or NPCA requirements, and supply copies of these records to the ME as requested. Ensure that the quality control technician performing all tests is certified as an ACI Field Testing Technician, Grade 1.

Submit certification of compliance as specified in 106.07.

If the concrete piece is spalled, honeycombed, chipped, or otherwise defective, the ME or RE will reject the piece.

904.02 PRECAST CONCRETE RETAINING WALLS

904.02.01 Component Materials

Provide materials as specified:

Concrete	903.03
Self-Consolidating Concrete (SCC)	903.06.02
Mortar	903.08.01
Curing Materials	903.10
Reinforcement Steel	905.01

Welded steel wire fabric used for reinforcement need not be galvanized.

904.02.02 Fabrication

Use a system listed on the QPL to fabricate prefabricated modular walls or mechanically stabilized earth walls. Fabricate precast concrete at a plant as specified in 1011.01.

1. **Placing Reinforcement Steel.** Place reinforcement steel as specified in 504.03.01. Before placing the concrete, place reinforcement in position as shown on the approved working drawings, and firmly tie the reinforcement to prevent displacement during placing of the concrete.

2. **Forms.** Cast the units in steel forms to ensure the production of uniform units. Place the forms on a flat surface with the front face of the form down.

3. **Placing Concrete.** Place concrete as specified in 504.03.02.D and 504.03.02.E. Before placing concrete, ensure that reinforcement steel and other embedded materials are free of loose rust, frost, dirt, oil, or contaminants that may prevent a bond with the concrete. Consolidate concrete with internal vibrators. The fabricator may use external vibration to supplement internal vibration.

   If using SCC, minimize the use of vibrators to prevent segregation.

4. **Fabrication Requirements.** Fabricate posts and panels free of honeycombing or voids and true to the size and dimensions specified in Table 904.02.02-1. Clearly mark the name of manufacturer, name of contract, date of manufacture, mark numbers, and type of unit, as shown on the approved working drawings, in the inside or back face of each unit.

Table 904.02.02-1 Dimensional Tolerances

For MSE Walls	
All Panel Dimensions	±1/4 inch
Deviation from Vertical	1/8 inch per 5 feet
For Modular Walls	
Length and Height of Face	±3/16 inch
Deviation from Square for Units < 10 feet wide[1]	5/16 inch maximum
Deviation from Square for Units ≥ 10 feet wide[1]	3/4 inch maximum

1. Measure deviation from square on the diagonal.

904.02.03 Curing

Cure as specified in 904.01.03, except that the required stripping strength is 3000 pounds per square inch.

904.02.04 Form Removal and Finishing

Remove forms and finish concrete as specified in 904.01.04.

904.02.05 Shipping and Handling

Handle and ship as specified in 904.01.05.

904.02.06 Quality Control and Acceptance Requirements

Notify the ME in writing at least 21 days before start of production.

For quality control, keep applicable records according to PCI Division 1, Quality Control, or NPCA requirements, and supply copies of these records to the ME as requested. Ensure that the quality control technician performing all tests is certified as an ACI Field Testing Technician, Grade 1.

During production, the ME will inspect the quality of materials and the process of manufacture. The ME will accept the concrete as specified in 903.03.05 and will inspect the finished pieces before shipping for dimensional tolerances and damage. The ME will reject units for any of the following:

1. Variations in the exposed face that substantially deviate in appearance.
2. Dimensions not conforming to the tolerances in specified in Table 904.02.02-1.
3. Honeycombed or open texture not properly repaired.

4. Defects that would affect the structural integrity of the unit.
5. Stained front face due to excess form oil or other reasons.
6. Broken or cracked corners.

904.03 STRUCTURAL PRECAST CONCRETE

904.03.01 Component Materials

Provide materials as specified:

Concrete	903.03
Self-Consolidating Concrete (SCC)	903.06.02
Mortar	903.08.01
Curing Materials	903.10
Reinforcement Steel	905.01
Bolts and Bolting Materials	908.01
Epoxy Waterproofing	912.02.02

904.03.02 Fabrication

Fabricate precast concrete at a plant as specified in 1011.01. Provide an office for the ME as specified in 1011.03.

1. **Placing Reinforcement Steel.** Before placing the concrete, place all reinforcement steel in position as shown on the approved working drawings and as specified in 504.03.01. Firmly tie the reinforcement steel to avoid displacement during placing of the concrete.

   For longitudinal distribution reinforcement steel, the fabricator may use welded wire fabric or deformed billet steel bars. Ensure that welded wire fabric is shipped in mats.

   In precast concrete box culverts, the ME will allow lifting devices in each precast unit for the purpose of handling and erection. If using lifting hooks or lugs, galvanize the devices according to ASTM A 153.

2. **Placing Concrete.** Place concrete as specified in 504.03.02.D and 504.03.02.E. Before placing concrete, ensure that reinforcement and any other embedded material are free of loose rust, frost, dirt, oil, or contaminants that may prevent a bond with the concrete. Consolidate concrete with internal vibrators. The fabricator may use external vibration to supplement internal vibration.

   If using SCC, minimize the use of vibrators to prevent segregation.

3. **Fabrication Requirements**. Identify each precast concrete unit with a permanent marking. Manufacture the precast concrete units in steel forms.

   For precast culverts, ensure that units conform to the requirements specified in Table 904.03.02-1. Provide 2 rows of threaded inserts or bar extensions in the last precast culvert section for the cast-in-place end section and the wingwall attachment and for the headwall attachment, if necessary.

Table 904.03.02-1 Fabrication Requirements for Culverts

Wall Thickness	8 inches minimum
Top and Bottom Slab Thickness	10 inches minimum
Concrete Cover for Walls and Bottom Slab	1-1/2 inches minimum
Concrete Cover for Top Slab	2 inches minimum

For precast concrete arch structures, ensure that units comply with Table 904.03.02-2.

Table 904.03.02-2 Fabrication Requirements for Precast Concrete Arch Structures

Concrete Cover Outside Face	2 inches minimum
Concrete Cover Inside Face	1.5 inches minimum
Internal Dimension Tolerance	±1% or ±2 inches, whichever is less
Wall Thickness Tolerance[1]	−5% or −1/2 inch, whichever is more
Difference in Side Lengths[2]	±3/4 inch

1. The ME will not reject structures having thicknesses that exceed that shown in the approved working drawing.
2. Requirement waived for skewed ends for laying curves.

904.03.03 Curing

Cure as specified in 904.01.03, except that the required stripping strength is 4000 pounds per square inch.

904.03.04 Removing Forms and Finishing

Ensure that units remain in their steel forms for the duration of the curing operation.

Upon removal of the forms, provide a Class 1 finish as specified in 504.03.02.H.1 to the entire precast concrete culvert unit, including exterior, interior, and lap surfaces. For culverts, after approval of the Class 1 finish, apply 1 coat of an epoxy waterproofing on the exterior of the roof slab. Apply this coating in the precaster's plant not earlier than 72 hours after fabrication, and after the concrete compressive strength has reached 4000 pounds per square inch. Ensure that the concrete surfaces of the precast units are dry during application of the epoxy waterproofing. Apply the epoxy waterproofing according to the product manufacturer's recommendations.

904.03.05 Shipping and Handling

Handle and ship as specified in 904.01.05.

904.03.06 Quality Control and Acceptance Requirements

Notify the ME in writing at least 21 days before start of production.

For quality control, keep applicable records according to PCI Division 1, Quality Control, or NPCA requirements, and supply copies of these records to the ME as requested. Ensure that the quality control technician performing all tests is certified as an ACI Field Testing Technician, Grade 1.

During production, the ME will inspect the quality of materials and the process of manufacture. The ME will accept the concrete as specified in 903.03.05 and will inspect the finished pieces prior to shipping for dimensional tolerances and damage. If the concrete piece is spalled, honeycombed, chipped, or otherwise defective, the ME may reject the piece or approve repairs.

904.04 PRESTRESSED CONCRETE

904.04.01 Component Materials

Provide materials as specified:

Concrete 903.03
Mortar 903.08.01
Curing Materials 903.10
Reinforcement Steel 905.01
Prestressing Reinforcement 905.02
Bolts and Bolting Materials 908.01
Epoxy Waterproofing 912.02.02
Epoxy Bonding Compound 919.07

In the construction of prestressed concrete I-beams or prestressed concrete slab and box beams, when the use of galvanized reinforcement steel is planned for the deck construction, galvanize all reinforcement steel that will provide composite action.

For prestressed concrete piles in a marine environment, use grit impregnated epoxy-coated prestressing steel strands as specified in 905.02. When storing, cover the strands with an opaque polyethylene sheeting or other suitable protective material to protect the reinforcement from exposure to sunlight, salt spray, and weather. For stacked bundles, drape the protective covering around the perimeter of the stack. Adequately secure the covering; however, allow air circulation to prevent condensation under the covering. Do not store epoxy-coated prestressing steel within 1000 feet of ocean or tidal water for more than 2 months.

904.04.02 Fabrication

Fabricate prestressed concrete at a plant as specified in 1011.02. Provide an office for the ME as specified in 1011.03.

1. **Placing Reinforcement and Prestressing Steel.** Store reinforcement above ground, and cover strand packs when not in use. Place reinforcement steel as specified in 504.03.01 and as shown in the working drawings. Position or loosely tie reinforcement steel until prestressing strands have been positioned. After pre-stressing, firmly tie the reinforcement prior to placing concrete.

   If using an anti-bonding agent on the forms to facilitate their removal, protect the prestressing strands against contamination by the anti-bonding agent. Use supports, spaced a maximum of 10 feet apart, to support bottom strands and side reinforcement steel. If necessary, provide horizontal and vertical spacers to hold the wires in place in the enclosures.

2. **Prestressing.** Provide protection, for the ME inspecting the prestressing operation, adequate to stop a flying strand. Use shields, placed at both ends of the bed, made of steel, reinforced concrete, heavy timbers, or other material to provide protection acceptable to the ME.

   Apply stress to each cable as shown on the working drawings using either the single strand or the multi-strand jacking method.

   If performing prestressing by the multi-strand jacking method, bring the individual strands to a uniform initial tension before applying the full pretensioning. Measure the initial tension of each strand using a dynamometer, a gauge, or other such means. After the initial tensioning, stress the strands until the specified elongation and jacking pressure are attained.

   If performing prestressing by the single strand jacking method, do not construct more than 1 splice per strand. When multi-strand jacking is used, either splice all strands or splice no more than 10 percent of the strands. Ensure that spliced strands are similar in physical properties, are from the same source, and have the same twist or lay. Position splices outside of the prestressed members. Do not torch cut the ends of the strand lengths to be spliced.

   For prestressing draped strands, apply stress by either partially jacking at the end of the bed, followed by raising or lowering the strands to their final position, or entirely by the jacking operation. Regardless of the method of prestressing, use low-friction devices at all points of slope change in the strand trajectory. If the strands are tensioned in their draped position, support the strands using lubricated rollers with bronze bushings or roller bearings at all hold-up points, and low-friction, free-turning rollers at all hold-down points. When strands are deflected after partial tensioning, simultaneously raise or depress the strands at all points or in an approved specified sequence.

   Replace broken strands if the allowable number of wire breaks specified in Table 904.04.02-1 is exceeded. Locate and tie wire breaks directly to the strand to prevent raveling during the vibration of the concrete.

Table 904.04.02-1 Maximum Allowable Wire Breaks	
Number of Strands	**Maximum Allowable Wire Breaks**
Less than 20 strands	0
20 to 39 strands	1
40 to 59 strands[1]	2
60 and more strands[1]	3

1. Replace the strand if more than 1 break occurs in an individual strand.

If concrete is not placed within 72 hours of prestressing, the ME may require the bed to be checked for proper stresses before placement of concrete.

After final stressing, position strands and uniformly distribute the stress in the strands throughout the bed length.

3. **Placing Concrete.** Before placing concrete, ensure that the prestressing is acceptable to the ME and that reinforcement and any other embedded materials are free of loose rust, frost, dirt, oil, or contaminants that may prevent a bond with the concrete. Place concrete as specified in 504.03.02.D and 504.03.02.E. Consolidate concrete with internal vibrators. The fabricator may use external vibration to supplement internal vibration. Only place concrete in the presence of, or as directed by, the ME.

   For prestressed concrete box beams, place voids in the forms after the ME has inspected the concrete poured to encase the strands in the bottom portion of the beam.

4. **Fabrication Requirements.** Fabricate the prestressed concrete members to plan dimensions within the tolerances specified in applicable sections of *PCI MNL-116*. The ME will reject members having dimensions outside the tolerance limits, unless the Contractor performs corrective measures. Obtain approval from the Department before taking any corrective measures. Adhere to beam camber tolerances so that preformed transverse tie holes for prestressed box and slab beams line up correctly during erection, facilitating the placement of transverse ties.

   Cast a permanent, unique, identification mark and the date of the casting in the top of members. Upon removal of the forms, mark the ends of members with the same identification marking.

5. **Detensioning.** Do not detension the bridge members until the strength tests indicate that the concrete has reached a compressive strength of at least 4000 pounds per square inch for Class P, 4500 pounds per square inch for Class P-1, and 5000 pounds per square inch for Class P-2 concrete.

   Before detensioning, submit to the ME a plan for the pattern and schedule for releasing the strands. Strip or loosen forms that may tend to restrict the horizontal or vertical movement of the member.

   For detensioning, use either the multiple strand release method or the single strand release method.

   If the multiple strand method of release is used, gradually and simultaneously release all of the strands or a symmetrical group of strands. Transfer the load on the strands from the anchorage to the jacking system. Gradually release the jack or jacks until the strands are relaxed.

   For the single strand release method, detension the strands in the sequence of the pattern and schedule of release by slow-heat cutting. Use a low-oxygen flame applied along the strand for a minimum of 5 inches until the metal gradually loses its strength. Apply the heat at a rate to induce failure of the first wire in the strand at least 5 seconds after the heat is applied.

   The ME will reject pieces if the fabricator fails to follow the detensioning procedure.

904.04.03 Curing

Cure as specified in 904.01.03, except that the required stripping strength is 4000 pounds per square inch for Class P, 4500 pounds per square inch for Class P-1, and 5000 pounds per square inch for Class P-2 concrete. In addition, when the ambient air temperature is above 100 °F, initiate a water cure or other approved method as soon as the concrete is able to receive the water without physical damage to its surface. The fabricator may discontinue this cure upon introduction of steam, provided that a relative humidity of 100 percent is maintained.

904.04.04 Removing Forms and Finishing

Do not remove side forms until the strength of 2 cylinders, similarly cured as the member, achieves at least 2500 pounds per square inch. Do not move the member from the bottom forms before detensioning.

Upon the removal of forms, the ME may reject any member that has 1 prestressing strand exposed for a length in excess of 24 diameters, or 2 or more strands visually exposed. In addition, the ME may reject any unit that is honeycombed to such an extent that chipping away from honeycombed concrete results in the conditions described for exposed strands. If the ME determines that the defective areas can be repaired, submit a repair procedure to the ME for approval. Perform approved patching before detensioning.

Provide a Class 1 finish, as specified in 504.03.02.H.1, on formed surfaces of the concrete members. For surfaces of concrete exposed to view in the finished structure, perform additional finishing by rubbing mortar on the surface using burlap. Ensure that the rubbing produces a smooth surface of uniform color and texture. Transversely score the top surface of members using a stiff wire brush. After the removal of hold-down devices from the bottom of the beams, coat the resulting holes with an epoxy bonding compound, and plug the holes with mortar while the epoxy bonding compound is still tacky. If the epoxy bonding compound dries out before the placement of the mortar, sandblast the area and reapply the bonding compound. Patch vent holes for box beams upon removal from forms after the internal void drains are opened.

Treat portions of prestressed concrete beams as shown on the Plans with an epoxy waterproofing. Do not apply the epoxy waterproofing to the top surface of a beam. Use an epoxy waterproofing that closely matches the color of the concrete. Do not apply the epoxy waterproofing sooner than 72 hours after detensioning. Ensure that the concrete surface is dry and clean of oil, grease, and dirt before applying the coating. Apply the epoxy waterproofing by brush only, unless otherwise approved by the ME. Ensure that the epoxy waterproofing is applied uniformly and provides adequate coverage.

904.04.05 Shipping and Handling

The fabricator may handle members immediately after completion of detensioning. Before placing members in storage, ensure that surface finishing operations are completed and the member is approved by the ME. Do not remove a girder from the bed unless the differential between girder and air temperature is less than 80 °F. Before box and slab beams are moved to storage, inspect nonmetallic draining devices and open to provide for passage of water.

Notify the ME at least 2 days before shipping. Do not ship until the class design strength as specified in Table 903.03.06-3 has been attained and a minimum of 72 hours have elapsed following detensioning. Determine shipping strength by testing a complete set of cylinders that represent the lot of concrete and were cured with the item.

Transport girders in an upright position. Ensure that the points of support and directions of the reactions with respect to the girder are approximately the same during transportation and storage as in its final erection position. Request the Department's approval for transportation or storage of girders in any other position.

904.04.06 Quality Control, Quality Assurance, and Acceptance Requirements

Notify the ME in writing at least 21 days before start of production.

For quality control, keep applicable records in conformance with PCI Division 1, Quality Control, or NPCA requirements, and supply copies of these records to the ME as requested. Ensure that the quality control technician performing all tests is certified as an ACI Field Testing Technician, Grade 1.

During production, the ME will inspect the quality of materials and the process of manufacture. The ME will accept the concrete as specified in 903.03.05 and will inspect the finished pieces prior to shipping for dimensional tolerances and damage. If concrete is placed on the same bed at different times in the day, the ME will split the day's production into separate lots. If the concrete member is spalled, honeycombed, chipped, or otherwise defective, the ME may reject the piece or approve repairs.

SECTION 905 – REINFORCEMENT METALS

905.01 REINFORCEMENT STEEL

For uncoated reinforcement steel, submit a certification of compliance as specified in 106.07. Attach copies of the mill certifications for each heat of reinforcement steel. The ME will randomly sample and test heats of uncoated reinforcement steel for quality assurance.

The ME will inspect galvanized and epoxy coated reinforcement steel before and after fabrication. For coated steel reinforcement bars, the ME will inspect the coating and take four 2-1/2-foot samples from each production heat for testing. For coated welded wire reinforcement, the ME will inspect the coating and take one 2-square foot sample from each production heat for testing. Provide the ME with mill certifications for each heat of reinforcement steel.

905.01.01 Reinforcement Bars

Use deformed bars according to ASTM A 615, Grade 60. Fabricate using the detailing dimensions for hooks, bends, and tolerances according to the CRSI *Manual of Standard Practice*. Bend bars using the cold method with positive powered machines in the shop or field. Compute the weight of reinforcement steel according to ASTM A 615.

If specified, galvanize according to ASTM A 767, Class I. Fabricate bends and details before galvanizing.

If specified, apply epoxy coating according to ASTM A 775.

905.01.02 Spiral Reinforcement

Use spiral reinforcement that is plain round hot-rolled steel bars according to ASTM A 615, Grade 60. Compute the weight of reinforcement steel according to ASTM A 615.

905.01.03 Welded Wire Reinforcement

Use plain steel welded wire reinforcement according to ASTM A 185 or deformed steel welded wire reinforcement according to ASTM A 497. When used for concrete pavement, use welded wire reinforcement mats at least 5 feet in width.

When approved as an alternate to galvanized reinforcement bars, use galvanized welded wire reinforcement according to ASTM A 641, Class C. When approved as an alternate to epoxy coated reinforcement bars, use epoxy coated welded wire reinforcement according to ASTM A 884, Class A.

905.01.04 Structural Shapes, Plates, and Bars

Ensure that structural shapes, plates, and bars used for reinforcement or other miscellaneous embedded metal work conform to the requirements for structural steel specified in 906.01. Galvanize according to ASTM A 123.

905.01.05 Dowels

Use 1-inch diameter plain reinforcement bars according to ASTM A 615, Grade 60. Galvanize according to ASTM A 123.

905.02 PRESTRESSING AND POST-TENSIONING REINFORCEMENT

The ME will sample and test each heat of steel reinforcement prior to use for acceptance. For prestressing strand, the ME will test two 4-foot cables with flame cut ends and one 1-foot piece with sawcut ends from each heat. For high-strength alloy bars, the ME will test one 6-foot bar from each heat. For post-tensioning, the ME will test one 6-foot cable (between fittings) from each reel or one 6-foot bar (between threads) from each lot. Provide a certification of compliance as specified in 106.07. Attach the mill certification for each heat used with the certification of compliance.

905.02.01 High-Tensile-Strength 7-Wire Prestressing Strand

Use high-tensile-strength, low-relaxation 7-wire strand for prestressing reinforcement according to ASTM A 416, Grade 270. When specified, use grit impregnated epoxy-coated steel strands according to ASTM A 882.

905.02.02 High-Tensile Strength Alloy Bars

Use high-tensile strength alloy bars for prestressing or post-tensioning according to ASTM A 722.

905.02.03 Post-Tensioning Reinforcement

A. Bars. For transverse ties for prestressed concrete voided slab and box beams, use steel bars according to ASTM A 722, 3/4-inch diameter. Commercial blast clean bars (SSPC-SP 6), and coat with coal tar epoxy paint as specified in 912.01.03. The fabricator may epoxy coat bars according to ASTM A 775.

Ensure that end anchorages (nuts, washers, and anchor plates) used with high-tensile strength steel rod bars are shown on the working drawings. Use end anchorages compatible with the tie rod system. Galvanize according to ASTM A 123.

B. Strands. Use high-tensile-strength, low-relaxation 7-wire strand for prestressing reinforcement according to ASTM A 416, Grade 270. Ensure that anchorages and end fittings for 1/2-inch diameter strands and the corrosion protection method for the end fittings are shown on the working drawings.

905.03 REINFORCEMENT FOR CONCRETE PAVEMENT

905.03.01 Tie Bars and Joint Ties

For tie bars and joint ties in longitudinal joints for concrete pavement, use epoxy coated deformed reinforcement steel bar as specified in 905.01.01.

Provide certifications of compliance as specified in 106.07. Attach a mill certification for each heat used to the certification of compliance.

905.03.02 Tie Bolts

For tie bolts in longitudinal joints for concrete pavement, use epoxy coated plain reinforcement steel bar that meets the requirements as specified in 905.01.01. Perform all required bending of tie bolts in a fabrication shop. Do not field bend tie bolts. Use rebar coupling devices as specified in 905.04.

Provide certifications of compliance as specified in 106.07. Attach a mill certification for each heat used to the certification of compliance.

905.03.03 Dowel Bars

For dowel bars in transverse joints, use epoxy-coated, Grade 60, plain reinforcement steel according to ASTM A 615. If shown on the Plans, use dowel bars fitted with end caps. Ensure that the end caps are non-metallic and designed to prevent the entrance of grout or mortar into the expansion void. Provide end caps that have a maximum length of 2-1/2 inches, and allow a minimum of 3/4 inch of movement.

Provide certifications of compliance as specified in 106.07. Attach a mill certification for each heat used to the certification of compliance.

905.04 REBAR COUPLING DEVICES

To splice reinforcement steel, use a rebar coupling device that is listed on the QPL. Ensure that the mechanical coupling device develops a minimum of 125 percent of the specified yield strength of the reinforcement steel. If the reinforcement steel has either galvanizing or epoxy coating, use a mechanical coupling device with a matching coating system. Provide certifications of compliance as specified in 106.07.

SECTION 906 – STRUCTURAL STEEL

906.01 STRUCTURAL STEEL MATERIALS

Provide structural steel materials conforming to the requirements in Table 906.01-1 and as shown on the Plans.

Table 906.01-1 Structural Steel Materials Requirements

Product	Test Method	Type/Grade/Class
Structural Steel Plate[1]	ASTM A 709	Grade 36, 50, 50W, or HPS70W[2]
Tie rods, plate washers, tie backs, turnbuckles, plates, shapes, and shims	ASTM A 709	Grade 36
Steel tube and pipe for Sign Structures [3, 4]	ASTM A 53	Type S, Grade B or Type E, Grade B
Steel Piles		
Steel H-piles	ASTM A 572	Grade 50
Steel sheet piles	ASTM A 572	Grade 50
Steel pipe piles	ASTM A 252	Grade 2
Casings for Drilled Shafts[5]	ASTM A 252	Grade 2
Flooring		
Grid Flooring	ASTM A 709	Grade 36
Formed Steel Flooring	ASTM A 1011	Grade 30
Steel Forgings	ASTM A 668	Class C
Shear Connector Studs[6]	ASTM A 108	Grades G1015, 1018, or 1020
Stay-In-Place (SIP) Forms[7]	ASTM A 653	Grades 33, 37, 40, 49, or 80

1. For steel used in tension zones, ensure that the steel conforms to Zone 2 impact testing requirements.
2. For the manufacture of Grade HPS70W, the Department will allow the use of the Thermo-Mechanical Controlled Process.
3. For sizes less than or equal to 24 inches in diameter, only use electric resistance welded single seam pipe.
4. For pipe with wall thickness greater than 1/2 inch, the fabricator may substitute API Specification 5L, Grade B.
5. For casings, use smooth, non-corrugated steel pipe.
6. For shear connector studs, use cold-drawn bars that are killed or semi-killed.
7. For SIP, use a galvanized coating designation G235 or Z700.

Before using, submit to the ME a representative sample of each size for material testing and approval. Provide a mill certification that indicates the chemical and physical properties for each heat of material. For SIP forms, steel forgings and shear connector studs, submit certifications of compliance, as specified in 106.07, with the mill certifications attached.

906.02 STEEL PILES

Use materials as specified in 906.01. When used in a marine environment, coat piles with coal tar epoxy paint as specified in 912.01.03.

Ensure that the closure plate for steel pipe piles is equal to the pile outside diameter and has a minimum thickness of 3/4 inch. Weld around the entire circumference.

For H-pile tips, use steel castings that conform to AASHTO M 103, Grade 65-35 or 70-36 or high-strength steel castings that conform to ASTM A 148.

Submit certifications of compliance, as specified in 106.07, with mill certifications attached.

906.03 STEEL CASINGS FOR DRILLED SHAFTS

Use materials as specified in 906.01. Ensure that the casing is capable of withstanding handling and driving stresses and the pressures of the concrete and surrounding earth. Use a casing with an inside diameter that is at least as large as the indicated shaft size. The Contractor may increase the size of the casing to facilitate construction operations.

For permanent casings, clean and coat the exterior surfaces with prime coat of an inorganic zinc coating system as specified in 906.06.

Submit certifications of compliance, as specified in 106.07, with mill certifications attached.

906.04 STRUCTURAL STEEL FABRICATION

906.04.01 AISC Certification

Ensure that the structural steel fabricating plant is certified under the AISC Quality Certification Program in the following categories by the type of work performed:

1. **Simple Steel Bridge Structures (SBr).** Includes highway sign support structures, parts for bridges (such as cross frames), unspliced rolled steel bridges, steel bridge bearings, and HLMR bearing assemblies.
2. **Major Steel Bridges (MBr).** Includes all bridge structures other than unspliced rolled beam bridges.
3. **Fracture Critical Members Endorsement (F).** Able to perform procedures required to produce critical members according to a fracture control plan, as defined by AASHTO or American Railway Engineering and Maintenance of Way Association.

Structural steel fabricators that are certified by AISC for Major Steel Bridges are automatically certified for Simple Steel Bridges.

906.04.02 Fabrication

Before fabrication, submit a copy of the proposed welding procedures to the ME for approval. Follow the approved welding procedures and ensure that welders are qualified according to ANSI/AWS D1.5.

Use structural steel materials as specified in 906.01 and bolting materials as specified in Section 908. Fabricate according to *AASHTO LRFD Bridge Construction Specifications* and as shown on the working drawings. Construct welds according to the requirements of ANSI/AASHTO/AWS D1.5 Bridge Welding Code, as modified by the following:

1. Do not use electro-slag welds on main structural members.
2. Remove all steel weld backing on the outside faces of fascia girders. Grind or finish the joints smooth.

Induce camber in structural steel girders at the mill, or fabricate structural steel girders in the shop in a manner that provides a true curve without abrupt changes.

In the shop, completely pre-assemble stringers involving field splices and built-up girders with field splices.

Submit to the Department, for approval, all changes in the number or location of shop or field splices.

Without the Department's approval, do not weld to members or parts of members subject to tension or reversal of stress. If necessary to weld in these areas, ensure that the actual stress range (FSR) at the point of attachment does not exceed the value for Category F according to the *AASHTO LRFD Bridge Design Specification*.

Obtain the ME's approval for all shop fabrication and assembly before blast cleaning and coating.

906.04.03 Cleaning and Coating

A. Weathering Steel (Grade 50W or HPS70W). As soon after fabrication as practical, blast-clean all structural steel components including diaphragms, cross frames, and welded connections, according to SSPC-SP6. Ensure that the steel is kept free and clean of all foreign materials, such as grease, oil, concrete spatter, chalk marks, crayon marks, dirt, and any foreign matter that may affect the natural oxidation of the steel.

If foreign matter gets on the steel after it has been blast cleaned, remove as soon as possible with solvent according to SSPC-SP 1.

Clean and paint weathering steel, as specified in 906.06, in the following areas:

1. **Cap Girders.** Clean and paint the exterior surfaces of the top and the sides, including the brackets.

2. **Structural Steel Adjacent to Deck Joints.** With the exception of steel designated to be galvanized, clean and paint all structural steel from the ends of the girder to a distance of 3 times the depth of the girder. For steel designated to be galvanized, galvanize as specified in 912.02.01.

3. **Integral Abutment Construction.** On structures that include integral abutment construction, clean and paint the ends of the girder for a distance that extends 1 foot beyond the concrete diaphragm.

B. Non-weathering Steel. If coating is specified or shown on the Plans, clean and paint as specified in 906.06 or galvanize as specified in 912.02.01.

906.04.04 Shipping and Handling

Notify the ME at least 3 days before shipping to the Project so that a final quality inspection can be performed. The ME will seal all materials approved for shipping and provide written approval to the fabricator.

Ensure that members are loaded, hauled, and unloaded so that they are not deformed, damaged, or subjected to stresses in excess of those provided for in the design. When hauling and storing steel members, to the extent possible, place the members in a position similar to their final erected position.

Ensure that all steel girders are shipped and stored with their webs vertical, unless their size precludes vertical shipment. Place points of bearing within 20 percent of the length of the girder from the ends, and secure with chain tie downs. If not provided for in the design, brace long members during shipment with temporary vertical stiffeners extending the full height of the web on both sides of the member. Place the temporary stiffeners at the bearing points, mid-span, and at additional locations to ensure that the maximum interval between bracing does not exceed 25 feet. Ensure that temporary stiffeners are in full contact with the web and both flanges. Pad the temporary stiffeners with a material that will minimize damage to the painted surface.

For girders requiring shipment with their web horizontal, or for girders that will extend over 20 percent of the length beyond points of bearing, submit working drawings for approval. Include the following information:

1. Drawings or sketches, fully describing the shipping and handling procedures.
2. Calculations showing the dead load plus impact stresses induced by the loading and transportation procedure. Ensure that impact stresses do not exceed 200 percent of the dead load stress.
3. Location of all support points.
4. Type and locations of tie-downs. Include a sufficient number of tie downs for redundancy to ensure that if any one tie-down fails, the member will remain stable.
5. Temporary stiffeners, if used.
6. Details of a 4-way articulating bolster for each truck transporter to ensure that truck movements will not produce unnecessary stresses in the structural steel.

906.04.05 Quality Control and Acceptance

Notify the ME, in writing, at least 15 days before beginning work at the fabrication shop. The ME may reject any work done in his absence if proper notification was not received.

Perform at least the minimum specified number of quality control inspections according to the applicable ANSI/AASHTO/AWS specification and any other tests and inspections necessary to control the quality of the work. The ME will perform non-destructive testing quality assurance inspections following the non-destructive testing quality control (QC) inspection performed by the fabricator.

Ensure that all quality control inspectors are AWS Certified Welding Inspectors, qualified according to the provisions of AWS QC1.

Inspect and test structural steel bridge members according to ANSI/AASHTO/AWS D1.5 Bridge Welding Code, as modified by the following:

1. Assembly and fabrication may not continue until completed work has been inspected and accepted by the ME.
2. Grind flush butt welds scheduled for ultrasonic testing.
3. For acceptance, the ME will test 100 percent of complete joint penetration groove and butt welds, including butt welds in longitudinal stiffeners.

906.05 SIGN STRUCTURES FABRICATION

906.05.01 Fabrication

Ensure that the fabricating plant is certified under the AISC Quality Certification Program as specified in 906.04.01. Before fabrication, submit a copy of the proposed welding procedures to the ME for approval. Follow the approved welding procedures, and ensure that welders are qualified according to ANSI/AWS D1.1 or ANSI/AWS D1.2, as appropriate.

To fabricate sign structures, use structural steel materials as specified in 906.01, bolting materials as specified in Section 908, and aluminum materials conforming to ASTM B 308, Alloy 6061-T6. Weld and fabricate according to AWS D1.1, Structural Welding Code. For aluminum members, weld and fabricate according to ANSI/AWS D1.2 Structural Welding Code – Aluminum. Do not flame cut aluminum alloy materials. For cantilever sign support structures, ensure that the splice plates and truss chords do not warp during fabrication.

After fabrication and welding, hot-dip galvanize the steel assemblies as specified in 912.02.01. After galvanizing, but before shipment to the Project, return the truss and posts to the fabricator for final shop assembly to verify camber, alignment, and contact of splice mating surfaces.

906.05.02 Shipping and Handling

Notify the ME at least 3 days before shipping to the Project or galvanizer so that a final quality inspection can be performed. The ME will seal all materials approved for shipping and provide written approval to the fabricator.

Ensure that members are loaded, hauled, and unloaded so that they are not deformed, damaged, or subjected to stresses in excess of those provided for in the design.

906.05.03 Quality Control and Acceptance

Notify the ME, in writing, 15 days in advance of beginning work at the fabrication shop, so that arrangements for inspection may be made.

Perform at least the minimum specified number of quality control inspections according to the applicable ANSI/AASHTO/AWS specification, and any other tests and inspections necessary to control the quality of the work. The ME will perform non-destructive testing quality assurance inspections following the non-destructive testing quality control (QC) inspection performed by the fabricator.

Ensure that all quality control inspectors are AWS Certified Welding Inspectors, qualified according to the provisions of AWS QC1.

Inspect and test according to ANSI/AASHTO/AWS D1.1 Welding Code and the following:

1. Perform magnetic particle testing at a frequency of 10 percent of the number of welds per unit. For cantilever sign support structures, perform magnetic particle testing at a frequency of 100 percent on all chord splice assembly welds and post base welds.
2. Before shipping, assemble the completed and accepted truss units in the shop and check the truss span for dimensions, straightness, alignment, and camber. Measure the camber with the truss units on their sides.

906.06 CLEANING AND PAINTING OF STRUCTURAL STEEL IN THE SHOP

906.06.01 Painting Materials

Use an Inorganic Zinc coating system (IEU) of an inorganic zinc-rich primer, epoxy intermediate coat, and a urethane finish coat. Ensure that the coating system is as specified in 912.01.01.

In the fabrication of steel box girders, apply the IEU coating system to all exterior surfaces. Coat the interior of the box girders with only a prime coat of an organic zinc primer selected from an organic zinc coating system (OEU) listed on the QPL and as specified in 912.01.01. Unless approved by the ME, use an organic zinc primer from the same manufacturer as the IEU system for the exterior of the girder.

906.06.02 Surface Preparation

Before blasting, remove any oil and grease, according to SSPC-SP 1, using No. 1 solvent. Reclean after blasting if contamination remains.

Blast-clean all surfaces to a near-white condition, as defined in SSPC-SP 10. Ensure that the surface area of steel being blast cleaned is not greater than the surface area of steel that can be prime coated in the same day. If shot blast is used, use a NACE No. 2 Visual Standard T.M.-01-75 or Maryland Pictorial Standard to define the near-white blast condition. If sand or grit is used, use SSPC Pictorial Standard VIS-1 (Grade 2-1/2) to define the near-white condition. Blast clean to an anchor profile, from 1.5 mils to 3.0 mils deep. Grind any flame cut edges that do not attain the required anchor profile. Determine the profile depth using the elcometer surface profile gauge or Testex replica tape. Ensure that the pH of the abrasive is within the range of 6.0 to 8.5.

Remove fins, tears, slivers, and burred or sharp edges that are present, or that appear during the blasting operations, by grinding, and ensure that the reblasted area provides the required anchor profile.

Before blast cleaning steel, ensure that all reaming and drilling of holes in the steel has been completed, and the steel is free of burrs or other imperfections, such as torn or ragged edges. Remove all abrasive residue and dust from steel surfaces, and keep the surfaces clean until the prime coat is applied. Protect freshly coated surfaces from subsequent blast cleaning operations. Repair blast damaged primed surfaces using a wire brush, or, if visible rust occurs, reblast the surface to a near-white condition, re-clean, and re-prime the repaired area.

906.06.03 Conditions for Painting

Perform shop painting in an enclosure that is maintained at the required atmospheric conditions and that prevents exposure to inclement weather before the paint has completely cured. Perform painting according to the conditions specified in SSPC-PA 1 and the following:

1. Apply paint to clean dry surfaces. Do not apply paint for the prime and final coats when the temperature of the air, paint, or steel is below 40 °F, or when the temperature is expected to fall below 40 °F before the paint is dried. Ensure that the temperature is at least 50 °F when applying the intermediate coat. Do not apply coatings when the relative humidity is greater than 85 percent or when a combination of temperature and humidity conditions could cause moisture to condense on the surface being coated. During the drying time of the inorganic type primers, ensure that the relative humidity is at least 50 percent.
2. Do not apply paint when the steel surface temperature is less than 5 °F above the dew point. Determine the dew point using a psychrometer.
3. Remove all contaminants before applying subsequent coats of paint. Clean the primed surfaces with a high pressure water washing (800 pounds per square inch minimum).

906.06.04 Paint Application

Mix paint according to the manufacturer's recommendations. Apply paint as specified in SSPC-PA 1 and the following:

1. Apply the prime coat after the ME inspects and accepts the blast cleaned surface. Before the application of the full prime coat, apply a prime coating (striping) to all edges of plates and rolled shapes, corners, crevices, welds, rivet heads, and exposed parts of bolts. Before applying the full prime coat, allow the striping to set to touch. Apply the primer within 8 hours after cleaning the metal. If any blast cleaned metal remains unpainted after 8 hours, blast clean the metal again before priming. Do not apply succeeding coats until the previous coat is approved by the ME. Follow the manufacturer's recommendation for minimum and maximum drying time between coats. Allow additional time before applying succeeding coats in cooler temperatures. If the maximum time interval between coats is exceeded, submit to the ME the manufacturer's written recommendation for corrective action. Remove all dry spray, by sanding if necessary, before applying the succeeding coat.
2. Ensure that paint is applied to at least the minimum specified thickness, and ensure that the final appearance is uniform and smooth. If the coating is too thin in areas, follow the manufacturer's recommendations for recoating. Repair areas that run, bubble, sag, or mud crack by removing the coating back to soundly bonded coating and recoating to the required thickness and appearance.
3. Apply only a prime coat of paint to surfaces of steel that will be embedded in or in contact with concrete. Apply only a prime coat to contact surfaces at field bolted connections. Mask these surfaces during subsequent coating operations. Do not paint surfaces within 2 inches of field welds, except for stud shear

connectors. Apply a light coat of rust-inhibitive coating to these surfaces, and mask these surfaces during subsequent coating operations.

4. Remove all bolted shop connections before blasting and coating girders. Separately blast and prime the parts, then reassemble the parts and fully tension the bolts. Do not paint the inside of bolt holes.

906.06.05 Number of Coats and Film Thickness

Apply all 3 coats in the shop. Ensure that the dry film thickness meets the minimum requirement as specified in Table 906.06.05-1 but does not exceed the manufacturer's recommendation for maximum thickness. Determine dry film thickness according to SSPC-PA 2.

Table 906.06.05-1 Dry Film Thickness Requirements

Coat	Minimum Thickness (mils)
For the prime coat	1 mil more than the measured anchor profile
For the intermediate coat	3.5
For the finish coat	2
For the 3-coat system	8.5

Ensure that the dry film thickness of the prime coat at the contact surfaces of bolted friction splices on main members, and the top of top flanges where stud shear connectors are to be welded, is within the range of 1 to 2.5 mils.

906.06.06 Stenciling

After the final coat has dried, stencil the following information in 4-inch high, C series, letters and numerals on the outside web of both fascia beams, on both ends of the structure:

1. The 7-digit structure number.
2. The month and year of completion.
3. The paint system code number.

Stencil using a black paint that is the same type of paint as the finish coat. Locate the information at least 2 inches above the lower flange and within 3 feet from the abutment.

906.06.07 Additional Handling Requirements for Painted Members

Allow the paint to dry before loading and shipping the steel. Protect the coated steel from the binding chains using softeners. Use padded hooks and slings to hoist steel. Space diaphragms and similar pieces to prevent damage to the coating during shipment. Before shipping, submit to the RE for approval, all shipping and work site storage details.

906.06.08 Quality Control and Acceptance

Notify the ME, in writing, at least 15 days in advance of beginning work at the fabrication shop, so that arrangements for inspection may be made.

The ME will reject the coating system if rusting occurs; the paint lifts, blisters, wrinkles, or has excessive runs or sags; workmanship is poor; or unapproved paint is used. In addition, the ME will reject the total coating system if it is determined by measurement with a Tooke gauge that the dry film thickness of the prime, intermediate, or finish coat is less than the minimum specified or if the total dry film thickness is less than the 8.5-mil minimum for the 3-coat system.

906.07 4-BAR OPEN STEEL PARAPET

For 4-bar open steel parapet, provide anchor studs, washers, and exposed bolts according to ASTM F 568, Class 8.8, and all other bolts and nuts according to ASTM F 568, Class 4.6. Also, provide rail bars according to ASTM A 500 or A 501, rail post according to ASTM A 709, Grade 50, and all other shapes and plates according to ASTM A 709, Grade 36.

Fabricate 4-bar steel parapet according to 906.04 and paint according to 906.06.

SECTION 907 – BEARING ASSEMBLIES

907.01 STRUCTURAL BEARING ASSEMBLIES

907.01.01 General Requirements

Provide high-load multi-rotational (HLMR) or seismic isolation bearing assemblies conforming to the loads shown on the Plans. Provide the design from the manufacturer for each HLMR or seismic isolation bearing assembly.

Ensure that the materials and fabrication of bridge bearing assemblies conform to Section 18 of the *AASHTO LRFD Bridge Construction Specification*.

Ensure that the fabricating plant is certified under the AISC Quality Certification for Simple Steel Bridge Structures. Consider steel bridge bearings and HLMR bearing assemblies to be main load carrying members. Perform welding and ensure that welders are qualified according to the ANSI/AASHTO/AWS D1.5 Bridge Welding Code.

Unless otherwise specified, provide hot-dipped galvanized steel bearing components as specified in 912.02.01. When painting of steel surfaces is required, paint as specified in 906.06.

907.01.02 Types

A. High-Load Multi-Rotational (HLMR) Bearing Assemblies. HLMR bearings consist of a rotational element of the pot type, disc type, or spherical type when used as a fixed bearing and that may, in addition, have sliding surfaces to accommodate translation when used as an expansion bearing. The Contractor may use guide bars to constrain translation to a specified direction. Fabricate HLMR bearing assemblies according to Section 18 of the *AASHTO LRFD Bridge Construction Specifications*.

B. Seismic Isolation Bearing Assemblies.

1. Assembly Requirements. Use seismic isolation bearing assemblies consisting of seismic isolation bearings (isolators), sole plates, masonry plates, mounting plates, lead core, steel shims, bolts, washers, and anchor bolts. Fabricate seismic isolation assemblies according to Section 18 of the *AASHTO LRFD Bridge Construction Specifications*. Use one of the following types of isolation bearing assemblies:

a. Elastomeric Type. The isolator consists of alternate layers of natural rubber and steel plates with a preformed hole at the center of the unit filled tight with a pure lead plug core. For the isolator, use elastomer type NR, Grade 3, according to ASTM D4014. Use lead for the core that is a minimum of 99 percent pure.

b. Sliding Type. The isolator consists of polytetrafluoroethylene (PTFE) stainless steel surfaces that are to be used in conjunction with an optional spring/damping assembly. Use polyether urethane for the elastomer of the sliding bearing.

2. Testing Requirements. Provide the ME with the required test load for each isolator type. Determine the test load for each isolator type from the maximum design dead load plus the live load that is to be applied to that particular isolator type. Identify all isolator test results by the supplier identification number.

During the compression and combined compression/shear tests on completed isolators, closely inspect each isolator for indications of a lack of rubber to steel bond, laminate placements faults, or for the appearance of 3 or more separate surface cracks that are wider or deeper than 1/16 inch. Do not use isolators showing such indications.

Evaluate the results of each isolator test for the following performance requirements:

1. The effective stiffness (Keff) falling within a range of ±15 percent of the predicted value.
2. The slope of the loading curve (K) being greater than or equal to 90 percent of the predicted value.
3. The average value of energy dissipated per cycle being greater than or equal to 90 percent of the predicted value.

3. Certification. Submit certifications of compliance, as specified in 106.07, for the isolators. Submit the following data for acceptance of the isolators:

1. Test results as defined in the AASHTO Guide Specifications for Seismic Isolation Design.

2. Copy of the manufacturing specifications.
3. The name of the firm manufacturing the system.
4. Shake table test results demonstrating viability of the complete system.
5. Analytical results showing maximum seismic forces and displacements at all locations, according to the *AASHTO Guide Specifications for Seismic Isolation Design*.
6. Conformance to the design and construction requirements specified in Section 14 of the *AASHTO LRFD Bridge Design Specifications* and Section 18 of the *AASHTO LRFD Bridge Construction Specifications*.

907.01.03 Marking, Packaging, Shipping, and Handling

Mark each structural bearing in indelible ink on 2 sides with the Department Project Number, the structure number, location, orientation, order number, lot number, bearing identification number, and elastomer type and grade. For seismic isolation bearings, make a permanent mark on 2 of the 4 sides of each isolator, consisting of an isolator number specified by the supplier, the date of fabrication (month and year), the isolator type, and the supplier (name and address).

Ensure that the bearings are packaged to be protected against damage from handling, shipping, and storage. Securely bolt, strap, or otherwise fasten to prevent all relative movement. Wrap the bearings in moisture resistant and dust resistant material to protect them from weather.

When providing seismic isolation bearing assemblies, assemble the isolators and their mounting plates at the shop. Provide temporary assembly ties so that the entire assembly is shipped, in protective packaging, as a unit. Provide the RE with elastomeric bearing test results for both compression stiffness and combined compression and shear according to Section 15 of the AASHTO Guide Specifications for Seismic Isolation Design.

Enclose a copy of the materials, fabrication, and testing compliance certifications with each shipment. Supply a separate sheet showing the materials, critical dimensions, and clearances for each bearing.

907.01.04 Quality Control and Acceptance

Notify the ME, in writing, 15 days before the start of fabrication, so that arrangements for inspection may be made.

Ensure that quality control inspectors are AWS Certified Welding Inspectors, qualified according to the provisions of AWS QC1.

Test and inspect structural bearing assemblies according to Section 18 of the *AASHTO LRFD Bridge Construction Specifications*. Provide test results to the ME at the time of inspection.

Provide to the ME certifications of compliance, as specified in 106.07, for all non-ferrous metals, PTFE, adhesives, dowel bars, and bolts. Include with the certifications mill test reports for all steels used and material test reports for all elastomeric components.

907.02 REINFORCED ELASTOMERIC BEARING ASSEMBLIES

Provide reinforced elastomeric bearings conforming to the requirements shown on the Plans. Reinforced elastomeric bearing assemblies consist of circular or rectangular reinforced elastomeric bearings that are Grade 3 with a durometer hardness of 60. Fabricate reinforced elastomeric bearing assemblies according to Section 18 of the *AASHTO LRFD Bridge Construction Specifications*.

Ensure that the materials and fabrication of bridge bearing assemblies conform to Section 18 of the *AASHTO LRFD Bridge Construction Specification*.

Enclose a copy of the materials, fabrication, and testing compliance certifications with each shipment. Supply a separate sheet showing the materials, critical dimensions, and clearances for each bearing.

Provide to the ME certifications of compliance, as specified in 106.07. Include material test reports.

907.03 BEARING PADS

Provide elastomeric pads conforming to the requirements shown on the Plans. Provide elastomeric bearing pads that are a Grade 2 with a durometer hardness of 60 according to Section 18.2 of the *AASHTO LRFD Bridge Construction Specifications*.

Ensure that the materials and fabrication of bridge bearing pads conform to Section 18 of the *AASHTO LRFD Bridge Construction Specifications*.

Provide to the ME certifications of compliance, as specified in 106.07. Include material test reports.

SECTION 908 – BOLTS AND BOLTING MATERIAL

908.01 STEEL BOLTING MATERIALS

Before using, submit a sample of each size of bolt, anchor, washer, and nut to the ME for testing and approval. Provide a mill certification for each heat.

908.01.01 Bolts

Use steel bolts conforming to ASTM A 307. If galvanizing is specified, use the hot-dipped method according to ASTM A 153.

908.01.02 Nuts and Washers

Use nuts and washers according to ASTM A 194 or ASTM A 563. Ensure that plain nuts are Grade 2H, DH, DH3, 2, C, D, or C3. Ensure that galvanized nuts are Grade 2H, DH, or DH3. Use washers with high-strength steel bolts conforming to ASTM F 436.

If galvanizing is specified, use the hot-dipped method according to ASTM A 153.

908.01.03 Anchor Bolts

For anchor bolts intended for anchoring structural supports to concrete foundations, including piers, columns, column supports for sign support structures, lighting fixtures, traffic signals, steel bearing plates, and similar applications, use ASTM A 307, Grade C, or ASTM F 1554, Grade 36, 55, or 105, anchor bolts, as shown on the Plans.

If galvanizing is specified, use the hot-dipped method according to ASTM A 153.

908.01.04 Adhesive Anchor Bolt Systems

Use anchor bolts conforming to ASTM A 307, Grade C. If galvanizing is specified, use the hot-dipped method according to ASTM A 153. Ensure that the adhesive anchor bolt system conforms to the following proof loading requirements:

After concrete has achieved a minimum compressive strength of 3000 pounds per square inch, perform proof loading on 10 percent of the installed adhesive anchors at each location where the anchors have been placed. Provide calibration certificates for the test equipment before testing. Perform all testing in the presence of the RE. Tension test the anchor bolt system according to ASTM E 488 to 90 percent of the yield strength of the anchor bolts. If the location of the anchor bolts precludes the proof loading of anchor bolts according to ASTM E 488, propose an alternate testing method to the RE for approval. Repair all spalls or cracks caused by the testing.

Based on satisfactory performance in proof loading, the RE will approve the adhesive anchor bolt installation. The RE will reject the anchor bolt installation for failure to conform to the proof loading requirements. With the approval of the RE, replace the adhesive anchor bolt installation by using larger size anchors, increasing the embedment depth, or using another anchor bolt system.

908.02 HIGH-STRENGTH STEEL BOLTING MATERIALS

908.02.01 Material Requirements

For structural steel erection and for steel to steel chord splices of sign structures, use high-strength steel bolts, including nuts and plain hardened washers according to ASTM A 325 or ASTM A 490.

When galvanizing is specified, use the hot-dipped method according to ASTM A 153. Treat galvanized bolts, washers, and nuts as an assembly. Store and ship the assembly in plastic bags placed inside wood or metal containers.

Use ASTM A 325, Type 3 high-strength steel bolts for bolting unpainted corrosion resistant (weathering) steel.

908.02.02 Sampling and Testing Requirements for Bolt Assemblies

A. Sampling and Certification. Before use, submit a sample for each manufacturer's lot, size of bolt, anchor, washer, and nut to the ME for testing and approval. Provide a mill certification for each heat.

B. Tensile, Proof Load, Hardness, and Coating Thickness Tests. For each lot, the manufacturer shall perform tensile, proof load, and hardness tests and shall measure galvanized coating according to ASTM A 325.

Proof load test bolts according to ASTM F 606, Method 1. Perform wedge tension testing of full size bolts according to ASTM F 606. If bolts are to be galvanized, test after galvanizing.

Proof load test nuts according to ASTM F 606; if galvanized, test after galvanizing, overtapping, and lubricating.

