SECTION 000101
PROJECT TITLE PAGE

PROJECT MANUAL

FOR

BLANCHARD SPRINGS CAVERNS TUNNEL REHABILITATION

PROJECT NUMBER: 127J1819F0082

USDA FOREST SERVICE

OZARK-ST. FRANCIS NATIONAL FOREST
(R08) SOUTHERN REGION
SYLAMORE RANGER DISTRICT

DATE: MARCH 30, 2021

PREPARED BY:
GOLDER ASSOCIATES INC.

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SECTION 011000
SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: Blanchard Springs Caverns Tunnel Rehabilitation

B. Government's Name: USDA Forest Service.

1.02 SUMMARY OF WORK

The Project consists of the implementation of repair, ground support, instrumentation and monitoring tasks and the replacement of airlock and security doors at the Blanchard Springs Caverns. Multi-disciplinary design was completed by the ENGINEER, which has been finalized into Complete Stamped and Signed Construction Documents. The repairs, replacements, and modifications shall be constructed as designed and specified, according to all applicable law and requirements. The following is a summary of the work to be completed.

A. Elevator Room and Dripstone Cave Entrance: Work includes replacement of the airlock door system; installation of permanent ground support in the form of rockbolts, mesh and shotcrete through the entry tunnel; scaling of loose rock; demolition and replacement of existing suspended ceiling and utilities/ducting; demolition of existing chain link canopy; instrumentation near the interface with the natural cavern; and protection of existing features and the natural cave environment. Due to the complexity of this area, work is divided into three sections.

1. Elevator Room. Scope to include:

    i. Install water control at or past first airlock door, including all controls during operation (water pumping, etc.).

    ii. Protect floor, elevator doors, and wing walls during scaling.

    iii. Demolish suspended ceiling and remove or protect overlying ducting/utilities, as needed.

    iv. Scale Elevator Room to remove loose rock from the ceiling and upper sidewalls.

    v. Install 6-foot long, #5 fully resin grouted threaded rebar rockbolts on 4-foot centers.

    vi. Install 8-foot long, #5 fully resin grouted threaded rebar rockbolts on 4-foot centers in first two perimeter rows adjacent to elevator and stair/utility shaft.

    vii. Install geosynthetic mesh on the ceiling, supported by the rockbolt plates.

    viii. Pressure wash and clean all areas at close of work.

    ix. Install shoe-clean trough at inby end of work area at end of each day if returned to service, to prevent transport of any oil, dust, etc. into the cave.

    x. Reinstall ductwork and utilities (if removed) using cable trays and install new suspended tile ceiling.

2. Outer Airlock Door to Inner Airlock Door. Scope to include:

    i. Install water control at or past inner airlock door, including all controls during operation (water pumping, etc.).

    ii. Protect overlying electrical utilities, as needed.

iii. Scale tunnel to remove loose rock from the ceiling and upper sidewalls.

iv. Install 6-foot long, #5 fully resin grouted threaded rebar rockbolts on 4-foot centers.

v. Install geosynthetic mesh on the ceiling, supported by the rockbolt plates.

vi. Demolish pipe and chain link cover.

vii. Demolish existing inner and outer airlock doors and frames.

viii. Evaluate existing concrete and masonry bulkheads after door demolition and repair/replace if weak structural conditions are observed.

ix. Install new inner and outer airlock doors and frames.

x. Replace handrail.

xi. Pressure wash and clean all areas at close of work.

xii. Install shoe-clean trough at both ends of work area at end of each day, if to be returned to service, to prevent transport of any oil, dust, etc. into the cave.

xiii. Install cable tray for support of existing utility lines.

3. Inner Airlock Door to Cave Interface. Scope to include:

i. Install water control and temporary noise and containment barrier at the edge of the work area.

ii. Protect floor wing walls and utilities during scaling.

iii. Scale tunnel to remove loose rock from the ceiling and upper side walls. Protection of underlying structures. Existing timbers and steel beams to be removed.

iv. Install 6-foot long, #5 fully resin grouted threaded rebar rockbolts on 4-foot centers.

v. Install two rows of 8-foot long, #5 fully resin grouted threaded rebar rockbolts on 4-foot centers at the cavern interface end of this area.

vi. Install a minimum of 4-inches of fiber-reinforced shotcrete with 1-inch thick unreinforced finish coat on the left-hand sidewall (facing the cave).

vii. Install geosynthetic mesh on the ceiling, supported by the rockbolt plates.

viii. Install crack gauge monitoring device(s) across exposed bedding planes at the cavern interface.

ix. Install mechanical telltale monitoring device(s) at the cavern interface.

x. Pressure wash and clean all areas at close of work.

xi. Install shoe-clean trough at inby end of work area at end of each day, to prevent transport of any oil, dust, etc. into the cave.

B. Dripstone Bridge: Work includes tuckpointing of the masonry, especially on the lower sides of the abutment on the side of the bridge towards the Dripstone Cave Entry where some mortar loss was evident.

C. Dripstone Cave Bypass Tunnel: Work includes replacement of the door between the tunnel and the surface shaft; installation of permanent ground support in the form of rockbolts and mesh through the tunnel; scaling of loose rock; instrumentation at both ends near the interface with the natural cavern; and protection of existing features and the natural cave environment. Scope to include:

1. Install water control and temporary noise and containment barrier at interface between tunnel and natural cave at both ends of the tunnel, including all controls during operation (water pumping, etc.).
2. Scale tunnel to remove loose rock from the ceiling and side walls.
3. Install 6-foot long, #5 fully resin grouted threaded rebar rockbolts on 4-foot centers.
4. Install two rows of 8-foot long, #5 fully resin grouted threaded rebar rockbolts on 4-foot centers at both ends of the tunnel.
5. Install geosynthetic mesh on the ceiling, supported by the rockbolt plates.
6. Demolish existing door and frame.
7. Evaluate existing masonry bulkheads after door demolition and repair/replace if weak structural conditions are observed.
8. Install new door and frame.
9. Install crack gauge monitoring device(s) across exposed bedding planes at the cavern interface on both ends of the tunnel.
10. Install mechanical telltale monitoring device(s) at the cavern interface on both ends of the tunnel.
11. Pressure wash and clean all areas at close of work.
12. Install shoe-clean trough at both ends of work area at end of each day, to prevent transport of any oil, dust, etc. into the cave.

D. Dripstone Cave Exit: Work includes replacement of the airlock and security door system; installation of permanent ground support consisting of rockbolts, mesh and shotcrete through the exit tunnel; scaling of loose rock; demolition of existing steel canopy structure and replacement with structural concrete; demolition of existing chain link canopy; instrumentation near the interface with the natural cavern; and protection of existing features and the natural cave environment. Due to the complexity of this area, work is divided into three sections.

1. Cave Interface to Inner Airlock Door. Scope to include:
    i. Install water control and temporary noise and containment barrier at interface between tunnel and natural cave, including all controls during operation (water pumping, etc.).
    ii. Scale tunnel to remove loose rock from the ceiling and side walls.
    iii. Install 6-foot long, #5 fully resin grouted threaded rebar rockbolts on 4-foot centers.
    iv. Install two rows of 8-foot long, #5 fully resin grouted threaded rebar rockbolts on 4-foot centers at the cavern end of the tunnel.
    v. Install geosynthetic mesh on the ceiling, supported by the rockbolt plates.
    vi. Install crack gauge monitoring device(s) across exposed bedding planes at the cavern interface.
    vii. Install mechanical telltale monitoring device(s) at the cavern interface.
    viii. Pressure wash and clean all areas at close of work.
    ix. Install shoe-clean trough at end of each day, to prevent transport of any oil, dust, etc. into the cave.
2. Inner Airlock Door to Outer Airlock Door. Scope to include:

i. Install water control at or before the first airlock door, including all controls during operation (water pumping, etc.).

ii. Scale tunnel to remove loose rock from the ceiling and side walls.

iii. Install 6-foot long, #5 fully resin grouted threaded rebar rockbolts on 4-foot centers.

iv. Install geosynthetic mesh on the ceiling, supported by the rockbolt plates.

v. Demolish existing inner and outer airlock doors and frames.

vi. Evaluate existing concrete and masonry bulkheads after door demolition and repair/replace if weak structural conditions are observed.

vii. Install new inner and outer airlock doors and frames.

viii. Replace handrail.

ix. Pressure wash and clean all areas at close of work.

x. Install shoe-clean trough at end of each day, to prevent transport of any oil, dust, etc. into the cave.

3. Outer Airlock Door to Security Door. Scope to include:

i. Install water control at or before the outer airlock door, including all controls during operation (water pumping, etc.).

ii. Demolish steel beam and plate roofing with supporting masonry/steel column supports, with caution due to unknown conditions behind this structure.

iii. Scale tunnel to remove loose rock from the ceiling and side walls.

iv. Install 6-foot long, #5 fully resin grouted threaded rebar rockbolts on 4-foot centers.

v. Install a minimum of 7 inches of fiber-reinforced structural shotcrete with 1-inch-thick non-fiber finish coat on the ceiling and side walls in this area.

vi. Demolish existing security door and frame.

vii. Evaluate existing concrete and masonry bulkheads after door demolition and repair/replace if weak structural conditions are observed.

viii. Install new security door and frame.

ix. Replace handrail.

x. Pressure wash and clean all areas at close of work.

xi. Install shoe clean trough at inby end of work area at end of each day, to prevent transport of any oil, dust, etc. into the cave.

4. Security Door to Cave Exit. Scope to include:

i. Scale tunnel to remove loose rock from the ceiling and upper sidewalls.

ii. Install 6-foot long, #5 fully resin grouted threaded rebar rockbolts on 4-foot centers.

iii. Install geosynthetic mesh on the ceiling, supported by the rockbolt plates.

iv. Demolish pipe and chain link cover.

v. Pressure wash and clean all areas at close of work.

vi. Install shoe-clean trough at both ends of work area at end of each day, if to be returned to service, to prevent transport of any oil, dust, etc. into the cave.

E. Discovery Cave Exit: Work includes replacement of airlock and security door systems and protection of existing features and the natural cave environment. Scope to include:

1. Install water control and temporary noise and containment barrier between inner airlock door and natural cave, including all controls during operation (water pumping, etc.).
2. Demolish existing inner and outer airlock doors and frames.
3. Demolish existing security door and frame.
4. Evaluate existing concrete and masonry bulkheads after door demolition and repair/replace if weak structural conditions are observed.
5. Install new inner and outer airlock doors and frames.
6. Install new security door and frame.
7. Replace handrail.

F. Surface Sinkhole Area: Work includes the filling of the sinkhole with crushed limestone and the construction of a water diversion berm to divert surface water from the adjacent roadway and limit man-made water inflows. Seeding of disturbed areas.

1.03 CONTRACT DESCRIPTION

A. Contract Type: A Firm-Fixed Price.

1.04 DESCRIPTION OF ALTERATIONS WORK

A. Scope of demolition and removal work is indicated on Construction Drawings.

B. Scope of alterations work is indicated on Construction Drawings.

1.05 OWNER OCCUPANCY

A. Government intends to occupy the Project upon Substantial Completion.

B. Cooperate with Government to minimize conflict and to facilitate Government's operations.

1.06 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to areas noted on Construction Drawings.

1. Locate and conduct construction activities in ways that will limit disturbance to site.

B. Provide access to and from site as required by law and Government:

1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
2. Do not obstruct roadways, sidewalks, or other public ways without permit.

C. Time Restrictions:

1. Limit conduct to between the hours 6:00 pm and 8:00 am.

D. Utility Outages and Shutdown:

1. Prevent accidental disruption of utility services to other facilities.

1.07 SPECFICATION SECTIONS APPLICABLE TO ALL CONTRACTS

A. Unless otherwise noted, all provisions of the sections listed below apply to all contracts. Specific items of work listed under individual contract descriptions constitute exceptions.

B. Section 012000 – Price and Payment Procedures.

C. Section 013000 – Administrative Requirements.

D. Section 013216 – Construction Progress Schedule.

E. Section 014000 – Quality Control/Assurance.

F. Section 015000 – Temporary Facilities and Controls.

-END OF SECTION-

SECTION 01 20 00
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of application for progress payments.

B. Documentation of changes in Contract Sum and Contract Time.

C. Change procedures.

D. Correlation of CONTRACTOR submittals based on changes.

E. Procedures for preparation and submittal of application for final payment.

1.02 RELATED REQUIREMENTS

A. Section 01 78 00 – Closeout Submittals: Project record documents.

1.03 SCHEDULE OF VALUES

A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Contracting Officer's Representative for approval.

C. Forms filled out by hand will not be accepted.

D. Revise schedule to list approved Change Order, with each Application For Payment.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.

C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Contracting Officer's Representative for approval.

D. Forms filled out by hand will not be accepted.

E. For each item, provide a column for listing each of the following:

1. Item Number.
2. Description of work.
3. Scheduled Values.
4. Previous Applicants.
5. Work in Place and Stored Materials under this Application.
6. Authorized Change Orders.
7. Total Completed and Stored to Date of Application.
8. Percentage of Completion.
9. Balance to Finish.
10. Retainage.

F. Execute clarification by signature of authorized officer.

G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.

H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.

I. Submit one electronic and three hard-copies of each Application for Payment.

J. Include the following with the application:

1. Transmittal letter as specified for submittals in Section 013000.
2. Construction progress schedule, revised and current as specified in Section 013216.
3. Current construction photographs specified in Section 013000.
4. Partial release of liens from major subcontractors and vendors.
5. Affidavits attesting to off-site stored products.

K. When Contracting Officer's Representative requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and lite item by number and description.

1.05 MODIFICATION PROCEDURES

A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in the CONTRACTOR's employ or subcontractors of changes to Contract Documents.

B. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Contracting Officer's Representative will issue instructions directly to the CONTRACTOR.

C. For other required changes, Contracting Officer's Representative will issue a document signed by Government instructing the CONTRACTOR to proceed with the change, for subsequent inclusion in a Change Order.

1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
2. Promptly execute the change.

D. For changes for which advance pricing is desired, Contracting Officer's Representative will require a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. The CONTRACTOR shall prepare and submit a fixed price quotation within in 5 days.

E. The CONTRACTOR may propose a change by submitting a request for change to Contracting Officer's Representative, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 012500.

F. Computation of Change in Contract Amount: As specified in the Agreement Conditions of the Contract.

1. For change requested by Contracting Officer's Representative for work falling under a fixed price contract, the amount will be based on the CONTRACTOR's price quotation.
2. For change requested by the CONTRACTOR, the amount will be based on the the CONTRACTOR's request for a Change Order as approved by Contracting Officer's Representative.

G. Substantiation of Costs: Provide full information required for evaluation.

1. On request provide the following data:

a. Quantities of products, labor, and equipment.

b. Taxes, insurance, and bonds.

c. Overhead for profit.

d. Justification for any change in Contract Time.

e. Credit for deletions from Contract, similarly documented.

2. Support each claim for additional costs with additional information:

a. Origin and date of claim.

b. Dates and times work was performed, and by whom.

c. Time records and wages rates paid.

d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.

H. Execution of Change Orders: Contracting Officer's Representative will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

I. After execution of Change Order, promptly revise Schedule of Values and Application for Payments forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

J. Promptly revise progress schedules to reflect any changes in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

K. Promptly enter changes in Project Record Documents.

1. Prevent accidental disruption of utility services to other facilities.

1.06 **APPLICATION FOR FINAL PAYMENT**

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:

1. All closeout procedures specified in Section 017000.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

-END OF SECTION-

SECTION 012500
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

A. Section 013000 – Administrative Requirements: Submittal procedures, coordination.

B. Section 016000 – Product Requirements: Fundamental product requirements, production options, delivery, storage, and handling.

1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by the CONTRACTOR to materials, products, assemblies and equipment.

1. Substitutions for Cause: Proposed due to changed Project circumstances beyond the CONTRACTOR control.

   a. Unavailability.

   b. Regulatory changes.

2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.

   a. Substitution requests offering advantages solely to the CONTRACTOR will not be considered.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A substitution Request for products, assemblies, materials and equipment constitutes a representation that the submitter:

1. Has investigate proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.

2. Agrees to provide the same warranty for the substitution as for the specified product.

3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.

4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Government.

5. Waives claims for additional costs or time extension that may subsequently become apparent.

B. A Substitution Request for specified installer constitutes a representation that the submitter:

1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.

C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.

1. Note explicitly any non-compliant characteristics.

D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.

1. No specific form is required. The CONTRACTORs Substitution Request documentation must include the following:

a. Project Information:

1) Official project name and number, and any additional required identifiers established in Contract Documents.

2) Government's, Contracting Officer's Representative's, and the CONTRACTOR's names.

b. Substitution Request Information:

1) Discrete and consecutive Substitution Request number, and descriptive subject/title.

2) Indication of whether the substitution is for cause or convenience.

3) Issue date.

4) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).

5) Description of Substitution.

6) Reason why the specified item cannot be provided.

7) Differences between proposed substitution and specified item.

8) Description of how proposed substitution affects other parts of work.

c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing the essential attributes specified, as appropriate and relevant for the item:

1) Physical characteristics.

2) In-service performance.

3) Expected durability.

4) Visual effect.

5) Sustainable design features.

6) Warranties.

7) Other salient features and requirements.

8) Include, as appropriate or requested, the following types of documentation:

(a) Product Data:

(b) Samples.

(c) Certificates, test, reports or similar qualification data.

(d) Drawings, where required to show impact on adjacent construction elements.

d. Impact of Substitution:

1) Savings to Government for accepting substitution.

2) Change to Contract Time due to accepting substitution.

E. Limit each request to a single proposed substitution item.

1. Submit an electronic document, combining the request form with supporting data into a single document.

3.02 **SUBSTITUTION PROCEDURES DURING CONSTRUCTION**

A. Submittal Form (after award of contract): The CONTRACTOR's form is acceptable, provided it contains all required information.

B. Contracting Officer's Representative will consider requests for substitutions only within 15 days after date of Agreement.

C. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Contracting Officer's Representative, in order to stay on approved project schedule.

D. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Contracting Officer's Representative, in order to say on approve project schedule.

1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Government through cost savings, time savings, greater energy conservation, or in other specific ways.

2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.

3. Bear the costs engendered by proposed substitution of:

a. Other construction by Government.

b. Other unanticipated project considerations.

E. Substitutions will not be considered under one or more of the following circumstances:

1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.

2. Without a separate written request.

3. When acceptance will require revisions to Contract Documents.

3.03 **RESOLUTION**

A. Contracting Officer's Representative may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Contacting Officer's Representative will notify the CONTRACTOR in writing of decision to accept or reject request.

1. Contracting Officer's Representative's decision following review of proposed substitution will be noted on the submitted form.

3.04 **ACCEPTANCE**

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.05 **CLOSOUT ACTIVITIES**

A. See Section 017800 – Closeout Submittals, for closeout submittals.

B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

-END OF SECTION-

SECTION 013000
ADMINSTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.

B. Electronic document submittal service.

C. Preconstruction meeting.

D. Site mobilization meeting.

E. Progress meetings.

F. Construction progress schedule.

G. CONTRACTOR's daily reports.

H. Progress photographs.

I. Coordination drawings.

J. Number of copies of submittals.

K. Request for Interpretation (RFI) procedures.

L. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 013216 – Construction Progress Schedule: Form, content, and administration of schedules.

B. Section 016000 – Product Requirements: General product requirements.

C. Section 017000 – Execution and Closeout Requirements: Additional coordination requirements.

1.03 REFERENCE STANDARDS

A. AIA G716 – Request for Information 2004

B. AIA G810 – Transmittal Letter 2001.

1.04 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 017000 – Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of constructive activities.

B. Make the following types of submittals to Contracting Officer's Representative:

1. Requests for Interpretation (RFI)
2. Requests for substitution.
3. Shop drawings, product data, and samples.
4. Test and inspection reports.
5. Design data.
6. Manufacturer's instructions and field reports.
7. Progress schedules.

8. Coordination drawings.
9. Correction Punch List and Final Correction Punch List for Substantial Completion.
10. Closeout submittals.

1.05 **CONTRACTING OFFICER**

A. Project Coordinator: Contracting Officer.

B. Cooperate with the Contracting Officer in allocation of mobilization areas of site; for field offices and sheds, for site access, and parking facilities.

C. During, construction, coordinate use of site and facilities through the Contracting Officers.

D. Comply with Contracting Officer's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.

E. Comply with instructions of the Contracting Officer for use of temporary utilities and construction facilities. Responsibility for providing temporary utilities and construction facilities is identified in Section 011000 – Summary.

F. Coordinate field engineering and layout work under instructions of the Contracting Officer.

G. Make the following types of submittals to Contracting Officer's Representative through the Contracting Officer:

1. Request for Interpretation.
2. Requests for substitution.
3. Shop drawings, product data, and samples.
4. Test and inspection reports.
5. Design data.
6. Manufacturer's instructions and field reports.
7. Applications for payment and change order requests.
8. Progress schedules.
9. Coordination drawings.
10. Correction Punch List and Final Correction Punch List for Substantial Completion.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 **ELECTRONIC DOCUMENT SUBMITTAL SERVICE**

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.

1. Besides for submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, the CONTRACTOR's correction punchlist, and any other document any participant wishes to make of the project record.

2. The CONTRACTOR and Contracting Officer's Representative are required to use this service.
3. It is the CONTRACTOR's responsibility to submit documents in allowable format.
4. Subcontractors, supplies, and Contracting Officer's Representative's consultants are to be permitted to use the service at no extra charge.
5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com), unless such software capability is provided by the service provider.
6. Paper document transmittals will not be reviewed emailed electronic documents will not be reviewed.
7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

B. Cost: The cost of the service is to be paid by the CONTRACTOR; include the cost of the service in the Contract Sum.

C. Submittal Service: The Selected service is:

D. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Contracting Officer's Representative and the CONTRACTOR participating; further training is the responsibility of the use of the service.

E. Project Closeout: Contracting Officer's Representative will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for the OWNER.

3.02 PRECONSTRUCTION MEETING

A. Attendance Required:

1. The OWNER.
2. Contracting Officer's Representative.
3. The CONTRACTOR.

B. Agenda:

1. Execution of OWNER--CONTRACTOR Agreement.
2. Submission of executed ponds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
5. Submission of initial Submittal schedule.
6. Designation of personnel representing the parties to Contract
7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
8. Scheduling
9. Scheduling activities of the ENGINEER.

C. Record minutes and distribute copies within two days after meeting participants, with two copies to Contracting Officer's Representative, the OWNER, participants, and those affected by decisions made.

3.03 SITE MOBILIZATION MEETING

A. Attendance Required:
   1. The CONTRACTOR.
   2. The OWNER.
   3. Contracting Officer's Representative.
   4. The CONTRACTOR's superintendent.
   5. Major subcontractors.