If galvanized washers are supplied, perform hardness testing after galvanizing; however, remove galvanized coating before taking hardness measurements.

Report the results of all tests and submit with certifications. Also report the location and date of testing.

C. Rotational-Capacity Test. Perform the rotational-capacity test on each lot of bolt, nut, and washer assemblies by the manufacturer or distributor before shipping and by the Contractor within the Project Limits before installation. Test high-strength steel bolt assemblies for the rotational capacity requirements according to NJDOT S-1 or NJDOT S-2 and the following:

1. Test a minimum of 2 assemblies per rotational-capacity lot.
2. Test each combination of bolt production lot, nut lot, and washer lot as an assembly. Where washers are not required by the installation procedures, they need not be included in the lot identification.
3. Assign a rotational-capacity lot number to each combination of lots tested.
4. Assemble the bolt, nut, and washer assembly in a Skidmore-Wilhelm calibrator or an acceptable equivalent device for testing as specified in NJDOT S-1.
5. For bolts that are too short to be assembled in the Skidmore-Wilhelm calibrator, use a steel joint and test according to NJDOT S-2.

After testing according to NJDOT S-1 or NJDOT S-2, loosen and remove the nut and examine the threads on the nut and bolt. If, for either assembly tested, there are any signs in the nut or bolt of thread shear failure, stripping, or torsional failure, the lot fails and is to be replaced.

908.02.03 Test Reports and Certification

Record the results of all tests. Also report the date and location of testing.

1. Mill Certifications. Provide mill certifications for each heat of steel used in the manufacture of the bolts, nuts, or washers. Indicate the place where the material was melted and manufactured.

2. Manufacturer Certified Test Reports. Provide manufacturer certified test reports from the manufacturer of the bolts, nuts, and washers. Include the following:

1. The lot number of each of the items tested.
2. The rotational-capacity lot number and test results, as specified in 908.02.02.C, if performed by the manufacturer.
3. The results of all tests required in 908.02.02.B.
4. The date and location of testing.
5. The location where the bolt assembly components were manufactured.

3. Distributor Certified Test Reports. If the rotational-capacity test is performed by a distributor instead of a manufacturer, provide the test results on the distributor certified test reports. Report the rotational capacity lot number and test results as specified in 908.02.02.C and attach the manufacturer certified test reports.

908.02.04 Shipping and Handling

Ship bolts, nuts, and washers from each rotational-capacity lot in the same container. If there is only one production lot number for each size of nut and washer, the manufacturer or distributor may ship the nuts and washers in separate containers. Permanently mark each container with the rotational-capacity lot number to allow identification at any stage before installation.

Treat galvanized bolts and nuts as an assembly and ship together.

Supply mill certifications, manufacturer certified test reports, and distributor certified test reports for each rotational-capacity lot to the RE and ME.

908.03 DIRECT TENSION INDICATORS (DTI)

Use direct tension indicators conforming to ASTM F 959. If galvanizing of the bolt assembly is required, mechanically galvanize DTIs according to ASTM B 695, Class 50. If DTIs are used with ASTM A 325, Type 3 bolts, coat the DTIs with a black epoxy. Test DTIs according to ASTM F 959 and verify according to NJDOT S-3.

Provide manufacturer's certification and attach test results.

908.04 STAINLESS STEEL BOLTING MATERIALS

Use stainless steel bolts, screws, studs, anchor bolts, nuts, and washers that conform to ASTM A 320, Class 1, Grade B8. Prior to use, submit a sample of each size of bolts, anchors, washers, and nuts to the ME for testing and approval. Provide a mill test report for each heat.

908.05 ALUMINUM ALLOY BOLTING MATERIALS

Use bolts, nuts, set screws, and pins that conform to ASTM B 211, Alloy 2024-T4 with No. 205 Alumilite Finish. Ensure that bolt heads and nuts are American National Standard, Regular Series, hexagonal, semi-finished, conforming to ANSI B18.2.1 to B18.2.2, and that threads are American National Standard, Coarse Series, Class 2 Fit, conforming to ANSI B1.13M. Finish bolts with an anodic coating thickness of not less than 0.0002 inches and chromate seal.

Use washers conforming to ASTM B 209, Alloy 2024-T3.

Before using, submit a sample of each size of bolts, set screws, pins, washers, and nuts to the ME for testing and approval. Provide a mill test report for each heat.

SECTION 909 – DRAINAGE

909.01 PIPE BEDDING

909.01.01 Class A Bedding

Use concrete as specified in 903.03.

909.01.02 Class B Bedding

Use sand or sandy soil with 100 percent passing the 3/8-inch sieve and no more than 10 percent passing the No. 200 sieve.

909.01.03 Class C Bedding

Use a granular soil conforming to the gradation requirements in Table 909.01-1.

Table 909.01-1 Gradation for Class C Bedding

Sieve Size	Percent Passing
1 inch	100
No. 4	80 - 100
No. 200	0 - 12

909.01.04 Class D Bedding

Use coarse aggregate No. 8 as specified in 901.03.

909.02 PIPE

909.02.01 Reinforced Concrete Pipe

In the manufacture of reinforced concrete pipe, use concrete that is composed of cement, coarse aggregate, fine aggregate, and water. Concrete may include admixtures, fly ash, or slag. Provide materials as specified:

Aggregates 901.06
Admixtures:
Air-Entraining 903.02.01
Chemical 903.02.02
Fly Ash ..... ASTM C 618, Class C or F
Slag 903.02.03.B
Cement 903.01
Water 919.08

If fly ash is used to control alkali-silica reactivity, use Class F fly ash.

Manufacture reinforced concrete culvert pipe, storm drain, and sewer pipe to conform to AASHTO M 170, Class III, Wall B, unless otherwise designated. For jacked pipe, use reinforced concrete culvert pipe conforming to AASHTO M 170, Class V, Wall B. Manufacture reinforced concrete elliptical culvert, storm drain, and sewer pipe to conform to AASHTO M 207, Class HE-III, unless otherwise designated.

If required for watertight flexible joints, use preformed flexible joint sealants conforming to AASHTO M 198.

Notify the ME at least 2 days before shipping pipe to the Project. The ME will inspect and approve pipe in the supplier's yard after manufacture. For approval of the concrete pipe, perform 3-point loading in the supplier's yard at a frequency directed by the ME.

909.02.02 HDPE Pipe

Use corrugated HDPE drainage pipe that conforms to AASHTO M 294 and is Type S (smooth interior with annular corrugations) with gasketed silt-tight joints.

Use HDPE pipe from a manufacturer who is an Eastern States Consortium (ESC) qualified manufacturer of HDPE. For a list of qualified manufacturers, see the ESC website at www.nh.gov/dot/espc/.

Submit a certification of compliance, as specified in 106.07, for HDPE pipe.

909.02.03 Plastic Drainage Pipe

Use corrugated polyethylene drainage pipe according to AASHTO M 252, or use PVC drainage pipe according to ASTM D 2729.

Submit a certification of compliance, as specified in 106.07, for plastic drainage pipe.

909.02.04 Corrugated Aluminum Alloy Culvert Pipe and Pipe Arches

Use corrugated aluminum alloy culvert pipe and pipe arches conforming to ASTM B 745, Types I or II, and the following:

1. **Type I.** Fabricate corrugated aluminum alloy culvert pipe using 0.060-inch-thick sheet metal, unless other thicknesses are designated.

   Use only helical corrugations, unless annular corrugations are designated.

   Join the pipe in the field with locking bands conforming to ASTM B 745, except that coupling bands with projections (dimples) are not allowed.

2. **Type II.** Fabricate corrugated aluminum alloy pipe arches using 0.060-inch-thick sheet metal, unless other thicknesses are designated.

Submit a certification of compliance, as specified in 106.07, for corrugated aluminum alloy pipe and pipe arches.

909.02.05 Corrugated Aluminum Alloy Underdrain Pipe

Use corrugated aluminum alloy underdrain pipe conforming to ASTM B 745, Type III. Fabricate the pipe using 0.048-inch-thick sheet metal.

Submit a certification of compliance, as specified in 106.07, for corrugated aluminum alloy underdrain pipe.

909.02.06 Corrugated Steel Pipe and Pipe Arches

Use corrugated steel pipe and pipe arches conforming to ASTM A 760, Types I and II. Use special sections, such as elbows and flared end sections, that conform to ASTM A 760 and are of the same thickness as the conduit to which they are joined. Ensure that corrugated steel pipe and pipe arches and special sections also comply with the following:

1. **Type I.** Fabricate corrugated steel pipe from 0.079-inch-thick sheet metal, unless other thicknesses are designated.

   Use only helical corrugations, unless annular corrugations are designated.

   Field join the pipe with locking bands conforming to ASTM A 760, except that coupling bands with projections (dimples) are not allowed.

   Ensure that corrugated steel pipe and coupling bands, elbows, and flared end sections have a polymeric coating conforming to AASHTO M 246, Grade 36/11 (interior 0.010 inches and exterior 0.003 inches).

2. **Type II.** Fabricate corrugated steel pipe arches from 0.079-inch-thick sheet metal, unless other thicknesses are designated.

   Ensure that corrugated steel pipe, coupling bands, elbows, and flared end sections have a polymeric coating conforming to AASHTO M 246, Grade 36/11 (interior 0.010 inches and exterior 0.003 inches).

Submit a certification of compliance, as specified in 106.07, for corrugated steel pipe and pipe arches.

909.02.07 Steel Alloy Pipe for Bridge Storm Drains

Fabricate steel alloy pipe and fittings from alloy steel conforming to the chemical analysis of ASTM A 53, Grade B or ASTM A 500. The Contractor may use ductile iron pipe conforming to ASTM A 377 (ANSI/AWWA C151/A21.51) as an alternate. Ensure that the pipe and fittings are zinc-coated (galvanized) according to ASTM A 123. Weld steel pipe and fittings together before galvanizing.

If ductile iron pipe is used, ensure that ductile iron pipe fittings conform to ASTM A 48, Class 30. Bend pipe using the long radius type of bend. Form pipe joints using groove-type couplings, consisting of a housing clamp keyed into a groove cut around the full pipe circumference. Provide a gasket of molded or extruded butyl rubber or ethylene propylene diene monomer to create a sealed joint. Use track-type bolts, conforming to ASTM A 183, with oval necks and heavy hexagonal standard nuts. Galvanize the assembly according to ASTM A 153.

Submit a certification of compliance, as specified in 106.07, for steel alloy pipe.

909.02.08 Ductile Iron Water Pipe

Use ductile iron water pipe conforming to ANSI/AWWA C151/A21.51. Use threaded flanges conforming to ANSI/AWWA C115/A21.15, and fittings conforming to ANSI/AWWA C110/A21.10 or C153/A21.53. Do not field weld ductile iron pipe. Perform required welding of a ductile iron pipe assembly in a fabrication shop.

Submit a certification of compliance, as specified in 106.07, for ductile iron water pipe.

909.03 CASTINGS AND COMPONENTS FOR DRAINAGE STRUCTURES

Ensure that castings, grates, extension rings, extension frames, and covers for inlets and manholes are capable of withstanding HS-25 loading when tested as a complete, assembled unit and conform to the following:

1. **Gray Iron Castings.** Use gray iron castings conforming to AASHTO M 306, except that the manufacturer may use gray cast iron conforming to AASHTO M 105, Class 30B or Class 35B. Ensure that castings are true to pattern in form and dimensions and are free from pouring faults, sponginess, cracks, blowholes, and other defects in composition affecting their strength or integrity.

   To present a smooth, clean, and uniform surface, sandblast or clean the castings to remove sand and scale.

2. **Carbon Steel Extension Frames and Rings.** Use carbon steel extension frames and rings for inlets and manholes. When specified, galvanize the extension frames and rings according to AASHTO M 111. Perform welding of fabricated steel shapes and structures according to AWS D1.1. Do not punch, drill, ream, weld, or cut extension frames and rings in the field. Repair any damage to the galvanized coating.

3. **Scuppers and Other Bridge Drainage.** Use structural steel shapes and carbon steel castings conforming to AASHTO M 103, Grades 65-35 or 70-36, and carbon steel forgings conforming to AASHTO M 102, Class D.

4. **Ductile Iron Castings.** Use ductile iron castings conforming to ASTM A 536, Grade 65-45-12 or Grade 80-55-06.

5. **Epoxy Bedding Compound.** Use an epoxy bedding compound that is listed on the QPL and is a 2-part, non-sag gel, rapid-setting epoxy adhesive conforming to the requirements of ASTM C 881, Type 4, Grade 3, Class B or C and is listed on the QPL. Use the epoxy in an ambient temperature range of 40 to 100 °F.

6. **Ladder Rungs.** For ladder rungs, use steel reinforced copolymer polypropylene. Use a 1/2-inch diameter reinforcement steel bar conforming to ASTM A 615, Grade 60, and a polypropylene coating conforming to classification PP0344B33534Z02 according to ASTM D 4101.

For gray iron castings, notify the ME at least 2 days before shipping to the Project. The ME will inspect and approve castings in the supplier's yard after fabrication. For approval of the gray iron casting, perform proof load or test bar testing according to AASHTO M 306 in the supplier's yard at a frequency directed by the ME.

For Items other than gray iron castings, submit certifications of compliance as specified in 106.07.

SECTION 910 – MASONRY UNITS

910.01 CLAY OR SHALE BRICK

Use clay or shale brick conforming to AASHTO M 114, Grade MW, with the dimensions as specified in Table 910.01-1.

Table 910.01-1 Dimensions of Clay or Shale Brick

Length	7-3/4 – 8-1/4 inches
Width	3-1/2 – 3-7/8 inches
Depth	2-1/8 – 2-3/8 inches

Submit a certification of compliance as specified in 106.07.

910.02 CONCRETE BLOCK FOR INLETS AND MANHOLES

In the manufacture of concrete block, use cement as specified in 903.01 and aggregates conforming to the requirements for concrete aggregates as specified in 901.06. Manufacture concrete block according to ASTM C 139. The manufacturer shall sample and test concrete block according to ASTM C 140.

Manufacture blocks to be either rectangular in shape or curved with the inside and outside surfaces curved to the required radii, whichever is appropriate for the shape of the structure. Ensure that the length is between 12 and 18 inches, the height is between 5 and 8 inches, and the width is at least 6 inches.

For the reduction of cross-sectional area of the cones or tops of manholes, the Contractor may use blocks of special shapes and heights. The Contractor may also use blocks of special shapes and heights in the top courses of all structures so that the head castings is set at the required elevation on a mortar bed not more than 1/2 inch thick without cutting the blocks.

Ensure that all blocks have an interlocking-type joint at the ends and are sound and free from cracks or other defects.

Submit a certification of compliance as specified in 106.07.

910.03 CONCRETE BRICK

In the manufacture of concrete brick, use cement as specified in 903.01 and aggregates conforming to the requirements for concrete aggregates as specified in 901.06. Manufacture concrete brick to conform to ASTM C 139 and to the dimensions specified in Table 910.01-1. The manufacturer shall sample and test concrete brick according to ASTM C 140.

Submit a certification of compliance as specified in 106.07.

910.04 STONE CURB

Use stone curbs that are of a lithology, color, and texture as specified in the Special Provisions. Fabricate stone curb from a commercially available material with an established history of satisfactory durability and resistance to weathering. Use curb stones from a single quarry with the same color and texture. The Department may allow reasonable variations in color and texture if the variations do not affect the architectural qualities or the structural properties of the stone.

1. **Quarry-Split Stone.** Ensure that the top face of quarry-split stone for curbs is machine-finished or dressed to an even surface, without depressions or projections of more than 3/8 inch below or above the plane of the face. Ensure that the edges are straight and even, and the ends are cut square for the entire depth of the exposed curb face. Dress curb stones so that joints are not more than 3/8 inch wide from top to gutter line and not more than 1 inch wide below the gutter line.

2. **Dressed Stone.** Ensure that dressed stone for curbs is dressed to an even, smooth finish on the top face, on the front face for the entire depth of the exposed curb face, on the back face to a depth of 2 inches, and on the ends to a depth of 1 inch. Ensure that projections and depressions on the various faces do not exceed the allowances in Table 910.04-1.

   Extend the rough-dressed part of end faces to 1 inch below the gutter line. Ensure that the back edge of the top is parallel to the front face, the top and front faces are sloped, and the front edge is rounded. Fabricate the stones to have the width specified at the top, and to have a bottom width of not less than 1 and not more than 3 inches different from the top width. Provide stones in lengths of between 4 and 8 feet.

Table 910.04-1 Maximum Allowable Deviations for Dressed Stone		
	Depression (inches)	**Projection (inches)**
Top	1/4	1/4
Front, dressed part	1/4	1/4
Front, undressed part	1-1/2	1/2
Back, dressed part	1/2	1/2
Back, undressed part	1-1/2	1-1/2
Ends, dressed part	1/4	1/4
Ends, rough-dressed part	1/2	1/4
Ends, undressed part	1-1/2	1/4

The Contractor may use straight-cut stone for curved curb having a radius of more than 50 feet, but shall dress the curb to true radius after it is set in place. For curved curb having radii smaller than 50 feet, cut the stone to the required radius, and cut the ends so that the joints are less than 1/4 inch wide for the full depth.

Submit a certification of compliance as specified in 106.07.

910.05 STONE FACING FOR PIER SHAFTS

Use stone facing for pier shafts that is of a lithology, color, and texture as specified in the Special Provisions. Ensure that the stone is sound, durable, and free from flaws, discoloration, and structural defects. Granite and stone of similar lithologies normally exhibit a relatively uniform color and texture. The Department may allow a reasonable variation in color and texture and an occasional irregular distribution of the component minerals of the granite, termed waves, or knots, if the variations do not impair the architectural qualities or affect the structural properties of the stone. Quarry the stone from quarries that have ample production capacity both as to quantity and quality.

Submit 1 × 1-foot duplicate samples to the Department to indicate the range of color, texture, and surface finish of the stone to be provided. After approval of the samples, the Department will return 1 set of samples for guidance. Ensure that all stone used in the Project matches the samples.

Ensure that the stone provided is capable of withstanding a crushing stress of 20,000 pounds per square inch on 2-1/2-inch diameter cores tested air-dry.

Submit a certification of compliance as specified in 106.07. Include with the certification a performance history indicating that the stone proposed for use has satisfactorily withstood prolonged exposure in environments similar to that of the Project.

910.06 STONE PAVING BLOCK

For stone paving block, use new or used stone block of good quality. Ensure that the color, texture, and uniformity conform to the requirements specified in the Special Provisions. Ensure that reclaimed blocks are free of bituminous and cement grout coatings and other foreign matter.

Submit a certification of compliance as specified in 106.07.

SECTION 911 – SIGNS, SIGN SUPPORTS, AND DELINEATORS

911.01 SIGNS

911.01.01 Materials

A. Aluminum Components. Use aluminum materials conforming to the requirements in Table 911.01.01-1.

Table 911.01.01-1 Aluminum Sign Components

Aluminum Items	Test Method	Alloy and Temper
Flat Sign Sheets[1] (0.080", 0.100", 0.125" thicknesses)	ASTM B 209	5052-H38 or 6061-T6
Extruded Sign Panels[1,2]	ASTM B 221	6063-T6
Demountable Letters, Numerals, Symbols (0.040" thickness)	ASTM B 209	5052-H38 or 6061-T6
Bars and Rods	ASTM B 221	6063-T6
Washers, Alclad	ASTM B 209	2024-T4
Flange Splicing Material	ASTM B 209	6061-T6
Shims	ASTM B 209	1100-O
Posts, Truss Chords, Truss Bracing Members	ASTM B 221	6061-T6
Post and Chord Caps	ASTM B 26	356.0-T6
Post Clips	ASTM B 26	356.0-T6
Structural Shapes (Z-Bar Reinforcement)	ASTM B 308	6061-T6
Nuts, 5/16 inch and larger	ASTM B 211	6061-T6
Tamperproof Nuts, 1/4 inch and under	ASTM B 211	2017-T4
Rivets (size and length recommended by the manufacturer)	ASTM B 316	5052-0
Bolts (finished bolts with at least 0.002" chromated sealed anodic coating)	ASTM B 211	2024-T4

1. For flat sign sheets and extruded sign panels, ensure that aluminum is chromate conversion coated according to ASTM B 449, Class 2.
2. For extruded panels, use lightweight panels.

B. Retroreflective Sheeting. Use retroreflective sheeting that is listed on the QPL and conforms to ASTM D 4956. Use sheeting types as specified in Table 911.01.01-2.

If overlay film is used, ensure that the combination of the overlay film with the background retroreflective sheeting conforms to the requirements of ASTM D 4956 for the required type of sheeting as specified in Table 911.01.01-2. Ensure that the color combination of the retroreflective sheeting with the overlay film meets the required color for the sign background. Use retroreflective sheeting and overlay film from the same manufacturer.

Table 911.01.01-2 Allowable Sign Sheeting Types

Sign Type	Test Method	Type
Regulatory and Warning Signs	ASTM D 4956	Type III
Guide Signs Mounted on Steel "U" Posts	ASTM D 4956	Type III
Guide Signs Mounted on Overhead Sign Structures, Breakaway Sign Supports, or Non-breakaway Sign Supports	ASTM D 4956	Type VIII or Type IX

C. Color Processing Ink. If a screening process is used for non-retroreflective legends and borders, use only inks recommended by the retroreflective sheeting manufacturer.

911.01.02 Fabrication

A. Sign Panels. Use flat sign panels or extruded panels to fabricate signs. Ensure that cut edges are true and smooth and free from excessive burrs or ragged breaks. Do not flame cut aluminum.

Fabricate flat sheet signs from a single piece of sheet aluminum without joints, using the thicknesses specified in Table 911.01.02-1. Drill or punch 3/8-inch diameter holes in the sign blank for attachment to sign supports.

Locate holes according to the *MUTCD Manual of Standard Highway Signs*. If the panel is larger than 5 feet in any dimension, reinforce the panel with z-bars.

Table 911.01.02-1 Requirements for Sheet Aluminum Thickness for Flat Panel Signs

Sign Type	Thickness (inches)
Signs measuring less than 8.0 square feet (except One-Way signs)	0.080
Signs measuring 8.0 square feet or greater	0.100
One Way Signs	0.125

For multiple panel signs, use 1-foot wide extruded sections bolted together. Join sign panel sections together at the flanges with 3/8-inch bolts. Attach the sign panels to vertical supports, ensuring that the span between vertical supports is a maximum of 18 feet. Do not use extruded sign panels with steel "U" post sign supports. Use the same material and color for trim molding that is used for the sign face.

B. Applying Retroreflective Sheeting. Apply sheeting according to the manufacturer's recommendations. If necessary, use 2 or more pieces of retroreflective sheeting to cover the sign face. Match color at the time of sign fabrication to provide uniform appearance. If using overlay film, use retroreflective sheeting that is the color of the proposed lettering or border. Butt-splice the sheeting and ensure that the gap between sheets does not exceed 1/32 inch. Cut sheeting flush with the edges of the panel.

C. Legends and Borders. The legend for each sign consists of letters, numerals, shields, and other symbols. Use Series E Modified 2000 lettering that conforms to the *MUTCD Manual of Standard Highway Signs*. Ensure that the lettering is aligned, spaced and sized according to *MUTCD Manual of Standard Highway Signs* and the working drawings. Apply the legend and borders using the following methods:

1. **Demountable.** Use sheeting type to match the required retroreflective sheeting for the sign. Apply the sheeting to cutout aluminum for demountable sign legend or border. Mount legend and border to the sign face.
2. **Direct Applied Retroreflective Sheeting.** Using sheeting type to match the required retroreflective sheeting for the sign, cutout legend, or border from the sheeting. Apply the legend or border according to the manufacturer's recommendations.
3. **Overlay Film.** If using overlay film to color background retroreflective sheeting, computer generate legend cutouts in the overlay film. Apply the overlay film according to the manufacturer's recommendations.
4. **Non-Retroreflective Legend and Border.** The fabricator may apply non-retroreflective legend or border using ink and application technique according to the retroreflective sheeting manufacturer's recommendations.

911.01.03 Packaging, Storing, and Shipping

Package, ship, and store panels on edge and according to the sheeting manufacturer's recommendations. Ensure that all signs are packaged so that they are protected from moisture and damage during shipment and storage.

911.01.04 Acceptance Inspection

Notify the ME at least 3 days before shipping to the Project so that arrangements for inspection can be made. The ME will reject signs not fabricated according to the *MUTCD Manual of Standard Highway Signs* and the Plans. The ME will ensure that finished signs are clear and legible without smudging, blisters, delamination, loose edges, or other blemishes. The ME will also ensure that the colors have a consistent chromaticity across all signs of the same color.

At the time of the inspection, provide copies of mill certifications for the aluminum components and copies of certification of compliance, as specified in 106.07, for the sign sheeting.

911.02 SIGN SUPPORTS

911.02.01 Steel "U" Post Sign Supports

Use steel "U" post sign supports conforming to ASTM A 499, Grade 50 or 60, with the length of post and minimum pounds per foot as shown on the Plans. Provide 18-8 stainless steel 5/16 × 18 UNC hexagonal headed bolts and nuts conforming to ASTM A 320, Grade B8, Class 1, for securing the signs to the steel "U" post. Provide sign mounting bolts that are sized to extend beyond the end of each nut by no more than 3/4 inches when fully tightened.

Submit a certification of compliance, as specified in 106.07, for "U" posts.

911.02.02 Breakaway Sign Supports for Ground Mounted Signs

Fabricate and construct breakaway sign supports for ground mounted signs as shown on the Plans, using materials conforming to the requirements in Table 911.02.02-1.

Table 911.02.02-1 Materials for Breakaway Sign Supports

Item	Test Method	Type or Grade
Aluminum Materials	911.01.01	
Spring Pins[1]	ASTM A 276	Type 304 or 420
Breakaway Coupling Assembly Hex Studs[2]	ASTM A 320	Grade L7
Breakaway Coupling Assembly Nuts[2]	ASTM A 194	Grade 2H
Load Concentrating Washers	ASTM A 564	Type 630, Condition H 1025
Washer Retainers	ASTM A 1011	Grade 40
Galvanized Steel Anchor Bolts	908.01.03	
Galvanized Steel Leveling Plates[3]	ASTM A 709	Grade 36
Breakaway Shock Absorber Cable (Stainless Steel Wire Rope)[4]	MIL-W-87161	
Cutting Pins	ASTM A 564	Type 630, Condition H 1025

1. Ensure that spring pins have a minimum strength in double shear of 5000 pounds.
2. Provide hex studs and nuts with a zinc electro-deposited coating according to ASTM B 633, SC4, Type III.
3. Galvanize leveling plates according to ASTM A 123.
4. Ensure that the wire rope has a diameter of 1/4 inch, a minimum breaking strength of 4700 pounds, and is 1 ×19 construction.

Use 1 piece of seamless aluminum tubing for posts. For aluminum members, weld according to ANSI/AWS D1.2 Structural Welding Code – Aluminum. Tire-wrap posts during shipment and handling to protect the finish.

Submit mill certifications for the component materials.

911.02.03 Non-Breakaway Sign Supports for Ground Mounted Signs

Fabricate and construct non-breakaway sign supports for ground mounted signs as shown on the Plans using materials as listed in Table 911.02.03-1.

Table 911.02.03-1 Materials for Non-Breakaway Sign Supports

Item	Reference
Aluminum Materials	911.01.01
Stainless Steel Hardware	908.04
Galvanized Steel Anchor Bolts	908.01.03
Galvanized Steel Leveling Plates[1]	ASTM A 709, Grade 36

1. Galvanize leveling plates according to ASTM A 123.

Use 1 piece of seamless aluminum tubing for posts used to mount signs. For aluminum members, weld according to ANSI/AWS D1.2 Structural Welding Code – Aluminum. Tire-wrap posts during shipment and handling to protect the finish.

Submit mill certifications for the component materials.

911.02.04 Timber Sign Supports

Use timber posts conforming to the requirements for sawn timber posts as specified in 915.01.

911.02.05 Mounting Materials for Overhead, Bridge-Mounted, and Cantilever Signs

Provide brackets for mounting signs (including future signs) to the structure. Ensure that the brackets are adjustable to allow mounting of the sign faces at any angle between a truly vertical position and 3 degrees from vertical. Obtain this angle by rotating the front lower edge of the sign forward of the top edge. Fabricate brackets to lengths equal to the height of the signs being supported.

Submit mill certifications for the brackets.

911.03 FLEXIBLE DELINEATORS

Ensure that flexible delineator units are made of a fiberglass reinforced, thermosetting, high-density polymer resin or an extruded polycarbonite resin, which are resistant to ultraviolet and infrared radiation, and which meet the following minimum physical and performance requirements:

1. **Delineator Dimensions.**

   a. **Ground Mounted.** Ensure that the unit for ground mounted flexible delineators has a minimum width of 3 inches and a minimum thickness of 1/8 inch. Use delineators that have a length to allow the top of the reflective area to be positioned 4 feet above the near roadway edge.

   b. **Guide Rail Mounted.** Ensure that the unit for beam guide rail mounted flexible delineators has a minimum width of 3 inches and a minimum thickness of 0.100 inch. Use units of a height that will ensure that the top of the reflective area is 32 ± 2 inches (40 ± 2 inches for deceleration and acceleration lanes) above the near roadway edge.

      Design the base of the unit to mount over the I-beam spacer, or to the top of a wood or synthetic spacer, of the beam guide rail.

   c. **Barrier Curb Mounted.** For barrier curb mounted flexible delineators, use a delineator that is 3-1/2 × 3-1/2 inches, with a minimum thickness of 0.100 inch, and that has a base that forms a "T" shape with the panel for mounting on the barrier curb. Use units of a height that will ensure that the top of the reflective area is 32 ± 2 inches (40 ± 2 inches for deceleration and acceleration lanes) above the near roadway edge.

2. **Delineator Color.** Use flexible delineators that are white in color.

3. **Impact Resistance for Ground Mounted Delineators.** Use flexible delineator units that are self-erecting to within 10 degrees of original upright position within 15 minutes after 5 vehicle impacts traveling at 55 miles per hour. Ensure that the re-erected unit retains the original cross-section, shows no evidence of shredding or splintering, and retains 80 percent of its original retroreflective sheeting when tested for both bumper impacts and wheel impacts and in both cold and hot weather.

4. **Retroreflective Sheeting.** Use retroreflective sheeting that is listed on the QPL and conforms to ASTM D 4956, Type VII or VIII. Affix yellow or white retroreflective sheeting to the traffic-facing side of the delineator according to the manufacturer's recommendations.

   a. **Ground Mounted.** Ensure that sheeting is a maximum of 2 inches from the top of the delineator and is at least 3 × 12 inches.

   b. **Guide Rail Mounted.** Ensure that the sheeting is a minimum of 3 inches square and is mounted on the upper portion of the delineator. For acceleration and deceleration lanes, use sheeting that is a minimum of 3 inches wide and 9 inches long.

   c. **Barrier Curb Mounted.** Ensure that the sheeting is 3-1/2 × 3-1/2 inches.

Submit a certification of compliance, as specified in 106.07, for delineators.

SECTION 912 – PAINTS, COATINGS, TRAFFIC STRIPES, AND TRAFFIC MARKINGS

912.01 PAINTS AND STAINS

912.01.01 Structural Steel Paint

Use paint systems for coating structural steel that are Northeast Protective Coating Committee (NEPCOAT) approved and listed on the QPL. Use the appropriate paint type for the application as follows:

1. Use an inorganic zinc, epoxy, urethane (IEU) paint system for coating new structural steel.
2. Use an organic zinc, epoxy, urethane (OEU) paint system for re-coating existing structural steel.
3. Use an epoxy mastic, urethane (EU) paint system for over-coating existing structural steel.

Ensure that the primer is tinted to contrast with the base metal. Use white or an approved color that contrasts with the prime and finish coats for the intermediate coat.

Use the finish color coat noted on the Plans. When the colors Lake Blue, Foliage Green, Brown, or Black are specified, match the color chips of FED-STD-595B as specified in Table 912.01.01-1.

Table 912.01.01-1 – Finish Coat Colors for Structural Steel

Color	Chip Number
Lake Blue	25189
Foliage Green	24172
Brown	30111
Black	27038

Before using paint, submit each lot to the ME for quality assurance testing and approval. The ME will verify that the pigment content, total solids, and infrared curve match that of the initial qualifying material. Do not use paint until the ME has approved the paint lot.

912.01.02 Aluminum Paint

Use aluminum paint conforming to AASHTO M 69, Type II. Submit certifications of compliance as specified in 106.07.

912.01.03 Coal Tar Epoxy Paint

Use coal tar epoxy-polyamide paint that conforms to SSPC-Paint No. 16 and is black or dark red in color. Submit certifications of compliance as specified in 106.07.

912.01.04 Concrete Stain

To stain concrete, use a penetrating stain that is a single component, water-based, thermoplastic acrylic emulsion that carries its color and water repellent protection into the concrete. Ensure that the stain conforms to the requirements in Table 912.01.04-1.

Table 912.01.04-1 Requirements for Concrete Stain

Property	Test Method	Requirement
Solids By Weight	ASTM D 2369	57 ± 2 percent
Gloss	ASTM G 23	Flat
Viscosity	ASTM D 562	70 - 75 Krebs Units

Submit certifications of compliance as specified in 106.07.

912.02 COATINGS

912.02.01 Galvanizing (Zinc Coating)

Apply hot-dip galvanized coating to iron and steel plates, pipe, tube, and structural shapes according to ASTM A 123.

Apply hot-dip galvanized coating to iron and steel hardware according to ASTM A 153.

Repair hot dipped galvanized coating on iron and steel plates, pipe, tube, structural shapes, and hardware according to ASTM A 780.

912.02.02 Epoxy Waterproofing

For concrete waterproofing, use epoxy-resin that conforms to ASTM C 881, Type 7, Grade 1, 2, or 3, Class D, E, or F, and is listed on the QPL. Ensure that the color is gray to match the color of the adjacent concrete.

Submit certifications of compliance as specified in 106.07.

912.02.03 Asphalt Waterproofing

For use below ground level, use an asphalt waterproofing conforming to ASTM D 449, Type I. For use above ground level, use an asphalt waterproofing conforming to ASTM D 449, Type II or III. Use a primer conforming to ASTM D 41.

912.02.04 Coating for Non-Vegetative Surface

Formulate a color coating with a pure acrylic vehicle that is durable, weather resistant, and suitable for use on bituminous surfaces. Use lusterless brown tint matching Federal chip No. 30277.

912.03 PERMANENT TRAFFIC STRIPES AND MARKINGS

912.03.01 Epoxy Traffic Stripes

A. Epoxy Resin. For long-life pavement striping, use an epoxy resin that is a 2 component, 100 percent solids formulation conforming to the following requirements:

1. **Color.** Ensure that the material conforms to the initial color requirements in ASTM D 6628.
2. **Yellowness Index.** When tested according to ASTM E 313 (with glass beads), ensure that the white epoxy resin exhibits a maximum 20.00 yellowness index after 72 hours of QUV exposure.
3. **Directional Reflectance.** Ensure that the epoxy resin compound (without glass beads) has a minimum directional reflectance, relative to a magnesium oxide standard, of 80 percent for white and 50 percent for yellow when tested according to ASTM E 1347.
4. **Drying Time.** Ensure that the epoxy resin compounds, when tested according to ASTM D 711, exhibit no pick-up after a 15 minute drying time.
5. **Abrasion Resistance.** When the epoxy resin material is tested according to ASTM C 501, with a CS-17 wheel under a load of 1000 grams for 1000 cycles, ensure that the abrasive wear index is no greater than 80. The abrasive wear index is the weight in milligrams that is abraded from the sample under the specified test conditions.
6. **Hardness.** After the epoxy resin material has cured between 72 and 96 hours at 70 °F, ensure that the Shore D hardness is between 75 and 100 when tested according to ASTM D 2240.

7. **Composition.** Ensure that the epoxy resin meets the composition requirements in Table 912.03.01-1.

Table 912.03.01-1 Composition of Epoxy Resin

Pigment Composition	Percent By Weight Minimum	Percent By Weight Maximum
White:		
Titanium Dioxide[1] (ASTM D 476, Type II or III)	18.0	25.0
Epoxy Resin	75.0	82.0
Yellow:		
Organic Non-Lead Yellow	7.0	8.0
Epoxy Resin	75.0	79.0
Titanium Dioxide (ASTM D 476, Type II or III)	14.0	17.0

1. Use titanium dioxide for the entire pigment composition for white epoxy.

8. **Packaging and Shipping.** Ensure that the epoxy resin material is shipped in appropriate containers and plainly marked with the following information:

1. Manufacturer's Name and Address.
2. Name of Product.
3. Lot/Batch Number.
4. Color.
5. Net Weight and Volume of Contents.
6. Date of Manufacture.
7. Date of Expiration.
8. Mixing Proportions and Instructions.
9. Safety Information.

9. **Sampling and Certified Analysis.** Test each batch of material for composition and IR mapping. Do not use material that deviates from the master IR curve. At least 15 days before use, submit to the ME the manufacturer's certified test results for each batch of epoxy resin material to be used on the Project. In addition, the ME will randomly sample epoxy resin for testing.

B. Glass Beads. Submit certifications of compliance as specified in 106.07 for each lot of glass beads used on the contract.

1. **Small Glass Beads.** Use small beads conforming to AASHTO M 247, Type 1, with a moisture resistant coating.

2. **Large Glass Beads.** Ensure that the large beads conform to AASHTO M 247, except as follows:

1. Provide beads with a silane adherence coating.
2. Ensure that the gradation is as specified in Table 912.03.01-2.

Table 912.03.01-2 Gradation Requirements for Large Glass Beads

Sieve Size	Percent Passing by Weight[1]
No.10	100
No. 12	95 – 100
No. 14	80 – 95
No. 16	10 – 40
No. 18	0 – 5
No. 20	0 - 2

1. According to ASTM D 1214

912.03.02 Thermoplastic Traffic Markings

For long-life traffic markings, use either preformed or hot extruded thermoplastic conforming to AASHTO M 249, except that for preformed thermoplastic, the minimum thickness requirement is 90 mils. Use beads conforming to AASHTO M 247, Type 1, with a moisture resistant coating.

Submit certifications of compliance, as specified in 106.07, for each batch of materials used on the contract.

912.03.03 Raised Pavement Markers (RPM)

Use raised pavement markers (RPMs) made of ductile iron castings with a 2-way, snow-plowable, replaceable prismatic reflector conforming to the following requirements:

1. **Castings.** Provide a ductile iron casting conforming to ASTM A 536, hardened to between 52 and 54 Rockwell "C". Ensure that the castings provided are between 9.25 and 10 inches long, 5.5 and 5.85 inches wide, and 1.70 and 1.92 inches high, and weigh approximately 5.5 pounds. Ensure that each casting is permanently marked with the manufacturer's name and model number.
2. **Epoxy Resin Adhesive.** Set castings in the pavement surfaces using an epoxy resin adhesive conforming to AASHTO M237, Type IV.
3. **Lenses.** Provide a lens conforming to ASTM D 4383 and Table 912.03.03-1.

Table 912.03.03-1 Requirements for Lenses

Property	Requirement
Nominal Dimensions	4 × 2 × 0.5 inch
Slope of reflecting surface	30 to 35 degrees
Area of each reflecting surface	1.44 to 1.87 square inches

Ensure that the lens has a thin untempered glass bonded to the front surface of the prismatic retroreflective lens face.

4. **Lens to Casting Adhesive.** Attach the reflector to the casting with an adhesive according to the reflector manufacturer's recommendations.

Submit a certification of compliance as specified in 106.07.

912.04 TEMPORARY TRAFFIC STRIPES AND MARKINGS

912.04.01 Latex Paint

For temporary traffic stripes, use latex traffic paint that is a fast-drying white, or non-lead yellow, ready-mixed pigmented binder emulsified in water and capable of anchoring reflective glass beads that are separately applied. Ensure that the color matches FED-STD-595B color chip No. 33538 for yellow and No. 37886 for white. Ensure that the paint has a maximum no-track time of 120 seconds when applied in a wet film thickness of 15 ± 1 mil, at 140 °F, and with 12 pounds per gallon of glass beads. In addition, ensure that the finished product meets the following:

1. Volume of solids is a minimum 61 percent.
2. Total solids are a minimum of 77.5 percent total non-volatiles by weight, when tested according to ASTM D 2369.
3. Weight per gallon is a minimum 14 ± 0.2 pounds per gallon for each color.
4. Hegman Grind is a minimum of 2 Hegman when tested according to ASTM D 1210.
5. Viscosity is between 70 and 95 Krebs Units at 77 °F, when tested according to ASTM D 562.

Use glass beads conforming to AASHTO M247, Type 1, with a moisture resistance coating.

If requested by the RE, provide a certification of compliance, as specified in 106.07, for latex or glass beads.

912.04.02 Removable Pavement Marking Tape

A. Temporary Pavement Tape. Use removable pavement marking tape consisting of polymeric backing materials with a retroreflective surface. Ensure that the underside of the tape is pre-coated with a pressure sensitive adhesive

to bond the tape to the roadway surface and is capable of withstanding traffic immediately after installation and for the duration of the intended service. Use a primer only if recommended by the manufacturer.

Provide tape that has a minimum skid resistance of 35 British petroleum number (BPN) when tested according to ASTM E 303. Do not use lead based pigment in traffic tape. Provide tape that conforms to the requirements specified in Table 912.04.02-1.

Table 912.04.02-1 Requirements for Temporary Pavement Tape

Property	White	Yellow
Minimum Specific Luminance (mcd/sq foot/foot-candles) ASTM D 4061[1]	500	300
Minimum Tensile Stress (psi)[2] ASTM D 638	40	40
FED-STD-595B Color Chip No.	37778	33538

1. Use an entrance angle of 88.76° and an observation angle of 1.05°.
2. Perform tensile stress testing with a testing speed of 6 inches per minute.

Use removable tape that is capable of being removed manually, intact or in large pieces, without the use of solvents, burning, grinding, or blasting and without damage to the underlying surface.

If requested by the RE, provide a certification of compliance, as specified in 106.07, for temporary pavement tape.

B. Removable Black Line Masking Tape. Use black line masking tape that is black in color, non-retroreflective, and a pliant polymer material. Ensure that the color conforms to FED-STD-595B color chip No. 37030. Provide tape that does not produce a sheen under day, night, or wet conditions. Ensure that the tape is capable of masking the underlying stripes so that they do not reflect through. Provide tape that has a minimum skid resistance of 30 BPN when tested according to ASTM E 303. Ensure that the underside of the tape is pre-coated with a pressure sensitive adhesive to bond the tape to the roadway surface and is capable of withstanding traffic immediately after installation and for the duration of the intended service.

Ensure that the removable tape is capable of being removed manually, intact or in large pieces, at temperatures above 40 °F, without the use of solvents, burning, grinding, or blasting and without damage to the underlying surface.

If requested by the RE, provide a certification of compliance, as specified in 106.07, for removable black masking tape.

912.04.03 Temporary Pavement Markers

Provide temporary pavement markers that have a maximum width of 4 inches perpendicular to traffic and a maximum height of 3/4 inch. Mold marker castings using acrylonitrile butadiene styrene, acrylic, polycarbonate, or high impact polystyrene of the same color as the retroreflective lens.

Use either mono-directional white or bi-directional yellow retroreflective lenses as shown on the Plans. Ensure that the lenses used for the retroreflective material are molded of methylmethacrylate conforming to ASTM D 788, PMMA0131V0, or PMMA0231V0 and meet the retroreflectance values specified in Table 912.04.03-1:

Table 912.04.03-1 Retroreflectance Requirements for Temporary Pavement Markers

Observation Angle (Degrees)	Entrance Angle (Degrees)	White (mcd/foot-candles)	Yellow (mcd/foot-candles)
0.2	0.0	2.0	1.4
0.2	20	1.0	0.7

Ensure that the underside of the marker is precoated with a pressure sensitive adhesive to bond the marker to the roadway surface and is capable of withstanding traffic immediately after installation and for the duration of the intended service. Ensure that markers are capable of being removed without damage to the underlying surface.

If requested by the RE, provide a certification of compliance, as specified in 106.07, for temporary pavement markers.

SECTION 913 – GUIDE RAIL, FENCE, AND RAILING

913.01 BEAM GUIDE RAIL

913.01.01 Rail Element

Fabricate rail element according to AASHTO M 180, Class A, Type I in Table 2. Ensure that the weight of the zinc coating conforms to AASHTO M 180, Type I in Table 1.

Notify the ME at least 3 days before shipment to the Project for inspection at the supplier's yard. Provide mill certifications to the ME at the time of inspection.

913.01.02 End Treatments

Use non-gating, guide rail end treatments that are NCHRP 350 tested, test level 3 (TL-3), approved and are listed on the QPL. Ensure that the components of the end treatment comply with the NCHRP 350 approved end treatment details.

Notify the ME at least 3 days before shipment to the Project for inspection at the supplier's yard. Provide mill certifications to the ME at the time of inspection.

913.01.03 Posts and Blockouts

For steel posts and blockouts, use structural steel conforming to ASTM A 709, Grade 36, that is galvanized according to ASTM A 123.

Use wood timber blockouts and posts as specified in 915.01.

Use synthetic routed blockouts that are NCHRP 350 tested, test level 3 (TL-3), approved and are listed on the QPL. Ensure that the name of the manufacturer and model number are stamped on each blockout and that the blockouts are of the same material and dimensions as the spacers that were NCHRP tested.

Notify the ME at least 3 days before shipment to the Project for inspection at the supplier's yard. Provide mill certifications for steel components to the ME at the time of inspection. Provide certifications of compliance, as specified in 106.07, for wood and synthetic components.

913.01.04 Rub Rail

For rub rail, use steel channels or bent plate of structural steel conforming to ASTM A 36 and galvanized according to ASTM A 123.

Notify the ME at least 3 days before shipment to the Project for inspection at the supplier's yard. Provide mill certifications to the ME at the time of inspection.

913.01.05 Miscellaneous Hardware

Ensure that connections or splices, nuts, bolts, washers, and plates conform to AASHTO M 180, except as follows:

1. If high-strength bolts are shown on the Plans for bridge guide rail, use high-strength bolts, nuts, and washers conforming to ASTM A 325, Type I, and galvanized according to ASTM A 153.
2. For base plate assemblies on bridge guide rail, use an adhesive anchor system with galvanized bolts as specified in 908.01.04 or galvanized anchor bolts, nuts, and washers as specified in 908.01.03.
3. Use plates for guide rail on bridges conforming to ASTM A 36 and galvanized according to ASTM A 123.

Notify the ME at least 3 days before shipment to the Project for inspection at the supplier's yard. Provide mill certifications to the ME at the time of inspection.

913.02 FENCE

913.02.01 Chain-Link Fence

Ensure that the materials for chain-link fence conform to AASHTO M 181. Submit certifications of compliance, as specified in 106.07, for fence materials. Attach mill certification to the certification of compliance.

913.02.02 Caution Fence

Ensure that the materials for caution fence conform to the following:

1. **Fabric.** Fabricate the fabric for plastic caution fence from HDPE with a minimum tensile strength of 5000 pounds per square inch when tested according to ASTM D 648. Use fabric that is blaze orange in color that matches FED-STD-595B color chip No. 38915 and is ultraviolet stabilized.
2. **Posts.** Use posts made of high carbon steel with a flanged leg channel section or flanged leg U-bar section having a uniform thickness of metal of not less than 1/8 inch. Ensure that the posts weigh at least 2 pounds per linear foot, exclusive of ground plate, and are designed to be easily driven into the ground. Equip each post with at least 11 riveted lugs. Do not equip posts with punched or welded lugs. Galvanize posts.

913.02.03 Snow Fence

Ensure that the materials for snow fence conform to the following:

1. **Wires.** Use wires of a galvanized stay-cable type, with a diameter of not less than 12-1/2 gauge.
2. **Wooden Pickets.** Use unpainted, wooden pickets made from cedar, spruce, maple, or other satisfactory species of wood. Ensure that the pickets are free from knots with a diameter greater than one-half of the width of the picket.
3. **Posts.** Use posts as specified in 913.02.02.2.

Submit certifications of compliance, as specified in 106.07, for fence materials.

913.03 BRIDGE RAILING

913.03.01 Steel Railing

Fabricate steel railing from structural steel as specified in 906.01. Construct welds according to the requirements of AWS D1.1 Structural Welding Code. Use bolts and bolting materials as specified in 908.01. When specified, paint as specified in 906.06 or galvanize as specified in 912.02.01. Submit certifications of compliance, as specified in 106.07 and copies of mill certifications.

913.03.02 Aluminum Railing

Fabricate aluminum railing from aluminum components as specified in Table 913.03.02-1. Construct welds according to the requirements of ANSI/AWS D1.2 Structural Welding Code - Aluminum. Use bolts and bolting materials as specified in 908.01. When specified, paint as specified in 906.06. Submit certifications of compliance, as specified in 106.07, and copies of mill certifications.

Table 913.03.02-1 Aluminum Alloys for Railings

Component	Test Method	Alloy and Temper
Castings, Sand	ASTM B 26	356.0-F or 356.0-T6
Die Castings, Permanent Mold	ASTM B 108	356.0-T6
Extruded Bars, Rods, Shapes, and Pipe	ASTM B 221	6061-T6
Pipe	ASTM B 241	6061-T6
Plates and Sheets	ASTM B 209	6061-T6
Rolled Shapes, Rods, and Bars	ASTM B 211	6061-T6

SECTION 914 – JOINT MATERIALS

914.01 PREFORMED JOINT FILLER

Use preformed joint fillers conforming to AASHTO M 33 or AASHTO M 213. For concrete pavement applications, punch holes in preformed joint filler to admit the dowels. Provide the filler for each joint in a single piece for the full depth and width required for the joint. If the RE approves the use of more than 1 piece for a joint, fasten the abutting ends securely, and hold to shape by stapling or other means of means of positive fastening.

Submit a certification of compliance, as specified in 106.07, for joint filler.

914.02 JOINT SEALER

For sealing joints and cracks in HMA and concrete pavements, use a hot-poured joint sealer that is listed on the QPL and conforms to ASTM D 6690. Use the following types in the listed applications:

1. For sealing cracks in HMA, use Type II sealer.
2. For sealing cracks and joints in concrete pavement and HMA saw and seal applications, use Type IV sealer.
3. In structural applications, use Type II sealer.

For concrete pavements, use cold-poured joint sealer that is listed on the QPL and conforms to ASTM D 5893, Type SL, except that ultimate elongation is required to be a minimum of 1200 percent.

In vertical applications, use cold-poured joint sealers that are listed on the QPL and conform to ASTM D 5893, Type NS, with a minimum ultimate elongation of 600 percent. If recommended by the manufacturer, apply primer before applying the sealer.

Use backer rod in conjunction with cold-poured joint sealer that conforms to ASTM D 5249, Type 1. Use backer rod with a width that is at least 25 percent greater than the width of the pavement joint or crack. Ensure that the backer rod is clean and dry at the time of installation.

Submit a certification of compliance, as specified in 106.07, for joint sealers and backer rods. Attach test results to the certification. The ME will randomly sample joint sealers at the source of manufacture or at the work site.

914.03 POLYMERIZED JOINT ADHESIVE

For longitudinal cold joints in HMA paving, use polymerized joint adhesive that is a hot-applied asphaltic joint adhesive listed on the QPL and conforms to the requirements in Table 914.03-1:

Table 914.03-1 Requirements for Polymerized Joint Adhesive

Property	Test Method	Requirement
Cone Penetration, 25 °C	ASTM D 5329	60-100
Flow, 60 °C	ASTM D 5329	5 mm maximum
Resilience, 25 °C	ASTM D 5329	30% minimum
Ductility, 4 °C	ASTM D 113	30 cm minimum
Tensile Adhesion, 25 °C	ASTM D 5329	500% minimum
Softening Point	ASTM D 36	77 °C minimum
Asphalt Compatibility	ASTM D 5329	Pass

Ensure that the polymerized joint adhesive has a viscosity at the recommended pour temperature to allow for proper application of the material. Obtain documentation of recommended pour temperature and safe heating temperature for the material from the manufacturer. Submit a certification of compliance, as specified in 106.07, for polymerized joint adhesive. Attach test results to the certification. The ME will randomly sample joint adhesive at the source of manufacture or at the work site.