B. Agenda:
   1. Use of premises by the OWNER and the CONTRACTOR.
   2. OWNER's requirements.
   3. Construction facilities and controls provided by the OWNER.
   4. Temporary utilities provided by the OWNER.
   5. Survey and building layout.
   6. Security and housekeeping procedures.
   7. Schedules.
   8. Application for payment procedures.
   9. Procedures for testing.
   10. Procedures for maintaining record documents.
   11. Requirements for start-up of equipment.
   12. Inspection and acceptance of equipment put into service during construction period.

C. Record minutes and distribute copies within two days after meeting to participants, with copies to Contracting Officer's Representative, the OWNER, participants, and those affected by decisions made.

3.04 **PROGRESS MEETINGS**

A. Schedule and administer meetings throughout progress of the work at maximum bi-monthly intervals.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required:
   1. The CONTRACTOR.
   2. The OWNER.
   3. Contracting Officer's Representative.
   4. The CONTRACTOR's superintendent.
   5. Major subcontractors.

D. Agenda:
   1. Review minutes of previous meetings.
   2. Review of work progress.
   3. Field observations, problems, and decisions.
   4. Identification of problems that impede, or will impede, planned progress.

5. Review of submittals schedule and status of submittals.
6. Maintenance of progress schedule.
7. Corrective measure to regain projected schedules.
8. Planned progress during succeeding work period.
9. Effect of proposed changes on progress schedule and coordination.
10. Other business relating to work.

E. Record minutes and distribute copies within two days after meetings to participants, with two copies to Contracting Officer's Representative, the OWNER, participants, and those affected decisions made.

3.05 **CONSTRCUTION PROGRESS SCHEDULE – SEE SECTION 013216**

A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remained of work.

B. If preliminary schedule requires revisions after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.

1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 10 days after join review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

3.06 **DAILY CONSTRUCTION REPORTS**

A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.

B. In addition to transmitting electronically a copy to the OWNER and Contracting Officer's Representative,

1. Submit in format acceptable to the OWNER.

C. Prepare a daily construction report recording the following information concerning events at Project site and project progress:

1. Date.
2. High and low temperatures, and general weather conditions.
3. List of subcontractors at Project site.
4. List of separate contractors at Project site.
5. Approximate count of personnel at Project site.
   a. Include a breakdown of supervisors, laborers, journeymen, equipment operators and helpers.

1. Major equipment at Project site.
2. Material deliveries.
3. Safety, environmental, or industrial relations incidents.
4. Meetings and significant decisions.
5. Unusual events (submit a separate special report).

6. Stoppages, delays, shortages, and losses. Include comparison between schedule work activities (in the CONTRACTOR's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
7. Emergency procedures.
8. Change Orders received and implemented.
9. Testing and/or inspections performed.
10. Signature of the CONTRACTOR's authorized representative.

3.07 PROGRESS PHOTOGRAPHS

A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.

B. Photography Type: Digital; electronic files.

C. Provide photographs of site and construction throughout progress of work produced by an experienced photographer, acceptable to Contracting Officers Representative.

D. In addition to periodic, recurring views, take photographs of each of the following events:

1. Structural framing in progress and upon completion.
2. Door installation in progress and upon completion
3. Shotcreteing in progress and upon completion
4. Rockbolting in progress and upon completion.
5. Final completion, minimum of ten (10) photos.

E. Take photographs as evidence of existing project conditions as follows:

1. Interior views: As required.
2. Exterior views: As required.

F. Views:

1. Provide a non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
2. Consult with Contracting Officer's Representative for instructions on views required.
3. Provide factual presentation.
4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of filed, and minimum distortion.
5. Point of View Sketch: Provide sketch identifying point of view of each photograph.

G. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.

1. Delivery Medium: Via email.
2. File Naming: Include project identification, date and time of view, and view identification.
3. Point of View Sketch: Include digital copy of point of view sketch with each electronic submittal; include point of view identification in each photo file name.
4. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.

3.08 COORDINATION DRAWINGS

A. Provide information required by Contracting Officer for preparation of coordination drawings.

B. Review drawings prior to submission to Contracting Officer's Representative.

3.09 **REQUEST FOR INTERPRETATION (RFI)**

A. Definition: A request seeking one of the following:

1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space(interference); or when an item of work is described differently at more than one place in Contract Documents.

2. A resolution to an issues which as arisen due to field conditions and affects design intent.

B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.

C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.

1. Prepare a separate RFI for each specific item.

a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.

b. Do not forward requests which solely require internal coordination between subcontractors.

2. Prepare in a format and with content acceptable to the OWNER.

a. Use AIA G716 – Request for Information.

3. Prepare using software provided by the Electronic Document Submittal Service.

4. Combine RFI and its attachments into a single electronic file. PDF format is preferred.

D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.

1. Include in each request the CONTRACTOR's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.

2. Unacceptable Uses for RFIs: Do not use RFIs to request the following:

a. Approval of submittals (use procedures specified elsewhere in this section).

b. Approval of substitutions (see Section – 016000 – Product Requirements)

c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).

d. Different methods of performing work than those included in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).

3. Improper RFIs: Requests not prepared in compliance with the requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.

4. Frivolous RFIs: Requests regarding information this is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.

a. The OWNER reserves the right to assess the CONTRACTOR for the costs (on time-and-materials basis) incurred by the Contracting Officer's Representative, and any of its consultants, due to processing of such RFIs.

E. Content: Include identifies necessary for tracking the status of each RFI, and information necessary to provide an actionable response.

1. Official Project name and number, and any additional required identifiers established in Contact Documents.
2. OWNER's, Contracting Officer Representative's, and CONTRACTOR's names.
3. Discrete and consecutive RFI number, and descriptive subject/title.
4. Issue date and requested reply date.
5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
7. CONTRACTOR's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example, routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.

1. Indicate current status of every RFI. Update log promptly and on a regular basis.
2. Note dates of when each request is made, and when a response is received.
3. Highlight items requiring priority or expedited response.
4. Highlight items for which a timely response has not been received to date.
5. Identify and include improper or frivolous RFIs.

H. Review Time: Contracting Officer's Representative will respond and return RFIs to the CONTRACTOR within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.

1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.

I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in the CONTRACTOR's belief it is likely to lead to a change to Contract or Contract Time, promptly issue to this effect, and follow up with an appropriate Change Order request to the OWNER.

1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issues forthwith. Identify the amended RFI with an R suffix to the original number.
2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.

3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI log.
4. Notify Contracting Officer's Representative within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.10 SUBMITTAL SCHEDULE

A. Submit to Contracting Officer's Representative for review a schedule for submittals in tabular format.

1. Coordinate with the CONTRACTOR's construction schedule and schedule of values.
2. Format schedule to allow tracking of status of submittals throughout duration of construction.
3. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered and role and name of subcontractor.
4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
   a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make correction or revisions to initial submittals, and time for their review.

3.11 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:

1. Product data.
2. Design data.
3. Shop drawings.
4. Samples for selection.
5. Samples for verification.

B. Submit to Contracting Officer's Representative for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for the record documents purposes described in Section 017800 – Closeout Submittals.

3.12 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:

1. Design data.
2. Sustainability design submittals and reports.
3. Certificates.
4. Test reports.
5. Inspection reports.
6. Manufacturer's instructions.

7. Manufacturer's field reports.
8. Other types indicated.

B. Submit for Contacting Officer's Representative knowledge as contract administrator or for the OWNER.

3.13 **SUBMITTAL FOR PROJECT CLOSEOUT**

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 017800 – Closeout Submittals:

1. Project record documents.
2. Operation and maintenance data.
3. Warranties.
4. Bonds.
5. Other types as indicated.

D. Final Property Survey

E. Submit for OWNER's benefit during and after project completion.

3.14 **NUMBER OF COPIES OF SUBMITTALS**

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFS at native size and right-side up; illegible files will be rejected.

B. Samples: Submit the number specified in the individual specification sections; one of which will be retained by Contracting Officer's Representative.

1. After review, produce duplicates.
2. Retained samples will not be returned to Design-Build Contractor unless specifically so stated.

3.15 **SUBMITTAL PROCEDURES**

A. General Requirements:

1. Use separate transmittal for each item.
2. Use a single transmittal for related items.
3. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
4. Transmit using form.
   a. Use the CONTRACTOR's form, subject to prior approval by Contracting Officer's Representative.
   b. Use for generated by Electronic Document Submittal Service software.
5. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
6. Identify: Project; CONTRACTOR; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.

7. Apply the CONTRACTOR's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
    a. Submittals from sources other than the CONTRACTOR, or without the CONTRACTOR's stamp will not be acknowledged, reviewed, or returned.
8. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties and is of the benefit to the project.
    a. Deliver samples to Contracting Officer's Representative at business address.
    b. Upload submittals in electronic form to Electronic Document Submittal Service website.
9. Schedule submittals to expedite the Project, and coordinate submission of related items.
    a. For each submittal for review, allow 15 days excluding delivery time to and from the CONTRACTOR.
    b. For sequential review involving Contracting Officer's Representative's consultants, OWNER, or another affected party, allow an additional 7 days.
10. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
11. Provide space for the CONTRACTOR and Contracting Officer's Representative review stamps.
12. When revised for resubmission, identify all changes made since previous submission.
13. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
14. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work and have received prior approval for their use.
15. Submittals not requested will not be recognized or processed.
16. Submittals not requested will be recognized, and will be returned "Not Reviewed",

B. Product Data Procedures:
    1. Submit only information required by individual specification sections.
    2. Collect required information into a single submittal.
    3. Submit concurrently with related shop drawing submittal.
    4. Do not submit (Material) Safety Data Sheets for materials or products.
    5. Submit sustainable design reporting submittals under separate cover.

C. Shop Drawing Procedures:
    1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
    2. Do not reproduce Contract Documents to create shop drawings.
    3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

D. Samples Procedures:
    1. Transmit related items together as a single package.

2. Identify each item to allow review for applicability in relation to shop drawings installation locations.
3. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each image.

3.16 **SUBMITTAL REVIEW**

A. Submittals for Review: Contracting Officer's Representative will review each submittal, and approve, or take other appropriate action.

B. Submittals for Information: Contracting Officer's Representative will acknowledge receipt and review. See below for actions to be taken.

C. Contracting Officer's Representative's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.

1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.

D. Contracting Officer's Representative's and Consultants' actions on items submitted for review:

1. Authorizing purchasing, fabrication, delivery, and installation:
   a. "Approved", or language with same legal meaning.
   b. "Approved as Noted, Resubmission no required" or language with the same legal meaning.
      1) At the CONTRACTOR's option, submit corrected item, with review notations acknowledged and incorporated.
   c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
      1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
      2) Non-responsive resubmittals may be rejected.
2. Not Authorizing fabrication, delivery, and installation:
   a. "Revise and Resubmit".
      1) Resubmit revised item, with review notations acknowledged and incorporated.
      2) Non-responsive resubmittals may be rejected.
   b. "Rejected".
      1) Submit item complying with requirements of Contract Documents.

E. Contracting Officer's Representee's and consultants' actions on items submitted for information:

1. Items for which no action was taken:
   a. "Received" – to notify the CONTRACTOR that the submittal has been received for record only.
2. Items for which action was taken:
   a. "Reviewed" – no further action is required from the CONTRACTOR.

-END OF SECTION-

SECTION 013216
CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preliminary schedule.

B. Construction progress schedule, bar chart type.

1.02 RELATED SECTIONS

A. Section 011000 – Summary: Work sequence.

1.03 REFENCE STANDARDS

1.04 SUBMITTALS

A. Within 10 days after date of Agreement, submit preliminary schedule.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.

D. Within 10 days after join review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

F. Submit under transmittal letter form specified in Section 013000 – Administrative Requirements.

1.05 QUALITY ASSURANCE

A. Scheduler: The CONTRACTOR's personnel or specialist Consultant specializing in CPM scheduling with one years minimum experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detail graphic printout with 48 hours of request.

B. CONTRACTOR's Administrative Personnel: 5 years minimum experience in using and monitoring CPM schedules on comparable projects.

1.06 SCHEDULE FORMAT

A. Listing: In chronological order according to the start date of each activity. Identify each activity with the applicable specification section number.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.

B. Identify each item by specification section number.

C. Identify work of sequence stages and other logically grouped activities.

D. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.

E. Provide separate schedule of submittal dates for shop drawings, product data, and samples, and dates reviewed submittals will be required from Contracting Officer's Representative. Indicate decision dates for selection of finishes.

F. Provide legend for symbols and abbreviations used.

3.03 **BAR CHARTS**

A. Include a separate bar for each major portion of Work or operation.

B. Identify the first work day of each week.

3.04 **REVIEW AND EVALUATION OF SCHEDULE**

A. Participate in joint review and evaluation of schedule with Contracting Officer's Representative at each submittal.

B. Evaluate project status to determine work behind schedule and work ahead of schedule.

C. After review, revise as necessary as a result of review, and resubmit within 10 days.

3.05 **UPDATING SCHEDULE**

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity.

C. Annotate diagrams to graphically depict current status of Work.

D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

E. Indicate changes required to maintain Date of Substantial Completion.

F. Submit reports required to support recommended changes.

G. Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect.

3.06 **DISTRIBUTION OF SCHEDULE**

A. Distribute copies of updated schedules to CONTRACTOR's project site file, to subcontractors, suppliers, Contracting Officer's Representative, the OWNER, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projects indicated in schedules.

-END OF SECTION-

SECTION 01 33 00
SUBMITTALS

PART 1 GENERAL

1.01 DESCRIPTION

This section specifies the following:

A. Submittal procedures

B. Construction progress schedules

C. Technical data

D. Safety Data Sheets

E. Quality control test results and daily field reports

F. Test reports

G. Certificates

H. Manufacturer's instructions

I. As-built survey documentation

1.02 RELATED WORK

A. Section 01 40 00 – Quality Control/Assurance

B. Section 01 60 00 – Product Requirements

1.03 SUBMITTAL PROCEDURES

A. Transmit each submittal with an ENGINEER accepted form.

B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix. Submittal number shall be formatted: specification number-submittal number-alpha version. Example 444414-001-A is the first submittal requirement for specification Section 44 44 14 and the first revision. A re-submittal to address comments will index the alpha (i.e., 444414-001-B).

C. Identify Project, CONTRACTOR, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.

D. Apply CONTRACTOR's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.

E. Schedule submittals to expedite Project.

1. Post electronic files to the project specific external sharing site established at project initiation.

2. Hard copies, when required, are delivered to ENGINEER at:

   a. Golder Associates Inc.
   13515 Barrett Parkway Drive, Suite 260
   Ballwin, MO 63021, USA
   Attn: Blanchard Caverns Assessment Project Manager

3. Coordinate submission of related items.

   a. For each submittal for review, allow 10 business days for ENGINEER response.

b. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of completed Work.

c. Allow space on submittals for CONTRACTOR review stamps.

d. When catalog pages are submitted, mark submittal to identify applicable products, models, options, and other data. Delete extraneous information. Supplement manufacturers' standard data to provide information specific to this Project.

e. APPROVED or APPROVED AS NOTED does not indicate a thorough review of all dimensions, quantities, and details of the material, equipment, devices, or items shown, and does not relieve the CONTRACTOR from any responsibility for errors or deviations from the contract requirements.

f. When the drawings and data are returned marked REVISE AND RESUBMIT the corrections shall be made as noted thereon and as instructed by the ENGINEER. Identify changes made since previous submission and resubmit.

g. When the drawings and data are returned marked REJECTED, the CONTRACTOR shall take necessary corrective actions to comply with contract documents. All items marked REJECTED will not be accepted and a substitute must be submitted for approval from the ENGINEER.

h. Distribute review comments of reviewed submittals to CONTRACTOR’s staff and subcontractors as appropriate. Instruct parties to promptly report inability to comply with requirements.

i. Submittals not requested will not be recognized or processed.

j. All drawings and data, after final processing by the ENGINEER, shall become a part of the Contract Documents and the Work shown or described thereby shall be performed in conformity therewith unless otherwise authorized by the OWNER or the ENGINEER

1.04 CONSTRUCTION PROGRESS SCHEDULES

A. Procedure:

1. Submit a preliminary progress schedule to the OWNER within 10 days after the date of OWNER–CONTRACTOR Agreement.

2. After OWNER's review, revise and resubmit schedule to comply with OWNERs review within 5 days. Provide electronic version upon request.

3. Submit revised progress schedule every two weeks or according to a schedule agreed upon by the OWNER.

4. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.

5. Provide subcontractors activity schedules.

6. Provide separate schedule of submittal dates for shop drawings, product data, and samples, including OWNER furnished products, and dates that reviewed submittals shall be required from the OWNER and ENGINEER. Indicate delivery data for products.

7. Schedules shall be in a form that is acceptable to the OWNER.

8. Distribute copies of reviewed schedules to the project file, Subcontractors, suppliers, and the ENGINEER.

9. Instruct recipients to promptly report in writing problems anticipated by projections indicated in schedules.

1.05 **TECHNICAL DATA**

A. Engineering data covering all equipment and fabricated materials to be furnished under this contract shall be submitted to the ENGINEER for review. These data shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and operation of component material and devices: the external connections, anchorages, and supports required; performance characteristics; and dimensions needed for installations and correlation with other materials and equipment. Data submitted shall include drawings showing essential details of any changes proposed by CONTRACTOR.

B. No work shall be performed in connection with the fabrication or manufacture of material and equipment, nor shall any accessory or appurtenance be purchased until the drawings and data have been reviewed and approved by the ENGINEER, except at the CONTRACTOR's own risk and responsibility.

1.06 **SAFETY DATA SHEETS**

A. Furnish copies of all Safety Data Sheets (SDS) to the OWNER and ENGINEER upon written request. CONTRACTOR shall retain on site all SDS for applicable products on site, including but not limited to paint, solvents, oils, adhesives, and construction materials, etc.

1.07 **QUALITY CONTROL TEST RESULTS AND DAILY FIELD REPORTS**

A. Properly deliver and handle materials to prevent contamination, segregation, or damage to materials.

B. Store cement in weathertight enclosures to protect against dampness and contamination.

C. Prevent segregation and contamination of aggregates by proper arrangement and use of stockpiles.

D. Store admixtures properly to prevent contamination, evaporation, freezing, or other damage.

1.08 **TEST REPORTS**

A. Submit test reports for OWNER/ENGINEER's knowledge and information for the purpose of assessing conformance with information given and design concept expressed in Contract Documents.

B. Electronic files are acceptable for submittal, hard copies shall be provided upon written request.

1.09 **CERTIFICATES**

A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or CONTRACTOR to OWNER/ENGINEER, in quantities specified for Product Data.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to OWNER/ENGINEER.

D. Electronic files are acceptable for submittal, hard copies shall be provided upon written request.

1.10 **MANUFACTURER’S INSTRUCTIONS**

A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to ENGINEER for delivery to

OWNER in quantities specified for Product Data. Electronic files are acceptable for submittal, hard copies shall be provided upon written request.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

C. Provide final Installation, Operations, and Maintenance manuals in printed and electronic (PDF) format.

1.11 **AS-BUILT SURVEY DOCUMENTATION**

A. As-built Survey Documentation

1. The CONTRACTOR shall be responsible for accurately surveying the locations and elevations and, where applicable, the type, and quantity of any and all rockbolts (areas of rockbolts should be surveyed and noted on as-builts, but survey of location and elevation of individual rockbolts is not required), geosynthetic mesh, shotcrete, general surface grading, fill materials, stormwater diversion berms, and any other aspect of the work required by the ENGINEER.

2. The CONTRACTOR shall submit as-built survey documentation.

3. Submittal: Completed as-built survey documentation will be submitted within two weeks of project acceptance in the following manner.

a. Submit one digital reproducible copy each to the OWNER and ENGINEER.

b. Submit one paper copy each to the OWNER and ENGINEER.

1) As-built documentation survey shall be sealed by a registered Professional Land Surveyor licensed in the State of Arkansas.

PART 2 PRODUCTS

2.01 **NOT USED**

PART 3 EXECUTION

3.01 **NOT USED**

- - - END OF SECTION - - -

SECTION 01 40 00
QUALITY CONTROL/ASSURANCE

PART 1 GENERAL

1.01 DESCRIPTION

This section specifies the following:

A. References

B. General quality control requirements

C. Manufacturer's quality control inspections, sampling, and testing

D. Quality control sampling and testing frequency

E. Quality assurance and inspection and testing

F. Testing and inspection services

G. Labeling

H. Tolerances

1.02 RELATED WORK

A. Section 01 33 00 – Submittals

B. Section 01 60 00 – Product Requirements

1.03 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date of Contract Documents unless specified otherwise in the specific section.

C. Should specified reference standards conflict with Contract Documents, the CONTRACTOR shall request clarification from ENGINEER before proceeding.

D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.04 GENERAL QUALITY CONTROL REQUIREMENTS

A. The Quality Control Team as defined in Section 01 10 00 shall perform the Quality Control testing and inspection required by these Specifications for all earthworks and ground support installation.

B. The Quality Control Team shall be under the direct supervision of a Quality Control Manager that has minimum of five years' experience with the quality control tasks being performed. All Quality Control test results shall be used as the record tests documented in the Quality Control As-built Report in accordance with Section 01 33 00.

C. Results of Quality Control tests are subject to verification by the ENGINEER. Should a discrepancy between results of the Quality Control Team and the ENGINEER, the ENGINEER's, results and conclusions shall prevail.

D. Quality Control test results are not a basis of acceptance of Work. Results of inspection and testing on in-place material approved by the ENGINEER or performed by the Quality Assurance Team shall prevail.

E. The CONTRACTOR shall be responsible to monitor Quality Control over suppliers, manufacturers, products, services, site conditions and workmanship to produce Work of specified quality.

F. Comply fully with Manufacturers' instructions, including each step in sequence. Should Manufacturers' instructions conflict with the Contract Documents, the CONTRACTOR shall request clarification from the ENGINEER prior to proceeding.

G. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes or specified requirements indicate higher standards or more precise workmanship.

H. The Quality Control Team's inspections will not relieve the CONTRACTOR of responsibility for the acceptance of the finished Work or portions thereof.

I. Work performed by the Quality Control Team personnel shall be qualified to perform specified testing in accordance with specified test methods and procedures as required by these Specifications.

J. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

K. A summary report of the Quality Control Work performed shall be submitted to the ENGINEER in accordance with Section 01 33 00.

L. Re-testing required due to the CONTRACTOR's non-conformance to specified requirements of these Specifications shall be performed by the same Quality Control Team, Quality Assurance Team, or independent third party, as instructed by the ENGINEER. The costs of re-testing shall be borne by the CONTRACTOR if re-testing requires the testing agency to work extra hours or overtime.

1.05 MANUFACTURER'S QUALITY CONTROL INSPECTION, SAMPLING, AND TESTING

A. The Manufacturer shall sample and perform Quality Control testing at the frequencies specified in these Specifications. Test results shall be submitted by the CONTRACTOR and/or the Manufacturer to the ENGINEER in accordance with Section 01 33 00.