914.04 JOINT ASSEMBLIES

914.04.01 Preformed Elastomeric (Compression Type)

A. Metal Components. Fabricate the structural steel components of the joint assembly as specified in 906.04 and as shown on the Plans and the approved working drawings. Ensure that the fabricator is AISC certified. The ME will inspect joint assemblies either at the fabrication shop or at the work site. Insert the elastomeric joint sealer according to the manufacturer's recommendations.

B. Joint Sealer. Use preformed elastomeric joint sealers that are manufactured from vulcanized elastomeric compound using polychloroprene (neoprene) as the base polymer. Manufacture the joint sealer to conform to ASTM D 3542, with a minimum range of motion of at least 30 percent of the nominal size of the sealer. Ensure that the width to height ratio of the joint sealer is at least 90 percent.

In new construction, do not field splice sealers. For reconstruction projects, the RE may allow field splices. If field splicing is allowed, splice using vulcanization or shop splicing methods. If shop splicing of sealer is unavoidable, splice using either factory vulcanization or cold-cured factory bonding using a high-strength, rapid-bonding adhesive. If splicing of a sealer is allowed, ensure that the sealer at the splice point has no significant misalignment at its sides or top and that misalignment at the bottom does not to exceed half of the bottom wall thickness.

Ensure that the manufacturer's name or trademark and lot number are marked on the joint sealer to identify each shipment. Submit certifications of compliance, as specified in 106.07, for joint sealers. Attach a copy of the test results with the certification. Submit a sample of each size joint sealer to be used on the Project to the ME for quality assurance testing. Ensure that the sample is at least the minimum length specified in Table 914.04-1.

Table 914.04-1 Minimum Lengths of Samples for Testing

Sealer Size Width (w) in inches	Minimum Length (inches)
$w < 2$	84
$2 \leq w < 3$	66
$3 \leq w < 4$	50
$w \geq 4$	42

914.04.02 Strip Seal Expansion (Glandular Type)

A. Metal Components. Use 2 parallel steel rail sections conforming to AASHTO M 270, Grade 36 or Grade 50. Use steel plates and concrete anchors consisting of studs, steel plates, or reinforcement steel welded to the steel rail sections. Ensure that the steel for plates, shapes, and other structural steel used in the deck joint system conforms to AASHTO M 270, Grade 36 or Grade 50. For steel anchors, use deformed bars conforming to ASTM A 615, Grade 60. Weld structural steel as specified in 906.04.02 and as shown on the Plans and the approved working drawings. After fabrication, hot-dip galvanize the entire joint system according to ASTM A 123.

B. Neoprene Strip Seal Gland. For the strip seal gland, use an extruded synthetic rubber consisting of polychloroprene (neoprene) as the base polymer. Manufacture the strip seal gland to have locking lugs that mechanically interlock in the cavities of the 2 steel rail sections.

Ensure that the material conforms to the requirement in Table 914.05-1.

Table 914.05-1 Tests for Neoprene Strip Seal Gland

Property	Test Method	Requirement
Tensile strength, minimum psi	ASTM D 412	2000
Elongation at break, minimum %	ASTM D 412	250
Hardness, Type A durometer	ASTM D 2240	60 ± 5
Oven aging, 70 hours at 212 °F		
Tensile strength loss, maximum %	ASTM D 573	20
Elongation loss, maximum %		20
Hardness, Type A durometer, points change		0 to +10

Table 914.05-1 Tests for Neoprene Strip Seal Gland		
Property	**Test Method**	**Requirement**
Ozone resistance 20% strain, 300 ppm in air, 70 hours at 104 °F	ASTM D 1149	No Cracks
Oil swell, ASTM oil No. 3 70 hours at 212 °F Weight change, maximum %	ASTM D 471	+45

C. Adhesive. For installing and bonding the neoprene strip seal gland in the cavity of the parallel steel rail sections, use an adhesive that is a one-part, moisture-curing polyurethane and hydrocarbon solvent and conforms to physical properties specified in Table 914.05-2:

Table 914.05-2 Requirements for Strip Seal Adhesive	
Property	**Requirement**
Average weight per gallon	8 ± 1 pounds
Solids content by weight	65 percent (minimum)
Temperature range at which material is in fluid from	5 to 120 °F
Film strength (ASTM D 412)	2000 pounds per square inch (minimum)
Elongation	250 percent (minimum)

D. Certification. Submit a certification of compliance, as specified in 106.07, for the strip seal joint assembly. With the certification, submit test results for the neoprene strip seal gland and mill certifications for the structural steel components.

914.04.03 Modular

A. Manufacturer. Use a manufacturer who is AISC certified for Major Steel Bridges, has at least 3 years experience in structural steel fabrication, and has completed fatigue testing of the designed structural elements.

B. Materials. Use materials that conform to the following requirements:

1. Use structural steel conforming to the requirements of AASHTO M183, AASHTO M223, Grade 50, or AASHTO M222. Do not use aluminum components.
2. Use stainless steel conforming to ASTM A240, Type 304.
3. Use PTFE that is 100 percent virgin material, woven PTFE fabric, or dimpled PTFE conforming to the material requirements in Section 18 of the AASHTO Standard Specifications for Highway Bridges.
4. Use neoprene strip seals conforming to the requirements in Table 914.06-1 and that have a maximum movement range of 3.15 inches. Do not use box seals or seals utilizing double webs.

Table 914.06-1 Tests for Neoprene Strip Seals		
Property	**Test Method**	**Requirement**
Tensile strength, minimum psi	ASTM D 412	2000
Elongation at break, minimum %	ASTM D 412	250
Hardness, Type A durometer	ASTM D 2240	55 to 70
Compression Set at 72 hr at 212 °F, maximum %	ASTM D 395	40

5. Use bolts and other hardware conforming to the requirements of AASHTO M 164 and galvanized according to AASHTO M 298.
6. Fabricate slide bearings and precompressed springs as steel reinforced elastomeric pads with a PTFE sliding surface. Do not manufacture components from polyurethane compounds.

C. Fabrication. Fabricate the structural steel components of the modular joint assembly as specified in 906.04 and as shown on the Plans and approved working drawings. Hot-dip galvanize the assembly according to ASTM A 123.

Perform field splices according to the details and procedures included in the approved working drawings.

D. Shipping, Handling, and Certification. The RE will reject joint systems damaged during shipping or handling. The Contractor may repair minor damage to the galvanizing according to ASTM A 780. Store the expansion joint system according to the manufacturer's recommendations.

Submit a certification of compliance, as specified in 106.07, for the modular joint assembly. With the certification, submit test results for the neoprene strip seal and mill certifications for the structural steel components.

SECTION 915 – TIMBER AND TIMBER TREATMENT

915.01 SAWN TIMBER POSTS, TIMBER SPACERS, AND ROUTED TIMBER SPACERS

Manufacture sawn timber posts, timber spacers, and routed timber spacers from Southern pine or Douglas fir with extreme fiber stress in bending in excess of 1200 pounds per square inch, as assigned according to Southern Pine Inspection Bureau or West Coast Lumber Inspection Bureau grading rules. The manufacturer may rough saw or dress timber posts, timber spacers, and routed timber. Treat timber as specified in 915.05.

Submit certification of compliance as specified in 106.07.

915.02 ROUND TIMBER PILING

In the manufacture of round timber piling, use Southern pine or Douglas fir conforming to AASHTO M 168 and ASTM D 25, except that untreated piles having smooth, tight bark need not be peeled. Treat piling as specified in 915.05.

Submit certification of compliance as specified in 106.07.

915.03 DIMENSION LUMBER FOR SHEET PILING

Manufacture sheet piling using Southern pine or Douglas fir No. 2 or better, dressed on 4 sides. Manufacture sheet piling to be tongue and grooved or grooved for splines. Treat sheet piling as specified in 915.05.

Submit certification of compliance as specified in 106.07.

915.04 DIMENSION LUMBER, TIMBER, AND DECKING FOR STRUCTURES

Use dimension lumber, timber, glued-laminated timber, and decking for structures that conform to AASHTO M 168 with the following modifications:

1. Manufacture dimension lumber and timber from Southern pine or Douglas fir of structural grade that conforms to the grading rules of the Southern Pine Inspection Bureau or the Western Lumber Inspection Bureau. Ensure that the grading is performed by an agency approved by the Board of Review of the American Lumber Standards Committee. Use Southern pine that is designated and graded as No. 2 if 1-1/2 to 3-1/2 inches thick and as No. 1 if 4-1/2 inches or thicker. Use Douglas fir that is designated and graded as Dense No. 1.
2. For decking subjected to vehicular traffic, use timber that is graded as Dense Commercial if Southern pine and Commercial DEX if Douglas fir. Dress timber for bridge decking square edged S4S.
3. For decking used exclusively by pedestrians, use Commercial grade timber that is dressed square edged S4S.
4. Treat timber as specified in 915.05, except do not preserve timber railing systems and decking used by pedestrians with creosote. In addition, do not preserve timber decking to be covered with an HMA overlay with creosote.

Submit certification of compliance as specified in 106.07.

915.05 TIMBER TREATMENT

Treat wood species according to AASHTO M 133 and AWPA Standards C1, C2, C3, C14, C18, and C28, as summarized in Table 915.05-1, Table 915.05-2, and Table 915.05-3.

915.05-1 Treatment for Timber Posts

Type of Wood	Location/Environment	Allowable Treatments	AWPA Standard Reference for Minimum Retention Level
Southern Pine	Soil or Fresh Water	CCA or Pentachlorophenol	C14
Douglas Fir	Soil or Fresh Water	ACZA	C14

915.05-2 Treatment for Round Timber Piles

Type of Wood	Location/Environment	Allowable Treatments	AWPA Standard Reference for Minimum Retention Level
Southern Pine	Soil or Fresh Water	CCA	C14
Southern Pine	Marine	CCA	C14
Douglas Fir	Soil or Fresh Water	ACZA	C14
Douglas Fir	Marine	ACZA	C14

915.05-3 Treatment for Timber Sheet Piling and Timber for Structures

Type of Wood	Location/Environment	Allowable Treatments	AWPA Standard Reference for Minimum Retention Level
Southern Pine	Soil or Fresh Water	CCA, or Pentachlorophenol	C14
Southern Pine	Marine	CCA	C14
Douglas Fir	Soil or Fresh Water	ACZA	C14
Douglas Fir	Marine	ACZA	C14

Notify the ME at least 14 days before treating timber. If directed by the ME, perform an assay to determine the retention of preservative according to AASHTO M 133. Submit certification of compliance as specified in 106.07. Attach the assay report to the certification.

915.06 TIMBER CONNECTORS AND HARDWARE

Use timber connectors and hardware that conform to Section 16 of the *AASHTO LRFD Bridge Construction Specifications*. Galvanize timber connectors and hardware as specified in 912.02.01.

Submit a certification of compliance as specified in 106.07.

SECTION 916 – FIBERGLASS COMPOSITE MATERIALS

916.01 FIBERGLASS REINFORCED PLASTIC LUMBER

Provide fiberglass reinforced plastic lumber (FRPL) that is listed on the QPL and conforms to the following material properties:

1. **Plastic.** Use plastic for FRPL that is a mixture of one or more of the following recycled post consumer or post industrial thermoplastics: HDPE, medium-density polyethylene or low-density polyethylene. Mix the plastic with appropriate colorants, ultraviolet inhibitors, and antioxidants so that the resulting product meets the material property requirements specified in Table 916.01-1.

   Manufacture the FRPL so that it does not absorb moisture, corrode, rot, warp, splinter, or crack. Ensure that the outer skin is smooth and black in color. Use hindered amine light stabilizers to provide sufficient resistance to ultraviolet light degradation so as to meet the requirements in Table 916.01-1.

Table 916.01-1 Plastic Material Properties

Property	Test Method	Component	Requirement
Density	ASTM D 792	Skin	55-63 lbs/ft^3
Density	ASTM E 1547	Core	34-48 lbs/ft^3
Water Absorption	ASTM D 570	Skin	2 hrs: < 1.0% wt. increase 24 hrs: < 3.0% wt. increase
Brittleness	ASTM D 746	Skin	No break at −40 °F
Impact Resistance	ASTM D 746	Skin	Greater than 4 ft-lbs/inch
Hardness	ASTM D 2240	Skin	44-75 (Shore D)
Abrasion Cycles = 10,000 Wheel = CS17 Load = 2.2 lbs	ASTM D 4060	Skin	 Weight Loss: < 0.03 g Wear Index: 2.5 to 3.0
Chemical Resistance Sea Water Gasoline No. 2 Diesel	ASTM D 543	Skin/Core	 <1.5% weight increase <7.5% weight increase <6.0% weight increase
Tensile Properties	ASTM D 638	Skin/Core	Minimum 500 psi at break
Compressive Modulus	ASTM D 695	Skin/Core	Minimum 40 ksi
Coefficient of Friction	ASTM F 489	Skin	Maximum 0.25, wet or dry
Nail Pull-Out	ASTM D 1761	Skin/Core	Minimum 60 lbs

2. **Reinforcement.** Reinforce FRPL using fiberglass reinforcement rods spaced inside the 4 corners of the member. Reinforce 10 × 10-inch and 12 × 12-inch FRPL with a minimum of four 1.5-inch diameter reinforcement rods placed in the corners of the section. Ensure that the reinforcement rods are continuous and have a minimum flexural strength of 70,000 pounds per square inch when tested according to ASTM D 4476 and a minimum compressive strength of 40,000 pounds per square inch when tested according to ASTM D 695. Do not use steel reinforcement rods. For FRPL used for constructing platforms, blocking, and wales, use at least 15 percent by weight of chopped glass reinforcement added to the polyethylene. Fiberglass rebar is not required for the smaller dimensional FRPL.

3. **Manufacturing.** Manufacture FRPL as one continuous piece, with no joints or splices, to the dimensions and tolerances specified in Table 916.01-2, and consisting of a dense outer skin surrounding a less dense core. Ensure that interior voids do not exceed 0.75 inch in diameter and that the FRPL is free of twist and curvature.

Table 916.01-2 Dimensions and Tolerances

Plastic Timber	Dimension	Tolerance
Length	Per order	±6 in
Width	As shown on Plans	±0.25 in
Height	As shown on Plans	±0.25 in
Corner Radius	1.75 inches	±0.25 in
Outer Skin Thickness	0.1875 inches	±0.125 in
Distance from outer surface to rebar elements	1.5 inches	±0.625 in
Straightness (gap, bend or bulge inside lying on a flat surface)		<1.5 in per 10 ft length

4. **Structural Properties.** Manufacture 10 × 10-inch and 12 × 12-inch FRPL to conform to the minimum structural properties specified in Table 916.01-3. Manufacture smaller dimensional FRPL for platforms and blocking to meet the minimum structural properties specified in Table 916.01-4.

Table 916.01-3 Structural Properties of 10 and 12-inch FRPL		
Property	**10 × 10-inch**	**12 × 12-inch**
Modulus of Elasticity, minimum[1]	521 ksi	405 ksi
Stiffness, E.I., minimum[1]	4.05E+08 lb-in^2	6.58E+08 lb-in^2
Yield Stress in Bending, minimum[1]	5.8 ksi	4.4 ksi
Weight	30-37 lbs/ft	42-51 lbs/ft

1. Determine the modulus of elasticity, stiffness, and yield stress according ASTM D 790 and the following:
   a. Use a deflection rate of 0.25 inches per minute.
   b. Use a minimum span length of 12 feet to perform testing on a full size FRPP specimen.
   c. Use the following equations for calculations:
      1) Strain = [6 × (depth of cross-section) × (deflection)] / (span length)^2
      2) Calculate the modulus at a strain of 0.01 inches per inch as follows:
      Modulus of Elasticity = [(load) × (span length)^3] / [(48) × (deflection) × (moment of inertia)]
      3) Calculate the yield stress from the maximum load reached prior to failure.

Table 916.01-4 Structural Properties of FRPL Smaller than 10 inches		
Property	**Test Method**	**Requirement**
Modulus of Elasticity, minimum	ASTM D 6109	175,000 psi
Flexural Strength	ASTM D 6109	No fracture at 1800 psi
Compressive Strength, minimum	ASTM D 6108	1500 psi
Compressive Strength Parallel to Grain, minimum	ASTM D 6112	1750 psi
Compressive Strength Perpendicular to Grain, minimum	ASTM D 6112	600 psi
Screw Withdrawal, minimum	ASTM D 6117	350 lbs

Submit a certification of compliance, as specified in 106.07, with the test results for the plastic material properties attached.

916.02 FIBERGLASS REINFORCED PLASTIC PILES

Provide fiberglass reinforced plastic piles (FRPP) that are listed on the QPL and conform to the following material properties:

1. Plastic. Use plastic for FRPP that is a mixture of one or more of the following recycled post-consumer or post-industrial thermoplastics: HDPE, medium-density polyethylene, or low-density polyethylene. Mix the plastic with appropriate colorants, ultraviolet inhibitors, and antioxidants so that the resulting product conforms to the material property requirements specified in Table 916.02-1.

Manufacture the FRPP so that it does not absorb moisture, corrode, rot, warp, splinter, or crack. Ensure that the outer skin is smooth and black in color. Use hindered amine light stabilizers to provide sufficient resistance to ultraviolet light degradation so as to meet the requirements in Table 916.02-1.

Table 916.02-1 Plastic Material Properties

Property	Test Method	Component	Requirement
Density	ASTM D 792	Skin	55-63-lbs/ft^3
Density	ASTM E 1547	Core	34-48-lbs/ft^3
Water Absorption	ASTM D570	Skin	2 hrs: < 1.0% wt. increase 24 hrs: < 3.0% wt. increase
Brittleness	ASTM D 746	Skin	No break at −40 °F
Impact Resistance	ASTM D 746	Skin	Greater than 4 ft-lbs/inch
Hardness	ASTM D 2240	Skin	44-75 (Shore D)
Abrasion[1]	ASTM D 4060	Skin	Weight Loss: <0.03g Wear Index: 2.5 to 3.0
Chemical Resistance in Sea Water in Gasoline in No. 2 Diesel	ASTM D 543	Skin/Core	 <1.5% weight increase <7.5% weight increase <6.0% weight increase
Tensile Properties	ASTM D 638	Skin/Core	Minimum 500 psi at break
Compressive Modulus	ASTM D 695	Skin/Core	Minimum 40 ksi
Coefficient of Friction	ASTM F 489	Skin	Maximum 0.25, wet or dry
Nail Pull-Out	ASTM D 1761	Skin/Core	Minimum 60 lbs

1. The duration of the abrasion test will be 10,000 cycles using a CS17 wheel with a load of 2.2 pounds.

2. **Reinforcement.** Reinforce FRPP using fiberglass reinforcement rods spaced evenly around the inside perimeter of the pile. Reinforce 10-inch outside diameter (OD) FRPP with a minimum of six 1.000-inch diameter fiberglass reinforcement rods. Reinforce 13-inch OD FRPP with a minimum of twelve 1.375-inch diameter fiberglass reinforcement rods. Reinforce 16-inch OD FRPP with a minimum of sixteen 1.375-inch diameter fiberglass reinforcement rods. Ensure that reinforcement rods are continuous and have a minimum flexural strength of 70,000 pounds per square inch when tested according to ASTM D 4476 and a minimum compressive strength of 40,000 pounds per square inch when tested according to ASTM D 695. Do not use steel reinforcement rods. For FRPP, use at least 5 percent by weight of chopped glass reinforcement added to the polyethylene.

3. **Manufacturing.** Manufacture FRPP as one continuous piece, with no joints or splices, to the dimensions and tolerances specified in Table 916.02-2, and consisting of a dense outer skin surrounding a less dense core. Ensure that interior voids do not exceed 0.75 inch in diameter and that the FRPP is free of twist and curvature.

Table 916.02-2 Dimensions and Tolerances

FRPP	Dimension	Tolerance
Length	Per order (105 ft max)	+6.0 in / −0.0 in
Outside Diameter	10.000 in / 12.875 in / 16.250 in	±0.375 in
Outer Skin Thickness	0.1875 in / 0.1875 in / 0.1875 in	±0.125 in
Distance from outer surface to rebar elements (FRPP)	0.880 in /0.750 in / 1.250 in	±0.375 in
Straightness (gap, bend, or inside lying on a flat surface)		< 1.5 in per 10 feet

4. **Structural Properties.** Manufacture 10-inch OD, 13-inch OD and 16-inch OD FRPP to conform to the minimum structural properties specified in Table 916.02-3.

   Conduct tests for structural properties on a full-scale product of the specified size. Calculate the properties specified in Table 916.02-3 using standard elastic beam flexure formulas (as found in references such as *Machinery's Handbook*; and *Formulas for Stress and Strain* by Roark and Young). Report the Stiffness (EI) as the average of the stiffness at all measurement locations, between zero load and half the load corresponding to the specification yield stress. If the FRPP fails before reaching the specified minimum yield stress in bending, do not use the FRPP. Calculate the stress at the load point, on the tension side of the FRPP.

The manufacturer may extend results of these tests, through engineering calculations, to a product of another size only if the other size has the same or smaller cross-section than the tested product. Do not use smaller cross-sections to predict the performance of larger cross-sections.

Table 916.02-3 Structural Properties

Member Size	10-inch OD	13-inch OD	16-inch OD
Modulus of Elasticity,[1] minimum	458 ksi	1054 ksi	997 ksi
Stiffness, EI, minimum	2.25E+09 lb-in^2	1.48E+09 lb-in^2	3.21E+09 lb-in^2
Yield Stress in Bending, minimum	4.3 ksi	8.6 ksi	7.8 ksi
Bending Moment at Yield, minimum	422 in-kips	1860 in-kips	3168 in-kips
Weight	24-29 lbs/ft	45-55 lbs/ft	66-81 lbs/ft

1. Determine the modulus of elasticity, stiffness, and yield stress according ASTM D 790 and the following:
   a. Use a deflection rate of 0.25 inches per minute.
   b. Use a minimum span length of 12 feet to perform testing on a full size FRPP specimen.
   c. Use the following equations for calculations:
      1) Strain = [6 × (depth of cross-section) × (deflection)] / (span length)^2
      2) Calculate the modulus at a strain of 0.01 inches per inch as follows:
      Modulus of Elasticity = [(load) × (span length)^3] / [(48) × (deflection) × (moment of inertia)]
      3) Calculate the yield stress from the maximum load reached prior to failure.

5. **Recoverable Deflection.** Manufacture FRPP to exhibit recoverable deflection properties. Ensure that FRPP does not exhibit more than a 5 percent reduction in bending stiffness (EI) when cyclically load tested. For a minimum of 200 load cycles, use a 4-point load condition with a minimum 30.5-foot clear span and a minimum 15-foot shear span. Ensure that the applied load produces a minimum of 40 percent of the FRPP's bending moment at yield. Calculate the bending moment at yield as follows:

$$M = f\left(\frac{I}{c}\right)$$

Where:
M = bending moment at yield (in-lbs).
f = yield stress in bending (lb/in^2).
I = moment of inertia of cross-section (in^4).
c = distance from neutral axis to point where stress is desired (inches).

6. **Wrapping**. Provide 0.5-inch diameter steel cable (5/8-inch OD covering) polypropylene impregnated wire rope for wrapping FRPP that are to be placed in clusters.

Submit a certification of compliance, as specified in 106.07, with the test results for the plastic material properties of the FRPP attached.

916.03 FIBERGLASS-CONCRETE COMPOSITE PILES

Provide fiberglass-concrete composite piles (FCCP) consisting of a hollow composite tube, a concrete core, and a durable coating. Ensure that the FCCP is listed on the QPL and conforms to the following material properties:

1. **Composite Tubes.** Produce composite tubes of composite FRP (fiber reinforced polymer) materials that have been formed by means of pultrusion, filament winding, or resin infusion molding processes. In the shell, incorporate E-Glass or other continuous fiber reinforcement that is impregnated with vinyl ester, polyester, or epoxy resin. Ensure that the wall is 50 to 70 percent glass with a minimum of 25 percent resin by weight.

   Ensure that the tubes to be used in the FCCP provide sufficient cross-section and strength to withstand stresses incurred during fabrication, handling, and driving of the piles to the required resistance.

   Manufacture the composite tubes according to the tolerances specified in Table 916.03-1.

Table 916.03-1 Tolerances for Composite Tubes

Property	Tolerance
Minimum Length	+1 foot, −0 inches
Maximum Sweep[1]	0.08% of total length
Ends out of Square	1.0% of diameter

1. Sweep is the deviation from straightness, measured at several points around the pile circumference while the pile is not subjected to bending stresses.

In the manufacture of composite tubes, use fiberglass products specified in Table 916.03-2 and conforming ASTM D 2310 or ASTM D 2996. Include an ultraviolet inhibitor in the fiberglass resin.

Table 916.03-2 Requirements for Fiberglass Composite Tubes

Class	RTRP (reinforced thermosetting resin pipe)
Type	Type I (filament wound)
Grade	Grade 1 (glass fiber reinforced epoxy resin pipe) Grade 2 (glass fiber reinforced polyester resin pipe), or vinylester resin

Manufacture fiberglass tubes to conform to the physical properties specified in Table 916.03-3.

Table 916.03-3 Physical Properties of Composite Tube

			Nominal Tube Diameter		
	Stress Direction	**Test Method**	**12-inch**	**14-inch**	**16-inch**
Elastic Moduli (ksi)	axial-tensile	ASTM D 2105	4000	3350	2800
	axial-compressive	ASTM D 695[1]	2800	2350	1900
	hoop-tensile	ASTM D 1599	4500	4500	4500
Strength (ksi)	axial-tensile	ASTM D 2105	70	58	49
	axial-compressive	ASTM D 695[1]	39	35	29
	hoop-tensile	ASTM D 1599	35	35	35
Wall thickness			0.200	0.210	0.230

1. Modify ASTM D 695 as follows:
   1.1 Test Specimen Dimensions: Diameter is equal to full diameter of tube being tested and Height is equal to 1 inch.
   1.2 Do not use the compression tool described in ASTM D 695. Center the specimen in the compression testing machine and place a steel plate on top of the specimen to distribute the load from the test machine.

2. Coating. Apply an ultraviolet resistant film coating of a minimum 3-mil thickness to portions of piles remaining exposed after installation. Use a coating that has a permanent color of gray or black.

3. Allowable Degradation. Ensure that the total ultraviolet resistance provided by resin inhibitors and color film is sufficient to limit the loss of properties as specified in Table 916.03-4. Conduct exposure testing according to one of the following ASTM methods: G 152, G 155, G 154, or B 117.

Table 916.03-4 Allowable Degradation of Coated Composite Tube[1]

Property	Test Method	Maximum Allowable Loss
Axial Tensile Strength Loss	ASTM D 2105	10%
Axial Compressive Strength Loss	ASTM D 695[2]	10%
Hoop Tensile Strength Loss	ASTM D 1599	10%
Color Film Adhesion Loss	ASTM D 4541	10%

1. After exposure to light and salt spray for a duration of 3600 hours
2. Modify ASTM D 695 as follows:
   2.1 Test Specimen Dimensions: Diameter is equal to full diameter of tube being tested and Height is equal to 1 inch.
   2.2 Do not use the compression tool described in ASTM D 695. Center the specimen in the compression testing machine and place a steel plate on top of the specimen to distribute the load from the test machine.

4. **Dimensional and Physical Stability.** Ensure that the dimensional and physical stability of materials used in the manufacture of composite piles conforms to the evaluation criteria of ASTM D 696.

5. **Concrete.** For infill of FCCP, use Class A concrete as specified in 903.03. In addition, use a composite tube with a textured inside surface, a chemical bonding agent, or shrinkage compensating concrete to establish a positive connection between the composite tube and concrete core to ensure composite action.

6. **Ultimate Flexural Strength.** Ensure that the ultimate flexural strength value for a 12-inch nominal dimension FCCP is at least 2100 inch-kips. For design of cyclically loaded bridge pier protection applications, assume an ultimate flexural strength value for the FCCP of 1400 inch-kips.

7. **Wrapping.** Provide 0.5-inch diameter steel cable (5/8-inch outside diameter covering) polypropylene impregnated wire rope for wrapping FCCP that are to be placed in clusters.

Submit a certification of compliance, as specified in 106.07, with the test results for the fiberglass composite material properties and the concrete infill compressive strengths of the FCCP attached.

SECTION 917 – LANDSCAPING MATERIALS

917.01 TOPSOIL

Provide topsoil containing no stones, lumps, roots, or similar objects larger than 2 inches in any dimension. Ensure that topsoil meets the following quality standards:

1. **Unacceptable Topsoil Sources.** Do not obtain topsoil from the following sources:

    1. Areas containing chemically contaminated soils.
    2. Areas from which the original surface has been stripped or covered over, such as borrow pits, open mines, demolition sites, dumps, and landfills.
    3. Wet excavation.
    4. Acid producing soils.

2. **pH.** Provide topsoil that conforms to the pH requirements specified in Table 917.01-1 when tested according to ASTM D 4972.

Table 917.01-1 Requirements for pH of Topsoil

pH Range	Acceptability/Remediation
pH < 4.1	Topsoil is unacceptable.
4.1 ≤ pH < 5.8	Add pulverized lime to increase the pH to 6.5 before use.
5.8 ≤ pH < 7.0	Topsoil is acceptable. No remediation needed.
7.0 ≤ pH < 7.2	Decrease pH to at least 6.8 before use.[1]
pH ≥ 7.2	Topsoil is unacceptable.[2]

1. Obtain Departmental approval of remediation method to lower pH.
2. The Department may approve the use of existing topsoil stripped from the Project Limits with a pH greater than 7.2.

3. **Organic Content.** Ensure that topsoil has a minimum organic content of 2.75 percent by weight. If the organic content is less than 2.75 percent, increase the organic content by adding soil additives, as specified in 917.02, at a rate necessary to attain the minimum organic content. The Department will determine the organic content of soils according to AASHTO T 194, except that the sample is to be taken from oven-dried soil passing a No. 10 sieve.

4. **Gradation/Particle Size.** Provide topsoil conforming to the particle size requirements in Table 917.01-2 and that has no more than 20 percent retained on a No. 10 sieve when mechanically graded. The Department will determine the particle size distribution for the portion of the topsoil passing the No. 10 sieve using hydrometer analysis according to AASHTO T 88.

Table 917.01-2 Particle Size Distribution for Topsoil	
Particle Size	**Percent**
Sand (2.0 mm to 0.05 mm)	40 - 80
Silt (0.05 mm to 0.005 mm)	0 - 30
Clay (0.005 mm and smaller)	10 - 30[1]

1. If more than 50 percent of the sand portion is larger than 0.5 millimeters, the allowable range for clay is 15 to 30 percent.

The Department will sample topsoil at a rate of at least 1 sample per source to ensure conformance to the requirements.

917.02 SOIL ADDITIVES

917.02.01 Composted Sewerage Sludge

Use composted sewerage sludge consisting of a stabilized, screened mixture of wood chips and sewerage sludge processed according to NJDEP. Obtain composted sewerage sludge from facilities operating in compliance with a New Jersey Pollutant Discharge Elimination System Permit or under an approved NJDEP Memorandum of Agreement. Ensure that the compost product is registered with the New Jersey Department of Agriculture according to the New Jersey Commercial Fertilizer and Soil Conditioner Act of 1970.

Use composted sewerage sludge that has a minimum organic content of 50 percent by weight and a pH of 6.0 or greater. If the average water content of the stabilized composted sludge exceeds 55 percent by weight, correct for the excess water content.

For shipments of composted sewerage sludge, provide delivery tickets with the certified weight and the name of the producer or supplier. The Department may take samples to verify the organic content, pH, and water content.

917.02.02 Compost

Use compost that is a stable, humus-like organic material produced by the biological and biochemical decomposition of source-separated compostable materials. Materials used in producing compost may include leaves, yard trimmings, food scraps, food processing residuals, manure, other agricultural residuals, forest residues, bark, and paper. Do not add non-organic materials such as sand, soil, or glass to the compost. Ensure that the compost contains no heavy metals or substances toxic to plants and has no objectionable odor. Ensure that the raw materials have decomposed sufficiently to be unrecognizable and that the compost meets the requirements of Table 917.02.02-1.

Table 917.02.02-1 Requirements for Compost		
Property	**Test Method**	**Requirement**
Organic Content, minimum	ASTM D 2974	30%
Moisture Content	ASTM D 2974	35 - 60%
Particle Size (percent passing the 1" sieve)	AASHTO T 27	100%
pH	TMECC 04.111	5.5 - 8.0
Maturity	Solvita Maturity Test	6 or higher
Soluble Salt, maximum	Determined using 1 part compost to 1 part distilled water	4.0 mmhos/cm

1. Electrometric pH determination according to the Test Methods for the Examination of Composting and Compost (TMECC) by the US Composting Council

Provide compost that is either commercially packaged or in bulk form. Obtain compost material from NJDEP regulated, permitted or approved facilities. For shipments of compost, provide delivery tickets with the certified weight and the name of the producer or supplier. The Department may take samples to verify the organic content, pH, and water content.

917.03 FERTILIZER

Use fertilizer for establishing turf that has a commercial designation of 10-20-10, or use any 1-2-1 ratio fertilizer containing a minimum of 5 percent nitrogen, 10 percent available phosphoric acid, and 5 percent soluble potash.

If the fertilizer is to be applied with mechanical spreader in dry form, ensure that a minimum of 75 percent passes a No. 8 sieve, a minimum of 75 percent is retained on a No. 16 sieve, and the maximum free moisture content is 2 percent.

Use fertilizer for establishing sod that is any 1-2-2 ratio fertilizer containing a minimum of 5 percent nitrogen, 10 percent available phosphoric acid, and 10 percent soluble potash.

With each delivery of fertilizer, provide a delivery ticket showing the weight and a certified chemical analysis of the composition of the fertilizer from the manufacturer.

917.04 PULVERIZED LIMESTONE

Use pulverized limestone composed of more than 85 percent calcium and magnesium carbonates equivalent to more than 40 percent calcium and magnesium oxides.

With each delivery of pulverized limestone, provide a delivery ticket indicating its weight and a certified analysis of the chemical composition and gradation, including calcium and magnesium oxide equivalents.

917.05 SEED MIXTURES

917.05.01 Grass Seed Mixtures

Provide grass seed mixtures that are not older than the sell by date and that conform to the requirements specified in Table 917.05.01-1 through Table 917.05.01-7.

Table 917.05.01-1 Type A Grass Seed Mixture

Kind of Seed	Minimum Purity, Percent	Minimum Germination, Percent	Percent of Total Weight of Mixture
Kentucky Bluegrass	85	75	20
Red Fescues (Creeping or Chewings)	95	80	35
Kentucky 31	95	80	20
Redtop	92	85	10
Perennial Ryegrass	98	85	10
White Clover	97	90	5

Table 917.05.01-2 Type A-3 Grass Seed Mixture

Kind of Seed	Minimum Purity, Percent	Minimum Germination, Percent	Percent of Total Weight of Mixture
Tall Fescue	95	80	60
Kentucky Bluegrass	85	75	10
Chewing or Hard Fescue	95	85	20
Perennial Ryegrass	98	85	10

Table 917.05.01-3 Type A-4 Grass Seed Mixture

Kind of Seed	Percent of Total Weight of Mixture
Spreading Fescue	30
Chewing or Hard Fescue	30
Kentucky Bluegrass	30
Perennial Rye	10

Table 917.05.01-4 Type B Grass Seed Mixture			
Kind of Seed	**Minimum Purity, Percent**	**Minimum Germination, Percent**	**Percent of Total Weight of Mixture**
Redtop	92	85	10
Red Fescues (Creeping or Chewings)	95	80	45
Blackwells Switchgrass	95	85	15
Weeping Love Grass	95	85	10
Perennial Ryegrass	98	85	5
Kentucky 31	95	80	15

Table 917.05.01-5 Type D Grass Seed Mixture			
Kind of Seed	**Minimum Purity, Percent**	**Minimum Germination, Percent**	**Percent of Total Weight of Mixture**
Kentucky Bluegrass	85	75	50
Red Fescues (Creeping or Chewings)	95	85	35
Redtop	92	85	5
Perennial Ryegrass	95	80	10

Table 917.05.01-6 Type F Grass Seed Mixture		
Kind of Seed	**Minimum Purity, Percent**	**Minimum Germination, Percent**
Perennial Ryegrass	95	90

Table 917.05.01-7 Type W Wetland Grass Seed Mixture			
Kind of Seed	**Minimum Purity, Percent**	**Minimum Germination, Percent**	**Percent of Total Weight of Mixture**
Blackwell Switchgrass (*Panicum virgatum*)	95	85	25
Virginia Wildrye (*Elymus virginicus*)	95	85	25
Red Top (*Agrostis alba*)	92	85	25
Annual Rye (*Lolium multiflorum*)	85	85	25

917.05.02 Wildflower Seed Mixture

Provide wildflower seeds that conform to the requirements in Table 917.05.02-1.

Table 917.05.02-1 Wildflower Seed Mixture	
Kind of Seed	**By Weight Per Acre**
Coreopsis lanceolata	40 oz.
Rudbeckia hirta	40 oz.
Echinacea purpurea	79 oz.
Festuca ovina	64 oz.
Total	223 oz.

917.05.03 Shipment and Certification

With each shipment of seed mixture, provide a certified weigh ticket and an analysis of the composition, purity, germination, germination test date, and sell by date of the seed mixture, certified by the seed house.

The Department may sample and test seed according to the New Jersey State Seed Law and with the Rules and Regulations for Testing Seeds adopted by the Association of Official Seed Analysts.

917.06 MULCH

917.06.01 Straw

Use straw that is derived from threshed, unrotted stalks of oat, wheat, rye, or barley and that is relatively free from seeds, noxious weeds, and other foreign material.

917.06.02 Wood Cellulose Fiber

Use wood cellulose fiber containing no growth or germination inhibiting materials. With each shipment, provide a manufacturer's certification indicating composition and weight.

917.06.03 Shredded Wood and Wood Chip

Use shredded wood mulch produced by a shredding machine that produces a wood particle varying in size from 5/8 to 3 inches, or use wood chip mulch produced by a wood chipping machine that produces a wood particle varying in size from 5/8 to 3 inches.

Ensure that the shredded wood mulch and wood chip mulch are clean, hard, and not decomposed and contain no leaves, twigs, wood shavings, dirt, stones, toxic material, or other foreign material. Do not use wood pallets, chemically treated wood, or materials from building demolition to produce mulch. Ensure that the pH is above 3.0.

Submit samples of shredded or wood chip mulch before delivery to the Project. The Department will visually inspect each shipment of shredded or wood chip mulch. Obtain the Department's approval before using wood mulch that is produced within the Project Limits.

With each shipment, provide a delivery ticket and a certification that the material was not derived from wood pallets, chemically treated wood, or material from building demolition.

917.06.04 Shredded Hardwood Bark

Use shredded hardwood bark mulch derived from the bark of hardwood trees. Ensure that it contains no leaves, twigs, wood shavings, dirt, stones, weed seeds, toxic material, or other foreign material. With each shipment, provide a delivery ticket indicating source and weight of the shredded hardwood bark.

917.06.05 Stone

For stone mulch, use coarse aggregate No. 4, as specified in 901.03.01. Before use, submit a sample for the Department's approval of size and color. With each shipment, provide a delivery ticket indicating source and weight of the stone mulch.

917.06.06 Gravel

For gravel mulch, use an uncrushed washed gravel No. 4, as specified in 901.03.02. Before use, submit a sample for the Department's approval of size and color. With each shipment, provide a delivery ticket indicating source and weight of the gravel mulch.

917.07 TACKIFIERS

Provide 1 of the following tackifiers for straw mulch:

1. **Fiber Mulch.** Use fiber mulch made from wood or plant fibers containing no growth or germination inhibiting materials.
2. **Synthetic Plastic Emulsion.** Use synthetic plastic emulsion that is miscible with all normally available water when diluted to any proportions, is not soluble or dispersible in water after drying, and remains tacky until the grass seed has germinated. Ensure that the plastic binder is physiologically harmless and does not have phytotoxic or crop-damaging properties.
3. **Vegetable Based Gels.** Vegetable based gels are naturally occurring powder-based hydrophilic additives formulated to produce gels and form membrane networks of water insoluble polymers after curing. Ensure that the vegetable gel is physiologically harmless and does not have phytotoxic or crop-damaging properties.

917.08 TOPSOIL STABILIZATION MATTING

917.08.01 Type 1 Mat

Provide Type 1 Mats conforming to the following:

1. **Excelsior Mat.** Provide wood excelsior, 48 ± 1 inch in width and weighing 0.8 pounds per square yard ±5 percent that is covered on both sides with a biodegradable netting to facilitate handling and to increase strength.

2. **Jute Mat.** Provide a cloth of a uniform plain weave of undyed and unbleached single jute yarn, 48 ± 1 inch in width and weighing an average of 1.2 pounds per linear yard of cloth with a tolerance of ±5 percent, with approximately 78 warp ends per width of cloth and 41 weft ends per linear yard of cloth. Ensure that the yarn is of a loosely twisted construction having an average twist of not less than 1.6 turns per inch and does not vary in thickness by more than one-half its normal diameter.

917.08.02 Type 2 Mat – Erosion Control Mulch Blanket

Provide a machine-produced mat of organic, biodegradable mulch material, such as straw, coconut fiber, or other approved materials that is covered on both sides with a 1/2 × 1/2-inch photodegradable polypropylene mesh netting. Ensure that the mesh contains an accelerant that will cause breakdown of the mesh within 6 months. Ensure that the Type 2 mat conforms to the property values specified in Table 917.08.02-1.

Table 917.08.02-1 Requirements for Type 2 Mat

Property	Test Method	Minimum Requirement
Mass per Unit Area of Blanket	ASTM D 5261	0.5 lb/yd^2
Performance @ shear stress of 1.75 lb/ft^2	ASTM D 6460	acceptable
Breaking Force	ASTM D 5035	75 lb/ft

917.08.03 Type 3 Mat – Turf Reinforcement Mat (TRM)

Provide a machine-produced, 3-dimensional matrix of UV stabilized, pre- or post-consumer, non-degradable synthetic fibers, filaments, nettings, and/or wire mesh designed for permanent and critical hydraulic applications where design discharge velocities and shear stresses exceed the limits of mature, natural vegetation. Ensure that the TRM provides sufficient thickness, strength and void space to allow soil filling or retention and the development of vegetation within the matrix. Ensure that the TRM conforms to the property values specified in Table 917.08.03-1.

Table 917.08.03-1 Requirements for TRM

Property	Test Method	Minimum Requirement
Thickness	ASTM D 6525	0.25 in.
Performance @ shear stress of 10.0 lb/ft^2	ASTM D 6460	acceptable
Breaking Force	ASTM D 6818	175 lb/ft
UV Stability @ 500 hours	ASTM D 4355	80%

917.08.04 Type 4 Mat – Mechanically Bonded Fiber Matrix (MBFM)

Provide a hydraulically applied, flexible erosion control blanket composed of long strand, thermally processed wood fibers, crimped, interlocking fibers, and performance enhancing additives. Ensure that the MBFM requires no curing period, and upon application, forms an intimate bond with the soil surface, creating a continuous, porous, absorbent erosion resistant blanket that allows for rapid germination and accelerated plant growth.

Ensure that the MBFM conforms to the property values specified in Table 917.08.04-1.

Table 917.08.04-1 Requirements for MBFM		
Property	**Test Method**	**Minimum Requirement**
Physical		
Mass Per Unit Area	ASTM D 6566	11.5 oz/yd^2
Thickness	ASTM D 6525	0.19 in
Percent Light Penetration	ASTM D 6567	99%
Water Holding Capacity	ASTM WK2652	1500%
Color (fugitive dye)	Observed	Green
Endurance		
Functional Longevity	Observed	1 yr
Performance		
Cover Factor (6 in/hr event)	ECTC Test Method No. 2	0.0066
Percent Effectiveness	ECTC Test Method No. 2	99.34%
Shear Stress	ECTC Test Method No. 3	1 lb/ft^2

917.09 SOD

Machine cut sod at a uniform soil thickness of 5/8 ± 1/4 inch at the time of cutting. Exclude top growth and thatch when measuring for thickness. Ensure that individual strips of sod are of a uniform width. The Department may reject broken strips and torn or uneven strips. If using strip sod, ensure that the strips of sod are strong enough to support their own weight and retain their size and shape when suspended vertically from the upper 10 percent of the strip. If using rolled sod, ensure that the sod is strong enough to be mechanically laid and adjusted without tearing.

Use sod that is Kentucky Bluegrass blend or Kentucky Bluegrass-fescue blend, inspected and certified by the New Jersey Department of Agriculture. Fasten sod on slopes using pegs of wood lath or similar pieces of wood that are at least 9 inches long. Submit certification at the time of delivery that lists the blend of grass seed used.

917.10 PLANT MATERIALS

A. Nomenclature. Plant materials are trees, shrubs, vines, seedlings, ground covers, perennials, bulbs, corms, tubers, ornamental grasses, and other plants conforming to the American Standard for Nursery Stock (ANSI Z60.1) sponsored by the American Nursery and Landscape Association. *Hortus III* is the authority for all plant names. Ensure that all plants are legibly labeled with their botanical names, including English name, genus, species, variety, and cultivar.

B. Quality Requirements. Ensure that the plant materials are healthy, vigorous, and true to species, variety, and cultivar, with well-developed branch and root systems typical of the genus, species, variety, and cultivar. Use plant materials that are free from disfiguring knots, gall, sun scald injuries, bark abrasions, fresh or healed mechanical wounds, or other objectionable disfigurements. Ensure that the average plant size falls within the middle of the allowable size range. The Department will reject plant materials that are weak or thin or that have been cut back from larger grades. Ensure that container-grown plants are well established in the container and have a root mass that will retain its shape and hold together when removed from the container, but that does not exhibit circling or kinked roots. Do not use collected or salvaged plant material except as specified. Provide certifications to the RE that the plant materials were inspected for diseases and infestation according to the applicable Federal, State, and local laws, rules and regulations.

1. Trees. Ensure that the following quality standards are met:

1. Tree crowns are well balanced, symmetrical, and typical for the genus, species, and cultivar.
2. Trees have a single, relatively straight, central leader and tapered trunks and are free of co-dominant stems and vigorous upright branches that compete with the central leader. Ensure that if the original leader has been headed, a new leader at least 1/2 the diameter of the original leader is present.
3. Main branches exhibit uniform scaffolding both radially around and vertically along the trunk, are well spaced with diameters no greater than 2/3 the diameter of the trunk measured 1 inch above the branch, and are free of included bark.

4. Trunk diameters and tapers are sufficient so that the trees will remain vertical without the support of a nursery stake.
5. Root collars (root crowns) and large roots are free of circling or kinked roots.

2. Shrubs. Ensure that the following quality standards are met:

1. Shrubs have the correct number of canes for the genus, species, cultivar and size, and are not several individual plants combined to appear as one plant.
2. Branches and canes are strong enough to support themselves.
3. Roots are well developed and free of circling or kinks.
4. Container grown plants are transplanted and grown in the same container for a sufficient period of time so that new fibrous roots have developed and the root mass will retain its shape and hold together when removed from the container.

3. Perennial Plants. Ensure that the following quality standards are met:

1. Provide bulbs, corms, and tubers that are firm, free of rot and disease, and were not previously frozen.
2. For *Hemerocallis*, provide plants that are established and have 1 to 2 fan divisions with a heavy root system. Ensure that container grown plants were transplanted and grown in the same container for a sufficient period of time so that new fibrous roots have developed and the root mass will retain its shape and hold together when removed from the container.
3. For *Narcissus*, provide bulbs that are, at a minimum, large size grade designated as DNII or RDII.
4. For other perennials, flowers, and ornamental grasses, provide plants according to the supplier's recommendations for each individual cultivar. Ensure that plants are established plants and are a single species plant grown, or transplanted and grown, in the same container for a sufficient period of time so that fibrous roots have developed and so that the root mass will retain its shape and hold together when removed from the container.

C. Substitutions. To request substitutions, provide written verification to the Department that an attempt was made to locate the contract item at a minimum of 9 different nursery sources that would normally supply the item, but that the item was found to be unavailable for planting before the Completion. Upon receipt of the documentation, the Department may allow alternates for unavailable plant materials. Do not make substitutions without the Department's approval.

D. Ball Sizes for Nursery Grown Trees and Shrubs. Ensure that the ball sizes of nursery grown trees and shrubs conform to the requirements specified in Table 917.10-1 through Table 917.10-5.

Table 917.10-1 Required Ball Sizes of Shade Trees and Deciduous Shrubs

Shade Trees		Deciduous Shrubs	
Caliper (inches)	**Minimum Diameter (inches)**	**Height (feet)**	**Minimum Diameter (inches)**
1/2 - 3/4	12	1 - 1-1/2	8
3/4 - 1	14	1-1/2 - 2	9
1 - 1-1/4	16	2 - 3	10
1-1/4 - 1-1/2	18	3 - 4	12
1-1/2 – 1-3/4	20	4 - 5	14
1-3/4 - 2	22	5 - 6	16
2 - 2-1/2	24	6 - 7	18
2-1/2 - 3	28	7 - 8	20
3 - 3-1/2	32	8 - 9	22
3-1/2 - 4	38	9 - 10	24
4 - 4-1/2	42	10 - 11	26
4-1/2 - 5	48		
5 - 5-1/2	54		

Table 917.10-2 Required Ball Sizes of Small Trees			
Height (feet)	**Minimum Diameter (inches)**	**Caliper (inches)**	**Minimum Diameter (inches)**
1-1/2 - 2	10	3/4 - 1	16
2 - 3	12	1 - 1-1/2	18
3 - 4	13	1-1/2 - 1	20
4 - 5	15	3/4	22
5 - 6	16	1-3/4 - 2	24
6 - 7	18	2 - 2-1/2	28
7 - 8	20	2-1/2 - 3	32
8 - 9	22	3 - 3-1/2	38
9 - 10	24	3-1/2 - 4	42
10 - 12	26	4 - 4-1/2	48
		4-1/2 - 5	54
		5 - 5-1/2	

Table 917.10-3 Required Ball Sizes of Columnar Conifers			
Regular Growing Type		**Rapid Growing Type**	
Height (feet)	**Minimum Diameter (inches)**	**Height (feet)**	**Minimum Diameter (inches)**
1 - 1-1/2	10	1 - 2	8
1-1/2 - 2	10	2 - 3	9
2 - 3	12	3 - 4	11
3 - 4	13	4 - 5	12
4 - 5	14	5 - 6	14
5 - 6	16	6 - 7	16
6 - 7	18		
7 - 8	20		
8 - 9	22		
9 - 10	24		
10 - 12	27		
12 - 14	30		
14 - 16	33		
16 - 18	36		
18 - 20	40		

Table 917.10-4 Required Ball Sizes of Conifers and Broadleaf Evergreens			
Spreading, Semi-Spreading, and Globe or Dwarf Type		**Conical and Broad Upright Type**	
Height (feet)	**Minimum Diameter (inches)**	**Height (feet)**	**Minimum Diameter (inches)**
3/4 - 1	8	1-1/2 - 2	10
1 - 1-1/4	9	2 - 3	12
1-1/4 - 1-1/2	10	3 - 4	14
1-1/2 - 2	10	4 - 5	16
2 - 2-1/2	12	5 - 6	20
2-1/2 - 3	14	6 - 7	22
3 - 3-1/2	16	7 - 8	24
3-1/2 - 4	18	8 - 9	27
4 - 5	21	9 - 10	30
5 - 6	24	10 - 12	34
6 - 7	28	12 - 14	38
7 - 8	32	14 - 16	42
8 - 9	36	16 - 18	46
		18 - 20	50

Table 917.10-5 Container Sizes		
Container	**Minimum Diameter (inches)**	**Minimum Depth (inches)**
4"	4	4
No. 1	7	7
No. 2	8	9
No. 3	10	10
No. 5	11	10
No. 7	12	14
No. 10	15	15
No. 15	17	15

E. Ball Sizes for Collected Trees and Shrubs. Ensure that the ball sizes of collected trees and shrubs are greater than or equal to that specified for the next larger size for nursery grown trees and shrubs. Consider trees grown in plantations, reforestation plantations, or without the benefit of root pruning as collected material, and ball and burlap the trees as specified for collected trees.

F. Ball Depths. Ensure that balls are of sufficient depth to encompass the fibrous and feeding root system necessary for the full recovery of the plant and conform to the requirements specified in Table 917.10-6.