B. The Manufacturer and/or CONTRACTOR will cooperate with the Quality Control Team; furnish samples of materials, design mixes, equipment, tools, storage, and assistance as required and:

1. Notify the ENGINEER and Quality Control Team 24 hours prior to expected time for operations requiring services.

2. Make arrangements with Quality Control Team and pay for additional samples and tests required for CONTRACTOR's use.

C. The Quality Control Team will submit to the ENGINEER one copy of reports indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents in accordance with Section 01 33 00.

3. If observations, inspections, or Manufacture Quality Control test results identify any materials or methods used to complete the Work that do not meet these Specifications, the ENGINEER shall be notified immediately.

4. In the event that a test failed to meet these Specifications and a retest is performed, the ENGINEER shall be notified regardless of the retest results.

5. Removal of materials, repairs, or retests shall be determined by the ENGINEER. Costs associated with the CONTRACTOR's actions to remediate deficiencies shall be borne by the CONTRACTOR.

1.06 QUALITY CONTROL SAMPLING AND TESTING FREQUENCY

A. The frequency of CONTRACTOR and Manufacturer Quality Control testing of materials is specified in the following sections:

Table 014000-1: Testing Frequency Reference Sections

Material	Reference Section	Quality Control (QC) and/or Quality Assurance (QA) Testing Required
Earthwork	31 00 00	QA
Cast in Place Concrete	03 30 00	QA / QC
Shotcrete	03 37 13	QA / QC
Masonry Mortar	04 05 13	QC
Masonry Stone	04 43 00	QC
FRP Doors	08 22 00	QA
Balanced Doors	08 42 36	QA
Rockbolts	31 33 13	QC
Seeding	32 92 19	QA / QC

1.07 QUALITY ASSURANCE AND INSPECTION AND TESTING

A. The Quality Assurance Team as defined in Section 01 10 00 shall perform the Quality Assurance testing and inspection required by these Specifications for all earthworks and ground support installation.

B. Quality Assurance Daily Field Reports shall be completed and submitted to the ENGINEER and/or OWNER within one working day in accordance with Section 01 33 00. The minimum information required for each Daily Field Report as well as an example is provided in this CQA Plan.

C. The Quality Assurance shall be under the direction of the ENGINEER. All Quality Assurance test results shall be used as the record tests documented in the Quality Control As-built Report in accordance with Section 01 33 00.

D. At any time during the project Work, the ENGINEER may collect a sample split from the Quality Control sample and perform a test for Quality Assurance.

1.08 TESTING AND INSPECTION SERVICES

A. CONTRACTOR will employ and pay for specified services of an independent firm to perform testing and inspection.

B. The independent firm will perform tests, inspections and other services specified in individual specification sections and as required by the OWNER and/or ENGINEER.

1. Laboratory: Authorized to operate in State of Arkansas.
2. Laboratory Staff: Maintain full time registered ENGINEER on staff to review services.

3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.

C. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by ENGINEER or OWNER.

D. Reports will be submitted by independent firm to the OWNER with copies provided to the ENGINEER, CONTRACTOR, and authority having jurisdiction, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

1. Submit final report indicating correction of Work previously reported as non-compliant.

E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.

1. Notify ENGINEER and independent firm 48 hours prior to expected time for operations requiring services.

2. Make arrangements with independent firm and pay for additional samples and tests required for CONTRACTOR's use.

F. Testing and employment of testing agency or laboratory shall not relieve CONTRACTOR of obligation to perform Work in accordance with requirements of Contract Documents.

G. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by ENGINEER. Payment for re-testing or re-inspection will be charged to CONTRACTOR by deducting testing charges from Contract Sum/Price.

H. Limits on testing authority:

1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.

2. Agency or laboratory may not approve or accept any portion of the Work.

3. Agency or laboratory may not assume duties of CONTRACTOR.

4. Agency or laboratory has no authority to stop the Work.

1.09 LABELING

A. Attach label from agency approved by authority having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.

B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label.

1. Model number.

2. Serial number.

3. Performance characteristics.

1.10 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers’ tolerances. When manufacturers’ tolerances conflict with Contract Documents, request clarification from OWNER/ENGINEER before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.11 MANUFACTURER’S FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to OWNER/ENGINEER 14 days in advance of required observations. Observer subject to approval of ENGINEER.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 QUALITY CONTROL

A. Maintain access at all times for the ENGINEER and/or Quality Assurance Team to perform inspection, sampling, and testing. At no time deny the Quality Assurance Team personnel, ENGINEER, or OWNER access to any Work area, fabrication area, staging area, or any other area associated with the Work.

B. Make allowance for the Quality Assurance sampling and testing to be performed and divert equipment elsewhere during the required sampling and testing.

C. Quality Control test results shall be provided to the OWNER and/or ENGINEER within one working day of collecting sample for testing, or upon request, for review and approval in accordance with Section 01 33 00.

D. Daily Field Reports shall be completed and submitted to the ENGINEER and/or OWNER within one working day in accordance with Section 01 33 00.

E. There is no provision for claims of delays due to Quality Assurance inspection, testing, or sampling. Should CONTRACTOR feel that delays are being incurred due to Quality Assurance inspection, testing, sampling, or other activities, notify OWNER and ENGINEER in writing documenting in detail the date, time, and quality assurance activity of each occurrence. Should OWNER and/or ENGINEER determine that excessive time is being spent at quality assurance activities causing delay to Work, corrective action will be taken.

F. If any Work should be covered up without prior approval or consent of the ENGINEER, it must, if required by the ENGINEER, be uncovered for examination. After the uncovered Work has been observed and authorization given by the ENGINEER, the Work shall be recovered in accordance with the Specifications. The cost of uncovering and recovering the Work and any consequential costs shall be the responsibility of the CONTRACTOR regardless of the condition of the Work uncovered. If the Work is found to be deficient, the CONTRACTOR shall expose all Work that was covered prior to approval, correct any Work that is deficient, and proceed according to the Specifications. The cost of uncovering deficient Work, correcting deficient Work and any consequential costs shall by borne entirely by the CONTRACTOR.

G. All Work performed by the CONTRACTOR shall meet the approval of the ENGINEER. The method and manner of doing the Work will be under the control of the CONTRACTOR. The ENGINEER may review the CONTRACTOR's work practices and make adjustments as necessary to minimize the risk of damage to critical components of the Work.

3.02 SUBMITTALS

A. The CONTRACTOR shall submit all Quality Control test results to the ENGINEER for review and approval on a regular basis, typically within one working day of performing the tests, or at the request of the ENGINEER.

B. Fill materials proposed by the CONTRACTOR for use to complete the Work shall be tested by the Quality Assurance Team prior to placement to verify that the material meets these Specifications.

C. Initial Quality Control test results of proposed materials shall be submitted to the ENGINEER for approval at least 24 hours prior to material placement.

D. At the completion of the Work, a sealed Quality Control Report shall be submitted to the OWNER and ENGINEER in accordance with Section 01 30 00 and include at a minimum:

1. Cover letter summarizing the quantities of materials placed, required testing frequency, and actual testing frequency achieved.
2. Typed field documentation including daily field reports, field and laboratory test results summary tables and individual test results forms for all tests performed for each construction material for the tests specified in these Specifications.
3. Summary tables shall be suitable for report presentation and regulatory agency review. One digital reproducible copy of the summary tables shall be provided to the ENGINEER.

- - - END OF SECTION - - -

SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 DESCRIPTION

This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained by the CONTRACTOR.

1.02 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. American Concrete Institute (ACI):

1. 506.4R-94 (R2004) - Guide for the Evaluation of Shotcrete

C. American Society for Testing and Materials (ASTM):

1. A370-12 - Standard Test Methods and Definitions for Mechanical Testing of Steel Products
2. A416/A416M-10 - Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
3. C31/C31M-10 - Standard Practice for Making and Curing Concrete Test Specimens in the Field
4. C33/C33M-11a - Standard Specification for Concrete Aggregates
5. C39/C39M-12 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
6. C109/C109M-11b - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
7. C136-06 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
8. C138/C138M-10b - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
9. C140-12 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
10. C143/C143M-10a - Standard Test Method for Slump of Hydraulic Cement Concrete
11. C172/C172M-10 - Standard Practice for Sampling Freshly Mixed Concrete
12. C173/C173M-10b - Standard Test Method for Air Content of freshly Mixed Concrete by the Volumetric Method
13. C330/C330M-09 - Standard Specification for Lightweight Aggregates for Structural Concrete
14. C567/C567M-11 - Standard Test Method for Density Structural Lightweight Concrete
15. C780-11 - Standard Test Method for Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
16. C1019-11 - Standard Test Method for Sampling and Testing Grout

17. C1064/C1064M-11 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete
18. C1077-11c - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
19. C1314-11a - Standard Test Method for Compressive Strength of Masonry Prisms
20. D422-63(2007) - Standard Test Method for Particle-Size Analysis of Soils
21. D698-07e1 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
22. D1140-00(2006) - Standard Test Methods for Amount of Material in Soils Finer than No. 200 Sieve
23. D1188-07e1 - Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
24. D1556-07 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
25. D1557-09 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft lbf/ft3 (2,700 KN/m3))
26. D2166-06 - Standard Test Method for Unconfined Compressive Strength of Cohesive Soil
27. D2167-08) - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
28. D2216-10 - Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
29. D2974-07a - Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
30. D3666-11 - Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
31. D3740-11 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as used in Engineering Design and Construction
32. D6938-10 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
33. E329-11c - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
34. F3125/F3125M-15 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions

D. American Welding Society (AWS):

35. D1.D1.1M-10 - Structural Welding Code-Steel

1.03 **REQUIREMENTS**

E. Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (i.e.; E329, C1077, D3666, D3740, A880, E543)

listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."

F. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by ENGINEER. When it appears materials furnished, or work performed by CONTRACTOR fail to meet construction contract requirements, Testing Laboratory shall direct attention of ENGINEER to such failure.

G. Written Reports: Testing laboratory shall submit test reports to ENGINEER, CONTRACTOR, unless other arrangements are agreed to in writing by the ENGINEER. Submit reports of tests that fail to meet construction contract requirements on colored paper.

H. Verbal Reports: Give verbal notification to ENGINEER immediately of any irregularity.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 EARTHWORK

A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:

1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the ENGINEER regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to ENGINEER extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.

2. Provide full time observation of fill placement and compaction and field density testing of soil placement to verify that earthwork compaction obtained is in accordance with contract documents.

3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.

B. Testing Compaction:

1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with ASTM D698.

2. Make at least one moisture content test in accordance with ASTM D2216 per 10,000 cubic yards of structural fill placed.

3. Make field density tests in accordance with the primary testing method following ASTM D6938 wherever possible. Field density tests using ASTM D1556, or ASTM D2167 shall be used on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they should provide satisfactory explanation to the ENGINEER before the tests are conducted.

   a. One test every 10,000 cubic yards of placed material, but in no case fewer than two tests per lift.

C. Testing Materials: Test suitability of on-site and off-site borrow as directed by ENGINEER.

3.02 **CONCRETE:**

A. Batch Plant Inspection and Materials Testing:

1. Provide batch mix design to ENGINEER for approval.
2. When concrete is batched or mixed off immediate site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck-load mixes conform to proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.

B. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the CONTRACTOR if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the CONTRACTOR's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least four cylinders (a set) for each 50 cubic yards or less of each concrete type, and at least one set for any one day's pour for each concrete type. ENGINEER may require additional cylinders to be molded and cured under job conditions.
4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 25 cubic yards thereafter each day. For concrete not required to be air-entrained, test every 100 cubic yards at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
9. Verify that specified mixing has been accomplished.
10. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
11. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
12. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.

13. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
14. Observe preparations for placement of concrete:
    a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
    b. Inspect preparation of construction, expansion, and isolation joints.
15. Observe concrete mixing:
    a. Monitor and record amount of water added at project site.
    b. Observe minimum and maximum mixing times.
16. Other inspections:
    a. Grouting under base plates.
    b. Grouting anchor bolts and reinforcing steel in hardened concrete.

C. Laboratory Tests of Field Samples:

1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and two cylinders at 28 days. Use remaining cylinder as a spare tested as directed by ENGINEER. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
2. Furnish certified compression test reports (duplicate) to ENGINEER. In test report, indicate the following information:
    a. Cylinder identification number and date cast.
    b. Specific location at which test samples were taken.
    c. Type of concrete, slump, and percent air.
    d. Compressive strength of concrete in MPa (psi).
    e. Weight of lightweight structural concrete in kg/m^3 (pounds per cubic feet).
    f. Weather conditions during placing.
    g. Temperature of concrete in each test cylinder when test cylinder was molded.
    h. Maximum and minimum ambient temperature during placing.
    i. Ambient temperature when concrete sample in test cylinder was taken.
    j. Date delivered to laboratory and date tested.

3.03 REINFORCEMENT

A. Mill test reports shall be furnished by CONTRACTOR.

B. Perform sampling at fabricating plant, if requested by the ENGINEER. Take two samples from each 23 t (25 tons) or fraction thereof of each size of reinforcing steel No. 10 thru No. 57 (No. 3 thru No. 18).

C. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.

D. Written report shall include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.

E. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

3.04 **SHOTCRETE**

A. Inspection and Material Testing

1. Provide field inspection and testing service as required by ENGINEER to certify that shotcrete has been applied in accordance with contract documents.
2. Periodically inspect and test proportioning equipment for accuracy and report deficiencies to ENGINEER.
3. Sample and test mix ingredients as necessary to ensure compliance with specifications.
4. Sample and test aggregates daily and as necessary for moisture content. Report instances of excessive moisture to ENGINEER.
5. Certify, in duplicate, that ingredients and proportions and amounts of ingredients in shotcrete conform to approved trial mixes.
6. Provide field inspection of the proper size and placement of the reinforcement in the shotcrete.

B. Shotcrete Sampling:

1. Provide a technician at site of placement to perform shotcrete sampling.
2. Take cores in accordance with ACI 506.
3. Ensure maintenance of water-cement ratio established by approved trial mix.
4. Verify specified mixing has been accomplished.

C. Laboratory Tests of Field Sample Panels:

1. Compression test core for strength in accordance with ACI 506. For each test series of five cores, test two cores at 7 days and two cores at 28 days. Use remaining core as a spare to be tested as required. Compile laboratory test reports as follows: Compressive strength test shall be result of one core, except when one core shows evidence of improper sampling or testing, in which case it shall be discarded and strength of spare core shall be used.
2. Submit certified compression test reports (duplicate) to ENGINEER. On test report, indicate following information:
   a. Core identification number and date cast.
   b. Specific location at which test samples were taken.
   c. Compressive strength of shotcrete in MPa (psi).
   d. Weather conditions during placing.
   e. Temperature of shotcrete in each test core when test core was taken.
   f. Maximum and minimum ambient temperature during placing.
   g. Ambient temperature when shotcrete sample was taken.
   h. Date delivered to laboratory and date tested.

D. Submit inspection reports certification and instances of noncompliance to ENGINEER.

3.05 **MASONRY**

A. Mortar Tests:

1. Laboratory compressive strength test:
   a. Comply with ASTM C780.
   b. Obtain samples during or immediately after discharge from batch mixer.
   c. Furnish molds with 50 mm (2 inch), 3 compartment gang cube.
   d. Test one sample at 7 days and 2 samples at 28 days.
2. Two tests during first week of operation; one test per week after initial test until masonry completion.

3.06 **ROCKBOLTS:**

NOT USED

3.07 **GEOSYNTHETIC MESH:**

NOT USED

- - - END OF SECTION - - -

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dewatering

B. Temporary utilities

C. Temporary sanitary facilities

D. Temporary controls: barriers, enclosures, and fencing

E. Security requirements

F. Vehicular access and parking

G. Waste removal facilities and services

H. Project identification sign

I. Field offices

1.02 REFERENCE STANDARDS

A. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials

B. ASTM E90 – Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016)

1.03 DEWATERING

A. Provide temporary means and methods for dewatering all temporary facilities and controls.

B. Maintain temporary facilities in operable condition.

C. Maintain temporary facilities as directed by OWNER.

1.04 TEMPORARY UTILITIES

A. Provide and pay for all electrical power, lighting, water, heating, cooling, and ventilation required for construction purposes.

B. Existing facilities may not be used.

C. Use trigger-operated nozzles for water hoses, to avoid waste of water.

1.05 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and closures. Provide at time of project mobilization.

B. Maintain daily in clean and sanitary condition.

1.06 BARRIERS

A. Provide barriers that prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public and to protect existing facilities and adjacent properties from damage from construction operations.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way.

C. Provide protection for plants designated to remain. Replace damaged plants.

D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.07 FENCING

A. Exterior construction: Commercial grade chain link fence.

B. Provide 6 foot high fence around exterior construction site; equip with vehicular gates with locks.

1.08 **EXTERIOR ENCLOSURES**

A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.09 **SECURITY**

A. Provide security and facilities to protect Work, existing facilities, and Government's operations from unauthorized entry, vandalism, or theft.

B. Coordinate with Government's security program.

1.10 **VEHICULAR ACCESS AND PARKING**

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.

B. Coordinate access and haul routes with governing authorities and Government.

C. Provide and maintain access to fire hydrants, free of obstructions.

D. Provide means of removing mud from vehicle wheels before entering streets.

E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

F. Existing parking areas located at site may be used for construction parking.

1.11 **WASTE REMOVAL**

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

B. Provide containers with lids. Remove trash from site periodically.

C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure or underground.

D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.12 **PROJECT IDENTIFICATION**

A. Erect on site at location established by OWNER.

B. Provide project identification sign of design, construction, and location approved by OWNER.

C. No other signs are allowed without OWNER permission except those required by law.

1.13 **FIELD OFFICES**

A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack and drawing display table.

B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.

1.14 **REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS**

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.

B. Remove underground installations to a minimum depth of 2 feet.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing facilities used during construction to original condition.

E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED

--- END SECTION ---

SECTION 01 56 19
TEMPORARY NOISE AND CONTAMINANT BARRIERS

PART 1 GENERAL

1.01 SUMMARY

A. This section includes furnishing all labor, materials, and equipment required to fabricate and install temporary noise and contaminant barrier systems as necessary for the execution and completion of the Work. This system should also retain any dust, fumes, or other foreign contaminants from entering the natural Cavern ecosystem.

B. The CONTRACTOR shall propose a temporary noise and contaminant barrier wall system. A representative example was included in the construction drawings. The material type can be modified from that indicated on the drawings. The system shall include all appurtenances as well as the removal of all system components. The system shall also include access (a doorway).

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittals

1.03 PERFORMANCE REQUIREMENTS

A. The sound level on the natural Cavern side of the barrier shall be a maximum of 65 dB. The CONTRACTOR shall demonstrate the noise reduction and make modifications to the barrier system until the noise reduction is acceptable to the OWNER.

1.04 SUBMITTALS

A. CONTRACTOR is to provide a submittal to the OWNER/ENGINEER for what they propose to construct for a barrier system.

PART 2 PRODUCTS

Not Specified.

PART 3 EXECUTION

A. Construct as necessary to achieve the performance requirements stated in Section 1.03.

END SECTION

SECTION 01 57 13
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 DESCRIPTION

A. The CONTRACTOR shall provide all materials and promptly take all actions necessary to achieve effective erosion and sedimentation control in accordance with all Laws and Codes, the Contract, and these Specifications. CONTRACTOR shall provide a "Competent Person" to implement and supervise all work.

B. The measures and requirements shown on the Contract Drawings and working drawings shall be considered a minimum requirement and shall not relieve the CONTRACTOR of the responsibility to actively take all steps necessary to control soil erosion and sedimentation.

C. Comply with all Laws and Codes.

D. CONTRACTOR shall prepare Stormwater Pollution Prevention Plan (SWPPP), if required by applicable Laws and Codes, and comply with all provisions of the SWPPP.

E. CONTRACTOR shall repair any material or existing surface conditions damaged by erosion or covered with sedimentation at the CONTRACTOR's expense.

F. Erosion Control Measures shall be provided for all Work activities in the clearing/grubbing construction area as well as other related work throughout the Project Site. CONTRACTOR shall maintain at least 20% overstock of erosion control items stockpiled on-site or have ready access to needed items via a supplier for ease of use to replace installed items as deemed necessary.

G. The temporary erosion control features installed by the CONTRACTOR shall be maintained by the CONTRACTOR until no longer needed as determined by the OWNER, or permanent erosion control methods are installed.

H. It shall be the sole responsibility of the CONTRACTOR to properly schedule and coordinate all necessary labor, equipment, and materials such that the specified Work is performed in accordance with the Project Schedule and the Contract requirements. At the discretion of the OWNER, the OWNER may reject or direct the CONTRACTOR to repair (at the CONTRACTOR's sole expense) those items which are detrimental to the Project or not in compliance with the Contract Documents. Such direction or rejection by the OWNER shall not relieve the CONTRACTOR of his obligation to properly schedule and perform other specified Work items in conformance with the Contract Documents.

1.02 RELATED SECTIONS

A. Earthwork – Section 31 00 00

1.03 SUBMITTALS

A. At the preconstruction conference, the CONTRACTOR shall submit for OWNER's approval, a schedule and construction drawing for accomplishment of temporary and permanent erosion control work, as applicable for clearing and grubbing, grading, and general construction. No Work shall be started until the erosion control schedules and methods of operations for each phase of the Work have been accepted by the OWNER. This plan will be referred to as the CONTRACTOR's Soil Erosion and Sediment Control Plan.

PART 2 PRODUCTS

2.01 SILT FENCE

A. Silt fence shall be Filter X, Mirafi 100X, Stabilinka T140N, or approved equal.

2.02 **TRIPLE-STACKED FILTER SOCK**

A. The triple-stacked filter sock shall consist of three Filtrexx SiltSoxx tubular sediment control devices, or approved equal.

2.03 **TEMPORARY EROSION CONTROL MAT**

A. Temporary Erosion Control Mat shall be either a natural or synthetic material that is photo- and bio-degradable matting suitable for seed establishment and capable of offering erosion protection for at least one growing season. CONTRACTOR shall supply information on proposed material to the OWNER'S ENGINEER for approval.

PART 3 EXECUTION

3.01 **GENERAL**

A. The Project-Specific erosion and sediment construction sequence outlined on the Project's construction drawings will contain specific items tailored for that construction activity, including required pre-construction meetings and inspections.

B. Conduct earthwork and excavation activities in such a manner to fit the topography, soil type, and condition.

C. Minimize the area being disturbed and the duration of exposure to erosion elements.

D. Stabilize disturbed areas immediately.

E. Prevent silt and sediment from entering any watercourse.

F. Where provisions of pertinent rules and regulations conflict with these Specifications, the more stringent provisions shall govern.

G. The OWNER has the authority to limit the surface area of erodible material exposed by clearing and grubbing, and to direct the CONTRACTOR to provide immediate temporary or permanent control measures to prevent sediment impact on adjacent watercourses.

H. Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion control features can follow immediately thereafter if the Project conditions permit; otherwise, erosion control measures may be required between successive construction stages.

I. The OWNER will limit the area of excavation with the CONTRACTOR's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current in accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion control measure shall be taken immediately to the extent feasible and justified.

J. In the event that additional temporary erosion and sedimentation control measures are required due to the CONTRACTOR's negligence, carelessness, or failure to install permanent controls as a part of the work schedule, and are ordered by the OWNER, such work shall be performed by the CONTRACTOR at the CONTRACTOR's expense, and no time extension shall be given.

3.02 **TEMPORARY EROSION AND SEDIMENTATION CONTROL**

A. Temporary erosion control measures shall be used to correct conditions that develop during performance of the Work that lead to soil erosion or deposition of waterborne sediments; that are needed prior to installation of permanent erosion control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the Project.

B. Temporary erosion and sedimentation control devices shall be installed and maintained prior to the initial land disturbance activity until the satisfactory completion and establishment of permanent erosion control measures. At that time, temporary devices shall be removed.

C. The CONTRACTOR shall coordinate the installation of temporary erosion and sedimentation control provisions contained herein with the permanent erosion control features, to ensure economical, effective, and continuous erosion control throughout the construction and post-construction period.

D. Silt fences, barriers, temporary sedimentation basins and other temporary measures and devices shall be installed, and shall be maintained until no longer needed, as determined by the OWNER. At that time, the items shall be removed by the CONTRACTOR. All temporary items and devices must be removed with the OWNER's approval prior to final demobilization from the Site.

E. All erosion and sedimentation control devices shall be inspected by the CONTRACTOR at least weekly and after each rainfall occurrence, and cleaned out and repaired by the CONTRACTOR as necessary. Normal debris clean-out will be considered routine maintenance.

3.03 TEMPORARY EROSION AND SEDIMENT CONTROL TECHNIQUES

A. Temporary Diversion Berms

1. A temporary diversion berm is constructed of compacted soil, with or without a shallow ditch upslope to direct storm water runoff, at the top of fill slopes.
2. These diversion berms are used temporarily at the top of newly constructed slopes to prevent excessive erosion until permanent controls are installed or slopes stabilized.
3. A temporary diversion berm shall be constructed of compacted soil, with a minimum width of 24-inches at the top and a minimum height of 12-inches with or without a shallow ditch. Side slopes shall be three horizontal to one vertical (3H:1V) or flatter.

B. Sediment Control Structures

1. Sediment basins, ponds and traps, are prepared storage areas constructed to trap and store sediment from erodible areas in order to protect stream channels below the construction areas from excessive siltation.
2. Sediment structures shall be used to control sediment where slope drains outlet. All sediment structures shall be at least twice as long as they are wide.
3. When use of temporary sediment structures is to be discontinued, all sediment accumulation shall be removed and all excavation backfilled and properly compacted. The existing ground shall be restored to its natural or intended condition.

C. Stacked Filter Sock

1. Triple-stacked filter socks are temporary measures to control erosion and retain the suspended silt particles in the runoff water leaving disturbed areas.
2. Socks shall be 12 inch in diameter. (Height will be less after installation.)
3. Perimeter control shall be placed parallel to the slope at locations indicated in the SWPPP.
4. The CONTRACTOR shall use wooden stakes to install the socks per the manufacturer’s recommendations.

5. The CONTRACTOR shall keep the bales in good condition by replacing broken or damaged bales immediately after damage occurs. Normal debris clean-out will be considered routine maintenance.

D. Silt Fences

1. Silt fences are temporary measures utilizing woven wire or other approved materials attached to posts with filter cloth attached to the upstream side of the fence to retain the suspended silt particles in the runoff water.
2. Temporary silt fences shall be placed on the natural ground, at the toe of fill slopes, in ditches or other areas where siltation is a problem. Temporary silt fences shall be anchored as indicated in the SWPPP.
3. The CONTRACTOR shall be required to maintain the silt fence in a satisfactory condition for the duration of the Work or until its removal is requested by the OWNER. The silt accumulation at the fence must be removed and placed on the Project Site as directed by the OWNER.

- - END OF SECTION - -

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 DESCRIPTION

This section specifies the following:

A. Products

B. Transportation and handling

C. Storage and protection

D. Product options

E. Substitution

F. Equipment electrical characteristics and components

1.02 RELATED WORK

A. Section 01 33 00 – Submittals

B. Section 01 40 00 – Quality Control/Assurance

1.03 PRODUCTS

A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

B. Furnish interchangeable components from same manufacturer for components being replaced.

1.04 TRANSPORTATION AND HANDLING

A. Transport and handle products in accordance with manufacturer's instructions.

B. CONTRACTOR is responsible for the off-loading of all shipments unless item is specifically identified to be off loaded by a subcontractor or supplier.

C. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged. CONTRACTOR is responsible for initiating claims.

D. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.05 STORAGE AND PROTECTION

A. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.

B. For exterior storage of fabricated products, place on sloped supports, above ground.

C. Cover products subject to deterioration from ultraviolet light or weather with impervious sheet covering.

D. Provide ventilation to avoid condensation.

E. Store loose granular materials on solid flat surfaces in a well-drained area.

F. Prohibit mixing with foreign matter.

G. Arrange storage of products to permit access for inspection.

H. CONTRACTOR shall inspect products to assure products are undamaged and maintained under specified conditions.

I. At the end of construction, catalog all remaining unused permanent materials and provide catalog list to OWNER, including description, quantity, and location. Store unused permanent materials in the location directed by the OWNER. Except for soil, rock, and geosynthetic products, all permanent materials shall be stored on pallets or other methods approved by OWNER to prevent ground contact. Containers holding permanent materials shall be protected against deterioration from rain and water.

1.06 **PRODUCT OPTIONS**

A. Products specified by reference standards or by description only: Any product meeting those standards or description.

B. Products specified by naming one of more Manufacturers: Products of manufacturers named and meeting Specifications, no options or substitutions allowed.

C. Products specified by naming one or more Manufacturers with a provision for substitutions: Submit a request for substitution for any manufacturer not named.

D. Products provided by OWNER.

1.07 **SUBSTITUTIONS**

A. ENGINEER will consider requests for Substitutions only within 10 days after date established in Notice to Proceed.

B. Substitutions may be considered when a product becomes unavailable through no fault of the CONTRACTOR.

C. A request constitutes a representation that CONTRACTOR:

1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
2. Will provide same warranty for Substitution as for specified product.
3. Will provide same warranty for Substitution as for specified product.
4. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to OWNER.
5. Waives claims for additional costs or time extension which may subsequently become apparent.
6. Will reimburse OWNER for review or redesign services associated with re-approval by authorities having jurisdiction.

PART 2 PRODUCTS

NOT USED

PART 3 PART 3 – EXECUTION

NOT USED

- - - END OF SECTION - - -

SECTION 017000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition.

C. Pre-installation meetings.

D. Cutting and patching.

E. Surveying for laying out the work.

F. Cleaning and protection.

G. Starting of systems and equipment.

H. Demonstration and instruction of Government personnel.

I. Closeout procedures, including the CONTRACTORS Correction Punch List, except payment procedures.

J. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 011000 – Summary

B. Section 013000 – Administrative Requirements

C. Section 014000 – Quality Control/Assurance

D. Section 015000 – Temporary Facilities and Controls

E. Section 015713 – Temporary Erosion and Sediment Control

F. Section 017800 – Closeout Submittals

G. Section 017900 – Demonstration and Training

1.03 REFERENCE STANDARDS

A. NFPA 241 – Standard for Safeguarding Construction, Alteration, and Demolition Operations 2013.

1.04 SUBMITTALS

A. See Section 013000 – Administrative Requirements, for submittal procedures.

B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.

1. On request, submit documentation verifying accuracy of survey work.
2. Submit a copy of site drawing signed by the LAND SURVEYOR, that the elevations and locations of the work are in compliance with Contract Documents.
3. Submit surveys and survey logs for the project record.

C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities

1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences. Include design drawings and calculations for bracing and shoring.

2. Identify demolition firm and submit qualifications.
3. Include a summary of safety procedures.

D. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:

1. Structural integrity of any element of Project.
2. Integrity of weather exposed or moisture resistant element.
3. Efficiency, maintenance, or safety of any operational element.
4. Visual qualities of sight exposed elements.

E. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.05 QUALIFICATIONS

A. For demolition work, employ a firm specializing in the type of work required.

B. For surveying work, employ a land surveyor registered in the state of Arkansas and acceptable to the Contracting Officer's Representative. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities.

C. For field engineering, employ a professional engineer of the discipline required for specific service on the Project, licensed in the state of Arkansas. Employ only individuals trained and experienced in establishing and maintaining horizontal and vertical control points necessary for laying out construction work on projects of similar size, scope and/or complexity.

D. For design of temporary shoring and bracing, employ a professional engineer experienced in design of this type of work and licensed in the state of Arkansas.

1.06 PROJECT CONDITIONS

A. Use of explosives is not permitted.

B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion in accordance with Section 015713.

D. Perform dewatering activities, as required, for the duration of the project.

E. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

F. Dust Control: Execute work by methods to minimize raising dust from construction operations provide positive means to prevent airborne dust from dispersing into atmosphere and over adjacent property.

G. Erosion and Sediment Control – see Section 015713

H. Noise Control – see Section 015619

I. Pest and Rodent Control: Provide methods, means, and facilities to prevent rodent, pests and insects from damaging the work.

J. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.07 COORDINATION

A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Coordinate space requirements…

PART 2 PRODUCTS

2.01 MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 – Product Requirements.

PART 3 EXECUTION

4.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specifications sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

4.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

4.03 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify Contracting Officer’s Representative four days in advance of meeting date.

D. Prepare agenda and preside at meeting:

1. Review conditions of examination, preparation and installation procedures.
2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting participants, with two copies to Contracting Officer's Representative, Government, participants, and those affected by decisions made.

4.04 **LAYING OUT THE WORK**

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Contracting Officer's Representative of any discrepancies discovered.

C. The CONTRACTOR shall locate and protect survey control and reference points.

D. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

E. Promptly report to Contracting Officer's Representative the loss or destruction of any reference point or relocation required because of changes in grade or other reasons.

F. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Contracting Officer's Representative.

G. Utility recognized engineering survey practices.

H. Establish a minimum of two permanent benchmarks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.

I. Establish elevations, line and levels. Locate and lay out by instrumentation and similar appropriate means:

1. Site improvements including pavements; stake for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
2. Grid or axis for structures.
3. Building foundation, column locations, ground floor elevations.
4. Controlling lines and levels required for mechanical and electrical trades.

J. Periodically verify layouts by same means.

K. Maintain a complete and accurate log of control and survey work as it progresses.

L. On completion of foundation walls and major site improvements, prepare a certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.

4.05 **OPERATION AND MAINTENANCE DATA**

A. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.

B. Install products as specified in individual sections; in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

F. Make neat transitions between different surfaces, with seamless transitions, unless otherwise indicated.

4.06 **ALTERATIONS**

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.

   1. Verify that construction and utility arrangements are as indicated.

   2. Report discrepancies to Contracting Officer's Representative before disturbing existing installation.

   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.

   1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.

   2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.

C. Remove existing work as indicated and as required to accomplish new work.

   1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.

   2. Remove items indicated on drawings.

   3. Relocate items indicated on drawings.

   4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.

   5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

D. Services (including but not limited to HVAC, Plumbing, Fire Protection, Electrical and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.

   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.

   2. Where existing systems or equipment are not active and Contact Documents require reactivation, put back into operational conditions; repair supply, distribution, and equipment as required.

   3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintaining existing systems in service until new systems are complete and ready for service.

      a. Disable existing systems only to make switchovers and connections; minimize duration of outages.

      b. Provide temporary connections as required to maintain existing systems in service.

   4. Verify that abandoned services serve only abandoned facilities.

   5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

E. Protect existing work to remain.

1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.

F. Adapt existing work to fit new work: Make as neat and smooth a transition as possible.

1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make a recommendation to the Contracting Officer's Representative.
2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceiling to a smooth plane with breaks, steps, or bulkheads.
3. Where a change of plan of 1/4-inch or more occurs in existing work, submit a recommendation for providing a smooth transition for Contracting Officer's Representative review and request instructions.

G. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existing prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

H. Refinish existing surfaces as indicated:

1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
2. If mechanical or electrical work is exposed accidently during the work, re-cover and refinish to match.

I. Cleaning existing systems and equipment.

J. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

K. Do not begin new construction in alterations areas before demolition is complete.

L. Comply with all other applicable requirement of this sections.

4.07 **CUTTING AND PATCHING**

A. Whenever possible, execute the work by methods that void cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:

1. Complete the work.
2. Fit products together to integrate with other work.
3. Provide openings for penetration of mechanical, electrical, and other services.
4. Match work that has been cut to adjacent work.
5. Repair areas adjacent to cuts to required condition.
6. Repair new work damaged by subsequent work.
7. Remove samples of installed work for testing when requested.
8. Remove and replace defective and non-complying work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material.

J. Patching

1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

2. Match color, texture, and appearance.

3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate repair substrate prior to repairing finish.

4.08 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

4.09 PROTECTION OF INSTALLED WORK

A. Protect installed work form damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

4.10 DEMONSTRATION AND INSTRUCTION

A. See Section 017900 – Demonstration and Training

B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with Government’s personnel in detail to explain all aspects of operation and maintenance.

C. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

D. The amount of time required for instruction on each item of equipment and system is that specified in individual sections.

4.11 **ADJUSTING**

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

4.12 **FINAL CLEANING**

A. Execute final cleaning prior to final project assessment.

1. Clean areas to be occupied by Government prior to final completion before Government occupancy.

B. Use cleaning materials that are nonhazardous.

C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

F. Clean filters of operating equipment.

G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains and drainage systems.

H. Clean stie; sweep paved areas, rake clean landscaped surfaces.

I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

4.13 **CLOSEOUT PROCEDURES**

A. Make submittals that are required by governing or other authorities.

1. Provide copies to Contracting Officer’s Representative

B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the CONTRACTOR’s Correction Punch List for the CONTRACTOR’s Notice of Substantial Completion.

C. Notify Contracting Officer’s Representative when work is considered ready for Contracting Officer’s Representative Substantial Completion inspection.

D. Submit written certification containing the CONTRACTOR’s Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Contracting Officer’s Representative’s Substantial Completion inspection.

E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Contracting Officer’s Representative’s and the CONTRACTOR’s comprehensive list of items identified to be completed or corrected and submit to Contracting Officer’s Representative.

F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Government-occupied areas.

G. Notify Contracting Officer’s Representative when work is considered finally complete and ready for Contracting Officer’s Representative’s Substantial Completion final inspection.

H. Complete items of work determined by Contracting Officer’s Representative listed in executed Certificate of Substantial Completion.

4.14 **MAINTENANCE**

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year form the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

D. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Government.

-END OF SECTION-

SECTION 01 71 13
MOBILIZATION AND DEMOBILIZATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Closeout procedures.

B. Final cleaning.

C. Demonstration.

D. Protecting installed construction.

E. Project record documents.

F. Operation and maintenance data.

G. Product warranties and product bonds.

H. Maintenance service.

1.02 RELATED SECTIONS

A. Section 01 10 00 – Summary of Work

B. Section 01 50 00 – Temporary Facilities and Controls

C. Section 01 60 00 – Product Requirements

1.03 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for OWNER/ENGINEER's review.

B. Provide submittals to OWNER/ENGINEER required by authorities having jurisdiction.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.04 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.

B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces.

C. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.

D. Clean debris from drainage systems.

E. Clean site; sweep paved areas, rake clean exterior surfaces.

F. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.05 DEMONSTRATION AND INSTRUCTION

A. Demonstrate operation and maintenance of products to OWNER's personnel.

B. Use operation and maintenance manuals as basis for demonstration. Review contents of manual with OWNER's personnel in detail to explain all aspects of operation and maintenance.

C. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.06 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

1.07 **PROJECT RECORD DOCUMENTS**

A. Maintain on site one set of the following record documents; record actual revisions to the Work:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed Shop Drawings, Product Data, and Samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by OWNER.

C. Store record documents separate from documents used for construction.

D. Record as-built information concurrent with construction progress, not less than weekly. As-built document is subject to revision by OWNER and/or ENGINEER.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:

1. Measured location and quantity of installed rockbolts and geosynthetic mesh.
2. Measured location and quantity of installed shotcrete, concrete, and/or masonry work.
3. Surveyed limits and grade of earthwork.
4. Location and quantity of temporary and permanent seeding.
5. Field changes of dimension and detail.
6. Details not on original Contract drawings.

G. Submit documents to OWNER/ENGINEER with claim for final Application for Payment.

1.08 **OPERATION AND MAINTENENANCE DATA**

A. Submit a draft electronic version of the data in pdf file format as detailed below. OWNER/ENGINEER will review the electronic draft and return with comments.

B. Three sets of the final version of the approved data shall be bound in 8-1/2 x 11 inch text pages, three D side locking ring binders with durable plastic covers and as an electronic file, pdf file format.

C. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.

D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

F. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:

1. Part 1: Directory, listing names, addresses, and telephone numbers of OWNER/ENGINEER, CONTRACTOR, and Subcontractors.

2. Part 3: Project documents and certificates, including the following:

a. Shop drawings and product data.

a. Certificates.

b. Photocopies of warranties and bonds. Note originals shall be submitted separately to the OWNER/ENGINEER.

3. Part 4: Building Products, Applied Materials, and Finishes:

a. Include product data, with catalog number, size, composition, and color and texture designations. Include information for re-ordering custom manufactured products.

b. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

c. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.

d. Additional Requirements: As specified in individual product specification sections.

1.09 PRODUCT WARRANTIES AND PRODUCT BONDS

A. All materials and workmanship furnished by the CONTRACTOR under this specification shall be guaranteed by the CONTRACTOR against failure due to defective materials or improper installation for a period of one year from the date of final acceptance, or as noted otherwise in these Specifications. Upon receipt of written notice of failure of guaranteed workmanship or materials during the guarantee period, the CONTRACTOR shall promptly furnish and install new materials and/or furnish the labor necessary to correct the failure at the expense of the CONTRACTOR.

B. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.

C. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.

D. Verify documents are in proper form, contain full information, and are notarized.

E. Co-execute submittals when required.

F. Include Table of Contents and assemble in three D side ring binder with durable plastic cover.

G. Submit prior to final Application for Payment.

H. Time of Submittals:

1. For equipment or component parts of equipment put into service during construction with OWNER's permission, submit documents within ten days after acceptance.

2. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.

3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.10 **MAINTENANCE SERVICE**

A. Furnish service and maintenance of components indicated in specification sections during warranty period.

B. DO NOT ASSIGN OR TRANSFER MAINTENANCE SERVICE TO AGENT OR SUBCONTRACTOR WITHOUT PRIOR WRITTEN CONSENT OF OWNER.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 **GENERAL**

A. Upon receipt of notice to proceed, the CONTRACTOR shall furnish, mobilize and install such temporary works, materials, and equipment as described in Section 01 50 00 – Temporary Facilities and Controls.

B. The CONTRACTOR shall obtain any permits necessary to complete the Work at CONTRACTOR's expense.

C. The demobilization work consists of repairing all slopes disturbed during construction, the removal of all construction debris, and returning the site to a suitable condition for permanent stabilization and reclamation of disturbed surfaces as required by the OWNER.

3.02 **SUMMARY**

A. Permanent cut slopes outside of the Work area that have been affected by the Work shall not have a slope steeper than 2.5H:1V unless otherwise shown in the Drawings or otherwise approved by the OWNER and ENGINEER.

B. The CONTRACTOR shall remove all trash, debris, hazardous and dangerous chemicals or waste, and waste material from the site that was brought on site by the CONTRACTOR and properly dispose of all said materials. The OWNER will have the right to determine what is waste or rubbish and the manner and place of disposal. All materials furnished for the execution of the Work and thereby purchased by the OWNER shall remain the property of the OWNER.

C. The CONTRACTOR shall clean out all installations and tear down and remove all temporary structures built by the CONTRACTOR. Any existing structures or installations that were in place prior to construction shall be left in a condition at least as good as the condition prior to construction. All trash and remnants of the CONTRACTOR's work shall be removed by the CONTRACTOR prior to final inspection and acceptance by the OWNER.

D. The final condition of the site is subject to approval by the OWNER.

--- END SECTION ---

SECTION 017800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project Record Documents

B. Operation and Maintenance Data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 013000 – Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 017000 – Execution and Closeout Requirements: Contract closeout procedures

C. Individual Product Sections: Specific requirements for operation and maintenance data.

D. Individual Product Sections: warranties required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Contracting Officer's Representative with claim for final Application of Payment.

B. Operation and Maintenance Data:

1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Contracting Officer's Representative will review draft and return one copy with comments.
2. For equipment, or component parts of equipment put into service during construction and operated by OWNER, submit completed documents within ted days after acceptance.
3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Contracting Officer's Representative comments. Revise content of all document sets as required prior to final submission.
4. Submit two sets of revised final documents in final form within 10 days dafter final inspection.

C. Warranties and Bonds:

1. For equipment or component parts of equipment put into service during construction with OWNER's permission, submit documents within 10 after acceptance.
2. Make other submittals with 10 days after Date of Substantial Completion, prior to final Application for Payment.
3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed shop drawings, product data, and samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by OWNER.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

1. Changes made by Addenda and modifications.

F. Shop Drawings: Legibly mark each item to record actual construction including:

1. Measured depths of foundations in relation to finish first floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measure locations of internal utilities and appurtenances concealed in construction, reference to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Contract Drawings.

G. As-built Survey Documentation: the CONTRACTOR shall submit as-built survey documentation.

1. Accurately survey the locations and elevations and, where appliable, the type, and quantity of any and all rockbolts (areas of rockbolts noted, survey of individual rockbolts not required), geosynthetic mesh, shotcrete, general surface grading, fill material, stormwater diversion berms, and any other aspect of the work required by the ENGINEER.
2. As-built survey documentation shall be sealed by a registered Professional Land Surveyor licensed in the State of Arkansas.

3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and supplies, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instruction for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINSHES

A. For Each Product, Applied Material, and Finish:

1. Product data, with catalog number, size, composition, and color and texture designations.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional information as specified in individual product specification sections.

E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for OWNER's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than on specification sections, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Contracting Officer's Representative, ENGINEER, CONTRACTOR and Subcontractor, with names of responsible parties.

F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

J. Arrangement of Contents: Organize each volume in parts as follows:

1. Project Directory.
2. Table of Contents, of all volumes, and this volume.
3. Operation of Maintenance Data: Arranged by system, then by product category.
   a. Source data.
   b. Product data, shop drawings, and other submittals.
   c. Operation and maintenance data.
   d. Field quality control data.
   e. Photocopies of warranties and bonds.