Table 917.10-6 Required Ball Depths			
Diameter of ball[1], inches	**Up to 20**	**Over 20 to 30**	**Over 30 to 48**
Minimum depth of ball[1], percentage of diameter	75	67	60
1. Dimensions may vary according to site and type of plant material as provided in the American Standard for Nursery Stock.			

G. Plant Support Materials. Provide the following materials, as necessary, to support plants during the establishment period:

1. Posts. Use white cedar posts that have a diameter of not less than 2 or more than 3 inches at the thinner end, or use wooden posts that have a nominal size of 2 × 2 inches, of solid, reasonably knot-free lumber. Ensure that the length of either post is one-half the height of the plant to be supported, plus a minimum of 2 feet for setting in the ground, except the maximum overall length of any post is 8 feet.

2. Wood Guy Stakes. Use wood guy stakes with a nominal size 2 × 4-inch lumber with a minimum length of 2 feet of solid and reasonably knot-free wood, or use 2-1/2-inch diameter white cedar with a minimum length

of 2 feet. Measure the diameter of the cedar stakes at the thinner end. Ensure that the stakes are pointed on the thinner end. Notch guy stakes 4 inches from the top for fastening the guy wires.

3. **Guy Wire.** Use 14 gauge steel wire for guy wire.

4. **Hose.** Use 1/2-inch OD black corded-rubber hose.

5. **Tree Protectors.** Use 1 of the following tree protectors:

    1. Plastic, wrap-around-the-trunk type, dark brown, dark gray, or dark green in color.
    2. Wire mesh, 1/4 × 1/4-inch mesh, forming a 6-inch diameter cylinder around the trunk, with the abutting edges fastened together with wire.

H. Inspection. Inspect and seal all plants in the nursery before they are shipped. Provide the seal numbers to the Department. If requested by the Department, make the following available for inspection:

1. Containerized plants before shipping and in-ground plants before digging.
2. Delivered plants.
3. Plants during installation.

The Department may inspect plant materials before delivery to the Project Limits and upon delivery to the Project Limits before installation. The Department may seal the inspected plant materials. For plant material originating from nurseries further than 100 miles from the Project Limits, stock plant material at a Contractor-provided holding yard that is acceptable to the Department. The Department may inspect plant material originating from nurseries within 100 miles of the Project Limits at the nursery. Ensure that all plant material is untied and located so that trunk or stem and branch structure can be easily inspected. Provide sufficient notice to allow Department inspection at the nursery or holding yard and to allow time for Contractor reordering of rejected material. Notify the RE at least 72 hours in advance of delivery to the Project Limits for installation. The Department will reject materials arriving with broken or missing seals, broken or loose balls, broken or pruned leaders, insufficient protection, or that have been damaged in transit. The Department may randomly inspect the root system of the plant material by breaking open the earth balls. Provide necessary assistance during Department inspections.

I. Shipment. Ensure that deciduous materials are completely dormant when they are dug. To prevent injury to fibrous roots, carefully dig plant materials immediately before shipment. Ball and burlap plant material marked "B&B" on the Plans.

Ensure that the following plant materials are drum laced or machine dug with wire baskets:

1. Shade trees – 1-1/4 inch caliper and larger.
2. Small trees – 1-1/2 inch caliper and larger.
3. Columnar conifers – 6 feet and taller.
4. Spreading, semi-spreading, and globe or dwarf type conifers – 42 inches in diameter and larger.
5. Conical and broad upright type conifers – 5 feet and taller.
6. Spreading, semi-spreading, and globe or dwarf type broadleaf evergreens – 42 inches spread and larger.
7. Conical and broad upright type broadleaf evergreens – 42 inches and taller.

Use biodegradable materials for burlapping and tying. Do not use non-biodegradable materials such as plastic or nylon.

Protect material that is shipped in open vehicles to prevent desiccation from exposure to the wind and sun. Adequately ventilate material shipped in enclosed vans or boxcars. At time of delivery, provide a delivery ticket indicating the date and origin of shipment, and the botanical names, sizes, grades, and the quantities of plants. Provide a nursery certification that the plants are true to specified genus, species, and variety, and are of the specified size and quality.

For *Hemerocallis*, *Narcissus*, bulbs, corms, tubers, roots, rhizomes, and other perennials, provide supplier's certification of botanical name, including genus, species, variety, and cultivar. The Department will verify the variety and cultivar before use on location.

917.11 MISCELLANEOUS LANDSCAPE MATERIALS

917.11.01 Disinfectant

Use methyl alcohol at 70 percent (denatured wood alcohol diluted appropriately with water) or commercial bleach.

917.11.02 Antidesiccant

Use a polyvinyl antidesiccant.

917.11.03 Herbicides

Use a glyphosate based herbicide. Apply herbicides according to N.J.A.C 7:301 *et seq.*

SECTION 918 – ELECTRICAL MATERIALS

918.01 CONDUIT AND FITTINGS

Ensure that exposed conduit and fittings on sign structures are aluminum conforming to UL standards for rigid metallic conduit. Use fittings and accessories for aluminum conduit that are made of aluminum or stainless steel.

Ensure that conduit and fittings used as a raceway for the installation of wires and cables conform to the following:

1. **Rigid Nonmetallic Conduit.** For rigid nonmetallic conduit, use PVC conduit made from virgin polyvinyl resins conforming to ASTM D 1784, Class 12454-B. Ensure that the conduit exceeds all the property requirements including impact strength, chemical resistance, and flammability as listed in UL 651 and NEMA TC 2. Use rigid nonmetallic conduit that is Type II, Schedule 40 suitable for direct burial under ground in grass and/or berm areas, and Schedule 80 under roadways. Use fittings that are made from high-impact PVC, are the socket type, and are joined to the conduit using PVC solvent cement. Ensure that fittings, including couplings, conform to NEMA TC 3. Use solvent cement to join PVC conduit that is a heavy-bodied cement complying with ASTM D 2564 and apply with a natural bristle or nylon brush.

2. **Rigid Metallic Conduit.** For rigid metallic conduit and fittings, use steel that conforms to UL 6, UL 514B, and ANSI C80.1.

   Manufacture steel conduit from milled steel tubing with a wall thickness equivalent to Schedule 40 pipe. Hot-dip galvanize the conduit for the entire length, including the threads. Ensure that the minimum weight of galvanized coating is 1 ounce per square foot. Supply electro-galvanized couplings. Manufacture rigid metallic conduit sweep elbows to conform to UL 6.

   Fabricate aluminum conduit and fittings from a copper-free, corrosion-resistant aluminum alloy, conforming to ASTM B 429, Alloy 6061-T6.

3. **Flexible Metallic Conduit.** Use flexible metal conduit that consists of spirally wound steel core covered with a PVC jacket manufactured according to Federal Specification A-A-55810 for liquid-tight, flexible, metal conduit. Ensure that associated fittings are of like material and provide positive grounding and a liquid-tight seal.

   Ensure that flexible metal conduit for use on sign structures has an aluminum core with a neoprene jacket.

4. **Flexible Nonmetallic Conduit.** Use flexible HDPE conduit made from a virgin HDPE resin according to the minimum standard of PE334420X according to ASTM D 3350. Ensure resin properties meet or exceed the values listed for HDPE. Ensure HDPE is according to ASTM D 3035, ASTM F 2160, and NEMA TC-7. Ensure the inner wall is ribbed and lubricated with the manufacturer's recommended lubricant. Ensure that the conduit is extruded coilable tubing and is integrally colored orange.

   a. **Direct Burial.** Use conduit material with a wall rating of SDR-9 and is listed for its intended purpose.

   b. **Innerduct.** Use conduit that has a schedule 40 wall rating and is manufactured in accordance with UL specifications.

Submit a certificate of compliance, as specified in 106.07, for all materials, components, and assemblies.

918.02 CABLE AND WIRE

The manufacturer shall provide to the RE and the Contractor all splicing and terminating information necessary for proper installation of the cables and wires.

Ensure that conductors are made of stranded copper and conform to the standard rules of the American Institute of Electrical Engineers and of the National Board of Fire Underwriters. Do not use conductors that are smaller than No. 14 AWG or Brown and Sharp Gage. Ensure that conductors are soft annealed copper wire according to ASTM B 3, Class B for tin-coated conductors or are bare copper conductors according to ASTM B 8, Class B. Submit a certificate of compliance, as specified in 106.07, for all materials, components, and assemblies.

918.02.01 Loop Detector Lead

Use only one type of loop detector lead on the Project.

918.02.02 Loop Wire

Ensure that the loop wire is thermoplastic single conductor wire with a 1/4-inch PVC tube or 1/4-inch, HDPE tube extruded over the loop detector wire, is manufactured in conformance with ICEA Publication No. S-61-402/NEMA Publication No. WC5, and conforms to the following:

1. For the conductor, use No. 14 AWG soft-drawn copper wire with 19-wire (Class C) stranding or 7-wire (Class B) stranding conforming to ASTM B 3 and ASTM B 8.
2. Use insulation that conforms to UL Type THHN/THWN and is rated for 600 volts.
3. Use extruded PVC tubing that is UL listed FR-1 rated at 221 °F, with a minimum wall thickness of 30 mils. Ensure that the tubing is chemical resistant and oil resistant with a moisture absorption of less than 1 percent. Use HDPE tubing that is UL listed with a minimum wall thickness of 30 mils.

918.02.03 Multiple Lighting and Service Wire

Use wire conforming to current ICEA-NEMA Standards Publication for Cross-linked-thermosetting-polyethylene-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy, *ICEA Publication No. S-66-524/NEMA Publication No. WC 7* and UL Type RHW-USE.

Ensure that the insulation is a heat-resistant, moisture-resistant submarine compound conforming to *ICEA Publication No. S-66-524/NEMA Publication No. WC 7*, except for the thickness of insulation. For all conductors, use insulation that is required for 600-volt rated circuit voltage according to Table 3-1 for cross-linked-thermosetting-polyethylene-insulated power cables, Column A of *ICEA Publication No. S-66-524/NEMA Publication No. WC 7*.

918.02.04 Traffic Signal Cable

Use only one type of traffic signal cable on the Project.

918.03 BONDING AND GROUNDING MATERIALS

For rigid metallic conduit with a diameter of 1 inch or more, use bushings that are hot-dip galvanized or electro-galvanized malleable iron, with a bakelite, nylon, or some other type of heat-resistant plastic molded and locked into the bushing. Use an aluminum, bronze, copper, or other corrosion-resistant metal lug. Ensure that the set screws, lug mounting, and binding screws are stainless steel. The Contractor may use threadless bushings at specific locations where the conduit is not threaded.

Fabricate insulating bushings for rigid metallic conduit with a diameter of less than 1 inch of molded high-impact thermoset plastic with a high dielectric and mechanical strength. Bond the conduit with bonding lock nuts. Do not use bushings made of materials that support combustion.

Use ground wire that is bare or insulated with a conductor that is 7-strand, soft-drawn copper conforming to ASTM B 8, Class B. Ensure that bare conductors are tinned. For insulated conductors, cover the conductor with an insulation that meets or exceeds the requirements of UL Type THW.

Use ground rods that are 5/8 inch in diameter and 12 feet long, composed of a steel core with copper covering. Thoroughly weld the 2 metals so that an interlocking crystalline union is secured between the 2 metals. Ensure that the minimum thickness of the copper on the cylindrical portion of the rod averages at least 0.010 inch.

Submit a certificate of compliance, as specified in 106.07, for all materials, components, and assemblies.

918.04 CABLE CONNECTORS

Use cable connectors that are fused for on line wires and nonfused on neutral wires. Ensure that the connectors are a waterproof inline type connector and are composed of a line side and a load side housing, each made of water-resistant synthetic rubber. In each housing, include a section to form a watertight seal around the cable, an interior arrangement to receive and retain the copper fuse contacts, and a watertight seal section at the point of disconnection.

Use contacts that are spring loaded, designed for a maximum current of 30 amperes at 600 volts and have a 90 percent minimum conductivity. Ensure that the contacts are suitable for gripping a cartridge-type midget fuse. Ensure that the fuse is 13/32 inch in diameter and 1-1/2 inches in length and is rated at 5 amperes and that the contacts are fully annealed and compressed onto the cable. Determine the size of each housing based on the cable diameter. Permanently mark each side of the housing as either load side or line side.

Submit manufacturer's certification for all materials, components, and assemblies as specified in 106.07.

918.05 RESIN SPLICING KITS

A. Traffic Signals. Ensure that resin splicing kits are of a type having a soft plastic sealing packet and meet or exceed the conductor's insulation voltage rating.

B. Highway Lighting and ITS. Ensure that resin splicing kits are of a type having a rigid molded plastic casing that is capable of being split laterally to allow insertion of the conductors. Ensure that the resin splicing kits meet or exceed the conductor's insulation voltage rating and are suitable for use with the insulation material.

918.06 ELECTRICAL TAPE

A. Friction Tape. Use friction tape that is the self-sticking, rubber-impregnated, woven cotton fabric type.

B. Insulating Tape. Use insulating tape that is self-bonding and designed for use with cross-linked polyethylene or rubber-insulated wire and cable and that provides a permanent electrical and watertight seal.

C. Jacket Tape. Use jacket tape that is a conformable vinyl, plastic electrical tape, is flame retardant, water resistant, and cold weather pliable. Ensure that the tape is heavy-duty with a minimum tensile strength of 20 pounds per inch, a minimum adhesion of 20 ounces per inch, and a minimum thickness of 8.5 mils.

918.07 CABLE RACKS

Use cable racks that are molded polycarbonate and have a dielectric strength of less than 2 microamps at 100,000 volts. Ensure that the polycarbonate used in the construction of the rack is fire retardant with an SE-1 rating. Use a cable rack that is 3 inches wide and 3 feet long in ground-installed junction boxes or that is 3 inches wide and 1 foot long in structures. Ensure that the cable rack contains 3 saddle arms with a capacity of 2 inches.

As an alternative, the Contractor may use steel cable racks that consist of a steel channel, welded steel supports, a clip, and porcelain insulators for each support. Hot-dip galvanize all steel components. Use a cable rack that is approximately 2 feet long with 3 supports in ground installed boxes and 7 inches long with 1 support in junction boxes located on structures. Space support holes on the channel approximately 1-1/2 inches on center. Ensure that the cable supports are designed with an interlocking feature at the rear of the support to prevent tilting and that the installed cable supports extend approximately 4 inches from the rack. Construct the porcelain insulator required on each support with a hook bottom groove to prevent slipping.

Submit a certificate of compliance, as specified in 106.07, for all materials, components, and assemblies.

918.08 CAST BOXES AND FITTINGS

Use cast boxes with suitable covers of like material held in place with stainless steel fasteners and sealed with a weatherproof neoprene gasket.

Provide mounting lugs with cast boxes. Ensure that all mounting hardware is stainless steel. For cast iron boxes, conform to the requirements specified in 909.03. Hot-dip galvanize cast iron boxes and covers.

Use aluminum boxes and covers that are either sand cast conforming to ASTM B 26, Alloy 356.0-F or 356.0-T6, or die cast conforming to ASTM B 108, Alloy 356.0-T6.

Use junction boxes for underdeck lighting that are cast iron of approved design, suited and adapted to the specific location and the number of conduit, nipples, and other required details. Use flush-type boxes for installation in a structure and surface-mounted-type boxes in all surface applications. Ensure that the cover has a neoprene gasket and is secured with stainless steel screws. If required, equip the box with busses to provide at least 5 full threads or a UL-approved watertight rigid conduit hub at each entry point of the conduit.

Use cast aluminum for pull boxes and pull fittings exposed on sign structures. Use boxes that are of approved design, suited and adapted to the specific location and the number and arrangement of conduit, and other details for the installation. Ensure that boxes have external lugs for mounting and internal mounting buttons for mounting equipment.

Submit a certificate of compliance, as specified in 106.07, for all materials, components, and assemblies.

918.09 CABINETS

For cabinets, use aluminum alloy conforming to ASTM B209, Alloy 6061-T6.

Label the door of all meter and control equipment cabinets, other than traffic signal cabinets, with a permanent reflective metallic sign indicating the voltage and the word **DANGER**. Apply the sign on a 0.040-inch minimum thickness aluminum alloy sheet. Use lettering that is approximately 1-1/2 inches high and is red on a white background. Install the sign with 4 stainless steel vandal proof screws.

Seal a print of the system field wiring in plastic and attach it to the inside of the door of each meter cabinet, control equipment, and controller cabinet.

Submit a certificate of compliance, as specified in 106.07, for all materials, components, and assemblies.

918.10 PANEL BOARDS AND CIRCUIT BREAKERS

A. Traffic Signals. Use panel boards that are single-phase, 3-wire, 120/240-volt, with 70-ampere main-rated busses, conforming to Federal Specification W-P-115C, Type 1, Class 2. Use circuit breakers that are UL listed, comply with NEMA Standards, and conform to Federal Specification W-C-375C, Class 10A.

Submit a certificate of compliance, as specified in 106.07, for all materials, components, and assemblies.

B. Highway and Sign Lighting and ITS Device. Use panel boards and circuit breakers conforming to the following:

1. 120/240-Volt. For 120/240-volt installations use panel boards that are single-phase, 3-wire with 100-ampere main-rated busses, conforming to Federal Specification W-P-115C, Type 1, Class 1. Use circuit breakers that are UL listed, comply with NEMA Standards, and to Federal Specification W-C-375B for Class 10A or Class 10B.

2. 240/480-Volt. For 240/480-volt installations use panel boards that are single-phase, 3-wire, have main busses, rated as designated, and conform to Federal Specification W-P-115C, Type 1, Class 1. Use circuit breakers that are UL listed, comply with NEMA Standards, and conform to Federal Specification W-C-375B for Class 13B.

3. 480-Volt. For 480-volt installations, use panel boards that are the size and type indicated and conform to Federal Specification W-P-115C, Type 1, Class 1. Use circuit breakers that are UL listed and comply with NEMA Standards. Ensure that the circuit breakers are manually operated, molded-case units conforming to Federal Specification W-C-375B for Class 13B.

Submit a certificate of compliance, as specified in 106.07, for all materials, components, and assemblies.

918.11 PHOTOELECTRIC CONTROLS

Use photoelectric controls that are rated for the control or lighting circuit voltage indicated. Provide mounting hardware to allow the unit to be installed in whatever type of location is shown. Ensure that the mounting conforms to the EEI-NEMA Standards for physical and electrical interchangeability of light sensitive control devices.

Submit a certificate of compliance, as specified in 106.07, for all materials, components, and assemblies.

918.12 PEDESTALS, POLES, TRANSFORMER BASES, AND MAST BRACKET ARMS

Fabricate pedestals, poles, transformer bases, and mast bracket arms for traffic signal and highway lighting with materials according to the appropriate ASTM standard and the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. Weld and fabricate steel members according to AWS D1.1, Structural Welding code. For aluminum members, weld and fabricate according to ANSI/AWS D1.2 Structural Welding Code - Aluminum. Ensure that welding is performed by welders who are qualified according to ANSI/AWS D1.1 or ANSI/AWS D1.2, as appropriate. Submit copies of the welder qualifications upon request. Perform at least the minimum specified number of quality control inspections according to the applicable ANSI/AASHTO/AWS specification and any other tests and inspections necessary to control the quality of the work.

Ensure that aluminum poles, lighting, bracket arms, and traffic signal mast arms have a rotary, sand-polish finish giving a nonreflecting outer surface. Ensure that the external surfaces of transformer bases and shoe bases have a satin-type finish. Hot-dip galvanize steel poles and steel traffic signal arms according to ASTM A 123.

If wire or cable passes through a hole or runs along a surface at any point, through or on the complete assembly, ensure that the holes and surfaces are deburred and void of any sharp edges or protuberances that may damage the wire or cable. Install rubber grommets in the entrance hole to the shaft and mast arms where mid-mounted traffic signals are installed.

When installing aluminum traffic signal standards, use stainless steel hardware, bolts, nuts, and washers conforming to 908.04. For steel traffic signal standards, use galvanized hardware, bolts, nuts, and washers conforming to 908.01.

The manufacturer shall test standards and mast bracket arms to ensure compliance with specified material and strength requirements. Perform testing that also ensures that the items have been manufactured in conformance with the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

Ensure aluminum poles and mast bracket arms are factory wrapped to protect them during shipment.

Submit a certificate of compliance, as specified in 106.07, for all materials, components, and assemblies. Submit 5 copies of the certification stipulating that the items conform to the strength and material requirements.

918.13 TOWER POLES

Fabricate according to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

918.14 LAMPS

Submit a certificate of compliance, as specified in 106.07, for all materials, components, and assemblies.

1. **Traffic Signal**. Ensure that traffic signal lamps are 120/125 volts and clear. Use 135-watt lamps that are rated for 6000 hours of life and 60-watt lamps that are rated for 8000 hours of life. Ensure that the lamps meet or exceed the beam candlepower requirements of the ITE signal lamp standard and conform to with the following:

Table 918.14-1 – Requirements for Traffic Signal Lamps

Indication Size	Wattage	Rated Initial Lumens	Center Length
8 inch	60	595	2-7/16 inches
12 inch	135	1750	3 inches
Pedestrian	60	595	2-7/16 inches

2. **Highway Lighting.** Use high pressure sodium lamps that have electrical, physical, and photometric characteristics that conform to ANSI Standards. Ensure that the lamps are rated for 24,000 hours of average

life (based on 10 hours per start) and are equipped with borosilicate glass, have a mogul base, have a universal burning position, and are of the following ANSI designation, initial lumen rating, and nominal lamp voltage:

Table 918.14-2 – Requirements for Highway Lighting Lamps

Wattage	Wattage Designation	Lumens	Voltage
150	SC-150	16,000	55
250	VA-250	27,500	100
400	WA-400	50,000	100

Use mercury vapor lamps that have electrical, physical, and photometric characteristics that conform to ANSI Standards. Ensure that the lamps are rated for 24,000 hours of average life (based on 10 hours per start), are equipped with borosilicate glass, have a mogul base, have a universal burning position, and are of the following ANSI designation and initial lumen rating in the vertical burning position:

Table 918.14-3 – Requirements for Highway Lighting Lamps

Designation	Wattage	Lumens
H 37-5KC/W	250	11,400
H 33-1GL/W	400	22,000

3. **Sign Lighting.** Use lamps for sign luminaires that are 250-watt, phosphor-coated mercury lamps conforming to ANSI H 37-KC-R250/DX.

SECTION 919 – MISCELLANEOUS

919.01 GEOTEXTILES

Provide geotextile rolls with protective wrapping and, before placement, store rolls in a manner that protects against moisture and minimizes exposure to ultraviolet radiation. For applications that are above ground or exposed to ultraviolet radiation, provide geotextiles that are inert to commonly encountered chemicals and are stabilized against ultraviolet light degradation. Label each roll to provide product identification.

Use geotextiles conforming to the requirements in Table 919.01-1 for the intended use.

Table 919.01-1 Requirements for Geotextiles

Category	Test Method	Class
Subsurface Drainage Geotextile	AASHTO M 288	Class 2
Stabilization Geotextile	AASHTO M 288	Class 1
Temporary Silt Fence[1]	AASHTO M 288	–
Erosion Control Geotextile[2, 3]	AASHTO M 288	Class 1 or 2[2]
Paving Fabric	AASHTO M 288	–

1. Use the same geotextile requirements for both silt fence and heavy-duty silt fence. Reinforce heavy-duty silt fence with wire mesh as shown on the Plans.
2. For inlet filters, use Class 2 for woven monofilament geotextiles or Class 1 for all other types of geotextiles.
3. For inlet filter, Type 2, in addition to the AASHTO M 288 requirements, ensure that the geotextile's burst strength is at least 650 pounds per square inch when tested according to ASTM D 3786.

For geotextiles that are being permanently incorporated into the Contract, submit a certification of compliance as specified in 106.07.

919.02 SEDIMENT CONTROL BAG

Manufacture sediment control bags using polypropylene non-woven geotextiles conforming to the requirements in Table 919.02-1. Manufacture sediment control bag with a fill spout large enough to accommodate a 4-inch discharge hose and with straps to secure the hose and prevent pumped water from escaping without being filtered.

Table 919.02-1 Requirements for Sediment Control Bag Geotextile		
Property	**Test Method**	**Requirements**
Weight, oz/yd^2, minimum	ASTM D 3776	10
Grab Tensile Strength, lbs, minimum	ASTM D 4632	250
Puncture Strength, lbs, minimum	ASTM D 4833	150
Flow Rate, gal/min/ft^2, minimum	ASTM D 4491	85
Permittivity, sec^{-1}, minimum	ASTM D 4491	1.2
Mullen Burst Strength, psi, minimum	ASTM D 3786	460
UV Stability, % , minimum	ASTM D 4355	70
Apparent Opening Size, mm, maximum	ASTM D 4751	0.150

919.03 HAY AND STRAW

Use stalks of oats, wheat, rye, or barley that is relatively free from seeds, noxious weeds, and other foreign matter as straw. Ensure that the stalks are free from decayed matter and from organic matter soluble in water.

Use timothy, redtop, or native grasses for hay. Bind haybales with wire or baling twine. Use an ultraviolet light stabilized polypropylene twine that has a knot strength of 170 pounds and straight break strength of 300 pounds.

919.04 GABION WIRE BASKETS

Provide gabion wire baskets that conform to the dimensions shown on the Plans within a tolerance of 5 percent. Use wire mesh that is galvanized steel wire having a minimum size of No. 12 gauge and a tensile strength between 60,000 and 80,000 pounds per square inch. Ensure that the zinc coating is 0.4 pounds per square yard when tested according to ASTM A 90.

Fabricate mesh openings to be hexagonal in shape and uniform in size. For baskets less than 24 inches in height, use openings measuring approximately 2-1/2 × 3-1/4 inches. For baskets greater than or equal to 24 inches in height, use openings measuring approximately 3-1/4 × 4-1/2 inches. Fabricate the wire mesh to be nonravelling when a single strand is cut.

Submit a certification of compliance as specified in 106.07.

919.05 GEOMEMBRANE LINER

For geomembrane liner systems, use HDPE sheeting with a nominal thickness of 30 mils. Manufacture the geomembrane of new, first quality resin formulated specifically for the intended purpose. Use resin as specified in Table 919.05-1.

Table 919.05-1 Requirements for HDPE Resin		
Property	**Test Method**	**Requirements**
Specific Gravity	ASTM D 792	> 0.940
Melt Index	ASTM D 1238	< 0.4 g/10 min
Carbon Black Content	ASTM D 1603	2 - 3%

Ensure that the surface of the geomembrane does not have striations, roughness, pinholes or bubbles and is free of holes, blisters and any foreign matter, such as soil or oil accumulation.

Submit a certification of compliance as specified in 106.07. If requested by the RE, attach a certification from the resin manufacturer certifying that the resin meets the requirements of Table 919.05-1.

919.06 WATERSTOPS

For metallic waterstops, use sheet copper conforming to ASTM B 152, UNS No. C11000, with a weight of 16 ounces per square foot.

Use synthetic rubber or PVC nonmetallic waterstops conforming to Section 8 of *AASHTO LRFD Bridge Construction Specifications*.

Submit certifications of compliance for waterstops as specified in 106.07.

919.07 EPOXY BONDING COMPOUND

For epoxy bonding, use a 2-component, epoxy-resin, bonding system for application to concrete. Ensure that the epoxy bonding compound conforms to ASTM C 881, Type 2, Grade 1 or 2, Class B or C and is listed on the QPL.

Submit certifications of compliance for epoxy bonding compound as specified in 106.07.

919.08 WATER

Use water in mixing or curing of concrete that is free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product. Ensure that water conforms to AASHTO T 26. The Contractor may use water known to be of potable quality without testing. If the source of water is shallow, enclose the intake to exclude silt, mud, grass, or other foreign materials.

If requested by the ME or RE, submit copies of test results for water.

919.09 SODIUM CHLORIDE (ROCK SALT)

Use sodium chloride conforming to ASTM D 632, Type I, Grade 1, with the following exceptions:

1. Ensure that the sodium chloride is in the form of rock salt containing, at the time of delivery, not more than 1.0 percent moisture as determined by drying at 230 ± 9 °F to constant weight.
2. Do not provide evaporated solar or other salt instead of rock salt.

919.10 SLEEVES

Use Schedule 40 PVC drainage pipe according to ASTM D 2729.

919.11 EPOXY INJECTION MATERIAL

Provide epoxy injection material listed on the QPL that meets the requirements of ASTM C 881, Type I or IV, Grade 1, Class B or C. Submit certifications of compliance for epoxy injection material as specified in 106.07.

919.12 POLYETHYLENE SHEETING

Provide polyethylene sheeting that is at least 10 mil in thickness. For concrete curing process, use white polyethylene sheeting as specified in 903.10.03.

919.13 FLOATING TURBIDITY BARRIER

Provide commercially made yellow or "international" orange floating turbidity barriers made of reinforced PVC sheeting as follows:

Table 919.13-1 Requirements for Floating Turbidity Barrier[1]

	Type 1	Type 2	Type 3
Fabric Type	Polyester or Nylon reinforced PVC	Polyester or Nylon reinforced PVC	Nylon reinforced PVC with polypropylene filtration panel[6]
Thickness, mils, minimum	45	45	45 for PVC and filtration panel
Weight, oz./yd^2., minimum	18	22	22
Grab tensile strength, lbs, minimum	300	397	500
UV Inhibited	Yes	Yes	Yes
Seams	Heat Welded	Heat Welded	Heat Welded
Stress Plates			Aluminum
Connecting Hardware	Galvanized	Galvanized	Galvanized
Floatation, lbs/ft, minimum[2]	13	22	29

Table 919.13-1 Requirements for Floating Turbidity Barrier[1]			
	Type 1	**Type 2**	**Type 3**
Bottom load chain or bottom weights[3]	1/4 in. Galvanized, 0.63 lbs/ft. minimum	5/16 in. Galvanized, 0.95 lbs/ft. minimum	5/16 in. Galvanized, 0.95lbs/ft min
Standard Depth[4]	5 ft.	5 ft.	5 ft.
Standard Length[5]	50 & 100 ft.	50 & 100 ft.	50 & 100 ft.

1. Submit manufacture specification to the Department for approval. Specifications vary slightly by manufacturer.
2. Floatation for barriers of depths greater than 10 feet is to be minimum 60 pounds per foot. Floatation must be sufficient to maintain the top of the barrier at an elevation 3 inches above the water.
3. Load chains or bottom weights shall be heavy enough to keep the floating turbidity relatively vertical in all flows.
4. The depth of the barrier may be greater than or lesser than 5 feet and shall be designed for the site.
5. The maximum length for barriers of depth greater than 10 feet is 50 feet.
6. The polypropylene filtration panel shall be no more than approximately 20 percent of the surface area.

919.14 DETECTABLE WARNING SURFACE

For detectable warning surfaces, use a surface or a coating material that is safety red in color according to FED-STD-595B color chip No. 31350 and has a 35 BPN minimum slip resistance when tested according to ASTM E 303. Ensure that the finished product is stabilized against UV degradation and adheres to the substrate without peeling or blistering.

DIVISION 1000 – EQUIPMENT

SECTION 1001 – TRAFFIC CONTROL EQUIPMENT

1001.01 FLASHING ARROW BOARD

Provide Type A and Type C flashing arrow boards according to the MUTCD and the following requirements:

1. Non-reflective, black boards equipped with battery-operated amber lights.
2. A minimum peak luminous intensity of 8800 candelas and equipped with photocells that will automatically reduce the luminous intensity to 1500 candelas when the ambient light level drops to 5 foot-candles.
3. A light on the rear face of the board to indicate that the lights are operating.
4. Solid state controls with polarity and surge protection.
5. Panel operation controls mounted in a lockable enclosure.

Ensure flashing arrow boards are equipped with a diesel charged battery system. Do not use gasoline powered systems. With RE approval, the Contractor may use flashing arrow boards equipped with solar charged battery systems in non-moving operations. The Department may require a solar charged battery system in noise sensitive areas.

Securely mount flashing arrow boards on a manufacturer-approved 2-wheeled towing trailer.

1001.02 PORTABLE VARIABLE MESSAGE SIGN

Provide a portable variable message sign capable of displaying messages that are visible under ideal day and night conditions from a minimum distance of 1/2 mile and that are legible from a minimum distance of 900 feet with a viewing angle of at least 25 degrees. Ensure that the portable variable message sign is able to operate in ambient temperatures of −30 to 160 °F and is capable of withstanding wind gusts up to 80 miles per hour when positioned. Provide a portable variable message sign with the following:

1. Sign Panel. Provide a sign panel capable of displaying 3 lines of a message, with each line capable of displaying up to 8 characters. Ensure that the characters have a minimum height of 18 inches, a minimum width of 12 inches, and are spaced at least 3 inches apart. Compose characters of a 5 wide by 7 high pixel matrix, with each pixel composed of between 4 and 6 LED lights. Ensure that the LED lights have a dominant wavelength between 585 and 595 nanometers and are set against a black background. Ensure that the LED lights provide a minimum daylight luminance of 1000 candelas per square meter. Ensure that the sign is equipped with a photocell to automatically reduce the LED lights' luminance to between 30 to 100 candelas per square meter when the ambient light level drops to 5 foot-candles. Ensure that LED lights maintain constant luminance intensity with changes in battery voltage.

Ensure that the sign panel is covered with an ultraviolet-resistant, clear polycarbonate.

2. Controller. Ensure that the controller is unaffected by radio transmissions. Ensure that the controller is capable of displaying 3 messages sequentially. Ensure that controller has an adjustable display rate with a minimum of 3 seconds per phase. Ensure that the controller is capable of storing 100 user programmed messages in nonvolatile memory that will retain the programmed messages when power is interrupted. Provide a controller display screen that allows the operator to review messages before displaying on the message sign. Ensure that the controller display shows the operator all programming instructions. Ensure that the messages are able to be programmed at the sign with an integral or plug-in keyboard, and remotely with a cellular telephone.

Secure panel controls in a lockable weatherproof enclosure. Prevent unauthorized access to the controller by requiring a password to the keyboard. Prevent unauthorized remote access by requiring a password. If the correct password is not entered within 60 seconds of initial phone contact, the phone call will terminate.

3. Power Source. Equip portable variable message signs with either a diesel charged or a solar charged battery system. Ensure that the variable message sign is also capable of operating on 120-volt AC electrical service. The Department may require a solar charged battery system in noise sensitive areas. Provide the power with a

battery back up system capable of providing continuous operation when the primary power source fails. Ensure that the power source meets the following requirements:

a. Diesel. Ensure that the fuel tank is capable of operating the sign for a period of 72 hours without refueling. Equip with an exhaust muffler and a United States Department of Forestry approved spark arrester. Ensure that the engine is shock mounted to reduce vibration and locked in a ventilated enclosure.

b. Solar. Provide solar panels capable of recharging the batteries at a rate of 4 hours of sun for 24 hours of sign usage. Ensure that the battery capacity is capable of operating the sign for a period of 18 days without sunlight.

4. Structural Support System. Mount the variable message sign on a portable 2-wheeled trailer. Ensure that the sign panel is capable of being raised or lowered during sustained wind speeds of 30 miles per hour. Ensure that the sign panel is capable of being locked into position and is capable of being positioned at the proper height and orientation required for visibility according to the MUTCD.

1001.03 TRAFFIC CONTROL TRUCK WITH MOUNTED CRASH CUSHIONS

Provide a truck having a minimum gross weight of 10 tons, affixed with a bed-mounted, type C flashing arrow board, as specified in 1001.01, and a rear mounted crash cushion. The Contractor may use precast concrete ballast to meet the weight requirement. When using ballast, ensure that it is securely fastened to the truck. Provide crash cushions that conforms to the following requirements:

1. Meets NCHRP 350 Level 3 crash-worthiness requirements.
2. Designed to be attached to the rear of a truck.
3. Equipped with a 90-degree hydraulic tilt system to raise and lower the crash cushion. The tilt system shall have a locking mechanism to secure the crash cushion when in the raised position.
4. If equipped with energy absorbing modules, ensure that they are painted yellow.
5. Displays alternating 6-inch wide black and yellow bands, composed of Type III-retroreflective sheeting, as specified in ASTM D 4956, in an inverted "V" chevron pattern on the surface of the rear module that faces traffic. When in the raised position, ensure that the surface of the rear facing module also displays the chevron pattern.
6. Equipped with standard trailer lighting systems, including brake lights, taillights, and turn signals that are visible in the raised and lowered positions.

SECTION 1002 – COMPACTION EQUIPMENT

1002.01 PNEUMATIC-TIRED COMPACTOR

Provide a self-propelled, 2-axle, pneumatic-tired compactor equipped with pneumatic tires mounted to completely cover the area to be compacted in a single pass. Provide compactors with a minimum width of 5 feet. Ensure that the wheels on at least 1 axle oscillate vertically, either independently or in pairs. Equip wheels with smooth, wide-tread compactor tires of equal size and diameter. Ensure that the compactor is capable of producing a uniform, ground contact pressure on a level, unyielding surface through a range of 60 to 95 pounds per square inch on all wheels.

Uniformly inflate all tires. Ensure that tire pressures do not vary by more than 5 pounds per square inch. Provide charts and tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the tires used. Maintain operating tire contact pressure using ballast, and do not allow tire inflation pressure combinations to exceed the recommendations of the Tire and Rim Association Incorporated for the applicable tire size and ply rating. Do not provide wobble-wheeled compactors.

1002.02 DYNAMIC COMPACTOR

Provide a vibratory roller or vibratory pad-type compactor capable of operating at the optimum frequency of vibration required for the size and type of compactor used and for the type of material being compacted. Mount on the vibratory

roller a readily visible instruction plate containing the manufacturer's recommended operating frequency, amplitude, and roller speed.

Provide vibratory pad type compactors when access with a vibratory roller is not practical.

1002.03 STEEL-WHEEL ROLLER

Provide a power-driven, 2-axle tandem roller with a load of at least 250 pounds per inch of width of tread of drive roll and a total ballasted weight of at least 8 tons.

1002.04 PADFOOT ROLLER

Provide a tamping type or padfoot roller, with 1 or more cylinders, having pads of not less than 6-1/2 inches in length and capable of developing a pressure of not less than 200 pounds per square inch of bearing surface when a complete row of pads is in contact with a level surface.

SECTION 1003 – HMA SITE EQUIPMENT

1003.01 MATERIALS TRANSFER VEHICLE (MTV)

Ensure that the MTV is capable of independently delivering HMA from the hauling equipment to the paving equipment. Ensure that the MTV is equipped with a high-capacity truck unloading system to receive mixtures; a storage system capable of holding at least 15 tons of HMA; and a discharge conveyor capable of swiveling to either side to deliver HMA to the paving spreader while allowing the MTV to operate from an adjacent lane. Ensure that the MTV is equipped with an automatic audible warning signal when operating in reverse.

Provide a paver hopper insert with a minimum capacity of 14 tons in the hopper of conventional paving equipment.

Provide a remixing system to continuously blend the HMA before placement. Remixing may occur within the MTV or in the paver hopper.

1003.02 HMA CURB MACHINE

Provide a self-propelled, automatic HMA curb machine specifically designed to produce HMA curb, or a paver with attachments that produces curb of uniform texture, shape, and density.

1003.03 HMA PAVER

For paving widths of 8 feet or more, provide a self-propelled HMA paver with an activated screed or strike-off assembly capable of spreading and finishing HMA in the lane widths and thicknesses required. Ensure that the paver is capable of being operated at forward speeds consistent with satisfactory laying of the mixture. Ensure that the paver is equipped with an automatic audible warning signal when operating in reverse.

Ensure that the paver is also equipped with the following:

1. **Receiving Hopper and Distribution System.** Ensure that the receiving hopper is equipped with a distribution system capable of placing the HMA uniformly in front of the screed.
2. **Screed or Strike-off Assembly.** Ensure that the screed or strike-off assembly produces finished surface of the required evenness and texture without tearing, shoving, or gouging the HMA. Ensure that the screed or strike-off assembly compacts the full width of the course being laid.
3. **Screed Heater.** Ensure that the paver is equipped with a system for heating the screed or strike-off assembly.
4. **Sloped Plate.** When constructing longitudinal wedge joints, ensure that the paver is equipped with a sloped plate. Ensure that the sloped plate is attached to the paver screed extension and is capable of producing a wedge edge having a face slope of 3H:1V. Ensure that the plate can accommodate compacted layer thicknesses from 1-1/2 to 4 inches. Mount the bottom of the sloped plate 3/8 to 1/2 inch above the existing surface. Ensure that the sloped plate is interchangeable for use on either side of the screed.

5. **Automatic Slope Controls.** Ensure that the automatic slope control system maintains the screed or strike-off assembly in a constant position relative to profile and cross-slope references. Use references to ensure that control of the screed or strike-off position is independent of irregularities in the underlying surface and spreader operation. When paving in widths that exceed the manufacturer's recommendations for use of the automatic slope control, use an RE approved grade reference system on both sides of the paver. If the RE determines that the automatic controls are ineffective, the Contractor may use other RE approved methods.

6. **Automatic Profile Control**. For the first lift of paving, use a stringline or an RE approved electronic grade reference system for longitudinal grade control. For a stringline reference system, provide a line supported by devices compatible with the type of automatic paver control system used. Use stringline and supports capable of maintaining line and grade at the point of support while withstanding the tensioning necessary to prevent sag in excess of 1/4 inch between supports spaced 50 feet apart. Install additional supports spaced 25 feet or less apart to remove any apparent deviation of the stringline from the specified grade. The RE may require spacings of 25 feet at the crest and bottom of vertical curves. If the first lift of paving is placed on or adjacent to a surface that has been placed to the specified line, grade, and cross-section and has been approved by the RE, the Contractor may use a ski-type reference system.

   For subsequent lifts of paving, use a ski-type grade reference system. The RE may allow the use of a joint-matching shoe instead of the ski during paving.

7. **Manual Override System.** Ensure that the paver is capable of manual override of the automatic controls while the paver is in automatic operation.

For paving widths of less than 8 feet, provide a paver that is capable of spreading and finishing HMA to the shown widths and thicknesses.

1003.04 ULTRA-THIN LIFT PAVER

Provide a self-propelled paver specifically designed for applying ultra-thin friction course. Provide a single unit capable of spraying the modified asphalt tack/seal coat and spreading the mixture. Ensure that the paver is capable of spreading, without tearing, shoving, or gouging the mixture, to produce a smooth surface. Use a paver that is heated and capable of spreading and finishing the modified asphalt tack/seal coat and the ultra-thin HMA material to the widths and application rates shown. Provide pavers capable of operation at forward speeds of 70 to 100 feet per minute. Do not operate pavers at speeds less than 30 feet per minute. Ensure that the paver is equipped with an automatic reverse signal alarm that is audible above the surrounding noise.

1003.05 HMA COMPACTOR

Provide to the RE the manufacturer's technical data sheets, including the weight and dimensions of the rollers to be used.

Ensure that the roller is equipped with adjustable scrapers to keep wheels clean and with a system to keep wheels moist to prevent HMA from sticking to the wheels. Use wheels free of flat areas, openings, or projections that may mar the surface.

Ensure that the roller is equipped with an automatic audible warning signal when operating in reverse. Use rollers capable of reversing direction without backlash and that conform to the following:

1. **Steel-Wheel Roller.** Provide a power-driven, 2-axle tandem roller with a load of at least 250 pounds per inch of width of tread of drive roll and a total ballast weight of at least 8 tons.

2. **HMA Vibratory Roller.** Provide a self-propelled vibratory roller with at least 2 smooth steel drums. Use a vibratory roller having a static weight of at least 6-1/2 tons and that is capable of maintaining the frequency and amplitude of vibration specified by the manufacturer. Ensure that the vibratory roller is also equipped with the following:

   1. One light on each fender, or alternatively, 1 light above the roller, visible from a distance of 200 feet. Ensure that the light blinks when the vibratory system is in operation.
   2. Provide a speed indicator in feet per minute or tenths of a mile per hour and a frequency indicator to allow the operator to closely control the rolling speed.
   3. Equip rollers with an automatic vibration disconnect system that automatically shuts off the vibration when the roller is in a stationary position. Provide a mechanical override system in the

event of temporary failure of the automatic system that shuts off the vibration when the roller is in a stationary position.

Provide instruction sheets for each vibratory roller used indicating operational instructions, recommended amplitude, vibrations per minute, and speed settings.

1003.06 VIBRATORY DRUM COMPACTOR

Provide a self-propelled vibratory drum compactor, equipped with 1 or 2 smooth steel drums having a minimum centrifugal force of 177 pounds per inch of width of tread of drive roll. Ensure that the self-propelled vibratory drum compactor is capable of maintaining the frequency of vibration and amplitude specified by the manufacturers. For each vibratory roller used, provide the manufacturer's recommendations indicating operational instructions, recommended amplitude, vibrations per minute, and speed settings.

1003.07 BITUMINOUS MATERIAL DISTRIBUTOR

Provide a pressurized bituminous material distributor capable of maintaining bituminous material within the specified temperature range and applying the material uniformly over variable surface widths of up to 15 feet. Ensure that the bituminous material distributor is equipped with the following:

1. Temperature gauge on the truck body to indicate the temperature of the contained bituminous material.
2. A separate power unit for the pump.
3. Full circulation spray bars that are adjustable laterally and vertically.
4. An analog or digital readout meter calibrated in English units.

1003.08 SEALER APPLICATION SYSTEM

Provide sealing equipment for sealing joints or cracks that consists of a kettle or melter and an applicator wand. Ensure that the melter is a double boiler, with the space between the inner and outer shells filled with oil or other heat transfer medium. Ensure that the melter includes positive temperature control, mechanical agitation, recirculation pumps, and thermometers for continuous reading of the temperature of both the sealing compound and the heat transfer medium. Use a heated or insulated applicator wand to maintain the pouring temperature of the sealant during the placing operation. Do not use pouring pots or similar devices to fill sawed joints or cracks.

SECTION 1004 – PILE DRIVING EQUIPMENT

1004.01 IMPACT HAMMER

Ensure that air, hydraulic, and diesel hammers develop at least 6000 foot-pounds of energy per blow. Ensure that drop hammers have a ram weight of at least 2000 pounds and a maximum drop of 8 feet.

For steam or air hammers, ensure that the weight of the ram is at least 1/3 the weight of the pile. For diesel hammers, ensure that the weight of the ram is at least 1/4 the weight of the pile.

Provide diesel hammers equipped with gauges and charts for the determination of the actual driving energy produced under all driving conditions.

1. **Hammer Cushion.** Ensure that impact pile driving equipment, except for gravity hammers, are equipped with a suitable thickness of hammer cushion material to prevent damage to the hammer and pile and to ensure uniform driving. Provide hammer cushions made of manufactured materials according to the hammer manufacturer's guidelines.

   Do not use wood, rope, wire rope, hose, tires, or asbestos hammer cushions.

   As recommended by the hammer manufacturer, place a striker plate on the hammer cushion to ensure uniform compression of the cushion material. Inspect the hammer cushion in the presence of the RE when beginning pile driving at each structure or after each 100 hours of pile driving, whichever is less. Replace the hammer cushion when its thickness is less than 75 percent of the original thickness.

2. **Pile Cushion.** Use pile cushions made of plywood to protect the heads of concrete piles. Ensure that the plywood thickness is at least 4 inches before driving. Ensure that the pile cushion dimensions match the cross-sectional area of the pile head.

   Provide a new pile cushion for each pile. Immediately replace the pile cushion if it splits, is compressed to half of its original thickness, begins to burn, or does not function as intended.

3. **Pile Drive Head.** Equip piles driven with impact hammers with a pile drive head to distribute the hammer blow to the pile head. Ensure that the pile drive head is aligned axially with the hammer and the pile. Use leads to guide the pile drive head. Ensure that the pile drive head fits around the pile head and prevents the transfer of torsional forces during driving operations while maintaining the proper alignment of the hammer and the pile.

   For steel and timber piles, ensure that the pile heads are cut squarely and provide a pile drive head to hold the longitudinal axis of the pile in line with the hammer.

   For precast concrete and prestressed concrete piles, ensure that the pile head is plane and perpendicular to the longitudinal axis of the pile to prevent eccentric impacts to the pile head.

   For special types of piles, provide appropriate pile drive heads, mandrels, or other devices to ensure that the piles are driven without damage.

1004.02 VIBRATORY HAMMER

Select the vibratory hammer that satisfies the equation in which driving amplitude equals 2 times the eccentric moment divided by the vibratory load, as shown below.

$$\text{Driving Amplitude} = \frac{2 \times \text{Eccentric Moment}}{\text{Vibratory Load}}$$

Ensure that the solution of this equation is between 1/4 and 1/2 inch. The vibratory load is the sum of the weight of the pile and the weight of the vibrating mass of the vibrator, including the weight of the clamp, housing, and jaws. Obtain the Eccentric Moment from the manufacturer.

1004.03 LEADS AND FOLLOWERS

Provide pile driving leads that are straight and support the vertical or battered pile and hammer in proper position throughout the driving operation. Use leads that allow the hammer to move freely and ensure concentric impact for each blow. Use leads that are of sufficient length so that followers are not required. Use either fixed or swinging leads.

Use guys or braces to hold fixed leads in position to ensure support of the pile during driving operations. When using swinging leads, fit with a pile gate at the bottom of the leads. When using swinging leads, the RE may require a horizontal brace for battered piles. To maintain alignment, ensure that swinging leads are embedded in the ground or that the pile is constrained in a structural frame, such as a template.

Except where piles are driven through water, do not use followers unless approved by the RE.

SECTION 1005 – CONCRETE SITE EQUIPMENT

1005.01 PAVEMENT FORMS

Provide straight-sided, metal forms with a thickness of at least 1/4 inch and sections at least 10 feet in length. Ensure that forms have a depth at least equal to the thickness of the concrete without horizontal joint and a base width at least equal to the depth of the forms. Use flexible or curved forms of wood or metal with the proper radius for curves with a 100-foot radius or less. Provide forms with devices for secure setting to ensure that when in place, the forms will withstand, without visible deflection or settlement, the impact and vibration of the consolidating and finishing equipment. Ensure that flange braces extend outward on the base at least two-thirds the height of the form. Ensure that the top face of the form does not vary from a true plane by more than 1/8 inch in 10 feet, and that the face of the form does not vary more than 1/4 inch.

Ensure that the forms are capable of tightly locking ends of abutting sections for secure setting. Use metal pins of the required size and length to hold the forms rigidly and securely in place. Ensure that pins are at least 2 feet in length.

1005.02 SPREADING AND FINISHING MACHINE

Provide a vibratory, power driven spreading and finishing machine capable of striking off, screeding, consolidating, and floating the concrete to the required cross-section and elevation. Ensure that the spreading and finishing machine has sufficient weight and strength to produce the necessary pressure and is capable of being adjusted to produce the cross-section and finish required. Ensure that the spreading and finishing machine is geared to operate consistently and smoothly and is equipped with at least 2 oscillating-type transverse screeds and a scraping device to keep the tops of the forms clean.

1005.03 SPREADING AND FINISHING MACHINE FOR CONCRETE BRIDGE DECKS

Provide a self-propelled, rotating cylinder type or oscillating type finishing machine. The Contractor may use longitudinal or transverse type finishing machines. Ensure that the finishing machine is capable of operating forward and backward to repeat passes to correct surface irregularities and to produce a surface that conforms to the required profile grade, cross-section, and surface tolerances. If using a longitudinal finishing machine, ensure that the machine is capable of finishing the full length of the span, or finishing the full length between designated or approved construction joints. If using a transverse finishing machine, ensure that the machine is of sufficient size to finish the full width of deck between curbs, or the full distance between longitudinal construction joints. Ensure that the machine is equipped to travel on steel rails, pipe, or other supported grade controls securely fastened in place to prevent any appreciable deflection between supports.

1005.04 VIBRATOR

Use spud vibrators for consolidating concrete. The Contractor may use hand operated vibrators or vibrators attached to the spreading and finishing machine, or mounted on a separate carriage. Ensure that vibrators have a minimum frequency of 5000 impulses per minute.

Except for hand-held vibrators, ensure that vibration operation is controlled by the forward movement of the spreading and finishing machine so that vibration automatically ceases when the forward movement of the spreader is stopped.

1005.05 SLIP-FORM PAVER

Provide a self-propelled slip-form paver designed to spread, consolidate, screed, and float-finish the concrete for the full depth of the slab in 1 pass of the machine. Ensure that the slip-form paver is equipped with automatic alignment and grade controls consisting of a sensing device that continuously remains in contact with a sensing guide. Use a slip-form paver that is capable of vibrating the concrete for the full width and depth of the slab and that automatically ceases vibrating when the paver's forward movement is stopped.