4. Design Data: To allow for addition of design data furnished by Contracting Officer's Representative or others, provide a tab labeled "Design Data" and provide a binder large enough to allow for insertion of at least 20 pages of typed text.

3.05 **WARRANTIES AND BONDS**

A. Obtain warranties and bonds, executed in duplicate by reasonable Subcontractors, supplies, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with OWNER's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in the proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.

F. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.

G. Cover: Identify each binder with typed or printed title "WARRANTEIS AND BONDS, with title of Project; name, address and telephone number of the CONTRACTOR and equipment supplier; and name of responsible company principal.

H. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.

I. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

-END OF SECTION-

SECTION 017900
DEMOSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.

B. Training of OWNER's personnel in operation and maintenance is required for:

1. Instrumentation and monitoring devices.
2. Items specified in individual product Sections.

C. Training of OWNER's personnel in care, cleaning, maintenance and repair is required for:

1. Doors, including balanced door entries and FRP doors and frames.
2. Finishes, including masonry and shotcrete finishes, suspended tile ceilings.
3. Cable trays for electrical systems
4. Ground support, including rockbolts and geosynthetic mesh.
5. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

A. Section 017800 – Closeout Submittals

B. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

A. See Section 013000 – Administrative Requirements, for submittal procedures; except:

1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
2. Submit one copy to the Commissioning Authority, not to be returned.
3. Make commissioning submittals on time schedule specified by Commissioning Authority.
4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of an overall Training Plan; submit in editable electronic format, Microsoft Word preferred.

B. Draft Training Plans: OWNER will designate personnel to be trained; tailor training to needs and skill-level of attendees.

1. Submit to Contracting Officer's Representative for transmittal to OWNER.
2. Submit to Commissioning Authority for review and inclusion in overall training plan.
3. Submit not less than four weeks prior to start of training.
4. Revise and resubmit until acceptable.
5. Provide an overall schedule showing all training sessions.
6. Include at least the following for each training session:
    a. Identification, date, time, and duration.
    b. Description of products and/or systems to be covered.
    c. Name of firm and person conducting training; include qualifications.

d. Intended audience, such as job description.

e. Objectives of training and suggested methods of ensuring adequate training.

f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.

g. Media to be used, such as slides, hand-outs, etc.

h. Training equipment required, such as projector, projection screen, etc., to be provided by the CONTRACTOR.

C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.

1. Include applicable portion of O&M manuals.

2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in the O&M manuals.

3. Provide one extra copy of each training manual to be included with operation and maintenance data.

D. Training Reports:

1. Identification of each training session, date, time, and duration.

2. Sign-in sheet showing names and job titles of attendees.

3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.

4. Include Commissioning Authority's formal acceptance of training session.

E. Video Recordings: Submit digital video recording of each demonstration and training session for OWNER's subsequent use.

1. Format: DVD Disc.

2. Label each disc and container with session identification and date.

1.04 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.

1. Provide, as instructors, the most qualified trainers of those contractors and/or installers who supplied and installed the systems and equipment.

2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by OWNER

B. Demonstrations conducted during Functional Testing need not be repeated unless Government personnel training is specified.

C. Demonstration may be combined with OWNER's personnel training if applicable

D. Non-operating Products: Demonstrate cleaning, scheduled and preventative maintenance, and repair procedures.

1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 **TRAINING - GENERAL**

A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.

B. Conduct training on-site unless otherwise indicated.

C. OWNER will provide classroom and seating at no cost to the CONTRACTOR

D. Do not start training until Function Testing is complete, unless otherwise specified or approved by the Commissioning Authority.

E. Provide training in minimum two hour segments.

F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide additional forms.

G. Training schedule will be subject to availability of OWNER's personnel to be trained; re-schedule training sessions as required by OWNER; once schedule has been approved by OWNER, failure to conduct sessions according to schedule will be cause for OWNER to charge the CONTRACTOR for personnel "show-up" time.

H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:

1. The location of the O&M manuals and procedures for use and preservation; backup copies.

2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specified information.

3. Typical uses of the O&M manuals.

I. Product- and System-Specific Training:

1. Review the applicable O&M manuals.

2. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.

3. Discuss common troubleshooting problems and solutions.

4. Discuss any peculiarities of equipment installation or operation.

5. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.

6. Review recommended tools and spare parts inventory suggestions of manufacturers.

7. Review spare parts and tools required to be furnished by the CONTRACTOR.

8. Review spare parts suppliers and sources of procurement procedures.

J. Be prepared to answer questions raised by training attendees, if unable to answer during training session, provide written response within three days.

-END OF SECTION-

SECTION 03 10 00
CONCRETE FORMWORK

PART 1 PART 1 - GENERAL

1.01 DESCRIPTION

This section specifies the requirements for forming for cast-in-place concrete

1.02 RELATED WORK

A. Section 03 20 00 – Concrete Reinforcing

B. Section 03 30 00 – Cast-in-Place Concrete

PART 2 PRODUCTS

2.01 MATERIALS

A. Forms shall be 5-ply, 3/4-inch, waterproof, exterior type plywood, free of loose knots, splinters, or other defects. The face adjacent to concrete shall be Grade B or better. Forms may be fiberboard, Fed. Spec. LLL-B-810, Type II, tempered, waterproof, screenback concrete form hardboard.

B. Forms shall be of the removable end, permanently embedded body type. Cones shall be provided on the outer ends of each tie and the permanently embedded portion shall be at least one inch back from the concrete face. Form ties for secondary-containment walls shall be provided with waterseal washers located on the permanently embedded portions of the tie at the approximate center of the wall. The cone ends of the form ties shall have a diameter of 1 inch and shall be constructed so that they are easily removed or broken off without damage to the concrete. Form ties may be Burke BA Penta-Tie with a waterseal washer, or an equivalent approved by the Engineer.

C. Form release or coating shall be nontoxic after 30 days and non-staining, such as Nox-Crete “Form Coating” or Protex “Pro-Cote,” or Richmond “Rich-Cote.”

D. Where required, waterstop shall be 6-inch by 3/16-inch flat ribbed PVC (Greenstreak Style 782 or approved equal).

PART 3 EXECUTION

3.01 INSTALLATION

A. The Contractor shall be responsible for the location and placement of all sleeves, pipe fittings, anchors, ties, and inserts, and shall make certain that offsets, recesses, openings, and block-outs are in place in the forms before concrete is placed.

B. A form release agent shall be used, and applied at no more than the manufacturer's recommended application rates.

C. Horizontal joints shall be level and continuous. Vertical joints shall be plumb.

D. Forms shall be sufficiently tight and rigid to prevent leakage of mortar.

E. Install waterstop in accordance with manufacturer’s recommendations.

F. Forms shall be properly tied, braced, shored, and supported to insure stability against pressure from any source and without deflection or failure of any component or part.

G. Forms shall be removed without damage to the concrete, chamfers, inserts, and anchors.

H. Forms shall not be removed until concrete has sufficiently hardened. Unless otherwise approved by the Engineer, forms shall not be removed within five days of placement.

- - END OF SECTION - -

SECTION 03 20 00
CONCRETE REINFORCING

PART 1 GENERAL

1.01 DESCRIPTION

This section specifies the requirements for reinforcing materials for cast-in-place concrete.

1.02 RELATED WORK

A. Section 01 33 00 – Submittals

B. Section 03 10 00 – Concrete Formwork

C. Section 03 30 00 – Cast-in-Place Concrete

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A615 – Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement

B. Ameren Concrete Institute (ACI):

1. ACI 315 – Details and Detailing of Concrete Reinforcement
2. ACI 318 – Building Code Requirements for Structural Concrete

1.04 SUBMITTALS

A. Submit reinforcing steel designs and shop drawings to the ENGINEER under provisions of Section 01 33 00.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing Steel

1. Reinforcing steel shall meet ASTM A615 Grade 60 and shall be uncoated.
2. Reinforcing steel shall be detailed in accordance with ACI 315 and ACI 318.
3. Reinforcing bars shall be shop fabricated and tagged with suitable identification to facilitate sorting and placement.

B. Tie wire shall be No. 16 AWG or heavier.

PART 3 EXECUTION

3.01 INSTALLATION

A. The CONTRACTOR shall be responsible for the location and placement of all reinforcing bars.

B. All reinforcing steel shall be of the size and shape shown on the drawings.

C. The use of a torch or heat source for cutting or bending steel shall not be allowed.

D. Bars shall be cleaned of scale, dirt, grease, or other foreign matter which are detrimental to bond.

E. Reinforcing bars shall be accurately placed with respect to spacing and clearance, and securely tied at intersections, and supported in such a manner as to prevent displacement during placement of concrete.

F. Reinforcing bar splices shall be used only in the locations shown on the approved shop drawings.

G. Welded or mechanical splices shall not be permitted.

H. Unless shown otherwise, minimum length of lap splices for #4, #5, or #6 bars shall be 24 inches in accordance with ACI 318.

- - - END OF SECTION - - -

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 DESCRIPTION

This section specifies the requirements for materials, proportioning, and application of cast-in-place structural concrete.

1.02 RELATED WORK

A. Section 01 33 00 – Submittals

B. Section 01 45 29 – Testing Laboratory Services

C. Section 03 20 00 – Concrete Reinforcing

D. Section 03 10 00 – Concrete Formwork

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM C 94 – Standard Specification for Ready-Mixed Concrete
2. ASTM C 150 – Standard Specification for Portland Cement
3. ASTM C 33 – Standard Specification for Concrete Aggregates
4. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
5. ASTM C 42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

B. Ameren Concrete Institute (ACI):

1. ACI 117 – Specification for Tolerances for Concrete Construction and Materials
2. ACI 301 – Specifications for Structural Concrete
3. ACI 318 – Building Code Requirements for Structural Concrete

1.04 SUBMITTALS

A. Submit mix designs to the ENGINEER under provisions of Section 01 33 00 and this section.

B. Product data for concrete mix design for each tentative mix for Structural Concrete.

C. Slump on which design is based.

D. Total gallons of water per cubic yard.

E. Brand, type, composition, and quantity of cement and other cementitious materials.

F. Specific gravity and gradation of each aggregate.

G. Ratio of fine to total aggregate.

H. Weight (surface dry) of each aggregate per cubic yard.

I. Brand, type, ASTM designation, active chemical ingredients, and quantity of each admixture.

J. Air content.

K. Compressive strength based on 7-day and 28-day compression tests.

L. Time of initial set.

M. Product data for products used at joints in the concrete, including, but not limited to waterstops, joint fillers, backer rods, and sealants.

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland Cement: ASTM C150, Type II.

B. Coarse aggregate: ASTM C33, Gradation Table 2.1.

C. Fine aggregate: ASTM C33, washed natural sand.

D. Chemical Admixtures: ASTM C494.

E. Air-entraining Admixture: ASTM C260.

F. Water: Fresh, Clean, and Potable.

G. Reinforcing Steel: ASTM A615, grade as shown.

H. Welded Wire Fabric: ASTM A185.

2.02 MIXES

A. Mix Designs

1. Concrete mix design shall be an independent testing laboratory.

B. Cast-in-Place Concrete

1. Cast-in-place concrete shall have a minimum 28-day compressive strength of 6,000 psi.
2. Maximum aggregate size of ¾ inch.
3. Shall not contain materials deleteriously reactive with alkalis in the cement.
4. Minimum cementitious material content shall be 560 pounds per cubic yard.
5. Water-cementitious material ratio shall not exceed 0.45.
6. Water-soluble chloride ion content of concrete shall not exceed 0.10%.
7. Placement slump of 3 inches, with tolerances of plus 1 inch or minus 1 inch.
8. Design mix shall assure 4 to 6 % air entrainment.
9. Use the same approved concrete mix (including admixtures) throughout the work.

2.03 CURING COMPOUNDS

A. Concrete curing compound shall be a clear compound conforming to ASTM C309, Type 1-D, Class A and B, such as “RES-X” by Burke, or an equivalent approved by the ENGINEER.

PART 3 EXECUTION

3.01 CAST-IN-PLACE CONCRETE

A. Place concrete in accordance with ACI 301, or as modified by the Contract Documents where applicable.

3.02 **INSTALLATION**

A. Ready-mix concrete shall be batched, transported, and placed in accordance with ASTM C94. Each batch delivered to the site shall be accompanied by a certified weightmaster's delivery ticket.

B. All mixed concrete, whether mixed on-site or delivered shall be placed within 90 minutes from the time of introduction of cement and water into the mix.

C. No water shall be added after leaving the batch plant without the approval of the ENGINEER.

D. Concrete shall not be placed on soil subgrade that has not been properly prepared.

E. Placement of concrete, once started, shall be performed as a continuous operation until the scheduled pour is completed.

F. Saw-cut joints, where required, shall begin as soon as concrete has hardened sufficiently to prevent dislodgment of aggregates, and shall be completed within 12 hours after concrete placement.

G. Minimum curing period shall be seven days.

H. Tolerances for the concrete work shall be per ACI 117, sections 1 through 4.

3.03 **CONSTRUCTION JOINTS**

A. Unless noted otherwise, a bonding agent shall be used on hardened concrete surfaces that will be joined with fresh concrete.

B. Provide 1.5-inch key and waterstop at all construction joints within the secondary containment area.

3.04 **FINISHES**

A. Formed surfaces: Smooth form finish

B. Unformed surfaces: Float finish

3.05 **SCHEDULES**

A. The CONTRACTOR shall notify the ENGINEER at least 48-hours before each concrete placement.

3.06 **FIELD QUALITY CONTROL**

A. Concrete testing will be performed by the Quality Assurance Team. Such testing shall not relieve the CONTRACTOR from ensuring concrete is in compliance with specification.

B. Follow testing specifications listed in Section 01 45 29 – Testing Laboratory Services.

C. Four test cylinders of 6-inch diameter by 12-inches long or five test cylinders of 4-inch diameter by 8-inches long shall be prepared for every 50 yards of concrete placed or one set per day of concrete placement, whichever is greater.

D. Performed compression strength tests conforming to ASTM C39 to determine the compressive strength: if 6-inch by 12-inch test cylinders are cast test one at 7 days, and two at 28 days; if 4-inch by 8-inch test cylinders are cast test one at 7 days, and three at 28 days. The remaining cylinder shall be kept in reserve for additional testing, if necessary.

E. Slump and air entrainment testing shall be performed at the time the cylinders are prepared.

- - - END OF SECTION - - -

SECTION 03 37 13
SHOTCRETE

PART 1 GENERAL

1.01 DESCRIPTION

This section specifies the requirements for materials, proportioning, and application of shotcrete using either dry-mix or wet-mix process

1.02 DEFINITION

Mortar or concrete pneumatically projected at high velocity onto a surface; also known as air-blown mortar; also pneumatically applied mortar or concrete, sprayed mortar and gunned concrete.

1.03 RELATED WORK

A. Section 01 45 29 – Testing Laboratory Services

B. Section 03 30 00 – Cast-in-Place Concrete

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittals.

B. Design Mix: Test Reports and Proportions.

C. Two 300 mm x 300 mm x 25 mm (12 inch by 12 inch by 1 inch) sample panels showing required finish. Submit panels within 30 days after receipt of notice to proceed.

D. Aggregate gradation.

E. Color.

F. Certificates: CONTRACTOR's qualifications as specified.

1.05 QUALITY CONTROL

A. CONTRACTOR Qualifications.

1. Work in this section shall be provided only by a CONTRACTOR specializing in and possessing the equipment, knowledge, and skilled operators for application of shotcrete.

2. Furnish evidence to ENGINEER that CONTRACTOR conforms to above requirements, has been specializing in this work for a period of at least five years, and will use only experienced shotcrete foremen, nozzlemen and delivery equipment operators on the work.

3. Conform to ACI 506R, Paragraphs 4.2 and 4.3, for qualifications and duties of craftsmen.

B. Tolerances:

1. Cover of reinforcement: ACI 506.2, Paragraph 3.6.2.

2. Alignment and thickness of shotcrete shall be controlled by installing ground wires. Alignment and thickness control shall conform to ACI 506R Section 5.6.

1.06 PRECONSTRUCTION TESTING

A. Conform to the requirements of ACI 506R, Paragraph 6.4.

B. Testing laboratory approved by the ENGINEER and reimbursed by CONTRACTOR shall design dry or wet mix, as applicable, to produce compressive strengths indicated on drawings.

C. Make 2 test panels for each mix design, 450 mm (18 inches) square and 75 mm (3 inch) minimum thickness. Take 5 cores or cubes from each 75 mm (3 inch) panel for compressive strength testing in accordance with ACI 506R, Paragraph 6.4.

D. Using the proposed mix design, make at least two sample panels approximately 2400 mm (8 feet) high and 1800 mm (6 feet) wide with thicknesses shown. The sample panels shall contain reinforcing typical of the work to be installed and other details to simulate actual job conditions. Finish sample panels as required for work to be installed. Sample panels must be approved by the ENGINEER before any work can begin.

1.07 CONSTRUCTION TESTING

A. Make one test panel 450 mm (18 inches) square and 75 mm (3 inches) thick for each day's work or portion thereof. Provide test panels to a testing laboratory approved by ENGINEER and reimbursed by the CONTRACTOR. Five compressive strength specimens will be obtained from each panel and tested for compressive strength in accordance with ASTMC42. Two (2) samples are to be tested at 7 days and 28 days after application. The fifth sample should be retained for 56 days should additional testing be required. Strength test results are to be reported to the ENGINEER 24 hours after completion of test. Shotcrete shall have a minimum compressive strength of 6,000 psi at 28 days.

B. Additionally, prepare one sawed beam test specimen 100 mm by 100 mm by 360 mm (4 inch by 4 inch by 14 inch) for every two day’s shotcrete work for flexural testing performed according to ASTM C1609M. Provide test specimens to a testing laboratory approved by ENGINEER and reimbursed by the CONTRACTOR. Flexural test results are to be reported to the ENGINEER 24 hours after completion of test and shall have a minimum flexural strength of 600 psi at 28 days.

1.08 DELIVERY, HANDLING, AND STORAGE

A. Properly deliver and handle materials to prevent contamination, segregation, or damage to materials.

B. Store cement in weathertight enclosures to protect against dampness and contamination.

C. Prevent segregation and contamination of aggregates by proper arrangement and use of stockpiles.

D. Store admixtures properly to prevent contamination, evaporation, freezing, or other damage.

1.09 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A820M – Standard Specification for Steel Fibers for Fiber-Reinforced Concrete
2. ASTM C33/C33M – Concrete Aggregates
3. ASTM C94/C94M – Ready-Mixed Concrete
4. ASTM C150/C150M – Portland Cement
5. ASTM C260/C260M – Air-Entraining Admixtures for Concrete
6. ASTM C494/C494M – Chemical Admixtures for Concrete
7. ASTM C1609M – Flexural Performance of Fiber-Reinforced Concrete (Using Beam with Third-Point Loading)

B. American Concrete Institute (ACI):

1. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete
2. ACI 506R – Guide to Shotcrete

3. ACI 506.2 – Specification for Shotcrete
4. ACI 506.4R – Guide for the Evaluation of Shotcrete

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland Cement: ASTM C150, Type I or II.

B. Coarse aggregate: ASTM C33, Gradation Table 2.1.

C. Fine aggregate: ASTM C33, washed natural sand.

TABLE 2.1: GRADATION LIMIT FOR COMBINED AGGREGATES

Sieve Size, U.S. standard square mesh	Percent by Weight Passing Individual Sieves		
	Gradation No. 1	Gradation No. 2	Gradation No. 3
20 mm 3/4 inch	---	---	100
13 mm 1/2 inch	---	100	80-95
10 mm 3/8 inch	100	90-100	70-90
No. 4	95-100	70-85	50-70
No. 8	80-100	50-70	35-55
No. 16	50-85	35-55	20-40
No. 30	25-60	20-35	10-30
No. 50	10-30	8-20	5-17
No. 100	2-10	2-10	2-10

D. Chemical Admixtures: ASTM C494.

E. Air-entraining Admixture: ASTM C260.

F. Water: Fresh, Clean, and Potable.

G. Steel Reinforcing Fibers: ASTM 820a, Type V Fibers

H. Color: Intent is to have an overall color approximate that of the average rock color.

PART 3 EXECUTION

3.01 PROPORTIONING, DELIVERY AND MIXING

A. Proportioning: Mix shall be designed by CONTRACTOR-retained testing laboratory; see "PRECONSTRUCTION TESTING" hereinbefore. Maintain water-cement ratio between 0.35 to 0.50 by weight.

B. Steel reinforcing fibers shall be added to the structural shotcrete mix at a minimum rate of 75 lbs/cubic yard.

C. Smoothing layer shotcrete mix shall be the same as the structural mix except it will not contain steel reinforcing fibers and will include color, as determined by the OWNER.

D. Mixing Processes:

1. Mixing, General: Strength of mix is specified on the drawings. At CONTRACTOR's option, use either the dry or wet mix process. Discharge entire batch before recharging. Clean mixer at least once every 8-hour shift or portion thereof. Reject material mixed and standing for 45 minutes; remixing or tempering not permitted.

2. Dry Mix Process: Conform to ACI 506R, Paragraph 1.6.1.

3. Wet Mix Process: Conform to ACI 506R, Paragraph 1.6.2.

4. Insert commercially available coloring agents to produce the desired surficial color, as determined by the OWNER. It is acceptable to add color only to the exterior cementitious paste portion of the shotcrete surface.

3.02 EQUIPMENT, DRY MIX PROCESS

A. Batching and Mixing Equipment: Batch by weighing, use rotating mixer or adequate capacity for dry-mixing aggregate and cement for continuous supply of material to gun, all conforming to ACI 506R, Paragraph 3.5.

B. Delivery equipment:

1. Gun and Nozzle: Premixing type conforming to the requirements of ACI 506R, Paragraphs 3.2 and 3.7 designed for material delivery and water injection.

2. Air Compressor and Hoses: Standard type, of capacity to provide without interruption, pressures and volume of air necessary for longest hose delivery; conform to ACI 506R, Table 3.1. Make allowances for air consumed by separate blow pipe in blowing away rebound, cleaning reinforcing and incidental uses.

3. Water Supply: Conform to ACI 506R, Paragraph 3.8.1 with adequate capacity to maintain water pressure approximately 65 N (15 pounds) higher than highest air pressure required, both air and water pressure uniformly steady, non-pulsating.

3.03 EQUIPMENT, WET MIX PROCESS

A. Batching and Mixing Equipment: ACI 506R, Paragraph 3.5. Batch by weighing; use rotating mixing equipment and mix in accordance with ACI 304R, and ASTM C94 for ready-mixed concrete.

B. Delivery Equipment: Use pneumatic feed or positive displacement type of design and size capable of delivering premixed materials accurately, uniformly and continuously through the hose, all in accordance with ACI 506R, Paragraphs 3.3 and 3.7.

C. Air Supply: ACI 506R, Paragraph 3.4.2.

3.04 ALIGNMENT CONTROL

A. General: To establish thickness and surface planes or shotcrete build-up provide ground wires, taut, secure, true to line and plane, conforming to ACI 506R, Paragraph 5.6.

3.05 EXHAUST SYSTEM

A. Construct a sealed air barrier around immediate area of work as approved by ENGINEER.

B. Continuously exhaust work area to outside (at surface) creating a negative pressure within area. Do not locate air exhaust near any Cavern or building air intakes.

3.06 **SHOOTING**

A. General: ACI 506R, Paragraph 8.5.7. Shoot and fill corners first, with continuous uniform material flow from nozzle held approximately 600 mm to 1500 mm (2 to 5 feet) from the work, at angle normal to the surface.

1. If flow is not uniform and slugs, sand spots or wet sloughs result, turn nozzle away until faulty work is cut out and repaired.
2. Do no shotcrete work if temperature is below 4^0 C (40 ^{0} F) without providing continuous heat and adequate protection from freezing.

B. Preparation of Surfaces to Receive Shotcrete: ACI 506R, Paragraph 5.2, as applicable to the work, as approved.

C. Rebound: ACI 506R, Paragraph 8.5.10. Do not work rebound into construction nor salvage rebound for subsequent batching.

D. Suspend application if:

1. High wind prevents nozzlemen from proper application of material.
2. Weather approaches freezing and shotcrete cannot be protected.
3. Rain, other than a very light sprinkle, occurs which would wash cement out of freshly placed material.

E. Time Between Coats:

1. In sloping, vertical or overhanging work, allow interval of time sufficient for initial, but not final, set to develop.
2. At development of initial set, lightly broom surface to remove any laitance to provide better bond with succeeding applications.

F. Construction Joints:

1. ACI 506R, Paragraph 5.7, tapering over a width of 300 mm (1 foot) to a 25 mm (1 inch) edge from board laid flat.
2. Before proceeding with additional shotcrete work, thoroughly clean joint and adjacent shotcrete, then wet and scour surfaces with air jet.

G. Warm Weather Application: Prevent dryout resulting in cracking and separation by keeping surfaces continuously moist and/or covered with continuously moistened burlap for 7 days after shotcreting.

H. Surface Finish: Bring final surfaces of shotcrete to an even plane, well-formed corners either square or to radius shown, working up to ground wires using somewhat lower placing velocity than normal.

1. Remove ground wires to 20 mm (3/4 inch) back from surface and fill holes with shotcrete to adjacent surface elevations.

3.07 **CURING**

A. ACI 506.2, Paragraph 3.7.

3.08 **HOT WEATHER SHOTCRETING**

A. ACI 506R, Paragraph 8.8.

3.09 **COLD WEATHER SHOTCRETING**

A. ACI 506R, Paragraph 8.9.

3.10 **PROTECTION AND CLEAN-UP**

A. Protection: Protect adjacent walls, windows, doors, other building surfaces, and natural Cavern environment from damage by shotcreting, rebound and dust.

1. Construct a sealed dust partition to confine rebound and dust to immediate work area. Dust partition shall be integral with exhaust system. A negative air pressure shall be maintained within partitioned area during shotcrete applications to prevent dust leakage beyond area.

2. Immediately clean all shotcrete materials and remove all rebound from site.

B. Clean-up: Continuously remove rebound material to ensure that base, intermediate, and finish surfaces are clean and ready for bonding layers.

3.11 DEFECTIVE WORK

General work will be evaluated be the ENGINEER or designated agent in accordance with ACI 506.4. If the evaluation reveals unbonded work or cores fail to meet specified strengths, or finishes are unsatisfactory, repair such defective work, as approved, without additional cost to the Government.

- - - END OF SECTION - - -

SECTION 04 01 20
MAINTENANCE OF UNIT MASONRY

PART 1 GENERAL

1.01 DESCRIPTION

A. This section includes maintenance of unit masonry consisting of stone masonry and cleaning as follows:

1. Repairing unit masonry, including replacing units.
2. Repointing joints.
3. Cleaning exposed stone surfaces

1.02 RELATED WORK

A. Section 01 33 00 - Submittals

B. Section 04 05 13 – Masonry Mortaring

C. Section 04 43 00 – Stone Masonry

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include recommendations for application and use. Include test data substantiating that products comply with requirements.

B. Samples for Initial Selection:

1. Pointing Mortar: Submit sets of mortar for pointing in the form of sample mortar strips, 6 inches long by ¼ inch wide, set in aluminum or plastic channels.
   a. Have each set contain a close color range of at least three Samples of different mixes of colored sands and cements that produce a mortar matching the cleaned masonry when cured and dried.
   b. Submit with precise measurements on ingredients, proportions, gradations, and sources of colored sands from which each Sample was made.

C. Samples for Verification:

1. Each type of masonry unit to be used for replacing existing units. Include sets of Samples as necessary to show full range of shape, color, and texture to be expected.
2. Each type of sand used for pointing mortar; minimum 1 lb. of each in plastic screw-top jars.
   a. For blended sands, provide Samples of each component and blend.
   b. Identify sources, both supplier and quarry, of each type of sand
3. Each type, color, and texture of pointing mortar in the form of sample mortar strips, 6 inches long by ¼ inch wide, set in aluminum or plastic channels.
   a. Include with each Sample a list of ingredients with proportions of each. Identify sources, both supplier and quarry, or each type of sand and brand names of cementitious materials and pigment if any.

D. Qualification Data: For restoration specialists, including field supervisors and restoration workers.

E. Quality-Control Program

F. Restoration Program

G. Cleaning Program

1.04 **DEFINITIONS**

A. Very Low-Pressure Spray: Under 100 psi.

B. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm

C. Saturation Coefficient: Ratio of the weight absorbed during immersion in cold water to weight absorbed during immersion in boiling water; used as an indication of resistance of masonry units to freezing and thawing.

D. Restoration Stone Mason: Individual workers who have demonstrable experience in masonry restoration.

E. Lead Restoration Stone Mason: An individual worker with exemplary skills in restoration who has been approved to serve as crew leader, shall be present at all times during masonry restoration, and shall personally direct the work.

F. Masonry Crew Members: Restoration Stone Masons, Lead Stone Masons, and Masonry Tenders.

1.05 **QUALITY CONTROL**

A. Restoration Specialist Qualifications: Engage an experienced masonry restoration firm to from work in this Section. Firms shall have completed work similar in material, design and extent to that indicated for this Project with a record of successful in-service performance.

1. Field Supervision: Restoration specialist firms shall maintain experienced full-time supervisors on Project site during times that masonry restoration and cleaning work is in progress. Supervisors shall not be changed during Project except for causes beyond the control of the firm.

2. Restoration Worker Qualifications: Persons who are experienced and specialize in restoration work of the types they will be performing.

B. Restoration Stone Masons:

1. Deteriorated material removed, material salvage, absorption control, mixing, re-pointing, curing, and finishing operations shall be performed by Restoration Stone Masons.

2. Before project start-up, every Restoration Stone Mason shall perform mock-ups.

3. During the progress of the project, if additional Masonry Crew Members are required due to personnel rotation and attrition or changes in the project schedule or the need to increase rate of production, the Subcontractor will be permitted to arrange for training of replacement or additional Masonry Crew members providing, however, that at no time shall the number of approved Masonry Crew Members fall below seventy-five percent, nor two-thirds on any given crew of three, nor one-half of any given crew of two.

4. Replacement Crew Members must be approved via the submittal process and shall perform mock-ups.

C. Source Limitations: Obtain each type of material for masonry restoration (stone, mortar, sand, etc.) from one source with resources to provide materials of consistent quality in appearance and physical qualities.

D. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow method and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage due to worker fatigue.

E. Restoration Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be to be used for each phase of restoration work including protection of surrounding materials and Project site.

1. Include methods for keeping pointing mortar damp during curing period.

2. If materials and methods other than those indicated are proposed for any phase of restoration work, add to the Quality-Control Program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project and worker's ability to use such materials and methods properly.

F. Preinstallation Conference: Conduct conference at Project Site.

1. Review methods and procedures related to masonry restoration and cleaning including, but not limited to, the following:

a. Construction schedule. Verify availability of materials, Restoration Specialist's personnel, equipment, and facilities needed to make progress and avoid delays.

b. Materials, material application, sequencing, tolerances, and required clearance.

1.06 **DELIVERY, HANDLING, AND STORAGE**

A. Deliver masonry units to Project site strapped together in suitable packs or pallets or in heavy-duty cartons.

B. Deliver other material to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

C. Store all materials on elevated platforms, under cover, and in a dry location.

D. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

E. Store sand where grading and other required characteristics can be maintained and contamination avoided.

1.07 **PROJECT CONDITIONS**

A. Repair masonry units and repoint mortar joints only when air temperature is between 40°F and 90°F and is predicted to remain so for at least 7 days after completion of the Work unless otherwise indicated.

B. Cold-Weather Requirements: Comply with the following procedures for masonry repair and mortar-joint pointing unless otherwise indicated:

1. When air temperature is below 40°F, heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40°F and 120°F.

2. When mean daily air temperature is below 40°F, provide enclosure and heat to maintain temperatures above 32°F within the enclosure for 7 days after completion and cleaning.

PART 2 PRODUCTS

2.01 **STONE MATERIALS**

A. Stone materials shall be in accordance with Section 044300 Stone Masonry

2.02 **MORTAR MATERIALS**

A. Masonry mortaring materials shall be in accordance with Section 040513 Masonry Mortaring.

2.03 **CLEANING MATERIALS**

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140°F to 160°F.

C. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including stone, brick, aluminum, plastics, and wood.

2.04 **ACCESSORY MATERIALS**

A. Miscellaneous Products: Select materials and methods of use based on the following, subject to approval of a mock-up:

1. Previous effectiveness in performing the work involved.
2. Little possibility of damaging exposed surfaces.
3. Consistency in each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:
   a. Remove, alter, or in any way harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in contract.
   b. Leave residue on surfaces.

2.05 **MORTAR MIXES**

A. Provide mortar mixes as indicated in specification Section 040513 Masonry Mortaring

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Do not use admixtures in mortar unless otherwise indicated.

2.06 **CHEMICAL CLEANING SOLUTIONS**

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended by chemical-cleaner manufacturer.

PART 3 EXECUTION

3.01 **RESTORATION SPECIALISTS**

A. Restoration Specialist Firms: Subject to compliance requirements, provide masonry restoration to oversee the work.

3.02 **PROTECTION**

A. Protect persons, surrounding surfaces on Project Site being restored from harm resulting from masonry restoration work.

B. Comply with chemical-cleaner manufacturer's written instructions for protecting surfaces against damage from exposure to its products. Prevent chemical-cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist chemical cleaners used unless chemical cleaners being used will not damage adjacent surfaces. Use materials that contain only waterproof, UV-resistant adhesives. Apply masking agents to comply

with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.

2. Keep surfaces wet below area being cleaned to prevent streaking from runoff.
3. Neutralize and collect alkaline and acid wastes for disposal off Owner's property.
4. Capture runoff from cleaning operations and dispose of by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, water penetration into the natural Cavern environment, and water penetration into building interiors.

C. Prevent mortar from staining face of surrounding masonry and other surfaces.

1. Cover wall, ledges, and projections to protect from mortar droppings.
2. Keep wall area wet below rebuilding and pointing work to discourage mortar from adhering.
3. Immediately remove mortar in contact with exposed masonry and other surfaces.

3.03 **TEMPORARY SHIM SUPPORT**

A. Provide temporary supports where necessary to prevent displacement of masonry during re-pointing and until mortar has achieved sufficient strength.

B. Notify OWNER/ENGINEER of need for temporary support and provide mock-up of temporary support.

3.04 **STONE REMOVAL AND REPLACEMENT**

A. At locations indicated, remove stones that are damaged, spalled, or deteriorated or are to be reused. Carefully demolish or remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Support and protect remaining masonry that surrounds removal area. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

C. Notify OWNER of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, or other deteriorated items.

D. Remove in an undamaged condition as many whole stone units as possible.

1. Remove mortar, loose particles, and soil from stone by cleaning with hand chisels, brushes, and water.
2. Store stone for reuse. Store off ground, on skids, and protected from weather.
3. Deliver cleaned stone not required for reuse to OWNER unless otherwise indicated.

E. Clean stone surrounding removal areas by removing mortar, dust, and loose particles in preparation for replacement.

F. Replace removed damaged stone with other removed stone and salvaged stone in good quality, where possible, or with new stone matching existing stone, including size. Do not use broken units unless they can be cut to usable size.

G. Do not allow face bedding of stone. Before setting, inspect to verify that each stone has been cut so that, when it is set in final position, natural bedding planes are essentially horizontal except for arches, where bedding planes are essentially radial or vertical, but perpendicular to the wall. Reject and replace stone with vertical bedding planes except as required for arches, lintels, and copings.

H. Install replacement stone into bonding and coursing pattern of existing stone. If cutting is required, use a motor-driven saw designed to cut stone with clean, sharp, unchipped edges. Finish edges to blend with appearance of edges of existing stone.

1. Maintain joint width for replacement stone to match existing joints.
2. Use setting buttons or shims to set stone accurately spaced with uniform joints.

I. Set replacement stone with completely filled bed, head, and collar joints. Butter vertical joints for full width before setting and set units in full bed of mortar unless otherwise indicated. Replace existing anchors with new anchors of size and type indicated.

1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing stonework.
2. Rake out mortar used for laying stone before mortar sets and point new mortar joints in repaired area to comply with requirements for repointing existing stone, and at same time as repointing of surrounding area.
3. When mortar is sufficiently hard to support units, remove shims and other devices interfering with pointing of joints.

3.05 REPOINTING MASONRY

A. Rake out and repoint joints to the following extent:

1. Joints where mortar is missing or where they contain holes.
2. Cracked joints where cracks can be penetrated at least 1/4 inch by a knife blade 0.027 inch thick.
3. Cracked joints where cracks are 1/16 inch or more in width and of any depth.
4. Joints where they sound hollow when tapped by metal object.
5. Joints where they are worn back 1/4 inch or more from surface.
6. Joints where they are deteriorated to point that mortar can be easily removed by hand, without tools.
7. Joints where they have been filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of 2-1/2 times joint width, but not less than 1/2 inch or not less than that required to expose sound, unweathered mortar.
2. Remove mortar from stone surfaces within raked-out joints to provide reveals with square backs and to expose stone for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of stone units or widen joints. Replace or patch damaged stone units as directed by OWNER.
   a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders without OWNER's written approval based on approved quality-control program.
   b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar by hand with chisel and resilient mallet. Strictly adhere to approved quality-control program.

D. Notify ENGINEER of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing. Do not rinse when temperature is below freezing.

2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.

3. After low areas have been filled to same depth as remaining joints, point all joints by placing mortar in layers not greater than 3/8 inch. Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.

4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.

5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours including weekends and holidays.

   a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.

   b. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

6. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

F. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.06 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff- nylon or -fiber brushes, and clean water, spray applied at low pressure.

1. Do not use metal scrapers or brushes.

2. Do not use acidic or alkaline cleaners.

B. Sweep and rake adjacent pavement and grounds to remove mortar and debris. Where necessary, pressure wash pavement surfaces to remove mortar, dust, dirt, and stains.

- - - END OF SECTION - - -

SECTION 04 05 13
MASONRY MORTARING

PART 1 GENERAL

1.01 DESCRIPTION

Section specifies mortar materials and mixes. Section applies to tuckpointing work at the Dripstone Bridge as well as any repair or replacement of masonry airlock and security door bulkheads at the Dripstone Cave Entrance, Dripstone Cave Bypass Tunnel, Dripstone Cave Exit, and Discovery Cave Exit.

1.02 RELATED WORK

A. Section 01 33 00 – Submittals

B. Section 04 01 20 – Maintenance of Unit Masonry

C. Section 04 43 00 – Stone Masonry

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM) including but not limited to the following:

1. ASTM C 5-18 Standard Specification for Quicklime for Structural Purposes
2. ASTM C 91 Standard Specification for Masonry Cement.
3. ASTM C 144 Standard Specification for Aggregate for Masonry Mortar.
4. ASTM C 150 Standard Specification for Portland Cement.
5. ASTM C 207 Standard Specification for Hydrated Lime for Masonry Purposes
6. ASTM C 780 Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
7. ASTM C 1489 Standard Specification for Lime Putty for Structural Purposes

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include recommendations for application and use. Include manufacturer's data sheets on each product, including:

1. Mixing and preparing instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

B. Samples for Initial Selection:

1. Pointing Mortar: Submit sets of mortar for pointing in the form of sample mortar strips, 6 inches long by ¼ inch wide, set in aluminum or plastic channels.

a. Have each set contain a close color range of at least three Samples of different mixes of colored sands and cements that produce a mortar matching the cleaned masonry when cured and dried.

b. Submit with precise measurements on ingredients, proportions, gradations, and sources of colored sands from which each Sample was made.

C. Samples for Verification:

1. Each type of sand used for pointing mortar; minimum 1 lb. of each in plastic screw-top jars.
    a. For blended sands, provide Samples of each component and blend.
    b. Identify sources, both supplier and quarry, of each type of sand
2. Each type, color, and texture of pointing mortar in the form of sample mortar strips, 6 inches long by ¼ inch wide, set in aluminum or plastic channels.
    a. Include with each Sample a list of ingredients with proportions of each. Identify sources, both supplier and quarry, or each type of sand and brand names of cementitious materials and pigment if any.

D. Quality-Control Program

1.05 **QUALITY CONTROL**

A. Source Limitations: Obtain each type of material for masonry (stone, mortar, sand, etc.) from one source with resources to provide materials of consistent quality in appearance and physical qualities.

B. Quality Assurance Testing: Test Reports prepared by a qualified independent laboratory indicating compliance with the following performance requirements:

1. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength
2. Testing Standard: Mortar samples tested in accordance with ASTM C 780.

1.06 **DELIVERY, HANDLING, AND STORAGE**

A. Deliver materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

D. Store sand where grading and other required characteristics can be maintained, and contamination avoided.

PART 2 PRODUCTS

2.01 **MORTAR MATERIALS**

A. Portland Cement: ASTM C 150, Type I or Type II, white or gray or both where required for color matching of exposed mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Factory-Prepared Lime Putty: ASTM C 1489.

D. Quicklime: ASTM C 5, pulverized lime.

E. Mortar Sand: ASTM C 144 unless otherwise indicated.

1. Color: Provide natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
2. For pointing mortar, provide sand with rounded edges.

3. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary, to achieve suitable match.

F. Mortar Pigments: Natural and synthetic iron oxides, compounded for mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortars.

G. Water: Potable.

2.02 **MORTAR MIXES**

A. Preparing Lime Putty: Slake quicklime and prepare lime putty according to appendix to ASTM C 5 and manufacturer's written instructions.

B. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mortar Proportions: Mix mortar materials in the following proportions:

1. Pointing Mortar for Stone: 1-part white Portland cement, 1 part lime, and 6 parts sand or 1 part white Portland cement, 2 parts lime, and 6 parts sand or 1 part white Portland cement, 6 parts lime, and 12 parts sand.

2. Rebuilding (Setting) Mortar: Comply with ASTM C 270, Proportion Specification, Type N unless otherwise indicated, with cementitious material limited to Portland cement and lime.

PART 3 EXECUTION

NOT USED

- - - END OF SECTION - - -

SECTION 04 43 00
STONE MASONRY

PART 1 GENERAL

1.01 DESCRIPTION

A. This section includes installation of stone masonry as follows:

1. Preparing surfaces for stone masonry installation.
2. Installing stone masonry.
3. Pointing masonry joints.
4. Cleaning exposed stone surfaces

B. This section applies to tuckpointing work at the Dripstone Bridge as well as any repair or replacement of masonry airlock and security door bulkheads at the Dripstone Cave Entrance, Dripstone Cave Bypass Tunnel, Dripstone Cave Exit, and Discovery Cave Exit.

1.02 RELATED WORK

A. Section 01 33 00 – Submittals

B. Section 04 01 20 – Maintenance of Unit Masonry

C. Section 04 05 13 – Masonry Mortaring

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM) including but not limited to the following:

1. ASTM C 615 Dimension Stone
2. ASTM C 1242 Guide for Selection, Design, and Installation of Dimension Stone

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include recommendations for application and use. Include test data substantiating that products comply with requirements.

B. Samples for Initial Selection:

1. Pointing Mortar: Submit sets of mortar for pointing in the form of sample mortar strips, 6 inches long by ¼ inch wide, set in aluminum or plastic channels.
   a. Have each set contain a close color range of at least three Samples of different mixes of colored sands and cements that produce a mortar matching the cleaned masonry when cured and dried.
   b. Submit with precise measurements on ingredients, proportions, gradations, and sources of colored sands from which each Sample was made.

C. Samples for Verification:

1. Each type of masonry unit to be used for replacing existing units. Include sets of Samples as necessary to show full range of shape, color, and texture to be expected.
2. Each type of sand used for pointing mortar; minimum 1 lb. of each in plastic screw-top jars.
   a. For blended sands, provide Samples of each component and blend.
   b. Identify sources, both supplier and quarry, of each type of sand

3. Each type, color, and texture of pointing mortar in the form of sample mortar strips, 6 inches long by ¼ inch wide, set in aluminum or plastic channels.
    a. Include with each Sample a list of ingredients with proportions of each. Identify sources, both supplier and quarry, or each type of sand and brand names of cementitious materials and pigment if any.

D. Qualification Data: For masonry specialists, including field supervisors and masonry workers.

E. Quality-Control Program

F. Restoration Program

G. Cleaning Program

1.05 **DEFINITIONS**

A. Very Low-Pressure Spray: Under 100 psi.

B. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm

C. Saturation Coefficient: Ratio of the weight absorbed during immersion in cold water to weight absorbed during immersion in boiling water; used as an indication of resistance of masonry units to freezing and thawing.

D. Stone Mason: Individual workers who have demonstrable experience in masonry stonework.

E. Lead Stone Mason: An individual worker with exemplary skills in stonework who has been approved to serve as crew leader, shall be present at all times during masonry stonework, and shall personally direct the work.

F. Masonry Crew Members: Stone Masons, Lead Stone Masons, and Masonry Tenders.

1.06 **QUALITY CONTROL**

A. Masonry Firm Qualifications: Engage an experienced masonry firm to perform work in this Section. Firms shall have completed work similar in material, design and extent to that indicated for this Project with a record of successful in-service performance.

1. Field Supervision: masonry firms shall maintain experienced full-time supervisors on Project site during times that masonry and cleaning work is in progress. Supervisors shall not be changed during Project except for causes beyond the control of the firm.

2. Stone Mason Qualifications: Persons who are experienced and specialize in masonry stone work of the types they will be performing.