1005.06 SLIP-FORM (EXTRUSION) MACHINE

Provide a slip-form (extrusion) machine capable of placing concrete through a mold of proper cross-section to produce concrete of the specified shape, surface texture, and density. Ensure that the slip-form machine is capable of consolidating the freshly placed concrete in 1 pass of the machine. Ensure that the slip-form machine is equipped with internal vibrators for consolidating the concrete along the faces of forms and adjacent to joints to produce a homogenous parapet, free from voids and honeycombs, and requiring no further finishing other than that required for Class 1 finish.

Ensure that the forming section of the slip-form machine is adjustable vertically during the forward motion of the machine to conform to the predetermined grade line. Attach a grade line gauge or pointer to the machine to ensure that continual comparison between the barrier being placed and the established grade line, as shown by the offset guide line, can be made.

Ensure that the slip-form machine is equipped with an automatic reverse signal alarm that is audible above the surrounding noise.

1005.07 EPOXY RESIN INJECTION EQUIPMENT

Provide a positive-placement, fixed-ratio type pump for injecting epoxy resin adhesive into concrete cracks. Ensure that the equipment is capable of automatically mixing 2 components at the nozzle. Also ensure that the equipment is equipped with a rubber nozzle arrangement that will allow injection of adhesive, without air entrapment, at pressures of up to 300 pounds per square inch to ensure complete penetration of cracks. Also ensure that the machine is equipped with a pressure gauge at or near the nozzle to verify the working pressure.

SECTION 1006 – CONCRETE PAVEMENT REHABILITATION EQUIPMENT

1006.01 BREAKER

A. Resonant Breaker. Provide a self-contained, self-propelled, resonant frequency breaker specifically designed for rubblizing concrete pavement. Ensure that the machine is capable of producing low-amplitude (1-1/2 inch maximum) blows with a 2000-pound force and delivering blows to the existing concrete surface at a rate of at least 44 cycles per second. Equip the resonant breaker with a screen to protect vehicles in adjacent lanes from flying chips during breaking.

B. Multi-Head Breaker. Provide a self-contained, self-propelled, multi-head breaker specifically designed for rubblizing concrete pavement. Ensure that the multi-head breaker is capable of rubblizing the full lane width. Mount pavement breaking hammers so that there is continuous breakage from side to side. Ensure that the lift height of the hammers is independently adjustable. Equip the multi-head breaker with a screen to protect vehicles in adjacent lanes from flying chips during breaking.

1006.02 SEATING EQUIPMENT

A. Z-Grid Roller. Provide a vibratory roller fitted with a "Z" pattern grid on the drum face. Ensure that the roller has a gross weight of at least 10 tons and is capable of seating the rubblized pavement.

B. Vibratory Roller. Provide a vibratory roller fitted with a smooth steel drum. Ensure that the roller has a gross weight of at least 10 tons and is capable of seating the rubblized pavement and providing an even surface for the HMA overlay.

1006.03 GROUT PUMPING UNIT

A. Positive-Displacement Injection or Non-Pulsating Progressive-Cavity Pump. Use either positive-displacement injection or non-pulsing progressive-cavity pumps. Ensure that the injection pump produces a maximum pressure of 200 pounds per square inch when pumping grout, and that meets the 12-second flow cone time. Ensure that the pump is capable of sustaining continuous pumping at rates as low as 1-1/2 gallons per minute. If the pump fails to meet this requirement, modify the system by adding a recirculating hose and valve at the discharge of the pump.

B. Truck-Mounted Pumping Unit. Provide a truck-mounted pumping unit capable of injecting high-density polyurethane at a controlled rate directly beneath the concrete pavement. Ensure that the pumping unit is equipped with a manufacturer's certified meter to measure the amount of high-density polyurethane injected at each location. Ensure that the system is capable of immediate control of the material flow to avoid excessive lifting of the pavement slabs.

Ensure that each pumping unit is equipped with a digital output device capable of recording pump strokes. Convert the pump strokes to pounds using a calibration chart obtained from the pump manufacturer. Ensure that each digital output device is equipped with a manual reset button.

1006.04 MIXER

Provide a high-speed centrifugal pump mixer or high-speed shear-blade mixer. Ensure that the centrifugal pump mixer is capable of pulling the grout through a mixing chamber at high pressure and high velocity. Operate the shear-blade mixer between 800 and 2000 rotations per minute, creating a high shearing action and subsequent pressure release to make the mixture homogenous.

1006.05 INJECTION DEVICE

Provide grout hole packers, of either the drive packer or expanding rubber type, to hold the injection pipe and discharge nozzle tightly in place while grout is being pumped. Ensure that hoses used for transporting grout from the pump to the packer are 3/4 to 1-1/2 inches in diameter.

1006.06 LIFT MONITORING EQUIPMENT

Provide dial gauges and a laser leveling unit, capable of measuring vertical uplift or deflection to 0.001 inch, to detect slab movement with respect to a stable reference point. Ensure that the equipment is capable of detecting the movement of the pavement edge or any 2 outside slab corners adjacent to a joint and the adjoining shoulder. Obtain RE approval of the devices before using.

1006.07 DEFLECTION TESTING EQUIPMENT

Provide a falling weight deflectometer capable of applying at least 12,000 pounds of force to test joints and cracks. Ensure that reference calibration of the falling weight deflectometer is performed annually at a Strategic Highway Research Program calibration center. Submit certification of reference calibration to the RE before beginning testing. Ensure that relative calibration is performed no more than 15 days before testing.

1006.08 GRINDING MACHINE

Provide a self-propelled machine equipped with diamond blades designed for grinding and texturing concrete surface courses. Ensure that the machine is properly sized to grind a strip at least 3 feet in width without operating in adjacent traffic lanes. Ensure that the grinding machine will not damage or cause strain to the underlying concrete surface course, or cause excessive ravels, aggregate fractures, spalls, or disturbance of transverse or longitudinal joints.

Ensure that the grinding machine is capable of immediately collecting the slurry produced from the operations. The Contractor may use a grinding machine that does not collect slurry if the RE approves an alternate slurry collection method.

1006.09 SCARIFICATION EQUIPMENT

Provide self-propelled scarification equipment that is capable of scarifying across the cutting path in 1 pass to a minimum depth of 1/4 inch. Use equipment capable of establishing profile grades by referencing from existing grades and capable of controlling cross slopes. Use equipment capable of removing milled material from the surface and preventing dust and other materials from escaping into the air. Use equipment with a floating type head that allows for deeper cutting in areas of deteriorated concrete and that is capable of locking out the head float.

SECTION 1007 – TRAFFIC STRIPING EQUIPMENT

1007.01 EPOXY STRIPING UNIT

Provide epoxy striping equipment designed to apply long-life material in variable widths at a consistent temperature. Ensure that the epoxy striping equipment is capable of continuously mixing and agitating the material and is equipped with the following:

1. **Epoxy Striping Units.** Provide the following with each epoxy striping unit:
    1. A calibration sheet, certified by the manufacturer or testing agency, that shows the number of the truck, the capacity, and an outage table in increments of not over 1/2 inch.
    2. A metal rod for each holding vessel, with accurate divisions marked and consecutively numbered starting at the bottom. Do not use a rod less than 1 foot longer than the depth of the vessel.
    3. Slip-proof steps with handrails to ground level and a slip-proof catwalk with handrail running along the top of the vessel.
2. **Epoxy Striping Applicator.** Ensure that the epoxy striping applicator is equipped with the following:
    1. A tachometer and a pressure gauge.

2. A calibrated holding vessel for each long-life material component. Ensure that the holding vessels for the epoxy pigments and hardener have thermometers for measuring the temperature of vessel contents.
3. A separate power unit for the pumps used to mix and distribute the components.
4. Mixing and conveying parts and the shaping dies or spray gun that is capable of maintaining the material at optimum plastic temperature.
5. A mechanical glass bead dispenser that automatically dispense beads uniformly on wet stripes or markings at the rates specified.

1007.02 THERMOPLASTIC APPLICATOR

Provide a thermoplastic applicator designed to apply thermoplastic in multiple widths between 4 to 12 inches and multiple thickness settings to achieve above the pavement thickness of 90 to 120 mils. Ensure that the thermoplastic applicator is equipped with the following:

1. An oil-jacketed or air-jacketed pre-melting kettle equipped with an automatic thermostat control device to provide positive temperature control and continuous mixing and agitation of the thermoplastic material.
2. An applicator storage kettle with an automatic thermostat control device to maintain the thermoplastic material at the application temperature and provide continuous mixing and agitation of the thermoplastic material during installation.

Ensure that the thermoplastic applicator has a capacity for containing a minimum of 1500 pounds of molten thermoplastic.

The Department may require special thickness equipment for in lane or shoulder transverse rumble strip pavement markings.

1007.03 TRAFFIC STRIPE AND MARKING REMOVAL EQUIPMENT

For removing traffic stripes and traffic markings, provide equipment containing a vacuum system to remove all millings from the pavement surface and prevent residue from becoming airborne.

1007.04 RUMBLE STRIP CUTTING MACHINE

Provide a rumble strip cutting machine equipped with an acceptable guide that extends in front of the machine and is clearly visible to the operator to maintain alignment.

SECTION 1008 – MISCELLANEOUS EQUIPMENT

1008.01 MILLING MACHINE

Provide a self-propelled planing, grinding, or cutting milling machine with variable operating speeds that is capable of removing HMA or concrete without the use of heat. Ensure that the milling machine is equipped with automatic grade controls. Use either a stringline or ski type reference system. If a ski type reference system is used, ensure that the ski has a minimum length of 20 feet. Ensure that the milling machine is equipped with an automatic audible warning signal when operating in reverse. The RE may not require use of the automatic grade controls at intersections and other locations.

Immediately replace teeth in the milling drum that become dislodged, broken, or unevenly worn with teeth of the same length as the remaining teeth in that row.

1008.02 STRAIGHTEDGE

Provide an aluminum straightedge at least 10 feet in length. Provide up to a 16-foot straightedge if requested by the RE. Ensure that straightedges are kept clean and straight.

1008.03 MECHANICAL SWEEPER

Provide a self-propelled vacuum or vacuum assisted sweeper that is capable of collecting and containing debris. Do not use steel bristles. Ensure that the sweeper is equipped with an automatic audible warning signal when operating in reverse.

1008.04 PAVEMENT SAW

Provide a power-driven pavement saw capable of sawing to the required dimensions in 1 pass without causing uncontrolled cracking. Equip the pavement saw with water-cooled, circular, diamond-edge blades or abrasive wheels, and alignment guides. Ensure that the pavement saw is capable of immediately collecting the slurry produced from the operations. The Contractor may use a pavement saw that does not collect slurry if the RE approves an alternate slurry collection method.

When sawcutting grooves, use a multi-bladed saw with an adequate number of blades and alignment wheels.

Provide within the Project Limits spare saw blades and at least 1 standby saw that meets the above requirements.

1008.05 AIR COMPRESSOR

Provide compressors for air blowing that filter moisture and oil from the air, deliver air at a minimum of 125 cubic feet per minute, and develop a nozzle pressure of at least 87 pounds per square inch.

1008.06 HOT-AIR LANCE

Provide a compressed air system designed for generating hot air at a temperature of at least 2000 °F. Ensure that the hot-air lance is capable of delivering air at the minimum rate of 80 cubic feet per minute at 100 pounds per square inch.

SECTION 1009 – HMA PLANT EQUIPMENT

1009.01 HMA PLANT

A. Requirements for HMA Mixing Plants. Use fully automated batch type or drum mixing type plants for the preparation of HMA mixtures. Ensure that the HMA plant is designed, equipped, calibrated, and operated to deliver well-coated, homogeneous HMA mixtures conforming to the job mix formula. Immediately correct defects that adversely affect the functioning of a plant or plant unit, or the quality of the mixture.

Ensure that all plant, laboratory, and truck scales are inspected and certified by an independent scale company accredited according to International Organization of Standards / International Electrotechnical Commission 17025, or a State or county Office of Weights and Measures. Ensure that certification is performed annually, or every 6 months if directed by the ME.

Ensure that the HMA plant is equipped with the following:

1. Plant Laboratory. Provide and maintain a plant laboratory at each plant site for the ME's use for sampling and acceptance testing, and for the producer's use for quality control testing during periods of production. Ensure that the plant laboratory has an unobstructed view of the trucks as they are loaded. Ensure that, excluding the sanitary facilities, the plant laboratory has a floor area of at least 350 square feet, a ceiling height of at least 7-1/2 feet, adequate ventilation, and artificial lighting. Provide sanitary facilities located within the same building. Ensure that the plant laboratory is weather-tight, heated, air-conditioned, and can maintain a temperature of between 68 and 80 °F. For plants producing more than 3000 tons of HMA mixture per day, obtain the ME's approval of the laboratory size and available facilities.

Ensure that the plant laboratory is equipped with the following:

a. General Equipment. Provide the following:

1. An office for the exclusive use of the ME with a floor area of at least 100 square feet.
2. Work benches, totaling at least 3 × 15 feet.
3. Two desks, 1 table, and at least 3 armed desk chairs.

4. Four-drawer, legal-size file cabinet with lock and 2 keys.
5. Shelves and supply cabinets.
6. Water cooler capable of dispensing hot and cold water, or a refrigerator supplied with bottled water.
7. Telephone, with a direct, private line with no monitoring or recording devices attached.
8. Class ABC fire extinguisher, meeting fire underwriters' approval.
9. A stocked, 5-person first-aid box according to ANSI standards.
10. Electrical outlets sufficient in number and capacity for operating equipment.
11. Approximately 4 × 4 feet of cork board or other mounting surface hung on a wall for the exclusive use of the ME.
12. Mechanical shakers, screens, and sieves according to AASHTO M 92. Install and bolt down the mechanical shaker in a sound-dampening and dustproof enclosure. Provide at least a 12-inch diameter exhaust fan in the enclosure.
13. Sink with hot and cold running water having adequate pressure, drainboard, and drain capable of handling elutriable material.
14. Stand that holds and elevates sieves to allow material to properly drain.
15. Two-element hot plate or electric range having dial-type thermostatic controls to adjust the heat for drying aggregates. Include a 12-inch fan capable of exhausting dust and fumes.
16. Small hand tools required for sampling and testing.
17. Computer and work station requirements as specified in 156.03.01.4.d. The ME may reduce or eliminate the requirement for the computer based upon operational needs.

b. Testing Equipment. Provide the following testing equipment:

1. Hood enclosed on 3 sides, top, and bottom, and of such size to enclose the operations of drying and weighing in which a vapor or gas is emitted. Ensure that the hood is designed and constructed so that any operation involving testing within the hood does not require the insertion of any portion of the tester's body, other than hands and arms. Ensure that the hood contains an exhaust system capable of exhausting air to the outside at 33 yards per minute, linear velocity, based upon an interior hood opening measuring 3 × 3 feet, with an exhaust fan rated at 80 to 118 cubic feet per minute.
2. When acceptance procedures for fully automated batch plants using hot bin samples according to NJDOT B-5 are used, an 8-inch shaker and a larger shaker are required.
3. Apparatus to perform testing according to AASHTO T 308, AASHTO T 166, AASHTO T 245, and AASHTO T 209.
4. Apparatus to perform testing according to AASHTO T 312. Calibrate the gyratory compactor using the internal angle.

2. Aggregate Storage. Provide storage space for each size and source of aggregate. Keep different aggregates separate until they have been delivered to the cold-feed belt or elevator. Maintain the aggregate storage area, and stockpile the separate materials as specified in 901.02.

3. Aggregate Bins. Ensure that the plant has cold-feed aggregate storage bins of sufficient number and capacity to store the amount of aggregate required to keep the plant in continuous operation. Ensure that the bins are designed to prevent overflow of material from each bin compartment to another. Provide at least 1 cold-feed aggregate bin for each stockpile of material to be used. Provide an indicator on each bin to show the gate opening.

4. Equipment for Preparation of Asphalt Binder. Ensure that the tanks for storage of asphalt binder are equipped to uniformly heat the material to the required temperature under effective and positive control at all times. Ensure that heating is accomplished so that no flame comes in contact with the heating tank.

Provide a circulating system of sufficient capacity for the binder to ensure continuous circulation between the storage tank and proportioning units during the entire operating period. Ensure that the discharge end of the binder circulating pipe is maintained below the surface of the binder in the storage tank to prevent discharge of hot binder into the open air.

Ensure that pipe lines and fittings are steam or oil jacketed, electrically or otherwise heated, and insulated to prevent heat loss.

Provide valves according to AASHTO T 40, except ensure that a sampling valve is also located in the lowest third of each storage tank.

5. **Feeder for Dryer.** Provide separate feeders for each size and source of aggregate. Feed each size onto the belt going to the dryer by mechanical feeders with separate adjustable gates. Use adjustable feeders capable of delivering the separate aggregates onto the belt in proper proportions to ensure a constant and uniform flow of material from each bin.

6. **Thermometric Equipment.** Affix an armored thermometer or dial thermometer of adequate range in the asphalt binder feed line near the charging valve at the mixer unit.

   Also ensure that plant is equipped with a recording thermometer, pyrometer, or other thermometric instrument positioned at the discharge chute of the dryer to indicate and automatically record the temperature of the heated aggregates.

7. **Dust Collector.** Ensure that the plant is equipped with a dust collector capable of wasting or uniformly returning to the plant all or any part of the material collected as directed. Install and operate dust collecting systems according to N.J.A.C 7:27-6.1 et seq.

8. **Safety.** Provide adequate and safe stairways to the mixer platform and sampling points. Place guarded ladders to other plant units at all points where accessibility to plant operations is required. Provide overhead protection at necessary locations. Provide ample and unobstructed space on the mixing platform. Maintain a clear and unobstructed passage at all times in and around the truck loading area. Keep this area free from drippings from the mixing platform.

   Provide accessibility to the top of truck bodies using 2 platforms located away from the mixing plant to enable samples and temperature data to be obtained from each side of loaded trucks. The Department will allow one platform if the truck has room to turn around and return to the platform.

   When plant production occurs during nighttime hours, provide permanently fixed lighting throughout the plant operations, plant laboratory, and truck scale areas to ensure a clear view of the operations. Also provide permanently mounted lighting at the sampling platforms to sufficiently illuminate the bed of the truck for inspection and sampling operations.

9. **Truck Scales.** Use direct-reading, cabinet dial type or an electronic load cell platform truck scales with a visual indicating device capable of automatically printing both gross and tare weights and time and date on the delivery ticket. Equip scales with a motion detection device or a time delay relay that prevents printing the weight on the delivery ticket until the scale is fully at rest. Remove or permanently lock tare beams in place.

   Ensure that the scale has a manufacturer's rating equal to or greater than the maximum gross load being weighed.

   Ensure that the approaches to the scale at both ends are at a level grade at the same elevation as the platform. House the scale cabinet and dial and the mechanical weight recorder in a suitable shelter with adequate heat and light.

10. **Automated Release Agent System.** Install and use a system that automatically sprays the truck bed with a release agent to prevent the build up of HMA in the bed. Ensure that the equipment sprays a thin, even coat of release agent over the entire interior surface. Supply a non-petroleum based release agent to the system.

11. **Surge and Storage Bins.** A plant may store HMA in a surge or storage bin if the supplier has obtained Department approval.

    Ensure that each bin is equipped with a signaling device that automatically provides a visible or audible signal when the material in the bin reaches the 25 ± 5 ton level. Ensure that the signal device is visible or audible from within the batch room, and remains in operation until the bin level exceeds the specified minimum.

    The supplier may store the HMA in a surge or storage bin for up to 8 hours. In extreme circumstances, the ME may approve the storage of HMA in a surge or storage bin for up to 12 hours.

    If the surge or storage system is changed or altered, notify the Department of the modification. The Department may require reevaluation to continue operations.

B. Requirements for Fully Automated Batch Type Plants. Use fully automated batch type plants only for mixtures containing up to 25 percent RAP. Perform daily checks to ensure that hoppers are discharging completely and that the balance returns to zero tare whenever the hoppers are emptied. When directed, make checks to verify the accuracy of the batch scales within the normal weighing range, and to ensure that the interlocking devices and automatic recording equipment are functioning properly. When the accuracy of the batch scales is not within the required weighing tolerances, the Department may require weighing of all trucks on an approved truck scale.

Ensure that the batch plant is equipped with controls for proportioning the RAP into the mixture without damaging the asphalt binder in the reclaimed material. If the RAP is introduced into the system before the hot bins, ensure that the proportioning controls include weigh belts or belt scales. Ensure that these items electronically interlock the new aggregate feed with the RAP feed and vary the feed rates, as required, to maintain the required ratio of new aggregate to RAP.

Prepare the recycled HMA mixtures by the heat transfer method of recycling. Ensure that the RAP does not come in direct contact with the flame in the dryer. Adjust the temperature of new aggregate leaving the dryer and the time interval of the dry and wet mixing cycles as needed.

Before combining with the heated new aggregate, ensure that the RAP passes through a 2-1/2-inch vibrating scalping screen.

Ensure that fully automated batch type plants are also equipped with the following:

1. **Dryer.** Provide a dryer or dryers that continuously agitate the aggregate during the heating and drying process. Use a dryer capable of drying and heating the aggregate to the specified moisture and temperature requirements without leaving any visible unburned oil or carbon residue on the aggregate when discharged.

2. **Screens.** Use plant screens that are capable of screening aggregates to the specified sizes and proportions, and have capacities greater than the capacity of the mixer.

3. **Aggregate Hot Bins.** Ensure that the plant is equipped with at least 4 aggregate storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Arrange the bins to ensure separate and adequate storage of appropriate fractions of the mineral aggregates. Provide separate dry storage when using mineral filler or hydrated lime, and ensure that the plant is equipped to feed such material into the mixer accurately and uniformly. Provide each bin with properly sized and located overflow pipes to prevent the material from backing up into other compartments or bins. Ensure that each compartment is provided with an individual outlet gate that is leak-free when closed and that will cut off flow quickly and completely. Provide bins with means to obtain representative samples. Ensure that each bin is equipped with a signaling device that automatically provides a visible or audible signal when the level of aggregate reaches the lowest 25 percent level, and remains in operation until the bin level exceeds the specified minimum.

4. **Plant Scales.** Use springless dial type or electronic load cell type plant scales with a readout accurate to within the tolerances allowed by the New Jersey Department of Law and Public Safety, Office of Weights and Measures.

   Locate scales so that they are plainly visible to the plant operator at all times.

   For aggregate amounts less than 5000 pounds, ensure that the graduation of scales used in weighing is not greater than 5 pounds. For aggregate amounts from 5000 to 10,000 pounds, ensure that the graduation of scales used in the weighing is not greater than 10 pounds. For aggregate amounts more than 10,000 pounds, ensure that the graduation of scales used in the weighing is not greater than 0.1 percent of the capacity of the scales.

   For weighting asphalt binder, use scales that conform to the requirements for aggregate scales, except that they shall read to the nearest pound and they shall have a capacity of not more than 250 percent of the normal amount of asphalt binder required.

   Ensure that plants are capable of continuously weighing the various components of the mixture for the full range of batch sizes within the tolerances specified in Table 1009.01-1. These tolerances are based on the total batch weight of the HMA mixture.

Table 1009.01-1 Weighing Tolerances	
Mixture Component	**Tolerance**
Each Aggregate Component	±1.5 percent
Mineral Filler	±0.5 percent
Asphalt Binder	±0.1 percent
Zero Return (Aggregates)	+0.5 percent
Zero Return (Asphalt Binder)	+0.1 percent

If mineral filler is used in a batch cycle, ensure that the allowable tolerance for the aggregate component weighed just before the filler in a cumulative weighing system is ±0.5 percent.

5. **Weigh Box or Hopper.** Ensure that the plant is equipped with the means for accurately weighing each size of aggregate in a weigh box or hopper suspended on scales that is sufficiently sized to prevent overflow to the pugmill.

   Ensure that no material can leak into the mixer while a batch is being weighed when the discharge gate is closed. Support the weigh box or hopper on fulcrums and knife edges that are not easily thrown out of alignment or adjustment.

6. **Asphalt Binder Control.** When using an asphalt binder bucket, use a type recommended by the plant manufacturer. Ensure that the length of the discharge opening or spray bar is at least 3/4 the length of the mixer and that it discharges directly into the mixer. Ensure that the asphalt binder bucket discharge valve and spray are adequately heated. Ensure that the plant has an adequately heated, quick-acting, nondrip charging valve located directly over the asphalt binder bucket.

   When a volumetric meter is used, ensure that it automatically meters the asphalt binder into each batch. Ensure that the dial to indicate the amount of asphalt binder has the capacity to measure at least 10 percent more than the asphalt binder required in 1 batch. Ensure that the meter can be locked at any dial setting and automatically resets to this reading after the addition of asphalt binder to each batch. Locate the dial in full view of the mixer operator.

   Automatically control the flow of binder material to begin when the dry mixing period is finished. Ensure that all of the asphalt binder material required for 1 batch is discharged within 15 seconds after the flow has started. Ensure that the size and spacing of the spray bar openings provide uniform application of asphalt binder for the full length of the mixer.

7. **Mixer.** Use a batch mixer capable of producing a uniform mixture within the job mix tolerances. If not enclosed, equip the mixer box with a dust hood.

   Ensure that the clearance of paddles does not exceed 1-1/2 inches from all fixed and moving parts.

8. **Control of Mixing Time.** Ensure that the mixer is equipped with an accurate time lock to control the operations of a complete mixing cycle. It shall lock the weigh box gate after charging of the mixer until the closing of the mixer gate at the completion of the cycle. It shall lock the asphalt binder discharge throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods. The dry mixing period is defined as the interval of time between the opening of the weigh box gate and the start of introduction of asphalt binder. The wet mixing period is defined as the interval of time between the start of introduction of asphalt binder and the opening of the mixer gate.

   Ensure that timing control is adjustable and capable of being set at intervals of 5 seconds or less. As a part of the timing device, install a mechanical batch counter designed to register only completely mixed batches.

   Set time intervals in the presence of the ME to provide aggregate coating as specified in 903.02.

9. **Automated Batching and Mixing Control.** Ensure that fully automated plants include an automatic batching and mixing control system, including an automatic printer system conforming to the following:

   1. Ensure that the recording equipment and batch scales are interlocked. Maintain the panels providing access to interlocking devices under sealed conditions.

2. Ensure that the system contains auxiliary interlocking cut-off circuits to interrupt and stop the automatic cycling of the batching operations any time the weighing tolerances are exceeded, when any aggregate bin becomes empty, or when there is a malfunctioning of any portion of the control system. A platform truck scale is not required. However, if the automatic proportioning or recording devices becomes inoperative or inaccurate, then manually operate the plant to complete the day's production with the approval of the RE. In this case, a platform truck scale is mandatory for manual operation.
3. The Department will make independent checks on batch weights by weighing trucks before and after loading, and may request an inspection of the plant scales by the New Jersey Department of Law and Public Safety, Office of Weights and Measures for verification of the automatic printout tickets.

C. Requirements for Drum Mixing Plants. The Contractor may use drum mixing plants in the preparation of HMA paving mixtures. Heat, coat, and mix the HMA mixture in a parallel flow, counter flow, or other approved type of dryer-mixer.

Ensure that the drum mixing plant includes the following:

1. Aggregate Bins. Equip the fine aggregate bin compartments with a vibrator or other anti-bridging device that is automatically actuated when bridging of the material occurs. Ensure that this device automatically shuts off when continuous material flow is restored.

2. Mineral Filler Bin. When adding mineral filler, use a bin and feeder that is separate from the aggregate cold bins. Ensure that the equipment is capable of feeding the mineral filler at adjustable rates. Ensure that the mineral filler feed rate in tons per hour is accurate to within 3 percent of the indicated rate throughout the range of the plant's production capacity. Ensure that the feeder is interlocked to stop production if the flow of mineral filler is interrupted.

3. Aggregate Feeder. Ensure that the plant is equipped with a mechanical system for uniformly and continuously feeding each aggregate in its proper proportion onto a collecting belt and then into the drum mixer.

Ensure that the feeder system is designed so that the aggregates on the collector belt pass through a 2-inch scalping screen or other device to remove oversized material or debris before entering the mixer. Provide one feeder for each bin compartment. Ensure that each aggregate feeder is interlocked to stop production if flow of aggregate from any of the cold bins is interrupted.

Use a variable speed system that provides for total and proportional control to regulate the quantity of aggregate fed to the drum mixer.

Ensure that the individual bin feeder belts or the intermediate collecting belt that delivers the aggregate to the main feed for the drum mixer are equipped with belt type scales (load cells). Use belt type scales (load cells) that are capable of continuously displaying, at the operator's station, the weight of aggregate flow in tons per hour or the corresponding percentage of total mix from each individual bin and the accumulated total from each bin in tons. Ensure that the aggregate feed rate in tons per hour from each bin is accurate to within 1 percent of the indicated rate throughout the range of the plant's production capacity.

Provide the means to conveniently divert the aggregate cold-feed delivery into trucks or other containers for checking the accuracy of the aggregate feed system. Provide the means to obtain representative samples of the composite aggregate from the main feed to the drum mixer at any time during production.

For mixes containing RAP, the drum mix plant shall have a means for adding the RAP to the dryer-mixer in a manner that does not damage the asphalt binder in the reclaimed material. Provide control for proportioning the RAP into the mixture. Provide the means for compensating for the moisture in the RAP. Ensure that the RAP passes through a 2-1/2 inch vibrating scalping screen before being combined with the heated new aggregate.

4. Asphalt Binder Metering System. Ensure that the plant is equipped with a metering system that introduces the proper amount of asphalt binder into the mix.

Use a system that is capable of measuring the quantity and temperature of the asphalt binder introduced into the mix and transmitting that data to the operator's station. Ensure that the metering system is interlocked to stop production if the flow is interrupted.

Ensure that the metering system includes a temperature compensation device to correct the quantity of asphalt binder introduced into the mix to 60 °F. Ensure that the flow of asphalt binder to the drum mixer is continuously displayed at the operator's station in units of tons per hour, corrected to 60 °F, or as the corresponding percentage of total mix. Ensure that the feed rate in tons per hour is accurate to within 1 percent of the indicated rate throughout the range of the plant's production capacity. Ensure that the accumulated weight of asphalt binder fed to the mixer is totaled.

Provide convenient means for diverting the asphalt binder into trucks or other containers for checking the accuracy of the metering system.

5. **Proportioning Controls.** Ensure that the combined aggregates pass over a weigh belt or belt scale that is electronically interlocked with the asphalt binder metering system to automatically vary the asphalt binder feed rate, as required, to maintain the required asphalt binder content in the mixture.

   Make provisions for introducing the moisture content of the cold-feed aggregates into the composite aggregate weigh belt signal and correcting wet aggregate weight to dry aggregate weight. Continuously display, by electronic readout at the operator's station, the dry weight of the composite aggregate flow in units of tons per hour and total. Ensure that the composite aggregate feed rate is accurate to within 1 percent of the indicated rate. Equip belt conveyors with scrapers or other suitable devices to prevent adherence or other loss of the weighed cold-feed aggregate.

   Before the start of production of Department mixes, ensure that plant controls are calibrated. Report to the ME any changes in or modifications to the equipment or operation occurring subsequent to the initial calibration. The ME may direct calibration checks or a new plant calibration. The ME may also direct recalibrating the plant if the finished mixture displays composition deficiencies. For each drum mix plant placed in operation, submit 2 complete sets of plant drawings, a plant operator's manual, and a plan detailing the method of plant calibration. The ME will witness the calibration of the individual cold-feeders at several production rates throughout the range of the plant's capacity. Submit a copy of the computations for the combined rate of flow, and a plot of calibration charts, indicating the rate of aggregate delivery in tons per hour from each cold-feeder for particular dial settings and gate openings. Determine calibration points by independently diverting each cold-feed into trucks (or running each feed through the plant) and determining the proper console dial setting corresponding to the measured rate of delivery. Determine calibration points in increments of approximately 100 tons per hour of total aggregate flow.

   The ME will witness a check on the mineral filler and asphalt binder feeds at several production rate increments throughout the range of the plant's capacity. Divert the asphalt binder into trucks or other containers for weight or volumetric measurements to calibrate the asphalt binder metering system and subsequent checks. The method used to calibrate the mineral filler feeder system is subject to approval.

6. **Drum Mixer.** Use a drum mixer that continually agitates the mixture of aggregate and asphalt binder during heating. The drum mixer should not adversely affect the aggregate or asphalt binder during drying and heating operations. Equip the mixer discharge with a pyrometer or thermometer probe to record the temperature of the mixture, with the data transmitted to the operator's station.

   Ensure that the mixer is equipped to safely and conveniently obtain representative mixture samples before introduction into the surge bin.

   The ME may perform test comparisons between the consistency of the asphalt binder in its original form from plant tank samples and in processed form from mixture recovery samples obtained before the mixture's introduction into the surge bin. The ME will use the results of the consistency tests to determine whether a processing improvement is necessary to eliminate excessive volatilization, oxidation, or other causes of premature hardening.

7. **Emission Control System.** Ensure that the plant is equipped with an emission control system conforming to all applicable emission limitations.

8. **Control Console.** Ensure that the following items are included in the control console at the operator's station:

   1. Cold aggregate feed controls capable of both total and proportional control of the aggregates.
   2. Dryer burner controls that automatically control the temperature of the mix and record the mix temperature at the dryer discharge.

3. Aggregate weigh belt readouts displaying the weight of material being proportioned from each aggregate bin in tons per hour or the corresponding percentage of total mix weight and the total flow over the main feeder to the drum mixer in tons per hour. Ensure that the accumulated weights in tons from each bin and the total feed to the mixer are separately totaled and are continuously displayed or are available on demand from a printout device.
4. Mineral filler readouts displaying the weight of material being proportioned from the mineral filler bin in tons per hour or the corresponding percentage of total mix weight together with an accumulative total in tons.
5. Asphalt binder metering system readouts indicating the quantity of asphalt binder, corrected to 60 °F, being proportioned into the mix together with an accumulative total in tons, and a recording pyrometer or thermometer that records the temperature of the asphalt binder at the pump.
6. Proportioning controls that set the asphalt binder content as well as the aggregate moisture adjustment.

9. Modifications. When producing mixes containing 26 to 50 percent of RAP, ensure that the mixing time allows thorough blending of new and reclaimed materials and complete coating all aggregate particles. If lumps of reclaimed material are observed in the mixture as it is discharged from the drum, adjust the mixing time in the drum or make other changes in the production process to correct this condition. Ensure that the temperature of the mixture at discharge from the plant or surge and storage bins is maintained at or above the temperature required to deliver the material to the work site and achieve optimum compaction.

1009.02 HMA TRUCKS

Transport the mixture from the mixing plant to the Project Limits in trucks equipped with tight, clean bodies. The Contractor may lightly coat the trucks with a fine aggregate, soap or lime solution, or other such non-petroleum-based release agent. Do not use a petroleum-based product as a release agent.

Permanently equip trucks with an airfoil that is capable, at any speed or under any weather conditions, to deflect air over the tarp and to prevent air from going under the tarp. Ensure that the airfoil is affixed no more than 2 feet in front of the tarp roll and be at least as high as the top of the tarp roll.

Provide a waterproof tarp that is capable of withstanding normal handling and placement temperatures of up to 400 °F without damaging the fabric, has a minimum weight of 18 ounces per square yard, and is properly sized to completely cover the load. Immediately cover each truckload after loading at the plant with the tarp to protect the mixture from the weather. Ensure that the tarp securely meets or overlaps the top of the tailgate and is securely held in place so as to prevent air from lifting the tarp during transportation.

Ensure that the truck body is heated or insulated as necessary to ensure delivery of the mixture at the specified temperature. Remove any truck from the work that does not have an airfoil or does not have an approved tarp until such conditions are corrected and the truck is presented for inspection to the RE. The RE or ME may require that the Contractor make available the vehicles used for transporting HMA mixture for inspection at the plant laboratory before shipping materials.

SECTION 1010 – CONCRETE PLANT AND MIXING EQUIPMENT

1010.01 BATCHING PLANT

Ensure that plant, laboratory, and truck scales are inspected and certified by an independent scale company accredited according to International Organization of Standards / International Electrotechnical Commission 17025, or a State or county Office of Weights and Measures. Ensure that certification is performed annually, or every 6 months if directed by the ME.

Ensure that aggregate reserves at the batching plant are stockpiled as specified in 901.02.

Provide a batching plant with the specified site, layout, and equipment features capable of ensuring a continuous supply of concrete to the work. Ensure that the batching plant is equipped with the following:

1. Plant Laboratory. Provide and maintain a plant laboratory at each plant site for the ME's use for sampling and acceptance testing, and for the producer's use for quality control testing during periods of production.

Ensure that the plant laboratory has an unobstructed view of the trucks as they are loaded. Ensure that, excluding the sanitary facilities, the plant laboratory has a floor area of at least 350 square feet, a ceiling height of at least 7-1/2 feet, adequate ventilation, and artificial lighting. The ME may re-approve a previously approved concrete plant with a undersized laboratory if it functionally meets the needs for testing. Provide sanitary facilities located within the same building. Ensure that the plant laboratory is weather-tight, heated, air-conditioned, and can maintain a temperature of between 68 and 80 °F.

Ensure that the plant laboratory is equipped with the following:

a. General Equipment. Provide general equipment as specified in 1009.01.1.a.

b. Testing Equipment. Provide the following testing equipment:

1. Platform scale of 200 pounds minimum capacity with a beam or dial with significant graduations of 1/10 pound or less.
2. Apparatus to perform testing according to AASHTO T 27, AASHTO T 248, AASHTO T 19, AASHTO T 119, AASHTO T 121, AASHTO T 196, AASHTO T 152, AASHTO T 84, and AASHTO T 85.
3. Miscellaneous items including rubber hammer, mason's trowels, pointed shovel, small and large sugar scoops, heavy galvanized pail (approximately 14-quart capacity), aggregate sample pans, brushes, flashlight, glassware, steel straightedge approximately 18 × 2 inches, and such expendable supplies necessary for the tests to be performed.

2. Batch Counter. Ensure that the batching plant is equipped with a non-resettable batch counter that indicates the number of batches proportioned.

3. Bins and Hoppers. Provide bins with separate compartments for fine aggregate, for each size of coarse aggregate, and for each brand and type of cement at the batching plant. Ensure that the weighing hoppers are sealed and vented to prevent dusting during operation. Use separate scales and hoppers for cement with a device to indicate the complete discharge of the batch of cement into the mixing drum. Ensure that the weighing hoppers and scales are of adequate size and capable of being locked. Ensure that the hopper discharge mechanism is interlocked against opening until the full batch is in the hopper and the scale is balanced, against opening while the hopper is being filled, against closing until the hopper is entirely discharged and the scale back in balance, and against opening if the batch in the hopper is either overweight or underweight by more than 1 percent of the amount specified. Ensure that the weighing hopper discharge gate operates in a manner that does not affect the scale balance. Ensure that the discharge chute, boot, or other such device is suspended from the encasement and not from the weighing hopper and is constructed so that cement does not lodge therein. Ensure that there is no loss of cement by air currents or otherwise. Ensure that there are means available to monitor the required cement content in each batch.

4. Scales. Use beam scales, springless dial scales, or electronic load cell scales with a readout when weighing aggregates and cement. Use scales that are accurate to within 0.5 percent for cement and within 1 percent for aggregate throughout the range of use. When using beam type scales, provide a dial for indicating to the operator the required load in the weighing beams and for indicating critical position. Ensure that the weigh beam and device are in full view of the operator who shall have convenient access to all controls while charging the hopper. Ensure that poises are capable of being locked in any position to prevent unauthorized change.

5. Water Measuring Equipment. Measure water by volume or by weight. Ensure that the range or error for water measuring equipment is less than 1 percent. Ensure that the measuring device automatically registers and stops the flow of water when the designated quantity has been delivered into the mixing drum. If measuring by volume, ensure that the water measuring device contains an auxiliary tank from which to fill the measuring tank. Ensure that the measuring tank is equipped with outside taps and valves, or equivalent means to accurately calibrate the tank, and to provide for the quick and accurate determination of the amount of water in the tank. Ensure that the volume of the auxiliary tank is at least equal to that of the measuring tank.

6. Chemical Admixtures. Use an automatic displacement dispenser for adding each admixture. Ensure that the plant is equipped with a separate dispensing system with a visual sight gauge for each chemical admixture incorporated into the concrete. Provide a system capable of dispensing the total amount required to within

±3.0 percent or 1 ounce, whichever is greater. Provide convenient means to calibrate each system. Provide chemical admixture devices with each truck mixer approved for dispensing admixtures at the placement site.

7. **Mineral Admixtures.** Ensure that mineral admixtures stored at the batching plant are located in a separate storage facility. Do not use a split silo to store mineral admixtures and cement, or 2 different mineral admixtures. Ensure that scales and batching tolerances are consistent with those specified for cement.

8. **Automatic Batching System.** Ensure that batching plants equipped to proportion aggregates and bulk cement by means of automatic weighing and recording devices contain the following:

   a. **Automatic Batching Controls.** Ensure that batching equipment in the system for batching by weight is actuated by a single starting mechanism. The Department will allow a separate starting mechanism for volumetric batching of water or admixtures not batched at the time of initial weighing.

      Ensure that each automatic batcher returns to zero balance and each volumetric device resets to start or signal empty before it may be charged.

      Ensure that the discharge of any ingredient in the system does not start until all weighed ingredients have been batched, until all batching controls have been cleared of the previous batch with scale returning to zero balance, and until volumetric devices reset to start or signal empty.

      For cumulative batchers, provide interlocked sequential controls.

      Ensure that automatic batching controls start the weighing operation of each material and stop automatically when the designated weight of each material has been reached, interlocked in such a way that:

      1. The charging device cannot be actuated until the scale has returned to zero balance within ±0.3 percent of the scale capacity.
      2. The discharge device cannot be actuated until the required material is within the applicable tolerances.
      3. The discharge device cannot be actuated if the charging device or the discharge device is open.

   b. **Recording Devices.** Ensure that automatic batching plants are equipped with an accurate recorder or recorders that provide a permanent and continuous record of batching operations. Provide a maximum of 2 recording units in lockable enclosures with each plant. Provide batching records as directed by the ME. Ensure each recorder produces a digital record on tickets, providing the following information:

      1. The quantity or batched weights of each aggregate, cement, water, and admixture.
      2. The zero-balance condition of each scale after batches have been discharged, or before the start of the batching operation.
      3. A means of identifying each admixture batched.
      4. The time, date, and batch number of each batch delivered.
      5. Mix formula or concrete classification identification.

9. **Safety.** Provide adequate and safe stairways at access points to plant operations. Provide overhead protection at locations where deemed necessary. Ensure that gears, pulleys, chains, sprockets, and other hazardous moving parts are guarded and protected.

1010.02 CONCRETE TRUCKS

Ensure that mixers have a fixed metal plate or plates on which the following information is plainly marked:

1. The manufacturer's capacity rating in terms of the gross drum volume;
2. The capacity of the drum in terms of the volume of mixed concrete; and
3. The manufacturer's designated drum speed of rotation for both mixing and agitation.

The ME will inspect the mechanical condition of the truck mixer, the mixing and agitation rates, the accuracy of the water-measuring device, the sizes of the discharge opening and chutes, and the general condition and wear of the blades. The ME will not approve mixers if the pickup and throw-over blades are broken, missing, or excessively worn. Examine

mixers on a daily basis for drum and blade cleanliness, leaks in the mixing water system, and the condition of the water-measuring device and revolution counter.

Ensure that the concrete supplier maintains, in a convenient location, a copy of the manufacturer's design for each size and type of truck showing the dimensions and arrangements of the blades, the dimensions of the drum, the gross volume of the drum, the recommended rates of rotation for all types of operations, and any other pertinent information.

Ensure that the mixing water-measuring device is plainly visible to the truck operator when operating the mixing water and the drum controls, and to the ME while standing on the ground. Keep measuring indicators clean and in good condition.

Ensure that trucks for the delivery of central-mix concrete have a revolving, watertight drum that is capable of uniformly transporting and discharging the mixed concrete. Ensure that the speed of the drum conforms with the manufacturer's stated agitating speed.

Ensure that the mixing water tank, pump, and the piping are kept clean and free of leaks.

Provide documentation showing the date and results of calibration of the water-measuring device on each truck mixer. Provide copies if requested. Ensure that "calibrated" with the date of the last calibration is stenciled on the mixing water tank near the measuring device.

1. **Central Mixing Plant Truck**. Ensure that mixers are equipped with electrically-actuated counters allowing easy verification of the number of revolutions of the drum. Ensure that the counter unit is positioned on the truck and plainly visible if the driver's door is open.

2. **Transit Mixing Truck.** If necessary, each transit mixer shall only use the mixing water tank and measuring device for providing tempering water.

   Ensure that truck mixers used for transit mix concrete are equipped with an electrically operated counter unit, containing 2 counters, that is non-resettable except by use of a 110-volt device utilizing a nonstandard plug located at the batching plant. Use one counter to record only those revolutions at speeds recommended by the manufacturer of the truck mixer as mixing speed and to record the total of all such mixing revolutions from the time the truck is loaded. Use the other counter to record revolutions of the drum at all speeds and to record the total revolutions from the time the truck is loaded. Ensure that the unit includes an indicator on the front panel that shows if the instrument has been turned off or tampered with in any manner after being reset at the time of loading. Ensure that the counter unit and the resetting device conform to the NEC. Ensure that the counter unit is positioned on the truck and plainly visible if the driver's door is open.

1010.03 MOBILE MIXER

Ensure that the truck mixer is equipped with a cement bin of sufficient capacity to store and supply the quantity of dry cement required to produce the maximum volume as rated by the manufacturer. Ensure that the cement bin is free of moisture and contamination at all times.

Ensure that the truck mixer is equipped with aggregate bins of sufficient capacity to separately store the quantities of fine and coarse aggregates required to produce the maximum volume of concrete as rated by the manufacturer. Ensure that the truck mixer is equipped with the means to prevent contamination or intermixing of the fine and coarse aggregates during loading and transporting. Ensure that aggregate bins are covered when moisture can enter the bins.

Ensure that the truck mixer is equipped with the means for readily determining the level of aggregates within the aggregate bins without the need to climb up on the truck. Ensure that the aggregate is maintained at the proper level to allow the correct volume to enter the mix.

Ensure that the aggregate bins are equipped with vibrators or other means to maintain a smooth, even, and continuous flow of aggregate from the bins.

Ensure that the truck mixer is equipped with water tanks of sufficient capacity to store enough water to produce the maximum concrete volume at the slump specified for each concrete item, as rated by the manufacturer. When using concrete additives in the mix, ensure that the truck mixer is capable of storing the additives, incorporating them into the mix, and measuring the rate of flow of each additive into the mix.

Ensure that the truck mixer includes a feeder unit mounted under the compartment bins to deliver the ingredients to the mixing unit.

Ensure that each bin on the truck has an accurately controlled individual gate or feeding mechanism to form an orifice for volumetrically measuring the material drawn from each bin compartment. Ensure that the cement bin feeding mechanism is set to discharge, continuously and at a uniform rate, the required volumetric weight equivalent of cement. Ensure that the gates of the aggregate bins are calibrated at the various openings to discharge the required volumetric weight equivalent of aggregates. Equip the mixer truck with a material flow indicator attached to the metering gates to monitor the continuous flow of material. Ensure that the indicator sounds an alarm when a continuous flow of material does not pass through the metering gates.

Ensure that the truck mixer is equipped to allow checking of the calibration of the gate openings and meters by means of weight test samples.

Ensure that the calibration of the gate openings and meters are checked and certified for each concrete mix design at least once per year by a certified testing agency. If approved by the ME, a representative of the Contractor may perform the calibration if it can be shown that the representative is knowledgeable in the proper techniques of calibration. Notify the ME at least 1 week before the annual calibration date.

The ME may require a calibration check or a yield test at any time. The accuracy of the mixer to proportion the specified mix is acceptable if the calibration check shows that the equivalent weights of each component are within the tolerances specified in Table 1010.03-1.

Table 1010.03-1 Weighing Tolerances

Mixture Component	Tolerance
Cement	0 to + 4 percent
Fine Aggregate	±2 percent
Coarse Aggregate	±3 percent
Admixtures	±3 percent
Water	±1 percent

Ensure that the truck mixer is equipped with a revolution counter indicator allowing the reading of the volumetric weight equivalent of cement discharged during the concrete mixing operation.

Ensure that the truck mixer is equipped with fine and coarse aggregate dials to allow adjustment of the gates of the aggregate bins for volumetric proportioning of aggregates.

Ensure that the truck mixer is equipped with a water meter or gauge to register the discharge rate of water by volume entering the mix.

Ensure that the truck mixer is equipped with automatic means for maintaining the operating speed of the proportioning and mixing equipment. Ensure that the truck mixer is operated within ±8 percent of the manufacturer's rated speed. Ensure that the tolerance is met whether the mixer is moving or standing still. Ensure that the truck mixer is equipped with a tachometer mounted on the unit to measure the operating speed.

Ensure that all indicators, dials, meters, tachometers, and controls are easily visible, in full view, and close enough to be read or adjusted by the operator while mixing concrete.

Instead of a time clock, the counter unit may contain a third counter, an electrically-operated timer that is non-resettable except by use of the 110-volt device.

1010.04 SMALL-BATCH MIXER

Where small quantities of concrete or mortar are needed, provide a mixer with a minimum mixing capacity to produce a 1-bag mix. Use small-batch mixers according to the manufacturer's recommendations.

SECTION 1011 – PRECAST AND PRESTRESSED CONCRETE PLANT EQUIPMENT

1011.01 PRECAST PLANT

A. Plant Certification. Ensure that the plant manufacturing precast concrete members is certified in the applicable category by the NPCA, the American Concrete Pipe Association (ACPA) or PCI certified as specified in 1011.02. Provide written documentation of the certification to the ME upon request.

B. Forms and Casting Beds. Ensure that forms and casting beds are carefully aligned, substantial and firm, braced, fastened tightly together to prevent mortar leakage, and strong enough to withstand the action of mechanical vibrators. Ensure that forms are constructed to allow movement of the members without damage during release of the prestressing force. Before placing concrete, obtain ME approval for the casting beds and all form work.

1011.02 PRESTRESSED PLANT

A. Plant Certification. Ensure that the plant manufacturing prestressed concrete members is certified by PCI in the category applicable to the work. Ensure that the certification of the plant is in accordance with Appendix D, Option (A) of the *PCI MNL-116*. Provide written documentation of the certification to the ME upon request.

B. Jacks. Ensure that prestressing is performed with jacking equipment. Use hydraulic jacks that are equipped with pressure gauges. Ensure that the combination of jack and gauge is calibrated by a certified testing agency, and provide calibration charts to the ME showing the relationship between dial gage pressure and force delivered. Ensure that jacks and pumps are calibrated as a unit, are clearly marked, and are used as a unit. Should other types of jacks be used, provide calibrated proving rings or other devices so that the jacking forces may be known.

Ensure that the calibration of jacks and gauges is performed at least once per year. If any jack or gauge provides erratic results, or if gauge pressure and elongations indicate differing stresses of more than 5 percent, ensure that recalibration is performed immediately. Ensure that strand elongations are measurable to at least the nearest 1/16 inch.

C. Forms and Casting Beds. Ensure that forms and casting beds are carefully aligned, substantial and firm, braced, fastened tightly together to prevent mortar leakage, and strong enough to withstand the action of mechanical vibrators. Ensure that forms are constructed to allow movement of the members without damage during release of the prestressing force. Obtain approval from the ME for the casting beds and all form work before placing concrete.

D. Load Cells. Ensure that plants manufacturing prestressed concrete members have at least 2 calibrated load cells to verify stressing operations.

E. Grouting Equipment. Provide grouting equipment according to Division II, Section 10 of the AASHTO Standard Specifications for Highway Bridges.

1011.03 ME'S OFFICE

Provide and maintain in good condition an office, conveniently located, at the prestressing plant for the exclusive use of the ME during production and until all items have been shipped to the Project Limits. Ensure that the office has a minimum area of 200 square feet. Provide means to maintain office temperature between 68 and 80 °F. Ensure that the office doors and windows are equipped with adequate locks and provide the necessary keys to the ME. Provide convenient access to potable water and clean, functional sanitary facilities. Provide the ME with access to a facsimile (fax) machine and photocopier at the fabrication plant for Department or Project-related use. Provide telephone and fax service.