B. Stone Masons:

1. Absorption control, mixing, stone placement, pointing, curing, and finishing operations shall be performed by Stone Masons.

2. Before project start-up, every Stone Mason shall perform mock-ups.

3. During the progress of the project, if additional Masonry Crew Members are required due to personnel rotation and attrition or changes in the project schedule or the need to increase rate of production, the Subcontractor will be permitted to arrange for training of replacement or additional Masonry Crew members providing, however, that at no time shall the number of approved Masonry Crew Members fall below seventy-five percent, nor two-thirds on any given crew of three, nor one-half of any given crew of two.

4. Replacement Crew Members must be approved via the submittal process and shall perform mock-ups.

C. Source Limitations: Obtain each type of material for masonry (stone, mortar, sand, etc.) from one source with resources to provide materials of consistent quality in appearance and physical qualities.

D. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow method and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage due to worker fatigue.

E. Masonry Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be to be used for each phase of restoration work including protection of surrounding materials and Project site.

1. Include methods for keeping pointing mortar damp during curing period.

2. If materials and methods other than those indicated are proposed for any phase of restoration work, add to the Quality-Control Program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project and worker's ability to use such materials and methods properly.

F. Preinstallation Conference: Conduct conference at Project Site.

1. Review methods and procedures related to masonry restoration and cleaning including, but not limited to, the following:

a. Construction schedule. Verify availability of materials, masonry specialist’s personnel, equipment, and facilities needed to make progress and avoid delays.

G. Materials, material application, sequencing, tolerances, and required clearance.

1.07 DELIVERY, HANDLING, AND STORAGE

A. Deliver stone units to Project site strapped together in suitable packs or pallets or in heavy-duty crates.

B. Deliver other materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

E. Store sand where grading and other required characteristics can be maintained and contamination avoided.

1.08 PROJECT CONDITIONS

A. Install stone and point mortar joints only when air temperature is between 40 and 90 deg F and is predicted to remain so for at least 7 days after completion of the Work unless otherwise indicated.

B. Cold-Weather Requirements: Comply with the following procedures for stone installation and mortar-joint pointing unless otherwise indicated:

1. When air temperature is below 40 deg F, heat mortar ingredients, repair materials, and existing stone to produce temperatures between 40 and 120 deg F.

2. When mean daily air temperature is below 40 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for 7 days after repair and pointing.

PART 2 PRODUCTS

2.01 STONE MATERIALS

A. Stone: Provide natural limestone or dolomite building stone of variety, color, texture, grain, veining, finish, size, and shape to match existing Cavern stone

B. Quarrying New Stone: Have quarry clearly label the direction of bedding planes when rough stone is quarried, to facilitate cutting stones so that natural bedding planes will be as required in "Cutting New Stone" Paragraph.

C. Cutting New Stone: Regardless of how existing stone was cut and set, cut each new stone so that, when it is set in final position, natural bedding planes are essentially horizontal except for arches, where bedding planes are essentially radial or vertical, but perpendicular to the wall plane.

D. Salvaged Stone: Obtain salvaged stone from OWNER, if available. Clean off residual mortar.

2.02 MORTAR MATERIALS

A. Masonry mortaring materials shall be in accordance with Section 04 05 13 Masonry Mortaring.

2.03 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F.

C. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including stone, brick, aluminum, plastics, and wood.

2.04 ACCESSORY MATERIALS

A. Stone Anchors and Pins: Type and size as required. Fabricate anchors and pins from Type 304 stainless steel.

B. Setting Buttons: Resilient plastic buttons, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units without intruding into required depths of pointing materials.

C. Masking Tape: Nonstaining, nonabsorbent material, compatible with pointing mortar, joint primers, sealants, and surfaces adjacent to joints; that will easily come off entirely, including adhesive.

D. Miscellaneous Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Little possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:
   a. Remove, alter, or in any way harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in contract.

b. Leave a residue on surfaces.

2.05 **MORTAR MIXES**

A. Provide mortar mixes as indicated in specification Section 040513 Masonry Mortaring

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Do not use admixtures in mortar unless otherwise indicated.

2.06 **CHEMICAL CLEANING SOLUTIONS**

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended by chemical-cleaner manufacturer.

PART 3 EXECUTION

3.01 **PROTECTION**

A. Protect persons, surrounding surfaces on Project Site from harm resulting from masonry stonework.

B. Comply with chemical-cleaner manufacturer's written instructions for protecting surfaces against damage from exposure to its products. Prevent chemical-cleaning solutions from coming into contact with people, animals, natural cavern environment, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist chemical cleaners used unless chemical cleaners being used will not damage adjacent surfaces. Use materials that contain only waterproof, UV-resistant adhesives. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.

2. Keep surfaces wet below area being cleaned to prevent streaking from runoff.

3. Neutralize and collect alkaline and acid wastes for disposal off OWNER's property.

4. Capture runoff from cleaning operations and dispose of by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, water penetration into the natural Cavern environment, and water penetration into building interiors.

C. Prevent mortar from staining face of surrounding masonry and other surfaces.

1. Cover wall, ledges, and projections to protect from mortar droppings.

2. Keep wall area wet below rebuilding and pointing work to discourage mortar from adhering.

3. Immediately remove mortar in contact with exposed masonry and other surfaces.

3.02 **EXAMINATION**

A. Do not begin installation until surfaces to receive stonework have been properly prepared.

B. Evaluate masonry at the following locations and determine if repairs are necessary:

1. Dripstone Cave Entrance Outer Airlock Door Bulkhead.
2. Dripstone Cave Entrance Inner Airlock Door Bulkhead.
3. Dripstone Cave Bypass Tunnel Door Bulkhead and surrounding wall.
4. Dripstone Cave Exit Outer Airlock Door Bulkhead.
5. Dripstone Cave Exit Inner Airlock Door Bulkhead.
6. Dripstone Cave Exit Security Door Bulkhead.
7. Discovery Cave Exit Outer Airlock Door Bulkhead
8. Discovery Cave Exit Security Door Bulkhead
9. Dripstone Bridge Culvert Walls

C. Examine surfaces to receive stone masonry, with OWNER/ENGINEER present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone masonry. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.03 **PREPARATIONS**

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods conforming to best industry practices for achieving the best result for the substrate under the Project conditions.

C. Clean stone surfaces which are dirty or stained prior to setting. Clean stones by scrubbing with fiber brushes and drenching with clear water. Use only mild cleaning compounds that contain no acid, caustic or abrasives.

3.04 **STONE INSTALLATION**

A. Place stone in accordance with industry standards and approved drawings. Setting and handling shall be done by competent Stonemasons, thoroughly experienced in work of this type and scope.

B. Do not allow face bedding of stone. Before setting, inspect to verify that each stone has been cut so that, when it is set in final position, natural bedding planes are essentially horizontal except for arches, where bedding planes are essentially radial or vertical, but perpendicular to the wall. Reject and replace stone with vertical bedding planes except as required for arches, lintels, and copings.

C. Install stone in bonding and coursing pattern similar to other stonework in the Cave. If cutting is required, use a motor-driven saw designed to cut stone with clean, sharp, unchipped edges. Finish edges to blend with appearance of edges of existing stone.

4. Use setting buttons or shims to set stone accurately spaced with uniform joints.

D. Set stone with completely filled bed, head, and collar joints. Butter vertical joints for full width before setting and set units in full bed of mortar unless otherwise indicated. Provide anchors, supports, fasteners and other attachments necessary to secure stonework in place and keep stone in level, plumb and square position with uniform joints.

5. Rake out mortar used for laying stone before mortar sets.
6. When mortar is sufficiently hard to support units, remove shims and other devices interfering with pointing of joints.

E. Provide chases, reveals, openings and other spaces as indicated for accommodating contiguous work. Close up openings in stonework after other work is in place with stonework which matches that already set.

F. Arrange stones for good fit, with pattern similar to existing stonework in the Cave, with joint widths within tolerances indicated. Arrange stones for uniformity of appearance, with color and size variations uniformly dispersed for an evenly blended appearance.

3.05 **POINTING MASONRY**

A. Rake out joints and point with mortar as follows, according to procedures demonstrated in approved mockup:

1. When mortar is thumbprint hard, tool joints to match appearance of joints in existing stonework as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.

2. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours including weekends and holidays.

a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.

b. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

3. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.06 **CLEANING**

A. Clean stone masonry as work progresses. Remove mortar fins and smears before tooling joints.

B. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff- nylon or -fiber brushes, and clean water, spray applied at low pressure.

1. Do not use metal scrapers or brushes.

2. Do not use acidic or alkaline cleaners.

C. Sweep and rake adjacent pavement and grounds to remove mortar and debris. Where necessary, pressure wash pavement surfaces to remove mortar, dust, dirt, and stains.

- - - END OF SECTION - - -

FIBERGLASS REINFORCED PLASTIC (FRP) DOORS AND FIBERGLASS RESIN TRANSFER MOLDED DOOR FRAMES MODEL CP8 PHARMACEUTICAL CONSTRUCTION SERIES SECTION 08 22 00

PART 1 GENERAL

1.01 **SUMMARY**

A. This Section Includes the Following:

1. Fiberglass Reinforced Plastic (FRP) Doors.
2. Fiberglass Resin Transfer Molded Door Frames.

1.02 **RELATED SECTIONS**

A. Related Sections Include the Following:

1. Section 01 33 00 - Submittals

1.03 **QUALITY ASSURANCE**

Test certification by independent and accredited laboratories. Reports available upon request.

A. Referenced Standards

1. Door and Frame Assembly Properties
   a. Standard test method for steady state thermal transmission properties by means of the heat flow meter apparatus.
   b. Successfully completed 1,000,000 cycles test in accordance with:
      1) AAMA 920-03 Specification for Operating Cycle Performance of Side-Hinged Exterior Door Systems.
      2) ANSI A250.4-2001 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings.
      3) NWWDA TM-7 Test Method to Determine the Physical Endurance of Wood Doors and Associated Hardware Under Accelerated Operating Conditions.
   c. Additional Testing
      1) SFBC PA 201 Impact Procedures for Large Missile Impact
      2) SFBC PA 202 Uniform Static Load on Building Components
      3) SFBC PA 203 Products Subjected to Cycle Wind Pressure
      4) SFBC 3603.2 Forced entry test
      5) ASTM E 330 Uniform Static Load
      6) ASTM E 1886 Impact and Cycling, Large Missile Impact
      7) ASTM E 1996 Specifications for Performance of Exterior Doors
      8) ASTM C 518 Standard test method for steady for state thermal transmission properties by means of the heat flow meter apparatus.
      9) ASTM D 1761 Mechanical Fasteners
2. Laminate Properties
   a. ASTM D 638 Tensile Strength

b. ASTM D 790 Flexural Strength

c. ASTM D 2583 Barcol Hardness

d. ASTM D 256 Impact Resistance

e. ASTM D 792 Density/Specific Gravity of Laminate

f. ASTM D 1761 Mechanical Fasteners

g. ASTM G 155 Gelcoat Xenon Arc light exposure test

h. ASTM D 635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

i. ASTM D 2843 Smoke Density

j. ASTM E 84 - Standard Test Method for a Surface Burning Characteristics of Building Materials.

k. ASTM D 1929 Self Ignition Temperature

3. Core Properties

a. ASTM C 177 Thermal Properties

b. ASTM D 1622 Density/Specific Gravity

c. ASTM E 84 Surface Burning Characteristics

d. WDMA TM-10 and TM-5 ASTM E 152 U.L. 10(b)

e. ASTM E90-04 – Standard Test Method for Laboratory Measurement of Airborne Sound

f. ASTM E413-04 – Classification for Rating Sound Insulation

g. ASTM E1332-90 – Standard Classification for Determination of Outdoor-Indoor Transmission Class

h. ASTM E2235-04 – Standard Test Method for Determination of Decay Rates for Use in Sound Insulation Methods

B. Qualifications

1. Manufacturer Qualifications: A company specialized in the manufacture of fiberglass reinforced plastic (FRP) doors and frames as specified herein with a minimum of 10 years documented experience and with a record of successful in-service performance for the applications as required for this Work.

2. Installer Qualifications: An experienced installer who has completed fiberglass door and frame installations similar in material, design, and extent to those indicated and whose work has resulted in construction with a record of successful in-service performance.

3. Source Limitations: Obtain fiberglass reinforced plastic doors and resin transfer molded fiberglass frames through one source fabricated from a single manufacturer. This ensures complete uniformity of physical properties and consistency in the resin chemistry tailored for this application.

4. Source Limitations: Hardware and accessories for all FRP doors shall be provided and installed by the fiberglass door and frame manufacturer.

5. Source Limitations: Glass for windows in doors shall be furnished and installed by door and frame manufacturer.

1.04 **SUBMITTALS**

A. Product Technical Data Including:

1. Acknowledgment that products submitted meets requirements of standards referenced
2. Manufacturer shall provide certificate of compliance with current local and federal regulations as it applies to the manufacturing process.
3. Manufacturer's installation instructions.
4. Schedule of doors and frames indicating the specific reference numbers as used on the OWNER's project documents, noting door type, frame type, size, handing and applicable hardware.
5. Details of core and edge construction. Include factory-construction specifications.
6. Certification of manufacturer's qualifications.

B. Submittal Drawings for OWNER approval shall be submitted prior to manufacture and will include the following information and formatting.

1. Summary door schedule indicating the specific reference numbers as used on OWNER's drawings, with columns noting door type, frame type, size, handing, accessories and hardware.
2. A drawing depicting front and rear door elevations showing hardware with bill of material for each door.
3. Drawing showing dimensional location of each hardware item and size of each door.
4. Individual part drawing and specifications for each hardware item and FRP part or product.
5. Construction and mounting detail for each frame type.

C. Samples:

1. Provide one complete manufactured door sample which represents all aspects of the typical manufacturing process, including molded-in gelcoat color and plate construction. One edge should expose the interior of the door, depicting the stile and rail, hardware reinforcement and core material.

D. Operation and Maintenance Manuals:

1. Include recommended methods and frequency for maintaining optimum condition of fiberglass doors and frames under anticipated traffic and use conditions.
2. Include one set of final as built drawings with the same requirements as mentioned in Section B above.
3. Include certificate of warranty for door and frame listing specific door registration numbers.
4. Include hardware data sheets and hardware manufacturer's warranties.

1.05 DELIVERY, STORAGE AND HANDLING

A. Each door and frame shall be delivered individually crated for protection from damage in cardboard containers, clearly marked with project information, door location, specific reference number as shown on drawings, and shipping information. Each crate shall contain all fasteners necessary for installation as well as complete installation instructions.

B. Doors shall be stored in the original container on edge out of inclement weather for protection against the elements.

C. Handle doors pursuant to the manufacturer's recommendations as posted on outside of crate.

1.06 **WARRANTY**

A. All fiberglass doors and frames have a lifetime guarantee against failure due to corrosion. Additionally, fiberglass doors and fiberglass frames are guaranteed for ten years against failure due to materials and workmanship, including warp, separation or delamination, and expansion of the core.

B. On site assistance available.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

A. Chem-Pruf Door Co., Ltd., P.O. Box 4560, Brownsville, Texas 78523 Phone: 1-800-444-6924, Fax: 956-544-7943, Website: www.chem-pruf.com

B. Tiger Door, 5224 FM 802 Brownsville, Texas 78521 Phone: 1-888-891-4416, Website: www.tigerdoor.com

C. Substitutions may be considered, provided manufacturer can comply with the specifications as written herein. Requests for substitution must be submitted in writing no less than 10 days prior to bid date. Substitution request to include a physical sample and written documentation that product will meet the specific manufacturing methods as highlighted below.

2.02 **FRP DOORS**

A. Doors shall be made of fiberglass reinforced plastic (FRP) using Class 1 premium resin with no fillers that is specifically tailored to resist chemicals and contaminants. Doors shall be 1 3/4-inch-thick and of flush construction, having no seams or cracks. Doors shall have equal diagonal measurements.

B. Door Plates shall be 0.125 inch thick minimum, molded in one continuous piece, starting with 25 mil gelcoat of the color specified, integrally molded with multiple layers of 1.5 ounces per square foot fiberglass mat and one layer of 18 ounce per square yard fiberglass woven roving. Each layer shall be individually laminated with resin as mentioned above. Door plate weight shall not be less than 0.97 lbs per square foot at a ratio of 30/70 glass to resin. Plate alone to withstand Large Missile Impact per FBC TAS 201. Face plates manufactured using the pultrusion process does not allow for a smooth molded gelcoat finish, the use of woven roving for adequate plate thickness, strength and weight, or the appropriate glass to resin ratio and will not meet the quality standards of this project.

C. Stiles and Rails shall be constructed starting from the outside toward the inside, with a matrix of at least three layers of 1.5 ounce per square foot of fiberglass mat. The stile and rail shall be molded in one continuous piece to a U-shaped configuration and to the exact dimensions of the door. In this manner there will be no miter joints and disparate materials used to form the one-piece stile and rail.

D. Core materials option to be:

1. Polypropylene plastic honeycomb core with a non-woven polyester veil for unparalleled plate bonding, 180 PSI typical compression range.

2. 2 PSF expanded polyurethane foam core, which completely fills all voids between the door plates. Foam properties ASTM E-84 comply with IBC Code.

3. As specifically requested.

E. Internal Reinforcement shall be a dense matrix of cloth glass fibers and premium resin with a minimum hinge screw holding value of 1000 lbs per screw.

F. Finish of door frame shall be identical with 25 mil resin-rich gelcoat of the specified color integrally molded in at time of manufacture resulting in a smooth gloss surface that is dense and non-porous. To achieve optimum surface characteristics, the gelcoat shall be cured within a temperature range of 120F to 170F creating an impermeable outer surface, uniform color throughout, and a permanent homogeneous bond with the resin/fiberglass substrate beneath. Only the highest quality gelcoat will be used to ensure enduring color and physical properties. Paint and/or post application of gelcoat result in poor mechanical fusion and will be deemed unacceptable for this application. The finish of the door and frame must be field repairable without compromising the integrity of the original uniform composite structure, function or physical strength.

G. Security doors are not to include any windows or louvers.

H. Transoms shall be identical to the doors in finish, construction, materials, thickness and reinforcement.

I. Door shall meet Forced Entry test pursuant to FBC requirement SFBC 3603.2 300 lb test.

2.03 **FRAMES**

J. Frames (rated and non-rated) shall be fiberglass and manufactured using the resin transfer method creating one solid piece (no voids) with complete uniformity in color and size. Beginning with a minimum 25 mil gelcoat layer molded in and a minimum of two layers of continuous strand fiberglass mat saturated with resin, the frame will be of one-piece construction with molded stop. All frame profiles shall have a core material of 2 psf polyurethane foam. Metal frames or pultruded fiberglass frames will not be accepted.

K. Finish of frame shall be identical to the door with 25 mil resin-rich gelcoat of the specified color integrally molded in at time of manufacture. To achieve optimum surface characteristics, the gelcoat shall be cured within a temperature range of 120F to 170F creating an impermeable outer surface, uniform color throughout, and a permanent homogeneous bond with the resin/fiberglass substrate beneath. Only the highest quality gelcoat will be used to ensure enduring color and physical properties. Paint and/or post application of gelcoat result in poor mechanical fusion and will be deemed unacceptable for this application. The finish of the door and frame must be field repairable without compromising the integrity of the original uniform composite structure, function or physical strength.

L. Jamb/Header connection shall be mitered for tight fit. Optional seamless one piece frame construction as indicated on the project schedules and related details.

M. Internal Reinforcement shall be continuous within the structure to allow for mounting of specified hardware. Reinforcing material shall be a dense matrix of cloth glass fibers and premium resin with a minimum hinge screw holding value of 1000 lbs per screw. All reinforcing materials shall be completely encapsulated. Documented strength of frame screw holding value after third insert must be submitted. Dissimilar materials, such as steel, will be deemed unacceptable as reinforcement for hardware attachment.

2.04 **HARDWARE**

A. Due to the special nature of the material in this section, all related hardware as specified must be furnished and installed by the door and frame manufacturer to ensure sufficient support/reinforcement, proper sealing, precision tooling and that all hardware complies with the regulations of the manufacturer's testing agencies.

B. Doors must have handles and deadbolt locking hardware on the exterior as well as rim exit devices and closers on the interior. No additional hardware should be included. Doors are to

remain unlocked during operating hours and serve as security points outside of operating hours.

PART 3 EXECUTION

3.01 INSTALLATION CONDITIONS

A. Verification of Conditions

1. Verify openings are correctly prepared to receive doors and frames.
2. Verify openings are correct size and depth in accordance with shop drawings or submittals.

B. Installer's Examination

1. Have the installer examine conditions under which construction activities of this section are to be performed and submit a written report if conditions are unacceptable.
2. CONTRACTOR shall submit two copies of the installer's report to the OWNER within 24 hours of receipt.
3. Begin construction activities of this section only after unacceptable conditions have been corrected.

3.02 INSTALLATION

A. Door shall be delivered to job site individually crated. Each crate to be clearly marked with the specific opening information for quick and easy identification.

B. All single doors to be shipped completely assembled in the frame with hardware installed. Double doors to be prehung at the factory to ensure a proper fit and that hardware functions properly, then disassembled for shipping purposes.

C. Install door opening assemblies in accordance with shop drawings and manufacturer's printed installation instructions, using installation methods and materials specified in installation instructions.

D. Field alteration of doors or frames to accommodate field conditions is strictly prohibited.

E. Site tolerances: Maintain plumb and level tolerance specified in manufacturer's printed installation instructions.

F. Fire labeled doors and frames must be installed in strict accordance with manufacturer's instructions and the latest version of NFPA 80.

3.03 ADJUSTING

A. Adjust doors in accordance with door manufacturer's maintenance instructions to swing open and shut without binding and to remain in place at any angle without being moved by gravitational influence.

B. Adjust door hardware to operate correctly in accordance with hardware manufacturer's maintenance instructions.

C. Door operation must comply with ADA requirements. Door closers should be adjusted such that doors are operable with five pounds of pressure.

3.04 CLEANING

A. Clean surfaces of door opening assemblies and exposed door hardware in accordance with respective manufacturer's maintenance instructions.

3.05 PROTECTION OF INSTALLED PRODUCTS

A. Protect door opening assemblies and door hardware from damage by subsequent construction activities until final inspection.

- - - END OF SECTION - - -

SECTION 08 42 36
BALANCED DOOR ENTRANCES

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes:

1. Balanced door and frame assemblies.
2. Adjacent sidelights/transoms.

1.02 RELATED SECTIONS

A. Related Sections Include the Following:

1. Section 01 33 00 - Submittals

1.03 REFERENCES

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2012.

B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 2012.

C. AAMA 612 - Voluntary Specification, Performance Requirements and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum; 2002.

D. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels; 2002.