Ensure that the office also includes the following equipment:

1. One telephone and direct, private telephone line with an answering machine or voice mail capability. Ensure the telephone line is free of monitoring or recording devices.
2. One direct, private telephone line for computer connectivity. Ensure the telephone line is free of monitoring or recording devices.
3. Two desks and 3 chairs.
4. One 3-drawer file cabinet with a lock and 2 keys.
5. A stocked, 5-person first-aid box conforming to ANSI standards.

NJDOT TEST METHODS

NJDOT A-1 – MORTAR-MAKING PROPERTIES OF FINE AGGREGATE

A. Scope. This test method is used to determine the mortar-making properties of fine aggregate by tensile strength at the age of 7 days when compared to Standard Ottawa mortar.

B. Apparatus. Use apparatus as required in AASHTO T 132 and AASHTO T 162.

C. Procedure. Perform the following steps:

1. Prepare Standard Ottawa mortar according to AASHTO T 162 and test according to AASHTO T 132.
2. Using the fine aggregate sample, prepare the mortar according to AASHTO T 162 and test according to AASHTO T 132. Replace the Standard Ottawa sand with the same weight of fine aggregate sample and use sufficient mixing water to produce the same consistency as obtained with the Standard Ottawa mortar.

D. Report. Report the strength of the fine aggregate sample as a percentage of the Standard Ottawa mortar at 7 days.

NJDOT A-2 – DETERMINING PERCENTAGE OF MICA IN FINE AGGREGATE

A. Scope. This test method is used to determine the mica content of fine aggregate.

B. Apparatus. Use the following apparatus:

1. Binocular microscope (Leica, Zeiss, Wild, or equivalent) with 20× minimum magnification and using a standard 10× high quality lens.
2. No. 10 and No. 100 sieves conforming to AASHTO M 92.
3. Mechanical sieve shaker conforming to AASHTO T 27.
4. Microsplitter or spinning riffler splitter.
5. Balance conforming to AASHTO M 231 and having a minimum capacity of 100 grams with a precision of 0.1 gram.
6. Balance for weighing separated mica in stainless steel containers having a minimum capacity of 50 grams with a precision of 0.001 grams and conforming to AASHTO M 231.
7. Stainless-steel sample container with lid.
8. Oven for drying sample to a constant weight at a temperature of 230 ± 9 °F.
9. Stainless-steel spatula.
10. Size 000 or smaller paintbrush with loose hairs trimmed.
11. Microscopic picking tray as used by the American Association of Petroleum Geologists or equivalent for placement within microscope working area.
12. Water in a suitable container for wetting paintbrush.
13. Various suitable larger brushes for moving and spreading sample on picking tray.

C. Procedure. Perform the following steps:

1. Ensure that the examiner has a minimum 4-year degree in geology or a related science and an understanding of mineralogy, petrographic analysis, and optical microscopy.
2. Take the test sample from a representative sample from a field stockpile. After oven drying to a constant mass at a temperature of 230 ± 9 °F, split the sample into approximately 200 grams weighed to the nearest 1 gram.
3. Sieve the 200 gram sample according to AASHTO T 27 using a No. 10 sieve and a No. 100 sieve. Retain the material passing the No. 10 sieve and retained on the No. 100 sieve.
4. Reduce the retained sample to approximately 20 grams. Using a microsplitter or a spinning riffler further split the sample into 20 approximately 1-gram samples of fine aggregate. Choose 2 of the twenty 1-gram samples at random for analysis.

5. Place the first chosen sample on a microscopic picking tray and quarter using a stainless-steel spatula. With a large brush, sweep 3 of the 4 sample aliquots to the periphery of the picking tray for possible further analysis.
6. Wet the bristles of the small paintbrush and under 10-20X viewing power, separate the mica minerals from the rest of the fine aggregate
7. After picking at least 95 percent of the mica from the sample aliquot, carefully brush the separated mica into pre-weighed and labeled stainless-steel sample container with lid. Brush the mica-free portion of the sample aliquot into another pre-weighed and labeled sample container with lid.
8. If deemed necessary, the examiner may analyze other quarter aliquots of the sample brushed aside in Step 5. Follow Steps 6 and 7 to analyze additional aliquots brushing the mica and the mica-free portions into their respective containers with the first aliquot analyzed.
9. With the lids off, dry both portions of the sample to constant weight.
10. Using a scale with a precision of 0.001 grams, weigh both samples with the lids on to prevent loss. Record weights of the mica and the mica-free portions. The sum of these is the "Weight of Sample" and should be approximately 0.25 grams for each aliquot analyzed.
11. Repeat Steps 5 through 10 for the second randomly chosen 1-gram sample.

D. Calculations and Report. Calculate the percent of mica for each sample analyzed using the following equation:

$$\text{Percent of Mica} = \frac{\text{Weight of Mica in Grams}}{\text{Weight of Sample}} \times 100$$

E. Report. Report the final mica content as the average of the results of the 2 samples to the nearest 0.1 percent.

NJDOT A-3 – PETROGRAPHIC ANALYSIS TO DETERMINE LITHOLOGICAL COMPOSITION OF COARSE AGGREGATE

A. Scope. This test method is used to determine the quantity of the rock types and deleterious material components in coarse aggregates or in the coarse aggregate fraction of a DGA or soil aggregate. Determinations may include the carbonate rock content of crushed gravels and the weathered and decomposed content of crushed stone or soil aggregate.

B. Apparatus. Use the following apparatus:

1. Binocular microscope (Leica, Zeiss, Wild, or equivalent) with 20× minimum magnification and using a standard 10× high quality lens.
2. No. 4 and No. 8 sieves conforming to AASHTO M 92.
3. Mechanical sieve shaker conforming to AASHTO T 27.
4. Balance conforming to AASHTO M 231 and having a minimum capacity of 100 grams with a precision of 0.1 gram.
5. Oven for drying sample to a constant weight at a temperature of 230 ± 9 °F.
6. 10:1 dilute hydrochloric acid (HCl) in an eye-drop container.
7. Geology or mason hammer.
8. Scratching devices with known Moh's hardness values.

C. Procedure. Perform the following steps:

1. Ensure that the examiner has a minimum 4-year degree in geology or a related science and an understanding of mineralogy, petrographic analysis, and optical microscopy.
2. Oven dry sample to a constant weight. Split the sample to a sample size that will result in a testing sample size as specified in Table A-3-1 after sieving.

Table A-3-1 – Test Sample Size		
Aggregate Size	**Sieve Size for Retention**	**Approximate Test Sample Size**
No. 67 or larger	No. 4	1000 grams
No. 7 or No. 8	No. 8	500 grams
DGA or I-5	No. 4	1000 grams

3. For aggregate sizes No. 67 and larger, sieve the sample over a No. 4 sieve. For aggregate size No. 7 or No. 8, sieve the sample over a No. 8 sieve. Ensure that the sample size after sieving is as specified in Table A-3-1.
4. Wash the sample to remove any coating that would make particle examination difficult. If needed, use a mild detergent, such as Calgon to clean the aggregate. After washing, oven-dry the sample to a constant mass at a temperature of 230 ± 9 °F.
5. Separate the prepared sample into rock types as defined in ASTM C 294. Perform the separation using visual examination with the aid of the binocular microscope, dilute HCl, hammer, and scratching implements.
6. Examine the sample for deleterious material such as weathered, leached, porous, friable, fault-fractured, altered or otherwise unsound particles that could impair coarse aggregate performance. Use the following guidelines to determine if coarse aggregate particles are deleteriously weathered or decomposed:

    6.1. Can be broken into several pieces by a light hammer tap.
    6.2. Show more than superficial oxidation or alteration of feldspars.
    6.3. Appear porous or are determined by the examiner to be porous.
    6.4. Show numerous microfractures, cleavage planes or slickensides due to faulting.
    6.5. Are of abnormal coloration throughout due to chemical or mechanical alteration.

7. Separate the deleteriously weathered and decomposed fraction into its own group.
8. Weigh the rock types and deleterious material group to the nearest 0.1 grams and record.

D. Calculations. Calculate the percentage of rock types and percentage of deleterious material by dividing the individual weight by the weight of the total sample and multiplying by 100.

E. Report. Report the percentage by weight of individual rock types, as defined in ASTM C 294, and percentage by weight of deleterious material.

NJDOT A-4 – DETERMINING PERCENT OF ADHERENT FINES PRESENT IN COARSE AGGREGATE

A. Scope. This test method is used to determine the percentage of adherent fines present in coarse aggregate.

B. Apparatus. Use apparatus as required in AASHTO T 11 and a No. 16 sieve conforming to the requirements of AASHTO M 92.

C. Procedure. Perform the following steps:

1. Obtain a test sample from a representative field sample.
2. Dry the test sample to constant mass at a temperature of 230 ± 9 °F.
3. Weigh the sample to the nearest 0.1 percent.
4. Sieve the sample for less than 1 minute over a No. 16 sieve. Weigh the material retained on the No. 16 sieve. Consider the material passing the No. 16 sieve as non-adherent fines.
5. Test the material retained on the No. 16 sieve according to AASHTO T 11 to determine the weight of material passing the No. 200 sieve. Consider material passing the No. 200 sieve as adherent fines.

D. Calculations. Calculate the percentage of non-adherent fines and the percentage of adherent fines as follows:

$$\text{Percent of Non - Adherent Fines} = \frac{W_T - W_{16}}{W_T} \times 100$$

$$\text{Percent of Adherent Fines} = \frac{W_{16} - W_A}{W_{16}} \times 100$$

Where:
W_T = Total weight of test sample as determined in Step 3
W_{16} = Weight retained on No. 16 sieve as determined in Step 4
W_A = Weight of sample after washing over the No. 200 sieve as determined in Step 5

E. Report. Report the percent non-adherent fines and the percent adherent fines.

NJDOT A-5 – SCRATCH HARDNESS TEST FOR COARSE AGGREGATE PARTICLES

A. Scope. This test method is used to determine the percent of soft particles contained in coarse aggregates on the basis of scratch hardness. This test method is suitable for use on No. 67, No. 57, or equivalent sized coarse aggregate.

B. Apparatus. Use the following apparatus:

1. Scratch hardness apparatus consisting of a brass rod, 1/16 inch in diameter, with a rounded point, mounted in a device so that a load of 2 ± 0.1 pounds is applied to the specimen tested. Ensure that the brass rod is of suitable hardness so that when filed to a sharp point, it will scratch a copper penny (US Lincoln design), but fail to scratch a nickel (US Jefferson design).
2. Sieve sizes 1 inch, 3/4 inch, 1/2 inch, and 3/8 inch conforming to AASHTO M 92.
3. Apparatus required to perform AASHTO T 27.

C. Procedure. Perform the following steps:

1. Dry the coarse aggregate sample and split into portions for the various tests to be performed. Ensure that the portion of the sample for scratch hardness testing is sized so that it will yield not less than the amounts of the sizes specified in Table A-5-1 that are available in amounts of 10 percent or more.

Table A-5-1 – Minimum Size of Sample to be Tested

Sieve Size (Inches)	Sample Mass (grams)
3/8 to 1/2	200
1/2 to 3/4	600
3/4 to 1	1 500

2. Perform a gradation test on 1 portion according to AASHTO T 27 to determine the percent retained on the 3/4, 1/2, and 3/8 inch sieves and the percent passing the 3/8-inch sieve.
3. Separate the test sample into fractionated sizes as specified in Table A-5-1. Discard material passing the 3/8 inch sieve or retained on the 1 inch sieve. Also, discard fractions on sieves that represent less than 10 percent of the overall sample.
4. If the sample contains less than 10 percent of any of the sizes specified in Table A-5-1, do not test that size. For the purpose of calculating test results, consider the fractionated size to contain the same percentage of soft particles as the average of the next larger and the next smaller size. If one of these sizes is absent, consider the fractionated size to contain the same percentage of soft particles as the next larger or next smaller size, whichever is present.
5. Take a representative sample meeting the sample size requirements in Table A-5-1 of each of the fractionated sizes to be tested.
6. Test each particle of aggregate in a fractionated size using the following Steps:

6.1 Place the piece of coarse aggregate under the scratch hardness apparatus forcing the piece of aggregate to touch the sharpened, brass rod.

6.2 Push up on the 2-pound weighted brass rod with the piece of aggregate and pull the aggregate forward. Ensure that the brass rod remains in firm contact with the piece of aggregate at least from the center to the edge of the aggregate on one face.

6.3 Examine the particle to determine if it was scratched. Consider the particle to be soft if a groove was made in it without deposition of metal from the brass rod or if separate particles are detached from the rock mass. Consider the particle to be hard if a metal streak was made on it by the brass rod and no groove was made. If a particle contains more than one type of rock and is determined to be partly hard and partly soft, consider the particle soft if the soft part is more than 30 percent of the particle.

6.4 Assign the particles to groups of soft or hard particles.

7. Separately weigh the hard and soft particles groups for the fractionated size to the nearest 0.1 percent.
8. Repeat Steps 6 and 7 for each of the fractionated sizes.

D. Report. Report the following:

1. For each fractionated size, mass of particles tested with the brass rod.
2. For each fractionated size, mass of particles classified as soft in the test.
3. For each fractionated size, percent of test sample classified as soft by mass.
4. For the sample, percent of soft particles calculated by weighted average based on the original gradation. Round the sample percent of soft particles to the nearest whole number.

NJDOT A-6 – DETERMINING GRADATION OF DENSE-GRADED AGGREGATE CONTAINING RAP

A. Scope. This test method is used to rapidly determine the gradation of DGA containing more than 10 percent RAP. Due to the melting and adhering of the asphalt portion of RAP, typical oven or hotplate drying of the sample is detrimental. This test method is a modification of AASHTO T 27.

B. Apparatus. Use apparatus according to AASHTO T 2, T 11, T 27, and M 92.

C. Procedure. Perform the following steps:

1. Sieve a minimum 5000-gram sample of DGA without drying (wet-sieved) through the following sieves: 2-inch 1-1/2-inch, 3/4-inch, and No. 4. Weigh the material retained on each sieve and the material passing the No. 4 sieve. Record the weights.
2. Reduce the material passing the No. 4 sieve to a 500-gram sample.
3. Spread the 500 gram sample out in a pan and put it in an oven preheated to 175 ± 5 °F for approximately 1.5 hours. At 15 minute intervals, remove the sample from the oven and weigh it. Remix the material to promote even and thorough drying then return it to the oven. Continue to dry the material until it reaches a constant weight.
4. After drying the material passing the No. 4 sieve to a constant weight, record the final weight.
5. Wash the material passing the No. 4 sieve according to AASHTO T 11 and dry the sample using the procedure in Step 3.
6. Determine the gradation of the sample according to AASHTO T 27.
7. Mathematically combine the gradation results of the plus No. 4 and minus No. 4 portions of the material for a final gradation.

D. Report. Report the mathematically combined gradation results reported as a total percent passing the required sieves.

NJDOT B-1 – FALLING HEAD PERMEABILITY TEST FOR ASPHALT-STABILIZED DRAINAGE COURSE

A. Scope. This test method is used to determine the permeability of Asphalt-Stabilized Drainage Course (ASDC) materials.

B. Apparatus. Use the following apparatus:

1. Falling head permeability apparatus consisting of the following:
   - 1.1 A 4-inch inside diameter standpipe that is at least 25 inches high with 2 timing marks approximately 16 inches apart
   - 1.2 A top support that will fit over the mold and into which the standpipe will fit with a clamping system to ensure that it will not leak during testing.
   - 1.3 A bottom support into which the mold can fit and capable of supporting the apparatus with a clamping system to ensure that it will not leak during testing. Include a flap gate in the bottom of the bottom support to keep the water from flowing until after the testing has begun.
   - 1.4 Two rubber gaskets.
2. Steel cylinder molds 8-inch high × 4-inch inside diameter.
3. A steel ruler with 0.01-inch graduations.
4. A stopwatch capable of measuring up to 30 minutes with an accuracy of ± 0.1 second.
5. A source of clean cold tap water.

C. Procedure. Perform the following steps:

1 Prepare and compact 3 ASDC specimens according to AASHTO T 167.
2. Measure the height of the mold, the distance from the top of the mold to the top of the compacted specimen, and the distance from the bottom of the mold to the bottom of the compacted specimen. Calculate the compacted height of the ASDC sample (L) in inches as the height of the mold minus the 2 distances measured.
3. Place a 4-inch diameter cylinder mold with a compacted ASDC specimen into the bottom support ring of the falling head permeability apparatus. Place a rubber gasket along the bottom edge of the cylinder mold to prevent water leakage.
4. Place a rubber gasket at the top edge of the cylinder mold.
5. Place the upper support ring and plastic standpipe on top of the 4-inch diameter cylinder mold.
6. Lock the upper support ring to the cylinder mold with the wing nuts. The permeability apparatus is now assembled and ready for permeability testing.
7. Place the assembled permeability apparatus near the water source and a suitable drain.
8. With the bottom flap gate closed, fill the plastic standpipe to the top with water and then turn off the water.
9. Start the permeability flow test by opening the bottom flap gate to allow water to flow through the specimen.
10. Start the stopwatch when the water level drops to the first timing mark down from top of the standpipe.
11. Stop the stopwatch when the water level drops to the second timing mark down from the top of the standpipe.
12. Record the time in seconds.
13. Repeat the permeability test with additional compacted ASDC specimens for a total of 3 trials.

D. Calculations. Calculate the permeability of each sample using the following equation:

$$K = \left(\frac{L}{T}\right) \times \left[\ln\left(\frac{h_1}{h_2}\right)\right] \times (7200)$$

Where:
K = Falling head permeability (feet/day).
L = Height of compacted ASDC specimen.
T = Time in seconds for water level to fall from first timing mark to second timing mark.
h_1 = Distance in inches from first timing mark to bottom of specimen.
h_2 = Distance in inches from second timing mark to bottom of specimen.
ln = Natural logarithm.

E. Report. For each of the 3 compacted ASDC samples, report L, T, h_1, h_2 and the permeability. Report the average permeability of the 3 samples.

NJDOT B-2 – SAMPLING HMA MIXTURES

A. Scope. This test method is used to sample HMA mixtures at the plant.

B. Apparatus. Use the following apparatus:

1. Table of random numbers.
2. Shovel.
3. Bucket or pail of suitable size to collect sample.
4. Scoop and spatulas.

C. Procedure. Perform the following steps:

1. Lot Sizes. When taking samples from the truck at the plant, apply the rates of sampling to the plant's production for all Department projects rather than for individual projects. Divide the production into successive lots of the size as specified in Section 902 for the mixture being sampled. Take 5 samples for volumetric acceptance testing, composition testing, maximum specific gravity testing, and comparison testing from each lot. The ME will assign consecutive lot numbers for each type of mix at the plant. Include the assigned lot identification number on each weigh ticket.

2. Obtaining Samples. The ME will use a table of random numbers to select the ton of mix to be sampled for each sample in the lot. Based on the ton of mix, determine the truckload to be sampled. Obtain samples from the designated truckloads of material using the following method:

1. Flip a coin to determine which half of the truck to sample. If **HEADS**, sample the front half of the truck. If **TAILS**, sample the rear half of the truck.
2. Do not sample at the very bottom of a pile or in areas between piles to reduce the possibility of including segregated material in the sample.
3. Dig a furrow 3 to 6 inches deep that extends along the conical pile within the half of the truck to be sampled. Follow the slope of the pile starting as near to the center of the truck as possible.
4. From the furrow, shovel approximately equal volumes of material from the top third, center third, and bottom third of the pile. Sample enough material to perform all required testing.

3. Mixing and Reducing Samples. Mix the sample taken from the truck using a scoop. Clean all tools by scraping with spatulas before and after each remixing to prevent build-up of asphalt and fines on the tools. Do not use solvents to clean tools between uses. After mixing, reduce the sample as follows:

a. Gyratory Specimen. Scoop a representative portion of HMA from the container of material to be molded into one specimen for volumetric testing according to AASHTO T 312. Ensure that the HMA is at the specified compaction temperature when molding the specimen.

b. Composition Sample. After the removal of material for the gyratory specimen, remix the remaining material. Perform composition testing by the ignition method by taking a representative sample from the

remixed material and testing according to AASHTO T 308. If composition analysis is being performed by hot bin analysis, NJDOT B-5, a composition sample of HMA mix is not necessary.

c. Maximum Specific Gravity Sample. Remix the remaining material. Take a sample for determining maximum specific gravity and test according to AASHTO T 209.

d. Comparison Sample. Remix the remaining material and prepare a comparison sample weighing approximately 9 pounds. Place the comparison sample in a container that is sealed and labeled. Store the comparison sample at the plant for at least 3 months so it will be available for selection by the ME.

4. Identifying Samples. Identify samples by lot number and position in the lot's sampling sequence. Use a number followed by a letter to identify the sample. Use the lot number as the number and label the first, second, third, fourth, and fifth samples in the lot as "A", "B", "C", "D" and "E", respectively. If multiple samples are taken from the same truckload of mix, assign the same identification code to each of the samples.

D. Report. Report deviations to the specified sampling procedure.

NJDOT B-3 – SELECTING CORES FOR MAXIMUM SPECIFIC GRAVITY TESTING IN AIR VOIDS DETERMINATION

A. Scope. This test method is used to randomly select the core samples on which the maximum specific gravity will be determined according to AASHTO T 209 for use in the calculation of air voids for acceptance of a lot, and the procedure to be followed in the event of a possible failing lot.

B. Procedure. Perform the following steps:

1. Determine the bulk specific gravity according to AASHTO T 166 on each core from the lot.
2. Randomly select 1 core sample from a 5-core sample lot using a computer-generated random number selection program.
3. Determine the maximum specific gravity of the randomly selected core according to AASHTO T 209.
4. Determine the air void comparison limits based on air void acceptance limits specified for the mix being tested. Add 0.5 percent to the lower acceptance limit for the lower comparison limit and subtract 0.5 percent from the upper acceptance limit for the upper comparison limit.
5. Calculate the air void content for the randomly selected core using its maximum specific gravity determined in Step 3 and its bulk specific gravity determined in Step 1.
6. If the percent air voids for the randomly selected core is outside the comparison limits determined in Step 4, perform maximum specific gravity testing on the remaining cores in the lot. Do not perform Steps 7 to 9.
7. If the air void content for the randomly selected core is within the comparison limits determined in Step 4, use the maximum specific gravity of the randomly selected core and the individual bulk specific gravities to determine the air void content of the remaining cores in the lot.
8. If the air void content of any 1 of the cores in the lot as calculated in Step 7 falls outside of the comparison limits as determined in Step 4, perform maximum specific gravity testing on the remaining cores in the lot. Use the individual maximum specific gravities and bulk specific gravities to determine the air void content of each core.
9. If the air void content of all of the cores in the lot as calculated in Step 7 fall inside of the comparison limits as determined in Step 4, use the air void contents for the individual cores as determined in Step 7.

C. Calculations. Calculate the air voids for each core as follows:

$$\text{Air Voids} = \frac{A - B}{A} \times 100$$

Where:
A = Maximum Specific Gravity
B = Bulk Specific Gravity

D. Report. Report the air void content for each core to the nearest 0.1 percent.

NJDOT B-4 – MEASURING THICKNESS OF HMA CORES

A. Scope. This test method is used to measure the individual lift thicknesses of drilled HMA cores.

B. Apparatus. Use the following apparatus:

1. Caliper device to measure the axial lengths of individual lifts to the nearest 0.001-inch mounted on a support.
2. Support designed to hold the specimen with its axis in a horizontal position by 2 metal roller bearings sufficiently rigid and stable to maintain alignment without distortion or deflection.
3. Gauge to calibrate and check the zero reference point of the apparatus.

Ensure that the apparatus accommodates specimens from 1/2 to 12 inches in length.

C. Procedure. Perform the following steps:

1. If the caliper device is electronic, turn it on. Ensure that the caliper device is zeroed and set to the correct units of measure.
2. Place the specimen in the measuring apparatus with the smooth end of the core, which is the top or upper surface of the pavement, firmly against the zero reference point.
3. Take 4 length measurements approximately 90 degrees apart around the circumference of the specimen using the caliper device to measure the distance from the zero reference point (top of the core) to the bottom of the first lift. If a measuring point is not representative of the plane of the core lift because of a small projection or depression, rotate the specimen slightly about its axis and take the measurement at the nearest representative point.
4. Read each of the 4 measurements for the lift to the nearest 0.001 inch. Calculate the average of the 4 measurements for the lift to the nearest 0.01 inch and record.
5. Repeat Steps 3 and 4 for each lift to be measured by measuring from the zero reference point (top of the core) to the bottom of the lift being measured.

D. Report. Report the following to the nearest 0.01 inch:

1. Average thickness of the first lift, which is the average distance for the first lift as determined in Step 4.
2. Average thickness of the second lift, which is determined by subtracting the average thickness for the first lift from the distance measured in Step 4 for the second lift.
3. Average thickness of subsequent lifts, which is determined by subtracting the average thicknesses for all preceding lifts from the average distance measured in Step 4 for the lift.

NJDOT B-5 – DETERMINING COMPOSITION OF HMA MIXTURE USING HOT BIN SAMPLE ANALYSIS

A. Scope. This test method is used to determine the gradation and asphalt content of a HMA mixture by use of bin samples and printout ticket.

B. Apparatus. Use apparatus according to AASHTO T 11, T 27, and T 37.

C. Procedure. Perform the following steps:

1. When taking samples for hot bin analysis, apply the rates of sampling to the plant's production for all Department projects rather than for individual projects.
2. Divide the production into successive lots of the size as specified in Section 902 for the mixture being sampled. Take 5 samples for composition testing from each lot. Take 5 samples of the HMA as specified in NJDOT B-2 for volumetric acceptance testing, maximum specific gravity testing, and comparison testing from each lot. Time the HMA sampling to correspond with the hot bin samples.
3. The ME will assign consecutive lot numbers for each type of mix at the plant. Include the assigned lot identification number on each weigh ticket.
4. The ME will use a table of random numbers to select the ton of mix to be sampled for each sample in the lot. Based on the ton of mix, determine the portion of the production to be sampled.

5. The supplier's quality control technician shall take random samples of not less than 25 pounds from each hot bin for each 600 tons batched as directed by the ME. When mineral filler is used, take a minimum of one filler sample per lot.
6. Use a minimum sample weight for testing of 25 pounds for bins No. 5 and No. 4, 10 pounds for bin No. 3, and 2 pounds for bin No. 2. Use a minimum test sample weight of 500 grams for bin No. 1 and 100 grams for mineral filler.
7. For test samples from bins No. 2, 3, 4, and 5, weigh the sample and sieve the aggregate according to AASHTO T 27 down to the No. 8 sieve with a catch pan underneath. Conduct the sieving operation by means of a mechanical sieve shaker. If more than 2 percent of the aggregate is passing the No. 8 sieve, wash and grade that portion according to AASHTO T 11 and T 27.
8. Wash and grade the bin No. 1 test sample according to AASHTO T 11 and T 27.
9. For each bin, record the weight retained on each sieve determined in the grading process and the wash loss and pan weights for determination of the percent passing the No. 200 sieve.
10. Wash and grade the mineral filler sample according to AASHTO T 37.

D. Calculations. Calculate the asphalt content by dividing the recorded delivery ticket asphalt cement weight for the load by the total load weight.

Calculate the percent of material from each bin by dividing the recorded delivery ticket weights for each bin by the total aggregate weight of the load. Calculate the mix gradation by computing the percentage of material passing each sieve for each bin and multiplying the percentage by the individual bin percentage and then summing the products for each sieve.

E. Report. Report the asphalt content to the nearest 0.01 percent on the work sheet and the daily inspection report and rounded to the nearest 0.05 percent when reported on the lot data report.

Report bin percentages, bin gradations, and the mix gradation to the nearest 0.1 percent on the work sheet and daily inspection report. On the lot data report, report the mix gradation to the nearest 0.5 percent on the No. 8 sieve, to the nearest 0.1 percent on the No. 200 sieve, and to the nearest 1 percent on all other sieves.

NJDOT B-6 – DETERMINING PERCENT OF AIR VOIDS IN OPEN-GRADED HMA

A. Scope. This test method is used to determine the percent of air voids in compacted open-graded HMA specimens.

B. Apparatus. Use the following apparatus:

1. Apparatus for determining maximum specific gravity according to AASHTO T 209.
2. Caliper accurate to 0.001 inch.
3. Balance accurate to 0.1 gram and conforming to requirements of AASHTO M 231.

C. Procedure. Perform the following steps:

1. Weigh specimen in air to the nearest 0.1 gram.
2. Measure the height of the specimen at 4 approximately equidistant locations and average. Record the average height to the nearest 0.001 inch.
3. Measure the diameter of the specimen at 4 approximately equidistant locations and average. Record the average diameter to the nearest 0.001 inch.
4. Determine the maximum specific gravity of the specimen as specified in AASHTO T 209.

D. Calculations. Perform the following calculations:

1. Calculate the volume of each specimen based on the average height and diameter and convert to cubic centimeters.

2. Calculate the bulk specific gravity of the specimens using the formula:

$$\text{Bulk Specific Gravity} = \frac{\text{Density g/cm}^3}{0.99707\ \text{g/cm}^3}$$

Where:
Density = Mass divided by volume
0.99707 g/cm^3 = density of water at 77 °F

3. Determine the maximum specific gravity of the specimen according to AASHTO T 209.
4. Calculate the percent of air voids using the formula:

$$\text{Percent Air Voids} = \frac{\text{Maximum Specific Gravity - Bulk Specific Gravity}}{\text{Maximum Specific Gravity}} \times 100$$

E. Report. Report the percent air voids of each specimen and the average percent air voids of the specimens to the nearest 0.1 percent.

NJDOT B-7 – DETERMINING OPTIMUM ASPHALT CONTENT FOR OPEN-GRADED FRICTION COURSE (OGFC)

A. Scope. This test method is used to determine the optimum percent asphalt in an OGFC mixture. The test method uses a visual draindown analysis to determine optimum asphalt content.

B. Apparatus. Use the following apparatus:

1. Ovens capable of maintaining temperatures as specified in this method.
2. Clear glass (Pyrex) 9-inch diameter pie pans.

C. Procedure. Perform the following steps:

1. Heat aggregate to 275 °F. Heat molds to 275 °F. Heat binder to the manufacturer's recommended mixing temperature.
2. Using 1000-gram batches, mix aggregate with asphalt at a minimum of 3 asphalt contents (1 at the estimated JMF asphalt content and 1 each at + and −0.5 percent of the estimated JMF asphalt content). After mixing, check the temperature to ensure that it is 250 ± 10 °F. Cool or reheat as necessary to meet the temperature tolerance.
3. Place each 1000-gram batch into a clean, clear glass (Pyrex) 9-inch pie pan.
4. Place samples in an oven at 255 ± 5 °F for 1 hour. Remove and let cool for 1 hour at room temperature.
5. Visually observe the amount of liquid asphalt on the bottom of each pan.
6. Select the asphalt content where ample bonding is evident, without having excessive drainage as evidenced by an appearance of unconnected pools of asphalt binder around aggregate points of contact.

D. Report. Report the asphalt contents tested, the observations for each asphalt content, and the optimum asphalt content determined in Step 6.

NJDOT B-8 – DETERMINING JOB MIX FORMULA FOR MODIFIED OPEN-GRADED FRICTION COURSE MIXES

A. Scope. This test method is used to determine gradation and the percent asphalt in a MOGFC mixture. The gradation is verified to ensure stone-on-stone contact, and the impact resistance of the final JMF is verified. The optimum asphalt content (AC) is determined from: (1) aggregate surface area, (2) relative Voids in Mineral Aggregate (VMA), and (3) visual drain-down determination of asphalt content. A simple average of these 3 criteria is used to determine the JMF asphalt content.

B. Apparatus. Use the following apparatus:

1. Equipment as needed for AASHTO T 19.
2. Equipment as needed for Superpave mix design as specified in AASHTO T 312.
3. Equipment as needed for AASHTO T 209.
4. Ovens capable of maintaining temperatures as specified in this method.
5. Clear, glass (Pyrex) 9-inch diameter pie pans.
6. L.A. Abrasion Machine conforming to AASHTO T 96.
7. Equipment as needed for AASHTO T 85.
8. No. 4 sieve according to AASHTO M 92.

C. Procedure. Perform the following steps:

1. Verification of Stone-On-Stone Contact. Choose the design gradation to meet the air void requirements and to ensure that the aggregate skeleton exhibits stone-on-stone contact. Sieve aggregates proportioned to meet the selected JMF gradation over a No. 4 sieve. Keep the material retained on the No. 4 sieve as the coarse aggregate fraction. Determine the unit weight G_{uwca} of the coarse aggregate fraction of the aggregate using the dry rodding technique according to AASHTO T 19 For the selected JMF, determine the voids in the coarse aggregate of the mix (VCA_{mix}) based on specimens compacted with 50 gyrations according to AASHTO T 312. Calculate:

$$VCA_{drc} = \frac{100\,(G_{sbca} - G_{uwca})}{G_{sbca}}$$

Where:
VCA_{drc} = The voids in the coarse aggregate fraction of the JMF aggregate skeleton.
G_{sbca} = The bulk specific gravity of the coarse aggregate fraction as determined by AASHTO T 85.
G_{uwca} = The unit weight of the coarse aggregate fraction (expressed in kilograms per cubic meter) as determined by AASHTO T 19.

$$VCA_{mix} = 100 - \frac{P_{ca} - G_{mb}}{G_{sbca}}$$

Where:
VCA_{mix} = The voids in the coarse aggregate fraction of the mix. The coarse aggregate fraction of the aggregate is that portion of the JMF aggregate skeleton not passing the No. 4 sieve.
P_{ca} = The percent of the coarse aggregate fraction by weight of total mix.
G_{mb} = The bulk specific gravity of the mix at the design AC content as determined by Section 3.4.
G_{sbca} = The bulk specific gravity of the coarse aggregate fraction as determined by AASHTO T 85.

For stone-on-stone contact VCA_{mix} must be less than VCA_{drc}

2. Surface Area Asphalt Content. Determine "surface area" asphalt content according to NJDOT B-9.

3. Relative VMA Asphalt Content. Mix aggregate graded to proposed JMF with asphalt and fiber at 5 asphalt contents (1 at the estimated JMF asphalt content, 1 each at + and −0.5 percent and 1 each at + and –1.0 percent of the estimated JMF asphalt content) according to AASHTO T 312. After mixing, return sample to the oven if necessary, and when at the recommended compaction temperature, compact the specimens. Compact 3 specimens at each asphalt content using 50 gyrations of a Superpave Gyratory Compactor according to AASHTO T 312. Determine the bulk specific gravity, G_{mb} from each specimen according to NJDOT B-6 or AASHTO TP 69.

Determine maximum specific gravity, G_{mm}, at each asphalt content according to AASHTO T 209. From G_{mb}, G_{mm}, and each known asphalt content, calculate volumetric information as follows:

Plot asphalt content versus "relative VMA" and select the asphalt content at the lowest point on the curve.

$$V_a = 100 \times \frac{1 - G_{mb}}{G_{mm}}$$

$$V_b = b \times G_{mb}$$

$$VMA_R = V_a \times V_b$$

Where:
b = Percent AC by weight of total mix
G_{mb} = the bulk specific gravity of the specimen as determined by NJDOT B-6 or AASHTO TP 69.
G_{mm} = the maximum specific gravity at each asphalt content as determined by AASHTO T 209.
V_a = Volume of air is equal to the percent air voids.
V_b = Percent by volume of asphalt cement.
VMA_R = Relative VMA

The volume of the fiber, absorbed asphalt, and specific gravity of asphalt binder are not accounted for in this procedure. This procedure measures "relative VMA" not the true VMA.

4. **Visual Draindown Asphalt Content.** Prepare 1000-gram samples of the uncompacted mix for each of the asphalt contents. Place each sample into a clean, clear glass (Pyrex) 9-inch pie pans. Place samples in oven for 1 hour at the binder manufacturer's recommended mixing temperature. Remove and let cool for 1 hour at room temperature. Visually observe the amount of liquid asphalt on the bottom of each pan. Select asphalt content where ample bonding is evident, without having excessive drainage as evidenced by an appearance of unconnected pools of asphalt binder around aggregate points of contact.

5. **Select Optimum Asphalt Content for JMF.** Determine the JMF asphalt content by averaging the results from the 3 methods (surface area, relative VMA, and draindown).

$$AC_{jmf} = \frac{AC_{sc} + AC_{vma} + AC_{dd}}{3}$$

Where:
AC_{jmf} = the design JMF
AC_{sc} = the asphalt content determined by the surface area in Step 2.
AC_{vma} = the asphalt content determined by relative VMA in Step 3.
AC_{dd} = the asphalt content determined by draindown in Step 4.

6. **Verification of Abrasion and Impact Resistance of JMF (Cantabro Test).** Compact 2 specimens using the JMF at the optimum asphalt content as specified in Step 3. Age the specimens for 7 days ± 8 hours in an oven at 140 ± 5 °F. Weigh each sample. Utilizing a Los Angeles Machine conforming to AASHTO T 96, without the charge of steel balls, subject the aged samples to 300 revolutions at 30 to 33 revolutions per minute. After the 300 revolutions reweigh the samples.

   Calculate the Percent Loss:

$$P_{loss} = \frac{A - B}{A} \times 100$$

   Where:
   P_{loss} = The loss expressed as percent of aged sample before L.A. Abrasion Machine treatment.
   A = The weight of the sample before modified L.A. Abrasion test.
   B = The weight of the sample after modified L.A. Abrasion test.

   If the loss is less than 30 percent, the JMF is acceptable. If the JMF is determined to be unacceptable, redesign the mix.

D. Report. Report all test results on ME provided forms.

NJDOT B-9 – DETERMINING ASPHALT CONTENT FOR MOGFC COURSES BY AGGREGATE SURFACE AREA

A. Scope. This test method is used to determine the asphalt content to be used in MOGFC mixes based on the surface area of the aggregate. This percentage is averaged with asphalt contents determined according to NJDOT B-8 to arrive at a design asphalt content for a MOGFC mix design.

B. Apparatus. Use the following apparatus:

1. Ovens capable of maintaining temperatures of 140 ± 5 °F and 230 ± 9 °F.
2. Balance meeting the requirements of AASHTO M 231, Class D.
3. Two metal funnels having minimum dimensions of 3-1/2 inch top diameter, 4-1/2 inch high and 1/2 inch orifice. The funnels shall have a metal strainer soldered where the base of the cone connects to the top of the spout. The equivalent size of the strainer shall not be larger than No. 10 sieve.
4. A 3/8-inch sieve and a No. 4 sieve according to AASHTO M 92.
5. SAE No. 10 lubricating oil.
6. Two rubber stoppers to fit the funnel outlets.
7. Ring stand to support the funnels during testing.
8. Equipment required in AASHTO T 85.

C. Procedure. Perform the following steps:

1. Determine the apparent specific gravity of the aggregate passing the 3/8-inch sieve and retained on the No. 4 sieve according to AASHTO T 85.
2. Through quartering, obtain 2 samples weighing approximately 110 grams representative of the material passing the 3/8-inch sieve and retained on the No. 4 sieve.
3. Dry the sample in the 230 °F oven to a constant weight and allow to cool to room temperature.
4. Weigh out 100.0 grams of the material and place in the metal funnel.
5. Place a stopper in the funnel outlet and fill funnel with SAE No. 10 oil, immersing the aggregate.
6. After 5 minutes, remove the stopper and allow the oil to drain for 2 minutes.
7. Place the funnel containing the aggregate on a pan in the oven maintained at 140 °F for 15 minutes of additional draining.
8. Remove the sample from the funnel, cool to room temperature, reweigh to the nearest 0.1 gram, and record.

D. Calculations. Perform the following calculations:

1. Calculate the percent oil retained for each sample as follows:

$$R = \frac{B - A}{A} \times 100$$

Where:
R = Percent oil retained
A = Weight of sample before test
B = Weight of sample after test

2. Using the average percent oil retained of the 2 samples, calculate the corrected percent oil retained as follows:

$$R_c = R - \frac{G_a}{2.65} \times 100$$

Where:
R_c = Corrected percent oil retained
G_a = Apparent specific gravity of aggregate
2.65 = Constant

3. Using the corrected percent oil retained, determine the surface constant (K_c) from Table B-9-1.

4. Calculate the design asphalt content as follows:

$$\text{Design Asphalt Content} = \frac{(2.0\,K_c + 4.0) \times 2.65}{G_a}$$

Table B-9-1 – Determination of Surface Constant K_c

CORR. %OIL	K_c	CORR. %OIL	K_c	CORR. %OIL	K_c	CORR. %OIL	K_c
0.1	0.1	2.6	1.2	5.1	2.2	7.6	3.1
0.2	0.1	2.7	1.2	5.2	2.2	7.7	3.1
0.3	0.2	2.8	1.2	5.3	2.2	7.8	3.2
0.4	0.2	2.9	1.3	5.4	2.3	7.9	3.2
0.5	0.3	3.0	1.3	5.5	2.3	8.0	3.2
0.6	0.3	3.1	1.4	5.6	2.3	8.1	3.3
0.7	0.4	3.2	1.4	5.7	2.4	8.2	3.3
0.8	0.4	3.3	1.4	5.8	2.4	8.3	3.4
0.9	0.4	3.4	1.5	5.9	2.5	8.4	3.4
1.0	0.5	3.5	1.5	6.0	2.5	8.5	3.4
1.1	0.5	3.6	1.6	6.1	2.5	8.6	3.5
1.2	0.6	3.7	1.6	6.2	2.6	8.7	3.5
1.3	0.6	3.8	1.6	6.3	2.6	8.8	3.5
1.4	0.7	3.9	1.7	6.4	2.6	8.9	3.6
1.5	0.7	4.0	1.7	6.5	2.7	9.0	3.6
1.6	0.7	4.1	1.8	6.6	2.7	9.1	3.6
1.7	0.8	4.2	1.8	6.7	2.8	9.2	3.7
1.8	0.8	4.3	1.8	6.8	2.8	9.3	3.7
1.9	0.9	4.4	1.9	6.9	2.8	9.4	3.8
2.0	0.9	4.5	1.9	7.0	2.9	9.5	3.8
2.1	1.0	4.6	2.0	7.1	2.9	9.6	3.8
2.2	1.0	4.7	2.0	7.2	2.9	9.7	3.9
2.3	1.0	4.8	2.0	7.3	3.0	9.8	3.9
2.4	1.1	4.9	2.1	7.4	3.0	9.9	3.9
2.5	1.1	5.0	2.1	7.5	3.1	10.0	4.0

E. Report. Report all test results on ME provided forms.

NJDOT C-1 – DETERMINING YIELD OF CONCRETE PRODUCED BY CONTINUOUS-MIXING-TYPE TRUCK MIXERS

A. Scope. This test method is used to determine the yield of concrete that is proportioned volumetrically in a continuous-mixing-type truck mixer.

B. Apparatus. The apparatus will consist of a 1/4-cubic yard container having dimensions of 36 × 36 × 9 inches. Construct the container using materials that do not become deformed when filled with concrete.

C. Procedure. Perform the following steps:

1. Set all controls of the mixer unit at the settings approved for the mix design being checked.
2. Activate the mixer and discharge sufficient material to fill the mixing auger assembly and discharge chute. Then deactivate the mixing unit.

3. Reset cement meter to zero and reactivate the mixer and discharge material into the 1/4-cubic yard container until it is level-struck full, making provision for the material settling into all corners.
4. Record the count as shown on the cement meter.

D. Calculation. Calculate the cement count that is equivalent to the amount of cement specified in the mix design for 1/4 cubic yard. Calculate the yield by dividing the actual cement count by the specified count and multiplying by 100. The result will be 100 ± 2 percent.

E. Report. Report the yield to the nearest 0.1 cubic yard.

NJDOT C-2 – QUICK-SETTING PATCH MATERIALS

A. Scope. This test method is used for determination of quick-set patch materials properties for approval and quality assurance.

B. Apparatus. Use apparatus as needed to perform testing according to AASHTO T 22, AASHTO T 27, AASHTO T 106, AASHTO T 126, AASHTO T 160, AASHTO T197, AASHTO T 260, and ASTM C 672.

C. Procedure. Perform the following steps:

1. Preparation of Samples. Prepare samples according to manufacturer's recommendations. If several design mixes are given, test the material with the highest allowable water amount that is consistent with its intended use as a patching material. If the material is to be used at temperatures different than 70 °F, the ME may test the time of set, bond, and compressive strength at a different temperature in the allowable range of temperature.

2. Tests. Test materials according to the following:

a. Time of Set. Run time of set test according to AASHTO T 197 except cardboard molds may be used.

b. Strength Development. For Type 1 and 2, test 2 cubes per test according to AASHTO T 106. For Type 1A and 1B, make two 4 × 8-inch cylinders per test according to AASHTO R 36. Cure specimens covered with a plastic cover over the cylinder for 3 hours and then cure without the plastic cover at 70.4 to 76.4 °F and 50 percent relative humidity until testing. Test according to AASHTO T 22.

c. Bond Strength - Arizona Shear Method. Prepare four 4 × 8-inch composite cylinders consisting of a base cylinder of hardened conventional concrete and an upper portion of the patching material.

Make the base concrete from 4 × 8-inch cylinders having a minimum compressive strength of 5000 pounds per square inch. Cut the cylinders into equal halves along a 30-degree angle with the vertical axis. After being cut, etch the base cylinders with a 50 percent solution of hydrochloric acid and placed in 4 × 8-inch cylinder molds with cut face up.

When preparing the composite cylinders, brush a small amount of the patching material into the saw-cut surface of the base cylinder. Fill the remaining half of the cylinder mold with patching material using the standard consolidation procedures defined in AASHTO R 36. Cure specimens covered with a plastic cover over the cylinder for 3 hours and then cure without the plastic cover at 70.4 to 76.4 °F and 50 percent relative humidity until testing. Remove the cylinders from the mold after 24 hours. Test 2 specimens at 7 days and 2 specimens at 28 days according to AASHTO T 22.

d. Expansion-Shrinkage. Monitor change in volume and length from batching until the materials reach equilibrium. Prepare four 2 × 2 × 10-inch autoclave bars according to AASHTO T 160 for Type 1 and Type 2. Prepare four 3 × 3 × 10-inch autoclave bars according to AASHTO T 160 for Type 1A and 1B. Cure at 70.4 to 76.4 °F and 50 percent relative humidity for 24 hours. Record initial reading after 24 hours, then place 2 bars in water bath in moisture room and leave the other bars in the initial curing conditions. Take a reading on each bar every 24 hours until stability has been attained.

e. Durability. Prepare four 4 × 8-inch cylinders for each material. Test 2 cylinders according to AASHTO T 22 for 28-day compressive strength. Test the remaining 2 cylinders as follows:

1. Cure for 24 hours at 70.4 to 76.4 °F and 50 percent relative humidity, followed by 6-day cure in a lime water solution.
2. Following the 7-day cure period, begin a 50-cycle freeze-thaw test. Each cycle will consist of 16 hours freeze (air) and 8 hours thaw (solution). Proportion the durability solution by weight of 96 percent water, 3.2 percent sodium chloride, and 0.8 percent calcium chloride.
3. After every tenth cycle, examine cylinders visually and record condition according to ASTM C 672.
4. At the end of the 50 cycles, perform compressive test according to AASHTO T 22 and report the results as a percentage of the 28-day compressive strength result.

f. Permeability. Prepare one 4 × 8-inch cylinder and cure for 24 hours at 70.4 to 76.4 °F and 50 percent relative humidity. Saw cut the cylinder into two 4 × 4-inch cylinders. Seal all sides and the bottom with hot paraffin, leaving the saw-cut surface exposed. Place cylinders in durability solution noted in Step e for 7 days. Measure the amount of chlorides at the 1-inch, 2-inch, and 3-inch levels, from the top surface, according to AASHTO T 260.

g. Chlorides in Raw Material. Measure the amount of chlorides according to AASHTO T 260.

h. Color. Note the color of the cured material.

i. Sieve Analysis. For Type 1B Patch, analyze the 1/2-inch, 3/8-inch, No. 4, No. 8, and No. 16 sieves according to AASHTO T 27. Report the amount and type of aggregate at approval.

D. Report. Include the following in the report:

1. Manufacturer and name of product.
2. Type of Patch material.
3. Mix design used.
4. Temperature tested at.
5. Time of Set to the nearest minute.
6. Strength Development to the nearest 10 pounds per square inch.
7. Bond Strength to the nearest 10 pounds per square inch.
8. Expansion/Shrinkage to 0.01 percent.
9. Durability to the nearest whole number.
10. Permeability to the nearest 0.1 pounds per cubic yard.
11. Chlorides to the nearest 0.01 percent.
12. Color of material.
13. Sieve Analysis to nearest 0.1 percent.

NJDOT C-3 – CALCIUM NITRITE PRESENCE IN PLASTIC CONCRETE

A. Scope. This test method is used to determine the presence of calcium nitrite in the plastic concrete state. Perform testing on a freshly mixed concrete sample.

B. Apparatus. Use the following apparatus and materials:

1. Quantofix Test Strips for high range nitrite No. 91322.
2. 10 cubic centimeter disposable syringes with Leur-Lok tip No. 309604.
3. Disposable filters 1 inch/0.45 micron No. SLHA02510.
4. Wide-mouth container.
5. Measuring cups marked in milliliters.

C. Procedure. Perform the following steps:

1. Determine the amount of concrete to be tested based on the design amount of Calcium Nitrite and Table C-3-1. Add concrete to pre-measured 0.5 gallons of water in a wide mouth container. Use the water in the container to rinse out the measuring cup.
2. Shake the container for 2 to 5 minutes until contents are well mixed.

3. Using the syringe, uptake approximately 10 milliliters of extraction water from the container. Attach a disposable filter to the end of the syringe.
4. Filter the extraction water into a clean cup.
5. Dip the test strip into the clear, filtered extraction water and compare the color to the chart on the side of the test strip container.
6. Use the Table C-3-1 to determine if the reading on test strips corresponds with the expected reading for the design amount of Calcium Nitrite.

Table C-3-1 – Parameters for Calcium Nitrite Testing

Design Amount of Calcium Nitrite, gal/CY	Volume of Concrete to be Added, oz.	Expected Reading on Test Strip
2.0	8	0.3
2.5	6	0.3
3.0	5	0.3
3.5	4	0.3
4.0	8	0.6
4.5	7	0.6
5.0	6	0.6

D. Report. Report the reading on the test strip. Report if the sample passed or failed.

NJDOT C-4 – SLUMP FLOW TEST AND VISUAL STABILITY INDEX TEST

A. Scope. The slump flow is used to assess the horizontal free flow of self-consolidating concrete (SCC) in the absence of obstructions. The test method is based on the test method for determining the slump (AASHTO T 119). The diameter of the concrete circle is a measure for the flowability of the SCC. The visual stability index (VSI) is a visual evaluation of the segregation of the SCC during the slump flow test.

B. Apparatus. Use the following apparatus:

1. Mold in the shape of a truncated cone with the internal dimensions 8-inch diameter at the base, 4-inch diameter at the top, and a height of 12 inches.
2. Base plate of a stiff non-absorbing material, at least 30-inches square, marked with a circle marking the central location for the slump cone.
3. Hand-held wood or metal float or trowel.
4. Wheelbarrow or other container to hold at least 0.2 cubic feet of SCC.
5. Ruler or tape measure at least 30 inches long.
6. A scoop or suitable container for filling specimen molds with SCC. Experience has shown pails and plastic cylinder molds to be suitable containers.

C. Procedure. Perform the following steps:

1. Sample the freshly mixed SCC according to AASHTO T 141.
2. Observe the SCC in the wheelbarrow for segregation.
3. Moisten the base plate and inside of slump cone.
4. Place base plate on level stable ground. Place the inverted slump cone centrally on the base plate and hold down firmly.
5. Fill the cone with the scoop or other suitable container in 1 lift. Do not tamp, rod, or vibrate. Strike off the SCC level with the cone with the trowel.
6. Remove any surplus SCC from the base plate around the cone.
7. Raise the cone vertically and allow the SCC to flow out freely.
8. Measure the final diameter of the SCC in 2 perpendicular directions.
9. Calculate the average of the 2 measured diameters (this is the slump flow in inches).
10. Rate the stability of the mixture in 0.5 increments by visual examination as specified in Table C-4-1.

Table C-4-1 – Visual Stability Index (VSI) Rating Criteria	
Rating	**Criteria**
0	No evidence of segregation in slump flow patty or in the wheelbarrow.
1	No mortar halo or aggregate pile in the slump flow patty but some slight bleed or air popping on the surface of the concrete in the wheelbarrow.
2	A slight mortar halo (<3/8 inch) and/or aggregate pile in the slump flow patty and highly noticeable bleeding in the wheelbarrow.
3	Clearly segregating by evidence of a large mortar halo (>3/8 inch) and/or large aggregate pile in the center of the concrete patty and a thick layer or paste on the surface of the resting concrete in the wheelbarrow.

D. Report. Report the following:

1. Identification number.
2. Location of concrete represented.
3. Date and time of testing.
4. Slump flow in inches.
5. VSI rating.
6. Results of any other tests on the fresh concrete.

NJDOT C-5 – STATIC SEGREGATION OF HARDENED SELF-CONSOLIDATING CONCRETE CYLINDERS

A. Scope. This test method is used for determining the static segregation resistance (stability) of SCC using hardened test specimens. This method provides a visual assessment of static segregation resistance of SCC using a Hardened Visual Stability Index (HVSI) rating to evaluate molded or cored hardened concrete cylinders cut lengthwise in 2.

B. Apparatus. Use the following apparatus:

1. 4 × 8-inch cylinder molds for casting concrete test specimens shall conform to the requirements of AASHTO M 205.
2. Hand-held wood or metal float or trowel.
3. A saw with a diamond or silicon-carbide cutting edge and capable of cutting specimens without excessive heating or shock.
4. A suitable container for filling specimen molds with SCC. Experience has shown pails and plastic cylinder molds to be suitable containers.

C. Procedure. Perform the following steps:

1. Sample plastic SCC according to AASHTO T 141.
2. Mold two 4 × 8-inch test specimens as near as practical to the place where they are to be stored. If it is not practical to mold the specimens where they will be stored, move them to the place of storage immediately after strike off. Place molds on a rigid surface free from vibration and other disturbances. Ensure that the supporting surface is level to within 0.25 inch per foot.
3. Fill the specimen molds in 1 lift poured using a suitable container without vibration, rodding, or tapping.
4. Strike off the surface of the concrete level with the top of the mold using a float or trowel.
5. Immediately after molding and finishing, cap the specimens with a plastic cylinder lid or cover with a plastic bag. Store for a period up to 24 hours at a minimum temperature of 60 °F.
6. Before subjecting the specimens to sawing, ensure that they have been cured for a minimum curing period of 24 hours or have attained a minimum compressive strength of 900 pounds per square inch according to AASHTO T 22.
7. Saw specimens lengthwise down the center. If a specimen cannot be satisfactorily sawed smooth due to lack of curing, then do not disturb the remaining specimens for an additional minimum curing period of 24 hours.
8. Make a visual assessment of the cut planes of the hardened concrete cylinder or core using the criteria in Table C-5-1. Wet the cut planes to facilitate visual inspection.

Table C-5-1 – HVSI Specimens Rating Criteria	
Rating	**Criteria**
0 stable	No mortar layer at the top of the cut plane and no variance in size and percent area of coarse aggregate distribution from top to bottom.
1 stable	No mortar layer at the top of the cut plane but slight variance in size and percent area of coarse aggregate distribution from top to bottom.
2 unstable	Slight mortar layer, less than 1 inch tall, at the top of the cut plane and distinct variance in size and percent area of coarse aggregate distribution from top to bottom.
3 unstable	Clearly segregated as evidenced by a mortar layer greater than 1 inch tall and/or considerable variance in size and percent area of coarse aggregate distribution from top to bottom.

D. Report. Report the following:

1. Identification number.
2. Location of concrete represented.
3. Date and time of molding.
4. HVSI rating for each hardened specimen.
5. Results of any other tests on the fresh concrete.

NJDOT R-1 – OPERATING INERTIAL PROFILER SYSTEMS FOR EVALUATING PAVEMENT PROFILES

A. Scope. This test method describes the procedure for operating and verifying the calibration of an ASTM E 950 Class 1 Inertial Profiler System (IPS).

B. Apparatus. Use an IPS that meets the requirements of AASHTO MP 11 and ASTM E 950, Class 1 and the following:

1. Certify the IPS according to AASHTO PP 49 at least every 2 years. If a system component is replaced, re-certify the system. Perform the certification at a site approved by the Department.
2. The data system provides the raw profile data in an ASCII format acceptable to the Department.
3. The computer program uses a high-pass filter set at 300 feet and reads an ASCII or text file for computing the International Roughness Index (IRI) in inches per mile.
4. The current version of *ROADRUF*, *ProVal*, or other Department approved pavement profile analysis software is used to compute the IRI.

C. Procedure. Perform the following steps:

1. Operate the IPS according to AASHTO PP 50 and ASTM E 950.
2. On a daily basis before data collection, check the equipment and operating system for operational stability and calibration. Perform necessary calibration procedures according to equipment manufacturer's procedures and applicable standards. Operators shall maintain a log documenting the calibration history.
3. Ensure that the operators of the IPS have completed a profile training course, such as NHI Course 131100, have been trained specifically on the IPS they will be operating, and are proficient in the operation of the IPS.
4. Make provisions to automatically start and stop the IPS recording at the beginning and end of testing. Place retroreflective traffic striping tape or other approved mechanism at the beginning and end of each direction of travel for automatically triggering the start and stop of profile measurements.
5. Collect at least 0.05-mile of data before the area to be tested to allow the system to stabilize before profile measurements are obtained. Collect data in a continuous run through the length to be tested. If the run is interrupted, discard the results and re-run the length.
6. Submit the raw data for determination of the IRI.

NJDOT S-1 – ROTATIONAL-CAPACITY TEST ON LONG BOLTS IN TENSION CALIBRATOR

A. Scope. This test method is used for determination of high-strength steel bolt assembly acceptance for rotational capacity using a tension calibrator. Use this test method for bolts long enough to fit in the tension calibrator. Use NJDOT S-2 for bolts that are too short to fit in the tension calibrator.

B. Apparatus. Use the following apparatus:

1. Calibrated bolt tension measuring device of size required for bolts to be tested, such as Skidmore-Wilhelm Calibrator.
2. Calibrated torque wrench (dial type).
3. Spacers and/or washers with hole-size no larger than 1/16 inch greater than bolt to be tested.
4. Steel section for mounting the bolt calibrator such as a flange of a girder or cross frame accessible from the ground.

C. Procedure. Perform the following steps:

1. To determine if the bolt is long enough for testing, mark the first 3 to 5 full threads that are located closest to the bolt head. Insert the bolt into the tension calibrator and assemble a washer and nut onto the bolt up to the marked threads. Use a rotational capacity washer from the same rotational capacity lot as the bolt and nut. If a washer is not required for the installation, use an ASTM F 436 washer of the proper diameter for the test. If the nut can not be fully threaded onto the bolt shank then the bolt is too short for testing and must be tested as specified in NJDOT S-2. If the nut is at least flush with the end of the bolt shank, then continue testing.
2. Take apart the bolt assembly. Use shim plates or washers under the bolt head, as needed, to ensure that the 3 to 5 threads that were marked in Step 1 are located within the grip of the device but are just visible from the opposite side. Re-assemble the bolt, washer, and nut.
3. Tighten the nut using a hand wrench to the minimum snug tension as specified in Table S-1-1. Do not exceed the minimum snug tension by more than 2 kips.

Table S-1-1 – Snug Tension Requirements

Bolt Size	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2
Minimum Snug Tension, kips	1	2	3	4	5	6	7	9	10

4. Match mark a corner of the nut and the face plate of the bolt calibrator.
5. Using the calibrated manual torque wrench, tighten the bolt to the minimum tension listed in Table S-1-2. Read and record the wrench torque required to reach the tension with the nut in motion. Read the actual bolt tension and record as the initial tension.

Table S-1-2 – Initial Tension Requirements

Bolt Size	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2
Minimum Initial Tension, kips	12	19	28	39	51	56	71	85	103

6. Further tighten the bolt to the rotation listed in Table S-1-3. Measure rotation from the match mark in Step 4. Record the bolt's final tension as indicated on the calibrator. If an assembly fails by stripping or fracturing before reaching the rotation listed in Table S-1-3, the assembly fails the test.

Table S-1-3 – Required Rotation

Rotation	Bolt Length
240 degrees (2/3 turn)	≤ 4 diameters
360 degrees (1 turn)	> 4 diameters and ≤ 8 diameters
480 degrees (1-1/3 turns)	> 8 diameters

7. The final bolt tension measured in Step 6 must equal or exceed the value in Table S-1-4. Assemblies that do not meet this tension fail the test.

Table S-1-4 – Final Tension Requirements									
Bolt Size	**1/2**	**5/8**	**3/4**	**7/8**	**1**	**1-1/8**	**1-1/4**	**1-3/8**	**1-1/2**
Minimum Final Tension, kips	14	22	32	45	59	64	82	98	118

8. Loosen the assembly and remove nut to examine the threads on the nut and bolt. Check for signs of thread shear failure, stripping, or torsional failure of the nut and bolt. Assemblies that have evidence of thread shear, stripping, or torsional distress fail the test.

D. Calculations. Calculate the maximum allowable torque in foot-pounds as follows:

$$\text{Maximum Allowable Torque} = 0.25 \times P \times D$$

Where:
P = Measured initial tension in pounds
D = Bolt diameter in feet

Compare the torque as measured in Step 5 to the maximum allowable torque. If the measured torque is greater than the maximum allowable torque, the assembly fails the test.

E. Report. Report the following:

1. Size, manufacturer and lot number for the bolt assembly.
2. Measured initial tension and torque.
3. Measured final tension and torque.
4. Observations of the thread condition.
5. Pass/Fail status of the bolt assembly.

NJDOT S-2 – ROTATIONAL-CAPACITY TEST ON BOLTS TOO SHORT TO FIT TENSION CALIBRATOR

A. Scope. This test method is used for determination of high-strength steel bolt assembly acceptance for rotational capacity for bolt assemblies that are too short to fit in a tension calibrator. Use NJDOT S-1 for bolts that are long enough to fit in the tension calibrator.

B. Apparatus. Use the following apparatus:

1. Calibrated torque wrench and spud wrench or equivalent.
2. Spacers and/or washers with hole-size no larger than 1/16 inch greater than bolt to be tested.
3. Steel section with normal size hole to install bolt. Any available splice hole can be used with a plate thickness that will provide the number of threads under the nut required in Step 1 of the procedure.

C. Procedure. Perform the following steps:

1. Before testing, verify that the bolt is too short for testing as specified in NJDOT S-1.
2. Mark on the first 3 to 5 threads that are located closest to the bolt head.
3. Insert the bolt into the steel section using shim plates or washers under the bolt head, as needed, to ensure that the 3 to 5 threads that were marked in Step 2 are just visible from the opposite side. Assemble a washer and nut onto the bolt up to the marked threads. Use a rotational capacity washer from the same rotational-capacity lot as the bolt and nut. If a washer is not required for the installation, use an ASTM F 436 washer of the proper diameter for the test.
4. Snug the bolt using a hand wrench. Do not exceed 20 percent of the torque determined in Step 6.
5. Match mark a corner of the nut and the plate.
6. Using the torque wrench, tighten the nut to the rotation listed in Table S-2-1. Use a second wrench to prevent rotation of the bolt head during tightening. Record the torque required to reach this rotation. Measure and record the torque required to reach the rotation with the nut in motion.

Table S-2-1 – Required Initial Rotation	
Rotation	**Bolt Length**
120 degrees (1/3 turn)	≤ 4 diameters
180 degrees (1/2 turn)	> 4 diameters and ≤ 8 diameters
240 degrees (2/3 turn)	> 8 diameters

7. If the measured torque exceeds the values listed in Table S-2-2, the assembly fails the test.

Table S-2-2 – Maximum Torque Requirements									
Bolt Size	**1/2**	**5/8**	**3/4**	**7/8**	**1**	**1-1/8**	**1-1/4**	**1-3/8**	**1-1/2**
Maximum Torque, ft-lbs	150	290	500	820	1230	1500	2140	2810	3690

8. Tighten the bolt further to the rotation required in Table S-2-3. Measure the rotation from the initial marking in Step 5. Assemblies that fail before this rotation either by stripping or fracture fail the test.

Table S-2-3 – Final Initial Rotation	
Rotation	**Bolt Length**
240 degrees (2/3 turn)	≤ 4 diameters
360 degrees (1 turn)	> 4 diameters and ≤ 8 diameters
480 degrees (1-1/3 turns)	> 8 diameters

8. Loosen the assembly and remove nut to examine the threads on the nut and bolt. Check for signs of thread shear failure, stripping, or torsional failure of the nut and bolt. Assemblies that have evidence of thread shear failure, stripping, or torsional failure fail the test.

D. Report. Report the following:

1. Size, manufacturer and lot number for the bolt assembly.
2. Measured torque at the initial rotation.
3. Observations of the thread condition.
4. Pass/Fail status of the bolt assembly.

NJDOT S-3 – VERIFYING DIRECT TENSION INDICATORS (DTI)

A. Scope. Use this test method to verify and install high-strength steel bolts using direct tension indicators (DTIs).

B. Apparatus. Use the following apparatus:

1. Calibrated bolt tension measuring device, such as a Skidmore-Wilhelm Calibrator, with a special flat insert in place of normal bolt head holding insert. The special insert is required to allow access to measure the DTI gaps.
2. Tapered leaf thickness (feeler) gauge 0.005 inch. Use the same gauge as to be used to inspect the bolts after installation.
3. Steel section to mount bolt calibrator, such as a flange of girder or cross frame that is accessible from the ground.
4. Impact and manual wrenches to tighten bolts. Equipment should be the same as to be used in the work.

C. Procedure. Perform the following steps:

1. Install bolt, nut, DTI, and standard washer into bolt tension measuring device. Ensure that the assembly matches that to be used in the work unless bolts are too short to fit in the device. If the bolts are too short, use longer bolts of the same diameter and from the same manufacturer to perform the DTI verification. Test 3 assemblies for each rotational-capacity lot.
2. Tighten the nut to the tension listed in Table S-3-1. Use another wrench on the bolt head to prevent rotation of the head against the DTI if the DTI is under the bolt head. If an impact wrench is used, tighten to a load slightly below the required load and use a manual wrench to attain the required tension.

Table S-3-1 – Bolt Tension for A 325 Bolts							
Bolt Size	**1/2**	**5/8**	**3/4**	**7/8**	**1**	**1-1/8**	**1-1/4**
Bolt Tension, kips[1]	13	20	29	41	54	59	75

1. Bolt Tension equals 1.05 × (Minimum Installation Tension)

3. Determine and record the number of spaces between the protrusions on the DTI that the 0.005 inch thickness gauge is refused. The total number of spaces and the maximum verification refusals are listed in Table S-3-2. If the number of spaces that the gauge is refused exceeds the maximum verification refusals listed in Table S-3-2, the DTI fails the verification test.

Table S-3-2 – DTI Maximum Verification Refusals							
Bolt Size	**1/2**	**5/8**	**3/4**	**7/8**	**1**	**1-1/8**	**1-1/4**
Number of Spaces on DTIs	4	4	5	5	6	6	7
Maximum Verification Refusals[1]	1	1	2	2	2	2	3

1. If the DTI is coated and under the nut, the maximum verification refusals is the number of spaces on the washer minus 1.

4. Further tighten the bolt until the 0.005-inch thickness gage is refused at all spaces but a visible gap exists in at least one space. Record the load as read on the tension measuring device.
5. Remove the bolt from the calibrator and turn the nut on the threads of the bolt by hand. If the nut is able to be turned on the complete length of the threads, the DTI is acceptable. If the nut is unable to go the full length, but the load at the minimum DTI gap measured in Step 4 is less than 95 percent of the average tension recorded during the rotational-capacity test, the DTI is acceptable. If the nut cannot be run the full thread length and the tension at the smallest gap condition is greater than 95 percent of the average tension recorded during the rotational-capacity test, the DTI is not acceptable.
6. If any of the 3 DTIs for the lot are found to be not acceptable, reject the DTI lot.

D. Report. Report the following:

1. Size, manufacturer and lot number for the bolt assembly used in the testing.
2. Size, manufacturer and lot number for the DTI.
3. Results of testing.

NJDOT ST –STATISTICAL TABLES

Table ST-1 Estimation of Lot Percent Defective for Sample Size 1[1]										
Q[2]	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
0.0	50.00	48.98	47.96	46.94	45.92	44.90	43.88	42.86	41.84	40.82
0.1	39.80	38.78	37.76	36.73	35.71	34.69	33.67	32.65	31.63	30.61
0.2	29.59	28.57	27.55	26.53	25.51	24.49	23.47	22.45	21.43	20.41
0.3	19.39	18.37	17.35	16.33	15.31	14.29	13.27	12.24	11.22	10.20
0.4	9.18	8.16	7.14	6.12	5.10	4.08	3.06	2.04	1.02	0.00

1. This empirically derived table for a sample size of 1 is suitable only for use in the concrete strength analysis in 903.03.
2. Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Table ST-2 Estimation of Lot Percent Defective for Sample Size 2[1]										
Q[2]	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
0.0	50.00	49.66	49.33	48.99	48.66	48.32	47.99	47.65	47.32	46.98
0.1	46.64	46.31	45.97	45.64	45.30	44.97	44.63	44.30	43.96	43.62
0.2	43.29	42.95	42.62	42.28	41.95	41.61	41.28	40.94	40.60	40.27
0.3	39.93	39.60	39.26	38.93	38.59	38.26	37.92	37.58	37.25	36.91
0.4	36.58	36.24	35.91	35.57	35.23	34.90	34.56	34.23	33.89	33.56
0.5	33.22	32.89	32.55	32.21	31.88	31.54	31.21	30.87	30.54	30.20
0.6	29.87	29.53	29.19	28.86	28.52	28.19	27.85	27.52	27.18	26.85
0.7	26.51	26.17	25.84	25.50	25.17	24.83	24.50	24.16	23.83	23.49
0.8	23.15	22.82	22.48	22.15	21.81	21.48	21.14	20.81	20.47	20.13
0.9	19.80	19.46	19.13	18.79	18.46	18.12	17.79	17.45	17.11	16.78
1.0	16.44	16.11	15.77	15.44	15.10	14.77	14.43	14.09	13.76	13.42
1.1	13.09	12.75	12.42	12.08	11.75	11.41	11.07	10.74	10.40	10.07
1.2	9.73	9.40	9.06	8.72	8.39	8.05	7.72	7.38	7.05	6.71
1.3	6.38	6.04	5.70	5.37	5.03	4.70	4.36	4.03	3.69	3.36
1.4	3.02	2.68	2.35	2.01	1.68	1.34	1.01	0.67	0.34	0.00

1. This empirically derived table for a sample size of 2 is suitable only for use in the concrete strength analysis in 903.03.
2. Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Table ST-3 Estimation of Lot Percent Defective for Sample Size 3										
Q[1]	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
0.0	50.00	49.72	49.45	49.17	48.90	48.62	48.35	48.07	47.79	47.52
0.1	47.24	46.96	46.69	46.41	46.13	45.85	45.58	45.30	45.02	44.74
0.2	44.46	44.18	43.90	43.62	43.34	43.05	42.77	42.49	42.20	41.92
0.3	41.63	41.35	41.06	40.77	40.49	40.20	39.91	39.62	39.33	39.03
0.4	38.74	38.45	38.15	37.85	37.56	37.26	36.96	36.66	36.35	36.05
0.5	35.75	35.44	35.13	34.82	34.51	34.20	33.88	33.57	33.25	32.93
0.6	32.61	32.28	31.96	31.63	31.30	30.97	30.63	30.30	29.96	29.61
0.7	29.27	28.92	28.57	28.22	27.86	27.50	27.13	26.76	26.39	26.02
0.8	25.64	25.25	24.86	24.47	24.07	23.67	23.26	22.84	22.42	21.99
0.9	21.55	21.11	20.66	20.19	19.73	19.25	18.75	18.25	17.74	17.21
1.0	16.67	16.11	15.53	14.93	14.31	13.66	12.98	12.27	11.51	10.71
1.1	9.84	8.89	7.82	6.60	5.08	2.87	0.00	0.00	0.00	0.00

1. Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Table ST-4 Estimation of Lot Percent Defective for Sample Size 4

Q[1]	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.67	49.33	49.00	48.67	48.33	48.00	47.67	47.33	47.00
0.1	46.67	46.33	46.00	45.67	45.33	45.00	44.67	44.33	44.00	43.67
0.2	43.33	43.00	42.67	42.33	42.00	41.67	41.33	41.00	40.67	40.33
0.3	40.00	39.67	39.33	39.00	38.67	38.33	38.00	37.67	37.33	37.00
0.4	36.67	36.33	36.00	35.67	35.33	35.00	34.67	34.33	34.00	33.67
0.5	33.33	33.00	32.67	32.33	32.00	31.67	31.33	31.00	30.67	30.33
0.6	30.00	29.67	29.33	29.00	28.67	28.33	28.00	27.67	27.33	27.00
0.7	26.67	26.33	26.00	25.67	25.33	25.00	24.67	24.33	24.00	23.67
0.8	23.33	23.00	22.67	22.33	22.00	21.67	21.33	21.00	20.67	20.33
0.9	20.00	19.67	19.33	19.00	18.67	18.33	18.00	17.67	17.33	17.00
1.0	16.67	16.33	16.00	15.67	15.33	15.00	14.67	14.33	14.00	13.67
1.1	13.33	13.00	12.67	12.33	12.00	11.67	11.33	11.00	10.67	10.33
1.2	10.00	9.67	9.33	9.00	8.67	8.33	8.00	7.67	7.33	7.00
1.3	6.67	6.33	6.00	5.67	5.33	5.00	4.67	4.33	4.00	3.67
1.4	3.33	3.00	2.67	2.33	2.00	1.67	1.33	1.00	0.67	0.33
1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1. Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Table ST-5 Estimation of Lot Percent Defective for Sample Size 5

Q[1]	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.64	49.29	48.93	48.58	48.22	47.86	47.51	47.15	46.80
0.1	46.44	46.09	45.73	45.38	45.02	44.67	44.31	43.96	43.60	43.25
0.2	42.90	42.54	42.19	41.84	41.48	41.13	40.78	40.43	40.08	39.72
0.3	39.37	39.02	38.67	38.32	37.97	37.62	37.28	36.93	36.58	36.23
0.4	35.88	35.54	35.19	34.85	34.50	34.16	33.81	33.47	33.12	32.78
0.5	32.44	32.10	31.76	31.42	31.08	30.74	30.40	30.06	29.73	29.39
0.6	29.05	28.72	28.39	28.05	27.72	27.39	27.06	26.73	26.40	26.07
0.7	25.74	25.41	25.09	24.76	24.44	24.11	23.79	23.47	23.15	22.83
0.8	22.51	22.19	21.87	21.56	21.24	20.93	20.62	20.31	20.00	19.69
0.9	19.38	19.07	18.77	18.46	18.16	17.86	17.55	17.25	16.96	16.66
1.0	16.36	16.07	15.78	15.48	15.19	14.91	14.62	14.33	14.05	13.76
1.1	13.48	13.20	12.93	12.65	12.37	12.10	11.83	11.56	11.29	11.02
1.2	10.76	10.50	10.23	9.97	9.72	9.46	9.21	8.96	8.71	8.46
1.3	8.21	7.97	7.73	7.49	7.25	7.02	6.79	6.56	6.33	6.10
1.4	5.88	5.66	5.44	5.23	5.02	4.81	4.60	4.39	4.19	3.99
1.5	3.80	3.61	3.42	3.23	3.05	2.87	2.69	2.52	2.35	2.19
1.6	2.03	1.87	1.72	1.57	1.42	1.28	1.15	1.02	0.89	0.77
1.7	0.66	0.55	0.45	0.36	0.27	0.19	0.12	0.06	0.02	0.00

1. Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Table ST-6 Estimation of Lot Percent Defective for Sample Size 6										
Q[1]	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
0.0	50.00	49.63	49.27	48.90	48.53	48.16	47.80	47.43	47.06	46.70
0.1	46.33	45.96	45.60	45.23	44.86	44.50	44.13	43.77	43.40	43.04
0.2	42.68	42.31	41.95	41.59	41.22	40.86	40.50	40.14	39.78	39.42
0.3	39.06	38.70	38.34	37.98	37.62	37.27	36.91	36.55	36.20	35.84
0.4	35.49	35.14	34.79	34.43	34.08	33.73	33.38	33.04	32.69	32.34
0.5	32.00	31.65	31.31	30.96	30.62	30.28	29.94	29.60	29.26	28.93
0.6	28.59	28.25	27.92	27.59	27.26	26.92	26.60	26.27	25.94	25.61
0.7	25.29	24.96	24.64	24.32	24.00	23.68	23.37	23.05	22.74	22.42
0.8	22.11	21.80	21.49	21.18	20.88	20.57	20.27	19.97	19.67	19.37
0.9	19.07	18.78	18.49	18.19	17.90	17.61	17.33	17.04	16.76	16.48
1.0	16.20	15.92	15.64	15.37	15.09	14.82	14.55	14.29	14.02	13.76
1.1	13.50	13.24	12.98	12.72	12.47	12.22	11.97	11.72	11.47	11.23
1.2	10.99	10.75	10.51	10.28	10.04	9.81	9.58	9.36	9.13	8.91
1.3	8.69	8.48	8.26	8.05	7.84	7.63	7.42	7.22	7.02	6.82
1.4	6.63	6.43	6.24	6.05	5.87	5.68	5.50	5.33	5.15	4.98
1.5	4.81	4.64	4.47	4.31	4.15	4.00	3.84	3.69	3.54	3.40
1.6	3.25	3.11	2.97	2.84	2.71	2.58	2.45	2.33	2.21	2.09
1.7	1.98	1.87	1.76	1.66	1.55	1.45	1.36	1.27	1.18	1.09
1.8	1.01	0.93	0.85	0.78	0.71	0.64	0.57	0.51	0.46	0.40
1.9	0.35	0.30	0.26	0.22	0.18	0.15	0.12	0.09	0.07	0.05
2.0	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1. Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Table ST-7 Estimation of Lot Percent Defective for Sample Size 7										
Q[1]	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
0.0	50.00	49.63	49.25	48.88	48.50	48.13	47.75	47.38	47.01	46.63
0.1	46.26	45.89	45.51	45.14	44.77	44.40	44.03	43.65	43.28	42.91
0.2	42.54	42.17	41.80	41.44	41.07	40.70	40.33	39.97	39.60	39.23
0.3	38.87	38.50	38.14	37.78	37.42	37.05	36.69	36.33	35.98	35.62
0.4	35.26	34.90	34.55	34.19	33.84	33.49	33.13	32.78	32.43	32.08
0.5	31.74	31.39	31.04	30.70	30.36	30.01	29.67	29.33	28.99	28.66
0.6	28.32	27.98	27.65	27.32	26.99	26.66	26.33	26.00	25.68	25.35
0.7	25.03	24.71	24.39	24.07	23.75	23.44	23.12	22.81	22.50	22.19
0.8	21.88	21.58	21.27	20.97	20.67	20.37	20.07	19.78	19.48	19.19
0.9	18.90	18.61	18.33	18.04	17.76	17.48	17.20	16.92	16.65	16.37
1.0	16.10	15.83	15.56	15.30	15.03	14.77	14.51	14.26	14.00	13.75
1.1	13.49	13.25	13.00	12.75	12.51	12.27	12.03	11.79	11.56	11.33
1.2	11.10	10.87	10.65	10.42	10.20	9.98	9.77	9.55	9.34	9.13
1.3	8.93	8.72	8.52	8.32	8.12	7.92	7.73	7.54	7.35	7.17
1.4	6.98	6.80	6.62	6.45	6.27	6.10	5.93	5.77	5.60	5.44
1.5	5.28	5.13	4.97	4.82	4.67	4.52	4.38	4.24	4.10	3.96
1.6	3.83	3.69	3.57	3.44	3.31	3.19	3.07	2.95	2.84	2.73
1.7	2.62	2.51	2.41	2.30	2.20	2.11	2.01	1.92	1.83	1.74
1.8	1.65	1.57	1.49	1.41	1.34	1.26	1.19	1.12	1.06	0.99
1.9	0.93	0.87	0.81	0.76	0.70	0.65	0.60	0.56	0.51	0.47
2.0	0.43	0.39	0.36	0.32	0.29	0.26	0.23	0.21	0.18	0.16
2.1	0.14	0.12	0.10	0.08	0.07	0.06	0.05	0.04	0.03	0.02
2.2	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1. Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Table ST-8 Estimation of Lot Percent Defective for Sample Size 8

Q[1]	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.62	49.24	48.86	48.49	48.11	47.73	47.35	46.97	46.59
0.1	46.22	45.84	45.46	45.08	44.71	44.33	43.96	43.58	43.21	42.83
0.2	42.46	42.08	41.71	41.34	40.97	40.59	40.22	39.85	39.48	39.11
0.3	38.75	38.38	38.01	37.65	37.28	36.92	36.55	36.19	35.83	35.47
0.4	35.11	34.75	34.39	34.04	33.68	33.33	32.97	32.62	32.27	31.92
0.5	31.57	31.22	30.87	30.53	30.18	29.84	29.50	29.16	28.82	28.48
0.6	28.15	27.81	27.48	27.15	26.82	26.49	26.16	25.83	25.51	25.19
0.7	24.86	24.54	24.23	23.91	23.59	23.28	22.97	22.66	22.35	22.04
0.8	21.74	21.44	21.14	20.84	20.54	20.24	19.95	19.66	19.37	19.08
0.9	18.79	18.51	18.23	17.95	17.67	17.39	17.12	16.85	16.57	16.31
1.0	16.04	15.78	15.51	15.25	15.00	14.74	14.49	14.24	13.99	13.74
1.1	13.49	13.25	13.01	12.77	12.54	12.30	12.07	11.84	11.61	11.39
1.2	11.17	10.94	10.73	10.51	10.30	10.09	9.88	9.67	9.47	9.26
1.3	9.06	8.87	8.67	8.48	8.29	8.10	7.91	7.73	7.55	7.37
1.4	7.19	7.02	6.85	6.68	6.51	6.35	6.19	6.03	5.87	5.71
1.5	5.56	5.41	5.26	5.12	4.97	4.83	4.69	4.56	4.42	4.29
1.6	4.16	4.03	3.91	3.79	3.67	3.55	3.43	3.32	3.21	3.10
1.7	2.99	2.89	2.79	2.69	2.59	2.49	2.40	2.31	2.22	2.13
1.8	2.04	1.96	1.88	1.80	1.72	1.65	1.58	1.51	1.44	1.37
1.9	1.31	1.24	1.18	1.12	1.07	1.01	0.96	0.91	0.86	0.81
2.0	0.76	0.72	0.67	0.63	0.59	0.55	0.52	0.48	0.45	0.42
2.1	0.39	0.36	0.33	0.30	0.28	0.26	0.23	0.21	0.19	0.17
2.2	0.16	0.14	0.13	0.11	0.10	0.09	0.08	0.07	0.06	0.05
2.3	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.00

1. Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Table ST-9 Estimation of Lot Percent Defective for Sample Size 9

Q[1]	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.62	49.24	48.85	48.47	48.09	47.71	47.33	46.95	46.57
0.1	46.18	45.80	45.42	45.04	44.66	44.29	43.91	43.53	43.15	42.77
0.2	42.40	42.02	41.64	41.27	40.89	40.52	40.15	39.77	39.40	39.03
0.3	38.66	38.29	37.92	37.55	37.19	36.82	36.46	36.09	35.73	35.37
0.4	35.00	34.64	34.29	33.93	33.57	33.21	32.86	32.51	32.15	31.80
0.5	31.45	31.10	30.76	30.41	30.07	29.72	29.38	29.04	28.70	28.36
0.6	28.03	27.69	27.36	27.03	26.70	26.37	26.04	25.72	25.39	25.07
0.7	24.75	24.43	24.11	23.80	23.49	23.17	22.86	22.56	22.25	21.94
0.8	21.64	21.34	21.04	20.75	20.45	20.16	19.87	19.58	19.29	19.00
0.9	18.72	18.44	18.16	17.88	17.61	17.33	17.06	16.79	16.53	16.26
1.0	16.00	15.74	15.48	15.23	14.97	14.72	14.47	14.22	13.98	13.73
1.1	13.49	13.26	13.02	12.79	12.55	12.32	12.10	11.87	11.65	11.43
1.2	11.21	10.99	10.78	10.57	10.36	10.15	9.95	9.75	9.55	9.35
1.3	9.16	8.96	8.77	8.59	8.40	8.22	8.04	7.86	7.68	7.51
1.4	7.33	7.17	7.00	6.83	6.67	6.51	6.35	6.20	6.04	5.89
1.5	5.74	5.60	5.45	5.31	5.17	5.03	4.90	4.77	4.64	4.51
1.6	4.38	4.26	4.14	4.02	3.90	3.78	3.67	3.56	3.45	3.34
1.7	3.24	3.14	3.03	2.94	2.84	2.75	2.65	2.56	2.47	2.39
1.8	2.30	2.22	2.14	2.06	1.98	1.91	1.84	1.76	1.70	1.63
1.9	1.56	1.50	1.44	1.37	1.32	1.26	1.20	1.15	1.10	1.05
2.0	1.00	0.95	0.90	0.86	0.82	0.77	0.73	0.70	0.66	0.62
2.1	0.59	0.55	0.52	0.49	0.46	0.43	0.41	0.38	0.36	0.33
2.2	0.31	0.29	0.27	0.25	0.23	0.21	0.20	0.18	0.17	0.15
2.3	0.14	0.13	0.11	0.10	0.09	0.08	0.08	0.07	0.06	0.05
2.4	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.01	0.01
2.5	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1. Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Table ST-10 Estimation of Lot Percent Defective for Sample Size 10

Q[1]	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.62	49.23	48.85	48.46	48.08	47.70	47.31	46.93	46.54
0.1	46.16	45.78	45.40	45.01	44.63	44.25	43.87	43.49	43.11	42.73
0.2	42.35	41.97	41.60	41.22	40.84	40.47	40.09	39.72	39.34	38.97
0.3	38.60	38.23	37.86	37.49	37.12	36.75	36.38	36.02	35.65	35.29
0.4	34.93	34.57	34.21	33.85	33.49	33.13	32.78	32.42	32.07	31.72
0.5	31.37	31.02	30.67	30.32	29.98	29.64	29.29	28.95	28.61	28.28
0.6	27.94	27.60	27.27	26.94	26.61	26.28	25.96	25.63	25.31	24.99
0.7	24.67	24.35	24.03	23.72	23.41	23.10	22.79	22.48	22.18	21.87
0.8	21.57	21.27	20.98	20.68	20.39	20.10	19.81	19.52	19.23	18.95
0.9	18.67	18.39	18.11	17.84	17.56	17.29	17.03	16.76	16.49	16.23
1.0	15.97	15.72	15.46	15.21	14.96	14.71	14.46	14.22	13.97	13.73
1.1	13.50	13.26	13.03	12.80	12.57	12.34	12.12	11.90	11.68	11.46
1.2	11.24	11.03	10.82	10.61	10.41	10.21	10.00	9.81	9.61	9.42
1.3	9.22	9.03	8.85	8.66	8.48	8.30	8.12	7.95	7.77	7.60
1.4	7.44	7.27	7.10	6.94	6.78	6.63	6.47	6.32	6.17	6.02
1.5	5.87	5.73	5.59	5.45	5.31	5.18	5.05	4.92	4.79	4.66
1.6	4.54	4.41	4.30	4.18	4.06	3.95	3.84	3.73	3.62	3.52
1.7	3.41	3.31	3.21	3.11	3.02	2.93	2.83	2.74	2.66	2.57
1.8	2.49	2.40	2.32	2.25	2.17	2.09	2.02	1.95	1.88	1.81
1.9	1.75	1.68	1.62	1.56	1.50	1.44	1.38	1.33	1.27	1.22
2.0	1.17	1.12	1.07	1.03	0.98	0.94	0.90	0.86	0.82	0.78
2.1	0.74	0.71	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46
2.2	0.44	0.41	0.39	0.37	0.34	0.32	0.30	0.29	0.27	0.25
2.3	0.23	0.22	0.20	0.19	0.18	0.16	0.15	0.14	0.13	0.12
2.4	0.11	0.10	0.09	0.08	0.08	0.07	0.06	0.06	0.05	0.05
2.5	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.01
2.6	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00

1. Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

INDEX

4

4-Bar open steel parapet 203

A

Abandoned vehicles, towing 96
Abbreviations 1
Absorbent boom 90
Acceptance 60
  Partial 59
Acid producing soil
  Document control 115
  Excavation 115
  Remediation 115
  Sampling and analysis 115
  Temporarily storing 115
Adhesive anchor bolt system 374
Adhesive anchors, bridge railing 205
Admixtures
  Air-entraining 337
  Chemical 337
  Corrosion inhibitor 339
Affirmative action 39
Aggregate 314
  Blast furnace slag 316
  Broken stone 315
  Coarse 314
  Concrete 319
  Dense-graded 320
  Fine aggregate 317
  HMA 317
  Mineral filler 317
  Mortar and grout 319
  Reclaimed asphalt pavement (RAP) 318
  Recycled concrete aggregate 321
  Riprap stones 320
  Soil aggregate 322
  Source 314
  Stockpiles 314
  Virgin and RAP mixture 321
  Washed gravel 316
Aggregate base course 124
  Compaction acceptance testing 125
  Correcting thickness 125
  Density control strips 124
    Compacting 124
    Density tests 125
  Placement 125
  Preparing subgrade or subbase 124
  Thickness requirements 125
Air compressor 433
Air-entraining admixtures 337
Aluminum alloy bolting 376
Anchorages 248
Annulment of award 13
Approach slabs 196
Approach, bridge 203
Approved working drawings 31
Asbestos removal 106
As-built, quantities 64
Asphalt binder 325
Asphalt price adjustment 98
Asphalt-stabilized drainage course 126
  Compacting 126
  Composition 336
  Delivering HMA 126
  Grading 126
  Mix design 336
  Paving plan 126
  Protecting 127
  Sampling and testing 336
  Spreading 126
  Thickness requirements 126
  Transporting HMA 126
  Weather limitations 126
Assignment 40
Audits 64
Authority
  Change, to make 16
  Department 26
  Inspection 27
  RE26
Automobile liability insurance 69
Award
  Cancellation of 12
  Conditional 12
  Contract, of 12

B

Backfilling
  Subsurface areas 106
Bar chart schedule 75
  Requirements 75
  Updates 75
Barrier curb 93
  Bridge 202
    Fixed-form 202
    Slip-form 202
  Concrete 242
  Dowelled 244
Base course
  Aggregate 124
  Concrete 127
Baseline schedule 73
Beam guide rail 247, 391
  Anchorages 248
  Blockouts 248
  Controlled release terminals 248
  Delineators 248
  Driving posts 247
  Element 247
  End treatments 248, 391
  Post spacing 247
  Posts and spacers 391
  Rail element 391
  Removal of 248
  Reset beam guide rail 248
  Rub rail 248, 391

Bearing assemblies
Reinforced elastomeric ... 373
Structural ... 372
High-Load Multi-Rotational (HLMR) ... 372
Seismic isolation ... 372
Elastomeric ... 372
Sliding ... 372
Bearing pads ... 373
Bearings
Installing ... 195
Anchor bolts ... 195
Bridge seat bearing areas ... 195
Setting ... 195
Shipping ... 195
Storing ... 195
Working drawings ... 194
Bicycle safe grates ... 234
Bid Documents, escrow ... 13
Bidder
Disqualification of ... 11
Qualifications ... 8
Registration ... 8
Bids
Balanced ... 10
Consideration of ... 11
Irregular ... 11
Preparation of ... 10
Public opening ... 11
Qualifications to ... 8
Rejection of all ... 12
Submission of ... 10
Withdrawal of ... 11
Bituminous material distributor ... 427
Bituminous materials ... 324
Aphalt binder ... 325
Cutback asphalts ... 325
Limitations for use ... 325
Emulsified asphalts ... 325
Temperature-volume correction factors ... 324
Blasting plan ... 110
Blockouts ... 248, 391
Bolts
Anchor ... 374
High-strength steel ... 374
Steel ... 374
Bond
Payment ... 68
Performance ... 68
Posted in lieu of retainages ... 64
Proposal ... 10
Bonding and grounding
Cable and wire ... 275
Materials ... 415
Boom, absorbent ... 90
Breaker
Multi-head ... 430
Resonant ... 430
Bridge
Approaches ... 196, 203
Barrier curb ... 202
Fixed-form ... 202
Slip-form ... 202
Decks ... 198
Drainage ... 204
Fence, Chain-Link ... 205
Grates ... 204
Inlet frames ... 204
Parapet ... 202
Fixed-form ... 202
Slip-form ... 202
Railing ... 205
Aluminum ... 392
Anchors ... 205
Steel ... 392
Scuppers ... 204
Bridge decks ... 196
Acceptance testing ... 201
Curing ... 200
Date panel ... 202
Dry run ... 199
Forms ... 198
Grooved surface ... 200
Installing joint assemblies ... 199
Installing reinforcement steel ... 199
Joint assemblies ... 197
Installation ... 197
Modular expansion ... 198
Preformed elastomeric ... 198
Strip seal expansion ... 198
Working drawings ... 197
Limitations of placing concrete ... 199
Loading ... 201
Opening to traffic ... 201
Permissible surface variations ... 201
Placement plan ... 198
Placing concrete ... 199
Rehabilitation ... 215
Repair of concrete deck ... 215
Scarification ... 216
Removable forms ... 198
Repair of ... 215
Saw cut grooved surface ... 200
SIP forms ... 198
Surface remedial measures ... 201
Surface requirements ... 201
Surface texture finish ... 200
Underdeck inspection ... 200
Bridges, existing
Painting ... 219
Removal of ... 102
Bulkheads ... 206
Timber sheet piling ... 208

C

Cabinets
Electrical ... 417
Meter ... 417
Cable
Bonding and grounding ... 275
Connecting to utilities ... 275
Electrical ... 415
Fiber optic ... 290
Installing ... 275
Racks ... 275, 416

Slack 275
Testing 276
Traffic signal 278
Cable connectors 416
Camera surveillance system 289
Camera 290
Camera Standard 290
Controller 290
Equipment training 290
Final documentation 290
Foundation 289
Maintenance 290
Testing 290
Cancellation of Award of Contract 12
Cast boxes 416
Cast stone lettering panel 202
Castings 379
Extension frames 234
Gray iron 379
Resetting 233
Rings 234
Setting 233
Cast-in-place retaining walls 214
Caution fence 88
Cell phones 78
Cement 337
Certification of compliance 36
Certified working drawings 30
Chain-link fence ..... *See* Fence
Change Order 17
Protesting 17
Changes to the Contract 16
Authority to make 16
Change Order 17
Character 19
Constructive acceleration 20
Delays 20
Differing site conditions 19
Field Order 16
Force Account 21
Inefficiencies 20
New Work 19
Notice 20
Protesting 17
Quantity decreases 17
Quantity increases 17
Tracking costs 21
Types 17
Unacceptable cost calculation methods 21
Unrecoverable costs 21
Channel protection 235, 236
Channelizing guide posts 94
Character of work, changes to 19
Chemical admixtures 337
Claims by Contractor 45
Claims committee 44
Clay or shale brick 379
Cleanup, final 100
Clearing and grubbing 101
Clearing site 101
Bridges 102
Clearing and grubbing 101
Mailbox and sign relocation 101
Plugging pipe 102
Preparation 101
Removing electrical material and equipment 102
Removing pipe, inlets, and manholes 102
Sidewalks, driveways, curbs, and gutters 102
Structures 102
Coarse aggregate 314
Cofferdams 165
Permanent 165
Temporary 165
Cold joint paving 136
Cold weather conditions 184
Color-Coated non-vegetative surface 246
Commencement of Work 48
Notice 48
Submissions 48
Communication equipment 78
Communication hub 288
Compacting
Asphalt-stabilized drainage course 126
HMA 137
Subbase 123
Compactor
Dynamic 424
HMA 426
Pneumatic-tired 424
Vibratory drum 427
Completion 60
Interim 59
Substantial 60
Compost 404
Composted sewerage sludge 404
Comprehensive automobile liability insurance 69
Comprehensive general liability insurance 69
Computer system 78
Concrete
Acceptance testing requirements 343
Slump and air entrainment 343
Strength 344
Non-pay-adjustment items 345
Pay-adjustment items 344
Admixtures 337
Aggregate 319
Approaches 203
Barrier curb 242
Bridge 202
Fixed-form 202
Slip-form 202
Base course 127
Batching plant 440
Automatic batching system 442
Batch counter 441
Bins 441
Chemical admixtures 441
Hoppers 441
Laboratory 440
Mineral admixtures 442
Scales 441
Water measuring equipment 441
Brick 380
Cement 337

Composition 339
Driveway 239, 240
HPC
Composition 350
Control and acceptance testing 351
Mix design 350
Mixing 351
Island 239, 240
Mix design 339
Mixer
Mobile 443
Small-batch 444
Mixing
Central-plant and transit 340
Batch tolerances 340
Batching 340
Delivery tickets 340
Rejection criteria 342
Requirements 341
Mobile 342
On the project 342
Small mixers 342
Parapet 202
Fixed form 202
Slip-form 202
Pavement
Partial depth repair 156
Placing seal for cofferdam 165
Precast
Non-structural 356
Acceptance requirements 357
Components 356
Curing 357
Fabrication 357
Finishing 357
Quality control 357
Removing forms 357
Shipping and handling 357
Retaining walls 357
Acceptance requirements 358
Components 357
Curing 358
Fabrication 358
Finishing 358
Form removal 358
Quality control 358
Shipping and handling 358
Structural 359
Acceptance requirements 360
Component 359
Curing 360
Fabrication 359
Finishing 360
Quality control 360
Removing forms 360
Shipping and handling 360
Precast plant 445
Prestressed 360
Acceptance requirements 363
Components 360
Curing 362
Fabrication 361
Finishing 363
Quality assurance 363
Quality control 363
Removing forms 363
Shipping and handling 363
Prestressed plant 445
Quality control 343
Rubblizng 128
SCC
Composition 351
Control and acceptance testing 352
Mix design 351
Mixing 352
Verification of pumpability 352
Sidewalk 239, 240
Bridge 202
Slope gutters 236
Slope protection 236
Sloping curb 243
Structures
Placing concrete
Seal method 166
Tremie 165
Trucks 442
Central mixing 443
Transit mixing 443
Concrete barrier curb, dowelled 244
Concrete base course 127
Placing concrete 128
Relief joints 151
Sawcutting 128
Slip-form paving 151
Setting joint assemblies 151
Thickness testing 128
Concrete block
Inlets and manholes 380
Concrete pavement repair
Diamond grinding existing 161
Full depth using concrete 158
Retrofit dowel bars 160
Sealing joints in concrete pavement 162
Concrete slab stabilization 154
Deflection testing 155
High-density polyurethane grout
Drilling holes 155
Experience 155
Lifting 155
Repairing cracks 155
Weather limitations 155
Pozzolan grout 154
Drilling holes 154
Repairing cracks 155
Testing 154
Void filling 154
Weather limitations 154
Concrete surface course 148
Concreting plan 149
Core samples 152
Curing 151
Diamond grinding 153

Fixed form method
Consolidating 150
Control testing 151
Finishing 150
Placing concrete 150
Removing forms 151
Setting forms 150
Setting joint assemblies 150
Setting tie bars 150
Surface correction 151
Forms 428
Installing longitudinal joint ties 149
Opening to traffic 152
Partial depth repair 156
Opening to traffic 157
Placing concrete 157
Preparation 156
Placing limitations 149
Placing methods 150
Protectin surface 151
Ride quality requirements 152
Sawcutting 152
Sealing joints 152
Strength requirements 152
Thickness requirements 152
Average core thickness 152
Individual core thickness 152
Underlayer preparation 149
Weather limitations 149
Concrete vertical curb 243
Concrete washout system 90
Concurrent delays 56
Conditional Award 12
Conductor cable assignments 278
Conduit
Flexible metallic 273, 414
Flexible nonmetallic 273, 414
Rigid metallic 270, 271, 414
Rigid nonmetallic 272, 414
Conflicts of interest 66
Conformity with
Contract 28
Plans 29
Specifications 29
Conformity with the Contract
Discrepencies 28
Construction
Barrier curb 93
Driveway 90
Layout 84
Signs 93
Constructive acceleration 20
Contract
Assignment 40
Award of 12
Conformity with 28
Examination of 8
Execution of 13
Failure to execute 13
Intent of 14
Non-waiver 40
Plans 29
Specifications 29
Working drawings 29
Contract Time 54
Extensions 55
Modifications to 55
Reductions 57
Time impact evaluation 56
Types of Delay 55
Excusable, Non-compensable 55
Non-excusable 55
Contractor
Damaged caused by 41
Independent 40
Responsibilities 27
Risks assumed by 40
Contractual claim resolution process 42
Satisfying notice requirements 42
Steps 43
I – RE 43
II – Dispute review board (DRB) 43
III – Claims committee 44
IV – Non-binding mediation 44
Contractual Notice 20
Initial 20
RE's response 20
Control center system 288
Control fill method 121
Control strip 121
Embankment 121
Control of work 26
Control points and stakes 84
Controlled low strength material (CLSM) 355
Controlled Release Terminals 248
Controlled traffic signal system 292
Controller 292
Equipment training 293
Final documentation 293
Maintenance 293
Testing 293
Controller
Controlled traffic signal system 292
ITS 287
Turn on 281
Converting inlets to manholes 234
Cooperation with
Others 31
Utilities 32
Coordinator, traffic control 92
Core samples
Concrete surface course 152
Correspondence with RE, format 26
Crash Cushion
Temporary 94
Traffic control truck 94
Crash cushions 254
Crosshole Sonic Logging (CSL) 174
Installing tubes 174
Reporting 174
Steel cage installation 174
Testing 174

Culverts
Precast concrete....233
Removal of....102
Curb....242
Concrete
Protection and curing....243, 244
Concrete barrier....242
Concrete barrier, dowelled....244
Concrete sloping....243
Concrete sloping, dowelled....244
Concrete vertical....243
Concrete, vertical....244
Construction barrier....93
Dresed stone....380
Granite....244
Reset....245
HMA....245
Quarry-spilt stone....380
Removal of....102
Stone....380
Curb pieces....234
Curing
Bridge decks....200
Structural concrete....186
Curing compound....186
Curing facility....82
Equipment....82
Furnishings....82
Maintenance....83
Utilities and lighting....82
Curing materials
Burlap cloth....356
Liquid membrane-forming compounds....356
Polyethylene sheeting....356
Cutback asphalts....325

D

Daily communications....49
Damages
Liquidated....60
Date panel....202
Debris
Disposal of....106
Default....58
Deflection inspection of HDPE pipe....231
Deflection testing....155
Deflection testing equipment....431
Delay Damages....24
Payment for
Labor escalation....25
Material escalation....25
Non-Productive activity....24
Storage....25
Delineators
Ground mounted....253
Mounting to beam guide rail....248
Delineators, flexible....385
Barrier curb mounted....385
Ground mounted....385
Guide rail mounted....385
Demolition of buildings....104
Rodents control and extermination....105
Safety Plan....105
Utility disconnections....105
Dense-graded aggregate....320
Recycled concrete aggregate....321
Virgin....320
Virgin and RAP mixture....321
Density control method....122
Density control strips
Aggregate base course....124
Compacting....124
Density tests....125
Department-furnished materials....35
Detectable warning surface....241, 422
Dewatering basin....89
Diamond grinding....153
Existing concrete pavement....161
Differing site conditions....19
Direct tension indicators....376
Disabled vehicles, towing....96
Disadvantaged business enterprises....39
Discrimination in employment....38
Disposal of
Debris....106
Excess or unusable material....116
Hazardous regulated material....117
Materials....106
Regulated material....116
Dispute review board (DRB)....43
Dolphins....206
Dowel bars....365
Drainage course
Asphalt-stabilized....126
Drainage structures....232
Cleaning....234
Culverts....232
Headwalls....232
Inlets....232
Manholes....232
Drainage, bridge....204
Drilled shafts....171
Aligning....175
Approval of....180
Constructing using casings....176
Permanent....177
Removable....176
Temporary....176
Constructing using slurries....177
Mineral....177
Polymer....178
Construction sequence limitations....175
Core drilling....174
Crosshole Sonic Logging (CSL)....174
Demonstration....172
Excavating....175
Cleaning....178
Dry method....175
Obstructions....175
Verification....178
Wet method....175

Excavation log 175
Installation plan 172, 175
Load tests 173
Linear Variable Displacement Transducers (LVDTs) 173
O-cell installation 173
Post-test grouting procedures 173
Reporting 173
Testing 173
Locating 175
Placing concrete
Limitations 179
Methods 179
Pumped method 179
Tremie method 179
Reinforcement steel cages 178
Removing obstructions 178
Rock socketing 178
Drilling and blasting 110
Blasting plan 110
Blasting test sections 110
Explosives 111
Presplitting 110
Production blasting 111
Safety 110
Driveway 239
Concrete 240
Construction 90
HMA 240
Ductile iron castings 379
Ductile iron water 379
Dynamic compactor 424
Dynamic message system 295
Controller 295
Equipment training 296
Final documentation 296
Foundation 295
Maintenance 295
Sign 295
Sign with controller 295
Standard 295
Testing 295
Dynamic pile load test 168

E

Echelon paving 136
Electrical 269
Bonding and grounding 275
Cable 275
Cable racks 275
Conduit, bridge 209
Controller 281
Existing systems 270
Foundations 274
General items 269
Highway lighting 282
Lighting mast arm 283
Lighting standard 283
Luminaire 283
Sign lighting 284
Temporary 285
Tower lighting 284
Underdeck lighting 284
Intelligent transporation systems (ITS) 286
ITS 286
Camera surveillance system 289
Controlled traffic signal system 292
Dynamic message system 295
Fiber optic cable 290
General system 287
Equipment training 289
Final documentation 289
Maintenance 288
General system testing 288
Road weather information system 294
Traffic volume system 297
Travel time systems 293
Weigh in motion system 296
Junction box 273
Meter cabinet 275
Pedestrian signal head 279
Rigid metallic conduit 270
Testing circuits and system 276
Traffic signal 277
Circuits 278
Controllers 277
Image detector 280
Interim 280
Loop detector 280
Loop detector cable 280
Mast arm 278
Push button 280
Standards 278
Temporary 280
Traffic signal cable 278
Traffic signal head 279
Wire 275
Electrical materials 414
Bonding and grounding 415
Bushings 415
Cabinets 417
Cable and wire 415
Cable connectors 416
Cable racks 416
Cast boxes and fittings 416
Circuit breakers 417
Conduit and fittings 414
Electrical tape 416
Friction 416
Insulating 416
Jacket 416
Ground rods 416
Ground wire 415
Lamps 418
Highway lighting 418
Sign lighting 419
Traffic signal 418
Loop wire 415
Mast bracket arms 418
Meter cabinets 417
Multiple lighting wire 415
Panel boards 417
Pedestals 418
Photoelectric controls 418
Poles 418

Resin splicing kits 416
Service wire 415
Single conductor signal wire 415
Traffic signal cable 415
Transformer bases 418
Electrical tape 416
Embankment 119
Constructing 119
Constructing with
Concrete 120
HMA 120
Rock 120
Soil aggregate and rock 120
Density control method 122
Placing and compacting methods 120
Control fill method 121
Density control method 122
Directed method 122
End-dumping method 121
Slope stabilizing 121
Emergency spill kit 90
Emergency towing service 96
Emerging small business enterprises 39
Employer's liability insurance 70
Emulsified asphalts 325
End treatments 248
End-dumping method 121
Enviornmental manager 87
Enviornmental protection 33
Archeological sites 33
Forests 34
Hazardous materials 34
Historical sites 33
Navigable waters 34
Epoxy
Bedding compound 379
Bonding compound 421
Injection material 421
Resin injection equipment 430
Striping applicator 431
Striping unit 431
Traffic stripes 387
Waterproofing 188, 387
Equipment
Air compressor 433
Bituminous material distributor 427
Concrete batching plant 440
Concrete trucks 442
Deflection testing equipment 431
Dynamic compactor 424
Epoxy resin injection equipment 430
Epoxy striping applicator 431
Epoxy striping unit 431
Flashing arrow board 423
Flexural beam testing 83
Grinding machine 431
Grout pumping unit 430
Cavity pump 430
Truck mounted 430
HMA compactor 426
Steel-wheel 426
Vibratory 426
HMA curb machine 425
HMA paver 425
HMA plant 433
HMA trucks 440
Hot-air lance 433
Impact hammer 427
Injection device 431
Leads and followers 428
Lift monitoring equipment 431
Materials transfer vehicle(MTV) 425
Mechanical sweeper 433
Milling machine 432
Mixer 430
Mobile mixer 443
Multi-head breaker 430
Nuclear density guage 83
Padfoot roller 425
Pavement forms 428
Pavement saw 433
Pneumatic-tired compactors 424
Portable variable message sign 423
Precast plant 445
Prestressed plant 445
Resonant breaker 430
Rumble strip cutting machine 432
Scarification 431
Sealer application system 427
Slip-form (extrusion) machine 429
Slip-form paver 429
Small-batch mixer 444
Spreading and finishing machine 429
Spreading and finishing machine, bridge decks 429
Steel-wheel roller 425
Straightedge 432
Thermoplastic applicator 432
Traffic control truck with mounted crash cushions 424
Traffic stripe and marking removal equipment 432
Ultra-thin paver 426
Vibrator 429
Vibratory drum compactor 427
Vibratory hammer 428
Vibratory roller 430
Z-Grid roller 430
Escrow
Bid Documents 13
Estimates 62
Subcontractor certification 63
Ethics standards 66
Evaluation of subsurface and surface conditions 9
Excavation 107
Acid producing soil 115
Temporily storing 115
Blasting plan 110
Dewatering 109
Disposal of
Acid producing soil 115
Hazardous regulated material 117
Material 116
Regulated material 116
Document control 114
Materials and handling reports 114
PPC logs 115

Sampling logs and analytical reports....115
Soil/sediment usage tracking log....114
Transport manifests....115
Drilling and blasting....110
Foundation and bridge areas....109
Measuring elevation....112
Regulated material....112
Document control....114
Sampling and analysis....114
Temporarily storing....114
Reuse of material....116
Rock areas....109
Stripping....108
Test pit....108
Unclassified....108
Temporarily storing....112
Water pipe....257
Wet areas....109
Excess liability insurance....70
Excusable, Compensable delays....56
Excusable, Non-compensable delays....55
By Others....55
Catclysmic natural phenomena....56
Extreme weather....55
Labor disputes....56
Shortage of materials....56
Sovereign acts of the state....56
Utilities....55
War and unrest....56
Execution of Contract....13
Explosives
Storage....34
Use of....34
Extension frames....234

F

Fence....238
Bridge....205
Caution....88, 392
Chain-link....238, 391
Gates....238
Heavy-duty silt....88
Material....391
Repairing....238
Silt....88
Snow....392
Temporary....238
Fender systems....206
Fertilizer....404
Application....305
Fertilizing....304
Fiber mulch....308, 309
Fiber optic cable....290
Equipment training....292
Final documentation....292
Installation....290
Maintenance....292
Splicing....291
Testing....291
Level 1....291
Level 2....291
OTDR....291
Power meter....292
Tracer wire....291
Fiberglass reinforced plastic lumber....397
Fiberglass reinforced plastic piles....399
Fiberglass-concrete composite piles....401
Field office....77
Cell phones....78
Communication equipment....78
Computer system....78
Fax machine....78
Lavatory....78
Maintenance....79
Office equipment....79
Office furnishings....78
Size requirements....78
Telephone....78
Telephone service....79
Utilities....78
Field Order....16
Filters
Inlet....88
Final Certificate....65
Final cleanup....100
Finishing structural concrete....187
Fire hydrant....259
Relocating....260
Resetting....260
Flagger....95
Flashing arrow board....94, 423
Flexible metallic conduit....273
Flexible nonmetallic conduit
Backfilling....273
Excavation....273
Installation....273
Flexural beam testing equipment....83
Floating turbidity barrier....89, 421
Fly ash....338
Force Account....21
Payment for
Direct labor....22
Equipment....22
Equipment, Contractor-owned....22
Equipment, Rented....23
Extraordinary expenses....22
Indirect labor costs....22
Insurance....22
Labor fringe benefits....22
Materials....22
Overhead....23
Profit....23
Subcontractors....24
Foreign material....35
Federal aid projects....35
Wholly State-funded projects....35
Forms
Pavement....428
Foundation
Electrical....274
Cast-in-place....274
Precast....274
Excavation....109
ITS....287

Fuel price adjustment....97
Fuel usage factor....97
Full depth concrete pavement repair
Curing concrete....159
Dowels....158
Joint ties....158
Opening to traffic....159
Placing concrete....159
Placing limitations....158
Preparation....158
Sawcutting and sealing joints....159
Setting forms....158

G

Gabion basket stone....320
Gabion walls....237
Gabion wire baskets....420
Galvanizing(zinc coating)....386
Gas mains....264
Air-pressure test....267
Backfilling....266
Bridges....267
Excavating....265
Handling....265
Installation prequalification....265
Installing....265
Bell joint encapsulation....266
Fusing plastic pipe....266
Hot tap preparation....266
Thrust restraints....266
Welding steel pipe....266
Scheduling....265
Storing....265
Tie-in....267
Tie-in assistance....267
Gas valve boxes, reset....268
Gates....238
General liability insurance....69
Geomembrane liner....420
Geotextiles....419
Grading
HMA....136
Granite curb....244, 380
Grass seed mixtures....405
Grates....204
Bicycle safe....234
Gray iron castings....379
Grinding machine....431
Ground mounted delineators....253
Grout....354
Mixer....430
Non-shrink type....354
Grubbing....101
Guide rail....*See* Beam guide rail
Guy wire....413

H

Hauling restrictions....34
Hay....420
Haybale....88
Haybale check dams with temporary stone outlets....88
Hazardous regulated material
Disposal of....117
Headwalls, precast concrete....233
Heating and housing....184
Heavy-duty silt fence....88
Herbicides....414
High voltage lines....32
Highway lighting....282
Lighting mast arm....283
Lighting standard....283
Luminaire....283
Sign lighting....284
Temporary system....285
Tower lighting....284
Underdeck lighting....284
HMA....326
Aggregates for....317
Compactor....426
Steel-wheel roller....426
Vibratory roller....426
Composition....326
Construction
Air void requirements....137
Compacting....137
Conditioning existing surfaces....133
Grading....136
Longitudinal joints....136
Opening to traffic....137
Paving plan....134
Prime coat application....134
Spreading....136
Tack coat application....133
Test strip....135
Transporation of HMA....135
Transverse joints....136
Weather limitations....134
Curb....245
Curb machine....425
Driveway....239, 240
Drum mixing plants....438
Aggregate bins....438
Aggregate feeder....438
Asphalt binder metering system....438
Control console....439
Drum mixer....439
Emission control system....439
Mineral filler bin....438
Modifications....440
Proportioning controls....439
Fully automated batch-type plants
Aggregate hot bins....436
Asphalt binder control....437
Automated batching and mixing control....437
Control of mixing time....437
Dryer....436
Hopper....437
Mixer....437
Plant scales....436
Screens....436
Weigh box....437
Fully automated batch-type plants....436
Island....240

Joints 136
Cold joing paving 136
Echelon paving 136
Longitudinal 136
Material 326
Mix design 327
Mix designation 326
Mixing plants 433
Aggregate bins 434
Aggregate storage 434
Automatic release agent system 435
Dust collector 435
Feeder for dryer 435
Laboratory 433
Preparation of asphalt binder 434
Safety 435
Thermometric equipment 435
Truck scales 435
Non-Vegetative surfaces 246
Patch 95
Paver 425
Automatic profile control 426
Automatic slope controls 426
Manual override system 426
Receiving hopper and distribution system 425
Screed 425
Screed heater 425
Sloped plate 425
Strike-off assembly 425
Plants and equipment
Surge and storage bins 435
Sampling and testing 329
Sidewalk 239, 240
Test strip 135
Nuclear density gauge readings 135
Quality control core density test results 135
Roller pattern 135
Temperatures 135
Trucks for transporting mixtures 440
HMA courses 131
Acceptance 140
Core samples 142
IRI140
Ride quality requirements 140
Thickness requirements 139
Surface course thickness 140
Total thickness 139
HMA friction courses 144
HMA overlays
Sawing and sealing joints 142
Hot weather concreting 184
Hot-air lance 433
Hydrostatic pressure testing 258

I

Image detector 280
Impact hammer 427
Hammer cushion 427
Pile cushion 428
Pile drive head 428
Independent Contractor 40
Inertial Barrier System 254
Injection device 431
Inlet frames 204
Inlets 233
Block and brick 233
Converting to manholes 234
Filters 88
Precast 233
Reconstructing 233
Removal of 102
Sediment traps, temporary 89
Setting castings 233
Inlets filters 88
Type 1 88
Type 2 88
Inlets sediment traps, temporary 89
Inquiries 6
After Award of the Contract 6
Before Award of the Contract 6
Inspection 27
Of plant materials 413
Plant 36
Safe access 27
Insulated blankets 184
Insulated forms 184
Insurance 69
Automobile 69
Comprehensive automobile liability 69
Comprehensive General Liability 69
Employer's liability 70
Excess liability 70
Liability 69
Maintenance 70
Marine liability 70
Owner's and Contractor's protective liability 70
Policies 69
Pollution liability 71
Protective liability 70
Railroad protective liability 70
Types 69
Workers compensation 70
Intent of Contract 14
Interim completion 59
Island 239
Concrete 240
HMA 240
ITS
Camera surveillance system 289
Controlled traffic signal system 292
Device testing
Level A 288
Level B 288
Level C 288
Dynamic message system 295
Fiber optic cable 290
General system 287
Communication cable 287
Communication hub 288
Control center 288
Controller 287
Final documentation 289
Foundation 287
Junction box 287

Maintenance 288
General system testing 288
Device testing 288
Project testing 288
Road weather information system 294
Traffic volume system 297
Travel time systems 293
Weigh in motion system 296

J

Joint assemblies
Modular 395
Preformed elastomeric 394
Strip seal expansion 394
Joint materials 393
Preformed elastomeric joint sealer 394
Preformed expansion joint filler 393
Sealer 393
Strip seal expansion dam 394
Joint ties 365
Junction box 273
Cast-in-place 273
Cover 274
Fabricated 273
Foundation 274
Cast-in-place 274
Precast 274
Frame 274
Metal 274
Precast 273

L

Laboratory
Materials field 80
Ladder rungs 379
Lamps 418
Landscaping
Fertilizing 304
Mowing 309
Mulching 308
Planting 310
Selective clearing 300
Selective thinning 300
Sodding 307
Soil preparation 302
Topsoil stabilization 306
Topsoiling 303
Tree removal 301
Tree trimming 301
Turf repair strip 303
Turf seeding 304
Landscaping materials 403
Binders 407
Composted sewerage sludge 404
Fertilizer 404
limestone, pulverized 405
Miscellaneous materials 414
Mulch 407
Plant materials 409
Seed mixtures 405
Sod 409
Topsoil 403
Topsoil stabilization matting 408
Lane occupancy charges 54
Latex paint 389
Laws, ordinances, and regulations
Insurance requirements 69
Lead health and safety plan (LHSAP) 221
Leads and followers 428
Legal jurisdiction 38
Applicable law 38
Approvals 38
Licenses 38
Permits 38
Soverign immunity 38
Liability
Insurance 69
Limitation of 39
Personal for public officials 40
Lift monitoring equipment 431
Lighting
Highway 282
Luminaire 283
Mast arm 283
Signs 284
Standard 283
Temporary highway 285
Tower 284
Underdeck 284
Limestone, pulverized 405
Limitation of liability 39
Limitations of placing
Structural concrete 183
Liquidated damages 60
Load restrictions 34
Long-life traffic stripes 250
Loop detector
Connecting 280
Installing 280
Testing 280
Loop detector cable 280
Luminaire 283
Lighting replacement assemblies 284

M

Mailbox and sign relocation 101
Maintaining and protecting traffic 92
Flagger 95
Police 95
Traffic control directors 95
Maintenance 54
Curing facility 83
ITS
Operational 289
Regular 288
Materials field laboratory 82
SESC 91
Manholes 233
Block and brick 233
Covers 234
Precast 233
Reconstructing 233
Removal of 102
Setting castings 233

Marine liability insurance 70
Markers
Temporary pavement 95
Masonry units
Clay or shale brick 379
Concrete block 380
Concrete brick 380
Granite curbs 380
stone facing for pier shafts 381
Stone paving block 381
Mass concrete 186
Mast arm 278
Mast bracket arms 418
Material
4-Bar open steel parapet 371
Aggregate for concrete, mortar, and grout 319
Coarse aggregate 319
Fine aggregate 319
Lightweight aggregate 320
Aggregate for HMA
Coarse Aggregate 317
Crushed recycled container glass (CRCG) 318
Fine Aggregate 317
Ground Bituminous Shingle Material (GBSM) 318
Mineral filler 317
Reclaimed asphalt pavement (RAP) 318
Remediated Petroleum Contaminated Soil Aggregate (RPCSA) 318
Aggregates 314
Aluminum alloy bolting 376
Aluminum paint 386
Asphalt binder 325
Asphalt-stabilized drainage course 336
Beam guid rail
End treatments 391
Miscellaneous hardware 391
Posts and blockouts 391
Rail element 391
Rub rail 391
Bearing pads 373
Bituminous 324
Blast furnace slag 316
Bridge railing
Aluminum 392
Steel 392
Broken stone 315
Castings 379
Ductile iron 379
Gray iron 379
Cement 337
Clay Brick 379
Coal tar epoxy paint 386
Coarse aggregate 314
Coatings
Asphalt waterproofing 387
Detectable warning surface 422
Epoxy waterproofing 387
For non-vegetative surface 387
Galvanizing(zinc coating) 386
Components for drainage structures 379
Carbon steel extension frames and rings 379
Ladder rungs 379
Scuppers 379
Concrete 339
Concrete admixtures
Air-entraining 337
Chemical 337
Corrosion inhibitor 339
Mineral
Fly ash 338
Silica fume 338
Slag 338
Viscosity modifying 338
Concrete block for inlets and manholes 380
Concrete brick 380
Concrete stain 386
Controlled low strength material 355
Curing
Burlap cloth 356
Liquid membrane-forming compound 356
White polyethylene sheeting 356
Curing facility 82
Cutback asphalts 325
Dense-graded aggregate 320
Recycled concrete aggregate 321
Virgin 320
Virgin and RAP mixture 321
Department-furnished 35
Dimensional lumber
For structures 396
Sheet piling 396
Direct tension indicators 376
Emulsified asphalts 325
Epoxy bonding compound 421
Epoxy injection 421
Epoxy traffic stripes 387
Fence
Caution 392
Chain-link 391
Snow 392
Fertilizer 404
Fiberglass reinforced plastic lumber 397
Fiberglass reinforced plastic piles 399
Fiberglass-concrete composite piles 401
Flexible delineators 385
Floating turbidity barrier 421
Foreign 35
Gabion basket stone 320
Gabion wire baskets 420
Geomembrane liner 420
Geotextiles 419
Grit 320
Grout
Epoxy 355
Non-shrink 354
Grout for undersealing concrete pavement
High-density polyurethane 355
Pozzolan 355
Hay 420
High tensile strength alloy bars 365
High-strength steel bolting 374
High-tensile-strength 7-wire prestressing strand 364
HMA 326
HPC 350

Inspection 36
Joint assemblies
Modular 395
Preformed elastomeric (compression type) 394
Strip seal expansion (glandular type) 394
Joint sealer 393
Lamps 418
Mast bracket arms 418
Modified open-graded friction course 330
Mortar 354
Mulch
Gravel 407
Shredded hardwood bark 407
Shredded wood 407
Stone 407
Straw 407
Wood cellulose fiber 407
Wood chip 407
Non-structural precast concrete 356
Open-graded friction course 330
Pavement repair mixes Class V and E 348
Pedestals 418
Photoelectric controls 418
Pipe
Concrete 377
Corrugated aluminum alloy culvert 378
Corrugated aluminum alloy underdrain 378
Corrugated steel 378
Ductile iron water 379
High-density polyethylene (HDPE) 377
Plastic drainage 377
Steel alloy for bridge storm drains 378
Pipe arches
Corrugated aluminum alloy
Culvert 378
Corrugated steel 378
Pipe bedding
Class A 376
Class B 376
Class C 377
Class D 377
Poles 418
Polyethylene sheeting 421
Polymer modified tack coat 326
Polymerized joint adhesive 393
Post-tensioning reinforcement 364
Bars 365
Strands 365
Precast concrete retaining walls 357
Preformed joint filler 393
Prestressed concrete 360
Prestressing reinforcement 364
Pulverized limestone 405
Quality requirements 34
Questionnaire 35
Quick-setting patch 353
Raised pavement markers(RPM) 389
Rebar coupling devices 365
Reinforced elastomeric bearing assemblies 373
Reinforcement for concrete pavement
Dowel bars 365
Tie bars and joint ties 365
Tie bolts 365
Reinforcement steel 364
Bars 364
Dowels 364
Spiral 364
Structural shapes, plates, and bars 364
Welded wire 364
Riprap stones 320
Samples 36
SCC 351
Sediment control bag 419
Shale Brick 379
Sign 382
Sign structures 369
Sign supports
Breakaway for ground mounted signs 384
Mounting materials 385
Non-Breakaway for ground mounted signs 384
Steel 384
Timber 385
Sleeves 421
Sodium chloride (rock salt) 421
Soil additives
Compost 404
Composted sewerage sludge 404
Soil Aggregate 322
Source of supply 34
Stainless steel bolting 376
Steel bolting 374
Adhesive anchor bolt system 374
Anchor bolts 374
Bolts 374
Nuts and washers 374
Steel casings for drilled shafts 366
Steel piles 366
Stone curb 380
Dressed stone 380
Quarry-split stone 380
Stone facing for pier shafts 381
Stone matrix asphalt 334
Stone paving block 381
Straw 420
Structural bearing assemblies 372
Structural precast concrete 359
Structural steel 366
Fabrication 367
Structural steel paint 386
Tackifers
Fiber mulch 407
Synthetic plastic emulsion 407
Vegetable based gels 407
Temporary traffic stripes and markings
Latex paint 389
Removable black line masking tape 390
Temporary pavement markers 390
Temporary pavement tape 389
Tests 36
Thermoplastic traffic markings 389
Timber
Round piling 396
Routed spacers 396
Sawn posts 396

Spacers 396
Timber connectors and hardware 397
Timber treatment 396
Topsoil 403
Tower poles 418
Transformer bases 418
Ultra-thin HMA 332
Unacceptable 37
Unusable, disposal of 116
Washed Gravel 316
Water 421
Waterstops 420
Materials field laboratory 80
Cell phones 80
Communication equipment 80
Computer systems 80
Fax machine 80
Laboratory equipment 81
Lavatory 80
Maintence 82
Office equipment 80
Office furnishings 80
Parking 80
Telephones 80
Utilities and lighting 80
Materials handling plan 113
Materials transfer vehicle(MTV) 425
Measuring
Elevation 112
Quantities 61
Mechanical sweeper 433
Meter cabinet 275
Meter cabinets 417
Milling
Concrete 132
Equipment 432
HMA 131
Milling machine 432
Mineral admixtures
Fly ash 338
Silica fume 338
Slag 338
Mineral filler 317
Mineral slurry 177
Mixer 430
Mobile mixer 443
Mobilization 76
Modified open-graded friction course
Compacting 144
Composition 330
Delivery 144
Grading 144
Mix design 331
Opening to traffic 145
Paving plan 144
Ride quality requirements 145
Sampling and testing 331
Spreading 144
Test strip 144
Thickness requirements 145
Transportation 144
Weather limitations 144
Monitoring wells 104
Monthly payments 62
Monument box 85
Monuments 85
Rock socket 85
Survey 85
Monuments and markers
Preservation of 84
Mortar 337, 354
Mowing 309
Existing areas 309
Seeded areas 309
Mulch 407
Gravel 407
Shredded hardwood bark 407
Shredded wood 407
Stone 407
Wood cellulose fiber 407
Wood chip 407
Mulching 308
Fiber 309
Plants 309
Straw 308
Multi-head breaker 430

N

New Jersey contractual liability act 39
New Work 19
Night operations 52
Illuminance levels 52
Lighting requirements 52
Visibility requirements
Equipment 53
Workers 53
Non-binding mediation 44
Conditions 44
Decision 45
Mediator 44
Meeting 45
Non-excusable delays 55
Non-third party beneficiary clause 40
Non-vegetative surfaces 246
Notice 20
Contractual claim resolution process 42
Nuclear density guage 83

O

Oil spill remediation 90, 91
Oil-only emergency spill kit 90
Oil-water separator 90
Open-graded friction course
Compacting 144
Composition 330
Delivery 144
Grading 144
Mix design 331
Opening to traffic 145
Paving plan 144
Ride quality requirements 145
Sampling and testing 331
Spreading 144
Test strip 144

Thickness requirements 145
Transportation 144
Weather limitations 144
Opening to traffic
after applying traffic stripes or markings 251
After applying traffic stripes or markings 252
Concrete surface course 152
HMA 137
Others, cooperation with 31
Owner's and Contractor's protective liability insurance 70

P

Padfoot roller 425
Paint
Aluminum, finish coat 386
Coal tar epoxy 386
Epoxy bonding compound 421
Epoxy waterproofing 387
Sampling and testing 388
shipping requirements 388
Structural steel 386
Painting
Bridges, existing 219
Painting existing bridges 219
Applying paint 225
Cleaning 223
Blast 223
Hand or power tool 223
Cleanup 226
Coating thickness 226
Epoxy mastic 226
Organic zinc 226
Conditions 225
Curing 226
Mixing paint 225
Pollution control system 220
Containment plan 220
Equipment storage plan 223
Lead health and safety plan(LHASP) 221
Waste disposal plan 221
Prime coat 226
Protection of
Environment 223
Persons 223
Property 223
Structures 223
Repair 226
Spot coat 226
Stenciling 226
Striping 226
Surface preparation 225
Waste disposal 224
Parapet
4-Bar open steel 203
Bridge 202
Fixed form 202
Slip-form 202
Partial acceptance 59
Partial depth concrete pavement repair 156
Patch
HMA 95
Patented
Devices 45
Materials 45
Processes 45
Pavement
Removing 115
Pavement markers, temporary 95
Pavement marking tape, temporary 95
Pavement repair mixes Class V and E 348
Pavement saw 433
Paver
HMA 425
Slip-form 429
Ultra-thin 426
Paving plan
Asphalt-stabilized drainage course 126
HMA 134
Modified open-graded friction course 144
Open-graded friction course 144
Stone matrix asphalt (SMA) 147
Ultra-thin friction course 146
Payment
Delay damages 62
Final 65
Force account 62
Materials, for 63
Scope of 61
Payment bond 68
Pedestals 418
Pedestrian bridge 196
Performance bond 68
Permanent sheeting
Construction 164
Dewatering 164
Plan 164
Photoelectric controls 418
Pier shafts
Stone facing 381
Piles
Capping 169
Cut-off 169
Damaged, correcting 169
Defective, correcting 169
Driving
Accuracy 167
Methods 167
Penetration 168
Rock bearing 168
Vibratory 167
Furnishing pile driving equipment 167
Load bearing 166
Prebored holes 167
Steel 166
Order lengths 169
Pipe shells 169
Production pile lengths 169
Shoes 169
Splices 169
Steel, painting 169

Test piles 168
Dynamic load test 168
Static load test 168
Wave equation analysis program (WEAP) 167
Pipe 228
Backfilling 230
Bedding 229
Cleaning existing 231
Concrete 377
Reinforced 377
Corrugated aluminum alloy
Culvert 378
Culvert arches 378
Underdrain 378
Corrugated steel
Culvert 378
Deflection inspection of 231
Ductile iron water 379
End sections 229
Excavating 228
For stream diversion 229
HDPE 377
Installing 228, 229
Alternate methods, using 230
Joining 229
Joints
Circular pipe 229
Gasket 230
Mortar 229
Plastic drainage 377
Removal of existing 102
Steel alloy 204, 378
Storing and handling 228
Underdrains 230
Video inspection of 231
Water 257
Bridge 259
Pipe bedding
Class A 376
Class B 376
Class C 377
Class D 377
Pipe lining 263
Plan
Blasting 110
Demolition Safety 105
Materials handling 113
Pollution prevention and control 113
Pre-excavation 112
Site-specific health and safety 112
Plans
Conformity with 29
Plant establishment period 312
Plant inspection 36
Plant materials, landscape 409
Planting 310
Acceptance 312
Backfilling 312
Balled and burlapped plants 312
Beds 311
Containerized plants 312
Delivering 310
Excavation 311
Furnishing 310
Location 311
Maintaining 312
Mulching 312
Optimal seasons 311
Protecting 312
Pruning 311
Restoration 312
Setting plants 311
Staking and guying 312
Watering 312
Plants
Mulching 309
Plugging pipe 102
Pneumatically applied mortar 218
Application 219
Cleaning of surfaces 218
Curing 219
Repair limits 218
Test panels 218
Pneumatic-tired compactors 424
Poles 418
Police 95
Policies
Insurance 69
Pollution insurance 71
Pollution prevention and control plan 113
Polyethylene sheeting 421
Polyethylene sheeting, white 356
Polymer slurry 178
Polymerized joint adhesive 393
Portable variable message sign 423
Controller 423
Power source 423
Diesel 424
Solar 424
Sign panel 423
Structural support system 424
Portable variable message sign 94
Posts
Channelizing guide 94
Post-tensioning reinforcement 364
Bars 365
Strands 365
Pozzolan grout
Drilling holes 154
Repairing cracks 155
Testing 154
Void filling 154
Weather limitations 154
Precast
Arch structures 191
Culverts 191, 233
Headwalls 233
Precast plant 445
Prefabricated modular walls 210
Working drawings 211
Preparation of
Bid 10

Preparing existing pavement....131
Milling concrete....132
Milling HMA....131
Repairing HMA pavement....133
Sealing cracks....132
Presplitting....110
Pressure injection sealing....217
Crack repair survey....217
Finishing surface....218
Injecting epoxy resin adhesive....217
Repair preparation....217
Sealing surface cracks....217
Prestressed concrete structures....190
Prestressed plant....445
Casting beds....445
Certification....445
Forms....445
Grouting equipment....445
Jacks....445
Load cells....445
ME's office....445
Prestressed structural concrete....189
Prestressing reinforcement....364
Price adjustment
Asphalt....98
Fuel....97
Prime coat....133
Application temperatures....134
Production blasting....111
Progress schedule....72
Project Limits
Examination of....8
Maintenance within....54
Property damage....69
Proposal Bond....10
Return of....12
Proposal documents
Downloading....8
Revisions to....8
Proprietary items, substitutes....37
Proprietary retaining walls
Backfilling....212
Compacting backfill....213
Drainage....212
Foundation....212
Handling....212
Installing....212
Shipping....212
Storing....212
Working drawings....211
Protection of
Enviornment....33
Markers and monuments....84
Push button....280

Q

Qualification to Bid....8
Quantities
As-built....64
Measurement....61
Quantity increases and decreases....17
Major....18
Minor....18
Quick-setting patch materials....353
Type 1....353
Type 1A....353
Type 1B....353
Type 2....354

R

Railing
Bridge....205
Anchors....205
Railroad
Insurance....70
Raised pavement marker (RPM)....252
RE, authority....26
Rebar coupling devices....365
Reclaimed asphalt pavement (RAP)
Drum mixing plant....438
In HMA....328
Recovery of monies by the State....46
Regulated material
Disposal of....116
Excavating....112
Reinforcement steel....182, 364
Bars....364
Coatings....183
Dowels....364
Field bending....182
Field cutting....182
Handling....182
High tensile strength alloy bars....365
High-tensile-strength 7-wire prestressing strand....364
Placing....182
Plates....364
Post-tensioning....364
Prestressing....364
Protecting....183
Shapes....364
Spiral....364
Splicing....182
Storing....182
Welded wire....364
Remediation
Oil spill....91
Schedule....75
Removal of
Asbestos....106
Bridges....102
Concrete base course and surface course....115
Electrical material and equipment....102
Pavement....115
Pipe, inlets, and manholes....102
Sidewalk, driveways, curbs, and gutters....102
Structures....102
Traffic Stripes....253
Underground storage tanks....103
Repair of concrete deck....215
Cleaning reinforcement steel....216
Deck condition survey....215
Patching....216
Class A concrete....216
Quick setting patch....216

Sawcut and removal 215
Splicing reinforcement steel 216
Type B 216
Type C 216
Reset beam guide rail 248
Reset granite curb 245
Resin splicing kits 416
Resonant breaker 430
Responsibilities of
Contractor 27, 28
Equipment 27
Fabricators 28
Labor 27
Subcontracted work 28
Suppliers 28
Inspectors 27
RE26
Retaining walls
Prefabricated modular walls 210
Retrofit dowel bars 160
Caps 161
Placing 161
Preparation 160
Retroreflective sheeting 382
Rigid metallic conduit
Earth 270
Backfilling 271
Excavation 270
Installation 270
Exposed 271
Open-cut 271
Roadway 271
Rigid nonmetallic conduit 272
Backfilling 272
Cutting 272
Excavation 272
Field bends 272
Installation 272
Riprap stones 320
Risks
Assumed by the Contractor 40
Claims on account of injury, loss or damage 41
Damage to construction 41
Loss of property 41
Road weather information system 294
Equipment training 294
Final documentation 294
Maintenance 294
Roadway devices 294
Testing 294
Weather station 294
Rock backfill 236
Rock socketing 178
Rodent control 105
Roller
Padfoot 425
Steel-wheel 425
Rolling and vibrating method 122
Row-of-Way restrictions 57
RPMs 389
Rub rail 248, 391
Rubblizing concrete pavement 128
DGA area patching 130
Existing subsurface facility investigation 129
Final subsurface facility survey 130
Installing drainage system 129
Multi-head method 130
Protecting 130
Removing existing HMA surfaces 129
Removing reinforcement steel 130
Removing transverse joint assemblies 130
Repairing subsurface facilities 130
Resonant method 130
Restrictions 130
Rubblization plan 129
Sawcutting joints 129
Seating 129
Test strip 129
Rumble strip cutting machine 432
Rumble strips 253

S

Safety program 50
Certification 50
Description 50
Elements 50
Identification of personnel 50
Responsibility 50
Sanitary provisions 49
Sanitary sewers 261
Backfilling 262
Bridge 262
Excavating 261
Gravity and force mains 262
Handling pipe and accessories 261
Installing 262
Manhole 263
Reconstruct 263
Reset 263
Pipe lining 263
Scheduling 261
Service connection 263
Testing 262
Force main 262
Gravity main 262
Exfiltration 262
Infiltration 262
Thrust blocks 262
Video inspection 264
Scarification
Bridge deck rehabilitation 216
Equipment 431
Schedule
Alternate staging 72
Bar chart 75
Requirements 75
Updates 75
Baseline submission 73
Constraints 73
CPM 72
Liquidated damages 76
Milestones 73
Missed updates 76
Preliminary submission 73

Progress ... 72
Submission requirements ... 72
Updates ... 74
Gantt Chart ... 74
Progress narrative ... 74
Remediation ... 75
Sorts ... 74
Tabular reports ... 74
Value engineering ... 72
Scheduling ... 72
Scope of payment ... 61
Scuppers ... 204, 379
Sealer application system ... 427
Sealing
Abandoned wells ... 104
Cracks in HMA surface course ... 132
Joints in concrete pavement ... 162
Seating
Multi-head method ... 130
Resonant method ... 130
Sediment control bag ... 89, 419
Sediment control tank ... 89
Sediment traps
Temporary inlet ... 89
Temporary stone outlet ... 89
Seed
Mixtures ... 405
Seeding
Wildflowers ... 305
Selective clearing ... 300
Selective thinning ... 300
Service connection
Gas ... 267
Sanitary sewer ... 263
Water ... 259
SESC
Absorbent boom ... 90
Caution fence ... 88
Concrete washout system ... 90
Construction driveway ... 90
Construction Requirements ... 87
Dewatering basin ... 89
Enviornmental manager ... 87
Floating turbidity barrier ... 89
Haybale ... 88
Haybale check dams with temporary stone outlets ... 88
Heavy-duty silt fence ... 88
Inlet filters ... 88
Maintenance ... 87, 91
Measures ... 87
Oil-only emergency spill kit ... 90
Oil-Water separator ... 90
Removal ... 91
Sediment control bag ... 89
Sediment control tank ... 89
Silt fence ... 88
Temporary inlet sediment traps ... 89
Temporary slope drains ... 88
Temporary stone check dams ... 88
Temporary stone outlet sediment traps ... 89
Sewers ... *See* Sanitary sewers
Shear connectors ... 195
Sheeting
Permanent ... 164
Temporary ... 164
Timber ... 206
Shielding, temporary ... 102
Sidewalk ... 239
Bridge ... 202
Concrete ... 240
HMA ... 240
Sign structures
Acceptance ... 369
Fabrication ... 369
Quality control ... 369
Shipping and handling ... 369
Sign support structures ... 209
Erecting posts ... 210
Erecting trusses ... 210
Erection plan ... 209
Excavation for ... 209
Installing electrical material ... 209
Placing concrete ... 209
Storage and handling ... 209
Tower structures ... 210
Working drawings ... 209
Signs ... 255
Construction ... 93
Fabrication ... 382
Applying retroreflective sheeting ... 383
Legends and borders ... 383
Panels ... 382
Flashing arrow board ... 94
Lighting ... 284
Materials
Aluminum components ... 382
Retroreflective sheeting ... 382
Packing, storing, and shipping ... 383
Portable variable message sign ... 94
Support structures ... 209
Supports
Breakaway ... 384
Flexible delineators ... 385
Non-breakaway ... 384
Steel ... 384
Timber ... 385
Types
GA breakaway ... 255
GO ... 255
GOX ... 255
Non-Breakaway ... 255
Regulatory ... 255
Warning ... 255
Silt fence ... 88
Site clearing ... 101
Site-specific health and safety plan ... 112
Slack, cable and wire ... 275
Slag ... 338
Sleeves ... 421
Slip-form (extrusion) machine ... 429
Slip-form paver ... 429
Slip-form paving ... 151
Slope
Protection ... 235

Slope drains, temporary 88
Slope protection
Concrete 236
Concrete slope gutters 236
Riprap stone 236
Rock backfill 236
Small-batch mixer 444
Snow fence 392
Sod 409
Sodding 307
Delivery 307
Installing 307
Mowing 308
Soil aggregate 322
Combining and mixing 323
Composition 322
Gradation 322
Soil erosion and sediment control 86
Soil preparation 302
Source
Materials 34
Specifications, conformity with 29
Spill kit 90
Spreading
HMA 136
Subbase 123
Spreading and finishing machine 429
Spreading and finishing machine, bridge decks 429
Stainless steel bolting 376
Standards 278
Static pile load test 168
Stay-in-place forms 198
Steel
Alloy pipe 204
Anchor bolts 374
Bolts 374
Castings 379
Grid flooring 196
Nuts 374
Posts for beam guide rail 391
Rail element for beam guide rail 391
Railing, bridge 392
Reinforcement 364
Sign supports: 384
Washers 374
Steel-wheel roller 425
Stockpiles 314
Stone
Facing for pier shafts 381
Mulch 407
Paving block 381
Stone check dams, temporary 88
Stone matrix asphalt (SMA) 147
Air void requirements 148
Compacting 148
Composition 334
Delivery 147
Grading 147
Mix design 334
Opening to traffic 148
Paving plan 147
Ride quality requirements 148
Sampling and testing 335
Spreading 147
Test strip 147
Thickness requirements 148
Transportation 147
Weather limitations 147
Straightedge 432
Straw 407, 420
Striping
Removable black line masking 94
Temporary 95
Stripping 108
Structural concrete 181
Bridge decks 196
Consolidating concrete 185
Curing 186
Curing compound 186
Wet burlap and sheeting 186
White polyethylene sheeting 187
Curing and protecting
Cold weather conditions 184
Heating and housing 184
Decks 199
Placing 199
Surface texture finish 200
Epoxy waterproofing 188
Falsework 183
Removal of 187
Finishing concrete surface 187
Class 1, surface finish 187
Class 2, rubbed finish 188
Forms 183
Removal of 187
Limitations of placing 183
Cold weather concreting 184
Hot weather concreting 184
Loading 188
Mass concrete 186
Placing concrete 185
Chutes and troughs 185
Pumped 185
Placing mass concrete 186
Precast arches 191
Backfilling 192
Erecting 192
Erection plan 192
Joints 192
Shipping 192
Storing 192
Working drawings 191
Precast culverts 191
Backfilling 191
Erecting 191
Erection plan 191
Grouting 191
Post-Tensioning 191
Shipping 191
Storing 191
Working drawings 191
Prestressed 189, 190
Erecting 190
Erection plan 190

Grouting 190
Post-tensioning 190
Shipping 190
Storing 190
Working drawings 190
Protecting 188
Waterstops 183
Structural steel 193, 366
Acceptance 368
Bearings 194
Casings for drilled shafts 366
Cleaning 367
Coating 367
Erecting 193
Erection plan 193
Fabrication 367
Flooring, grid 196
Handling 193
High-strength steel bolts
Installing 194
Rotational capacity test 194
Tightening 194
Paint 386
Painting 369
Acceptance 371
Application 370
Coatings 371
Conditions 370
Film thickness 371
Handling requirements 371
Quality control 371
Stenciling 371
Surface preparation 370
Pedestrian bridge 196
Piles 366
Quality control 368
Repairing damaged coating 194
Shear connectors 195
Shipping 193
Shipping and handling 368
Welding 367
Working drawings 193
Structures
Bulkheads 206
Demolition 104
Removal of
Bridges 102
Temporary 214
Timber 205
Stump removal 300
Subbase 123
Compacting 123
Preparing subgrade 123
Spreading and grading 123
Subbase outlet drains 230
Backfilling 231
Excavating for 230
Subcontracting 46
Federal aid projects 47
Limits and restrictions 47
Quantities 46
Requirements 47
Values 46
Wholly State funded projects 48
Subgrade
Preparing 123
Substantial completion 60
Superintendent
Alternate 28
Responsibilities 28
Surface course 131
Concrete 148
HMA courses 131
HMA friction courses 144
Stone matrix asphalt 147
Ultra-thin friction course 145
Suspension of Work 57
Contractor fault 57
Convenience of the Department 57
Unsuitable weather 57
Synthetic plastic emulsion 308

T

Tack coat 133
Tack coat, 64-22 133
Tackifiers 308
Fiber mulch 308
Synthetic plastic emulsion 308
Vegetable based gels 308
Tape
Removable black line masking 94
Temporary pavement marking 95
Taxes 45
Temperature-volume correction factors 324
Temporarily storing
Unclassified excavation 112
Temporary
Cofferdam
Construction 165
Dewatering 165
Dewatering plan 165
Removal 165
Working drawings 165
Crash cushion 94
Inlet sediment traps 89
Pavement markers 95, 390
Pavement marking tape 95
Sheeting 164
Construction 164
Dewatering 164
Removal 164
Working drawings 164
Shielding 102
Slope drains 88
Stone check dams 88
Stone outlet sediment traps 89
Structures 214
Erection plan 214
Working drawings 214
Traffic Stripes 95
Termination 58, 59
Cause 59
Convenience 59
Terms 2

Acceptance 2
acceptance testing 2
actual cost 2
addendum 2
approval 2
as-built quantity 2
authorized funding amount 2
bridge 2
Change order 3
Completion 3
construction operations 3
Contract 3
Contract Time 3
Contractor 3
day 3
Department 3
Department Laboratory 3
Estimate 3
Extra Work 3
Field Order 3
highway 3
holiday 3
inspector 3
Interim Completion 3
Item 4
land surveyor 4
manufacturer's recommendations 4
ME 4
New Work 4
Others 4
pavement structure 4
plan 4
Plans 4
Professional Engineer 4
Project 4
Project Limits 4
Proposal 4
qualified products list (QPL) 4
RE 4
Right-of-Way (ROW) 5
Right-of-Way Plans 5
road 3
Specifications 5
State 5
street 3
subcontractor 5
subgrade 5
Substantial Completion 5
Superintendent 5
Surety 5
Testing Agency 5
Total Adjusted Contract Price 5
Total Contract Price 5
traveled way 5
utility 5
Utility 5
work 5
Work 5
working day 5
working drawings 6
Test method
A-1 – Determining percent of mica in fine aggregate 446
A-1 – Mortar making properties of fine aggregate 446
A-3 – Petrographic analysis to determine lithological composition of coarse aggregate 447
A-4 – Determining percent of adherent fines present in coarse aggregate 448
A-5 – Scratch hardness test for coarse aggregate particles 449
A-6 – Determining gradation of dense-graded aggregate containing rap 450
B-1 – Falling head permeability test for asphalt-stabilized drainage course 451
B-2 – Sampling HMA mixtures 452
B-3 – Selecting cores for maximum specific gravity testing in air voids determination 453
B-4 – Measuring thickness of HMA cores 454
B-5 – Determining composition of HMA mixture using hot bin sample analysis 454
B-6 – Determining percent of air voids in open-graded HMA 455
B-7 – Determining optimum asphalt content for open-graded friction course 456
B-8 – Determining the job mix formula for modified open-graded friction course 456
B-9 – Determining asphalt content for MOGFC courses by aggregate surface area 459
C-1 – Determining yield of concrete produced by continuous mixing type truck mixers 460
C-1 – Operating inertial profiler systems for evaluation pavement profiles 465
C-2 – Quick-setting patch materials 461
C-3 – Calcium presence in plastic concrete 462
C-4 – Slump flow test and visual stability index 463
C-5 – Static segregation of hardened self-consolidating concrete cylinders 464
S-1 – Rotational-capacity test on long bolts in tension calibrator 466
S-2 – Rotational-capacity test on bolts too short to fit tension calibrator 467
S-3 – Verifying direct tension indicators (DTI) 468
Test pits 108
Testing, if and where directed 227
Thermoplastic applicator 432
Thermoplastic traffic markings 251, 389
Thrust blocks
Sanitary sewers 262
Water pipe 259
Tie bars 365
Tie bolts 365
Timber 396
Bearing piles 396
Connectors 397
For structures 396
Hardware for 397
Sheet piling 396
Sheeting 206
Sign supports 385
Structures 205
Treatment 396
Wales 206
Time impact evaluation 56
Topsoil 303, 403
Borrow 303
Placing 303
Stabilization matting 306, 408

Installing 306
Type 1 306
Type 2 307
Type 3 307
Type 4 307
Storing 303
Topsoil stabilization 306
Tower poles 418
Towing service, emergency 96
Tracking costs of changes 21
Traffic 249
Control 92
Directors 95
Flagger 95
Police 95
Markings 249, 251
Long-life thermoplastic 251
Extruded 251
Marking plan 251
Preformed 251
Replacing 252
Surface preparation 251
Removal of 253
RPMs 252
Lens removal 253
Lens replacement 253
Removal of 253
Rumble strips 253
Stripes 249
Long-life
Applying 250
Replacing 251
Striping plan 250
Surface preparation 250
Test strip 250
Long-life thermoplastic 251
Opening to traffic 251, 252
Removable black line masking 94
Removable black line masking tape 390
Removal 253
Removal of 253
Temporary 95
Traffic control
Changes to Traffic control plan 53
Coordinator 92
Duties 92
Devices 93
Flashing arrow board 423
Interference 53
Plan 53
Portable variable message sign 423
Truck with mounted crash cushions 424
Traffic control devices
Channelizing guide posts 94
Construction barrier curb 93
Construction signs 93
Flashing arrow board 94
Portable variable message sign 94
Temporary Crash Cushion 94
Traffic control truck w/mounted crash cushions 94
Traffic control truck with mounted crash cushions 94
Traffic signal 277
Cable 278
Circuits 278
Controllers 277
Head 279
Image detector 280
Interim 280
Loop detector 280
Loop detector cable 280
Mast arm 278
Pedestrian 279
Push button 280
Standards 278
Pedestrian signal 278
Traffic signal 278
Temporary 280
Traffic stripe and marking removal equipment 432
Traffic volume system 297
Controller 297
Equipment training 298
Final documentation 298
Maintenance 298
Roadway devices 297
Testing 297
Transformer bases 418
Travel time systems 293
Controller 293
Detector 293
Detector standard 293
Equipment training 294
Final documentation 294
Foundation 293
Maintenance 294
Testing 294
Trees 412
Protectors 413
Removal 301
Trimming 301
Turbidity barrier
Absorbent boom 90
Floating 89
Turf
Mowing 309
Repair strip 303
Turf seeding 304
Application 305
Establishment 305
Fertilizer application 305
Dry method 305
Hydraulic method 305
Maintenance 305
Mulching 305
Optimum seeding seasons 304
Seed application 305
Dry method 305
Hydraulic method 305
Soil preparation 304

U

Ultra-thin friction course 145
Compacting 146
Delivery of 146
Grading 146

Joints 146
Opening to traffic 146
Paving plan 146
Ride quality requirements 146
Spreading 146
Test strip 146
Thickness requirements 146
Transportation of 146
Weather limitations 146
Ultra-thin HMA
Composition 332
Mix design 333
Sampling and testing 333
Ultra-thin paver 426
Unacceptable cost calculation methods 21
Eichleay formula 21
Modified total cost method 21
Productivity factors 21
Total cost method 21
Unacceptable materials 37
Unclassified excavation 108
Underdeck inspection 200
Underdrains 230
Backfilling 231
Excavating for 230
Underground storage tanks
Disposing of Contaminated Soil 104
Permits and approvals 103
Recycling Contaminated Soil 104
Removal of 103
Storing excavated soil 104
Transporting Contaminated Soil 104
Underlayer preparation 149
Uniform hazardous waste manifest 117
Unrecoverable costs 21
Update
Bar chart 75
Schedule 74
Utilities
Cooperation with 32
Gas 264
Locating existing facilities 32
One call system 32
Protection of 32
Providing access 32
Providing notice 32
Sanitary sewers 261
Test pits 32
Water 257
Fire hydrant 259
Service connection 259
Water pipe 257
Backfilling 259
Bacteriological testing 259
Bridge 259
Disinfecting 259
Excavating 257
Installing 258
Leakage testing 258
Scheduling 257
Service interruption 257
Thrust blocks 259
Work performed by 33

V

Value Engineering 14
Conditions 14
Final documents 16
Final proposal 16
Initial proposal 15
Payment 16
Purpose 14
Savings 14
Schedule 72
Scope 14
Submittals 15
Vegetable-Based gels 308
Vibrator 429
Vibratory drum compactor 427
Vibratory hammer 428
Vibratory roller 430
Video inspection
Pipe 231
Sanitary sewers 264

W

Wales, timber 206
Warranties 60
Plants 312
Washed gravel 316
Waste manifest 117
Water 421
Water valve box, reset 260
Waterproofing
Asphalt 387
Epoxy 387
Waterstops 183, 420
Wave equation analysis program (WEAP) 167
Weigh in motion system 296
Controller 296
Equipment training 297
Final documentation 297
Maintenance 297
Roadway devices 296
Testing 296
Wells
Abandoned 104
Monitoring 104
Sealing 104
Wildflower seeding 304, 305
Application 305
Bed layout 305
Establishment 305
Maintenance 305
Mulching 305
Preparing seed mixtures 305
Seasons 305
Seed mixtures 305
Soil preparation 305
Wire
Bonding and grounding 275
Connecting to utilities 275
Installing 275
Slack 275

Testing....276
Wood guy stakes....412
Work
Commencement of....48
Work site and storage....49
Workers compensation....70
Working drawings....29
Approved....31
Bearings....194
Bridge decks
Joint assemblies....197
Bulkhead system....207
Certified....30
Composite piles....207
FCCP....207
FRPP....207
Dolphin system....207
Fender system....207
Format....29
FRPL....207
Precast concrete arch structures....191
Precast culverts....191
Prefabricated modular walls....211
Prestressed structural concrete....190
Sheet piling....207
Concrete....207
Steel....207
Sign support structures....209
Structural steel....193
Submission category....30
Submission requirements....29
Temporary structures....214
Title block format....29

Z

Z-Grid roller....430