E. AAMA 2604 -Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2010.

F. AAMA 2605 -Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2011.

G. ASTM B221 -Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2012.

H. ASTM B221M -Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2012.

I. BHMA A156.18 -American National Standard for Materials and Finishes; Builders Hardware Manufacturers Association, Inc.; 2012 (ANSI/BHMA A156.18).

J. SSPC-Paint 20 -Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

K. SSPC-Paint 25 -Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II; Society for Protective Coatings; 1997 (Ed. 2004).

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing balanced doors with minimum 10 years of documented experience with a record of successful in-service performance for the applications as required for this Work.

B. Installer Qualifications: An experienced installer who has completed balanced door and frame installations similar in material, design, and extent to those indicated and whose work has resulted in construction with a record of successful in-service performance.

C. Source Limitations: Hardware and accessories for all balanced doors shall be provided and installed by the balanced door and frame manufacturer. Certified hardware installer must be qualified in accordance with UL10(b), UL10(c) and FBC.

D. Source Limitations: Glass for windows in doors shall be furnished and installed by door and frame manufacturer.

1.05 **SUBMITTALS**

A. Submittal shall conform to Section 01 33 00 - Submittal Procedures.

B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.

C. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in OWNER's name and registered with manufacturer.

1.06 **DELIVERY, STORAGE, AND HANDLING**

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to metal when exposed to sunlight or weather.

1.07 **FIELD CONDITIONS**

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Balanced Door Entrances:

1. C.R. Laurence Co., Inc; U.S. Aluminum Balancer Series All Glass Balanced Doors: www.crl-arch.com.

2. Substitutions may be considered, provided manufacturer can comply with the specifications as written herein. Requests for substitution must be submitted in writing no less than 10 days prior to bid date. Substitution request to include a physical sample and written documentation that product will meet the specific manufacturing methods as highlighted below.

2.02 **BALANCED DOORS AND FRAMES**

A. Doors: All Glass Balanced Doors:

1. Heavy-duty 2 inches (51 mm) doors, 0.188 inch (5 mm) wall thickness; glazing pockets accepting ½ inch (12 mm) to ¾ inch (19 mm) tempered, non-tinted glass.

2. Top Rails:

a. 4 inches (102 mm).

3. Bottom Rails:

b. 10 inches (254 mm).

4. Mini Stiles:

c. 1 inch (25 mm).

B. Glazing Thickness: ½ inch (12 mm) or ¾ inch (19 mm) tempered, non-tinted glass.

1. Exposed glass edge: Flat polished.

C. Hinge shaft exposed or concealed in jamb of frame.

D. Frame Jambs: 2-1/2 inches face width, 5 inches deep (63 mm face width, 127 mm deep) or 2 inches face width, 4-1/2 inches deep (50 mm face width, 114 mm deep).

E. Headers: Same depth as jambs by 2-7/8 inches (73 mm) height.

F. Finish: Cladding over aluminum in 18 gauge, Grade 316 stainless steel, BHMA 629, Satin.

2.03 **BALANCED HARDWARE**

A. Operation:

1. Manual operation: Manual balanced door system. The customized cast iron hydraulic speed control with back checking feature is manufactured by LCN. This unit meets ANSI standards and is designated as a “Grade 1” speed control. The speed control is concealed in the head frame and has latch, general, and back check adjustments. The speed control is removable without requiring the removal of the door, head frame or any other structural members of the balanced door system.

B. Balanced Hardware:

1. Balanced door hardware is machined and assembled by the door and frame fabricator.
2. Cast iron hydraulic speed control and other integral parts are heavy-duty and designed to allow variation in adjustments to meet this particular job with respect to door size, door weight, and varying or internal building pressures.
3. Balanced hardware consists of the following items:
   a. Manual speed control is concealed in the head frame. The unit is removable without requiring the removal of the door, head frame or any other hardware.
   b. Heavy-duty steel tube hinge shaft is 1-3/4 inch (44 mm) diameter with 3/16 inch (4.8 mm) minimum wall thickness. Hinge shaft is furnished complete with integral closing force spring: adjustments are made with a floor gear box to meet ambient wind or building pressure conditions. Top and bottom arms (as specified below) are bolted to hinge shaft with expanding hardened steel wedges. When door leaf exceeds 350 pounds (158.8 kg), arms shall be welded to hinge shaft. Two-piece arms will not be acceptable except when installed at flush ceilings.
   c. Hardware includes a spring-cushioned door roller bumper located in the guide channel. The operating mechanisms in the head include ball bearing pivots, and manual speed control guide channel. Guide roller is of self-aligning design with no lubrication needed.
   d. Means are provided which make possible field adjustment for proper perimeter clearance of each door leaf in relation to its finished framework to accommodate on-site conditions.
   e. Manual doors have a semi-automatic hold open device located in the bottom rail.
   f. A.D.A. compliant openings: doors designated as handicap entrances have a maximum of 8 lbs. (3.63 kg) spring tension adjustment at pull handle. The clear opening is a minimum of 32 inches (812 mm) or greater depending on local codes. The hydraulic speed control shall be adjusted so that from an open position of 70 degrees, the door will take at least three seconds to move to a point 3 inches (76.2 mm) from the latch, measured to the leading edge of the door (optional time delay closer is available if desired; consult factory).
4. Exposed balanced hardware: pivot points in top and bottom arms contain self-aligning radial bearings and thrust bearings where applicable. Arms and pivots are one-piece stainless or bronze castings or aluminum extrusions, finished as specified.

C. Finish hardware by door manufacturer:

1. Standard locking: Sargent 8800 series rim exist devices or equivalent with lever handles on the pull side.
2. Standard push-pull hardware.

3. Doors are to act in pairs as airlocking devices with only one outward door opened at a time. Extra strength latches and hurricane rated hardware are to be considered when necessary.

2.04 **MATERIALS**

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless Steel.

C. Exposed Flashings: 0.032 inch (0.8 mm) thick aluminum sheet; finish to match framing members.

D. Concealed Flashings: 0.018 inch (0.5 mm) thick galvanized steel.

E. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

F. Shop and Touch-Up Primer for Steel Components: SSPC-Paint 25, zinc oxide, alkyd, linseed oil primer.

G. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

PART 3 EXECUTION

3.01 **INSTALLATION**

A. Install units in accordance with manufacturer's instructions.

B. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.

C. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

D. Provide alignment attachments and shims to permanently fasten to building structure.

E. Align units plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

F. Install perimeter sealant.

G. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.02 **ADJUSTING**

A. Adjust operating mechanisms for proper swing and closing speed.

B. Door operation must comply with ADA requirements. Door closers should be adjusted such that doors are operable with five pounds of pressure.

3.03 **CLEANING**

A. Remove protective material from pre-finish metal surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

3.04 **PROTECTION**

A. Protect installed products from damage during subsequent construction.

- - - END OF SECTION - - -

SECTION 09 51 00
SUSPENDED TILE CEILINGS

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope: Work under this Section includes all materials and installation necessary to provide Suspended Tile Ceilings, as specified herein.

1.02 QUALITY ASSURANCE

A. References:

1. General: Provide completely designed system complying with Section 808 of CBC and specified herein.
2. Ceilings and Interior Systems Contractors Association (CISCA): Acoustical Ceilings, Use and Practice.
3. Underwriters Laboratory (UL): Fire Resistance Directory and Building Material Directory.
4. AC 368: Acceptable Criteria for Suspended Ceiling Framing Systems

B. Qualifications: Installer specializing in the work of this Section with minimum three (3) years documented experience.

1.03 SUBMITTALS

A. General: Refer to Section 01 33 00 – Submittals.

B. Shop Drawings: Submit shop drawings showing suspension system details and reflected ceiling plans indicating location of light fixtures, mechanical air supply and return outlets and other items affecting ceiling construction. Identify locations of types of suspension systems and types of panels or tile including access panels, where required.

C. Samples:

1. Ceiling Panel: Submit manufacturer's standard color range.
2. Suspension System: Submit manufacturer's standard color range.

D. Product Data: Manufacturer's specification, data, and installation instructions.

E. Certificates: Manufacturer's certified test reports for each specified NRC and STC requirement.

1.04 MAINTENANCE

A. General: Section 01770 – Closeout Procedures.

B. Extra Stock: Deliver an extra ten (10) percent or a minimum of one full container of each kind and type of ceiling panel material installed.

C. Guarantee: On form provided at end of Section 01780 – Closeout Submittals, provide one (1) year written guarantee commencing from date of final acceptance by OWNER.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manufacturer:

1. Specified products are manufactured by McNichols Co., Inc., unless otherwise indicated.

B. Ceiling Panels

1. Item #1738916338 in Manufacturer Catalog, or approved equivalent.
2. Aluminum alloy 3003-H14.
3. Perforated Metal; round perforations, 14 Gauge (0.0630” thick), 3/8” round perforations on 9/16” staggered centers, 40% open area.
4. 24 inch by 24 inch.
5. 0.53 pounds per square foot.
6. Mill finish

C. Ceiling Suspension System:

1. Exposed system of aluminum components; fire endurance rated where shown, complying with DSA IR 47-4
2. Standard Sections: Heavy-duty (16 lb/ft) main and cross runner members, assembly devices, wall moldings; other accessories as required
3. Hanger Wires: 12 gauge when spaced at 4 ft. or 10 gauge when spaced at 5 ft., stainless steel wire of gage certified by load test data as capable of carrying five (5) times design load.
4. Finish: Mill finish aluminum.

PART 3 EXECUTION

3.01 PREPARATION

D. Examination: Examine conditions of work in place before beginning work; report defects.

E. Surface Preparation: Comply with ASTM C636 Article 3, Interference of Ceiling Related Components; coordinate requirements with other trades. Verify that required work has been installed above ceiling and that perimeter wall work, where ceiling abuts, is completed.

3.02 INSTALLATION

A. General: Install in conformance with referenced standards, manufacturer's written directions, as shown, and as specified.

B. Ceiling Suspension System:

1. General: Conform to ASTM C636 and ASTM E580 and 4701(E) of CBC and suspension system manufacturer's instructions, non-cumulatively; main runners at 4'-0" on center, with support wires at 4'-0" on center, maximum; exposed members parallel with one another, in grid layout.
2. Splices and Intersections: Install with interlocking device that draws members tightly together and prevents torsional deflection.
3. Compression Struts: Install as directed by manufacturer.
4. Perimeter Molding and Grid: Install intersections so fastenings are concealed.
5. Tolerances: Erect ceiling system level within ⅛” in 12'-0" in any direction.
6. Unattached ends of the grid system must have minimum ¾” clearance from the wall.
7. Hanger wires must be plumb within 1 in 6 unless counter sloping wires are provided.

8. Hanging and seismic bracing wires must be 6” minimum clear from unbraced conduits, pipes, ducts, etc., and 1” minimum from braced conduits, pipes, ducts, etc.

C. Ceiling Panels: Install in ceiling suspension system.

3.03 **ADJUSTMENT**

A. General: Adjust sags or twists which develop in ceiling systems; replace improperly installed or damaged suspension system components and acoustical panels, as directed by OWNER.

B. Tolerances:

1. Maximum Variation from Flat and Level Surface: ⅛” in 10'-0".

2. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.04 **CLEANING**

A. General: Upon completion, thoroughly clean exposed surfaces per manufacturer's instructions.

- - - END OF SECTION - - -

SECTION 09 77 00
SPECIAL WALL SURFACING

PART 1 GENERAL

1.01 DESCRIPTION

A. Section Includes: Durable, decorative wall panels with smooth or textured finishes. Mounting hardware, adhesives, accessories and trims.

1.02 REFERENCES

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

B. ASTM International:

1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM D256 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
3. ASTM D638 Standard Test Method for Tensile Properties of Plastics.
4. ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
5. ASTM D2583 Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

1.03 SYSTEM DESCRIPTION

A. Performance Requirements: Provide durable, decorative wall panels which have been manufactured and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

1.04 SUBMITTALS

A. General: Refer to Section 01 33 00 Submittals

B. Product Data: Submit manufacturer's product data, storage, handling and preparation requirements and installation instructions.

C. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors, patterns and textures. Indicate location and dimension of joints and fastener attachment.

D. Samples: Submit selection and verification samples for finishes, colors and textures. Submit 2 samples of each type of panel, trim and fastener.

E. General: Firm experienced in successful production of wall system similar to that indicated for the Project.

F. Quality Assurance/Control Submittals: Submit the following:

1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

2. Certificates:
   a. Submit manufacturer's certificate that products meet or exceed specified requirements.
   b. Submit certificate of installer's qualifications.
3. Manufacturer's Instructions: Manufacturer's installation instructions.

G. Closeout Submittals: Submit the following:
1. Operations and Maintenance Data: Operation and maintenance data for installed products in accordance with Section 01 78 00 – Closeout Submittals. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.
2. Warranty documents specified herein.

1.05 QUALITY ASSURANCE

A. General: Comply with Section 01 40 00 Quality Control/Assurance

B. Installer Qualifications: Installer shall have a minimum of 5 years experience with composite wall panel work similar in scope and size to this project.

1.06 DELIVERY, STORAGE & HANDLING

A. Lead Time: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
1. Store panels indoors.
2. Lay panels flat. Do not stand panels on edge.
3. Protect panels from moisture.
4. Do not store panels in contact with the floor or against an outside wall.
5. Do not remove protective film from panel surface until after installation (if applicable).
6. Maintain optimum storage conditions of 60-75 degrees F (16-24 degrees C) at 35 - 55% relative humidity. Avoid extremes in temperature and humidity.

D. Handling: Remove foreign matter from face of panel by using a soft bristle brush, avoiding abrasive action.

1.07 PROJECT/SITE CONDITIONS

A. Install panels between 60 degrees F - 75 degrees F and relative humidity below 55%, ideally at the same conditions as the room's normal operating temperatures after building is occupied.

B. Provide ventilation to disperse fumes during application of adhesive as recommended by adhesive manufacturer.

C. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.
1. Wall, ceilings, floors and openings must be level, plumb, straight, in-line and square.

1.08 **WARRANTY**

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

PART 2 PRODUCTS

2.01 **Composite Wall Panels**

A. Manufacturer: Nudo:

1. Contact: 1500 Taylor Avenue, Springfield, IL 62703; Telephone: (800) 826-4132, (217) 528-5636; Fax: (217) 528-8722; E-mail: info@nudo.com ; website: www.nudo.com.

B. Proprietary Products/Systems: Composite wall & ceiling panels, including the following:

FiberCorr™ Wall Panels:

FiberCorr: Corrugated polypropylene core with a Fiberglass Reinforced Plastic (FRP) face

Texture: Pebbled

High Pressure Laminate (HPL): NA Thickness: 0.400"

Fire-Rating Class: C

Color: Standard Finish: Black (806

Size: As indicated on drawings.

Physical Properties:

1. Flexural Strength (ASTM D790): 2,407 lbf/in2.
2. Flexural Modulus (ASTM D790): 105,782 psi.
3. Tensile Strength (ASTM D638): 1,121 psi.
4. Barcol Hardness (ASTM D2583): --
5. Izod Impact (ASTM D256): 2.87 ft-lb/in.
6. Surface Burning Characteristics (ASTM E84): Class C.

2.02 **PRODUCT SUBSTITUTIONS**

Substitutions: No substitutions permitted.

PART 3 EXECUTION

3.01 **MANUFACTURER'S INSTRUCTIONS**

A. Adhesive: Provide panel adhesive as recommended by panel manufacturer.

B. Trim and Seam Treatment:

1. Manufacturer: Acceptable to panel manufacturer.
2. Material and Color: Color matched acrylic latex caulk.
3. Material and Color: Standard PVC Moldings -Black

C. Fasteners: Provide appropriate fasteners and accessories as required to properly complete installation.

3.02 **PREPARATION**

A. Comply with the instructions and recommendations of the durable, decorative wall panel manufacturer.

Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions. Verify that site conditions are acceptable for installation of durable, decorative wall panels. Examine back-up surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails are countersunk and joints and cracks are filled flush and smooth with the adjoining surface. Do not proceed with installation of durable, decorative wall panels until unacceptable conditions are corrected.

3.03 **INSTALLATION**

A. General: Prior to installing panels, remove packaging and allow panels to acclimate to room temperature and humidity for at least 48 hours.

Wall substrate must be dry and free from dirt, dust, grease and other contaminants. Walls must be flat and even. Remove high spots and fill low spots with material acceptable to panel manufacturer.

Remove wallpaper, soluble or loose paint and other foreign matter that might interfere with proper adhesive bond. Painted walls must be prepared to adhesive manufacturer specifications for proper adhesion.

B. General:

Inspect panels for any defects immediately. Do not install panels of unacceptable quality. Field cutting of all wall systems should be accomplished using a circular saw with fine tooth carbide blade.

Position panel so that the saw blade enters the finished HPL side first to avoid chipping or damage. Protect decorative laminate face of panel by covering work area, do not remove protective will until after installation.

Follow adhesive manufacturer's recommendations for appropriate height of adhesive bead left by trowel and do not allow adhesive to skin over. When interior paneling is on an exterior wall or wet area, provide a barrier sheet and/or follow the adhesive manufacturer's installation recommendations for a secure bond.

C. For installation to studs or furring straps, for non-composite wall system applications, use mechanical fasteners spaced 24 inches on center (O.C.) Furring straps shall be no less than 18 gauge 3-1/2 inches wide. Joint Seam Treatment: Install panels using the following method.

Color matched acrylic latex caulk.

D. Installation Using Caulk:

1. Plan panel layout so seams are not directly over seams of substrate.
2. Apply adhesive directly to back of composite wall panel with 100% adhesive coverage using crosshatch pattern. Extend adhesive to all edges of panel.
3. Install panel. Place six-penny finishing nails at 1/8 inch (3.2mm) spacing against the panel about 2 feet (610mm) apart to hold panels in place while adhesive sets and provide proper spacing for color caulk. Continue installing panels using this method, leaving nails in place during installation.

4. Remove nails after adhesive sets.
5. Place a narrow piece of masking tape along panel edge from top to bottom, exactly at joint edge. Firmly apply tape to both panels.
6. Fill 1/8 inch (3.2mm) gap between the panels with caulk, making sure gap is completely filled.
7. Tilt caulking tube back from vertical so that tip of tube advances first in direction of travel.
8. Wet finger and smooth bead if necessary.
9. Remove masking tape before bead cures. Clean off excess caulk with damp cloth.
10. Install corner moldings as described in molding instructions.

3.04 **CLEANING**

A. Clean panel surfaces in compliance with manufacturer's recommendations.

1. Use a clean, damp, nonabrasive cotton cloth and a mild liquid detergent or household cleaner.
2. Rinse with clean water using a clean, nonabrasive cotton cloth.
3. Dry panels with a soft, clean nonabrasive cotton cloth.
4. Do not use cleaners containing acid, alkali or sodium hypochlorite.

3.05 **PROTECTION**

A. Protect installed work from damage due to subsequent construction activity on the site.

- - - END OF SECTION - - -

SECTION 26 05 36
CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes cable trays for electrical wiring.

1.02 SUBMITTALS

A. Product Data: For cable trays, fasteners, fittings, hangers.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1.03 RELATED WORK

A. Section 01 33 00 - Submittals

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. Electrical equipment and materials shall be new and within one year of manufacture, complying with the latest codes and standards. No used, re-built, refurbished and/or re-manufactured electrical equipment and materials shall be furnished on this project.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in unopened cartons or bundles as appropriate, clearly identified with manufacturer's name, Underwriters' or other approved label, grade or identifying number.

B. Store in clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect equipment and material from dirt, water, construction debris, and traffic.

PART 2 PRODUCTS

2.01 CABLE TRAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton; B-Line Series
2. MP Husky
3. Hoffman.
4. Schneider Electric.

B. All straight tray sections, angles, offset, corners, cable dropouts, reducers, splice plates, coupling connectors, including tray fittings and hardware shall be from the same selected manufacturer.

C. Bends, both horizontal and vertical, shall have a minimum center radius of 12 inches (300 mm), unless otherwise indicated.

D. Trays shall have an overall side rail height of 4 inches (100 mm) with a minimum loading depth of 3 inches (75 mm). Tray width shall be 18 inches (450 mm).

E. Fittings and Accessories: Include couplings, reducers, splice plates, trapeze-style hangers, threaded rod, and other fittings to match and mate with cable trays as required for complete system.

F. Finish for Cable Trays, Fittings, and Accessories: Suitable for marine environments, Aluminum or 316 Stainless Steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install cable tray in accordance with manufacturer's instructions and Construction Drawings.

B. Support cable tray system on 8-foot centers (maximum), at bends, and tee fittings in accordance with the manufacturer’s recommendation, codes and standards, and construction documents.

C. Connect sections of cable tray together with edges free from burrs and sharp projections.

D. Cable tray shall be supported on trapeze-style hangers, sized to support 18-inch wide cable trays, and 3/8 inch diameter threaded-rod hangars from roof rock. The tray supports shall be spaced in accordance with the requirements of NEC and manufacturer. Refer to Construction Drawings for additional installation details.

E. Where cable trays meet balanced door entries, tray will terminate approximately 2 inches from window or FRP panel and cables will continue through grommets installed in the window or FRP panel as shown in the Construction Drawings.

F. Tray system shall be assembled as one raceway system in accordance with the Construction Drawings. Splice plates shall be used for connecting straight sections and fittings with provision for thermal expansion. The nuts and bolts shall be installed so as not to damage the cables during their pull in the trays.

- - - END OF SECTION - - -

SECTION 31 00 00
EARTHWORK

PART 1 GENERAL

1.01 DESCRIPTION

A. The work under this section includes the furnishing of all labor, equipment and materials, and completing all operations in connection with backfilling, compacting, grading, placing soil materials and all other incidental work necessary for construction according to Contract drawings and technical Specifications.

B. The CONTRACTOR shall comply with all Laws and Codes.

C. The CONTRACTOR shall locate all existing active and abandoned utilities and structures in work areas prior to commencing any excavation activities and shall protect from damage those utilities and structures which are to remain in place. This work requires the use of a third party, private locate service.

1.02 RELATED WORK

A. Carefully examine the Contract for requirements affecting the Work in this section.

B. Other specification sections containing requirements relating to this section include, but are not limited to, the following:

1. Section 01 45 29 – Testing Laboratory Services
2. Section 01 57 13 - Temporary Erosion and Sediment Control

1.03 PROTECTION OF PEOPLE AND PROPERTY

A. The CONTRACTOR shall plan and conduct operations in accordance with Laws and Codes, including OSHA and local codes and ordinances, so as to prevent damage to existing structures, safeguard people and property, minimize traffic inconvenience, protect the structures to be installed, and provide safe working conditions.

B. The CONTRACTOR shall control stormwater such that run-on and run-off do not affect the quality of receiving wetlands, brooks, streams, or rivers. The CONTRACTOR shall be responsible for cleaning (removal of silt) stormwater structures (swales, culverts, basins) as needed during construction, after stabilization of project areas, and at the conclusion of Work prior to Demobilization.

C. The CONTRACTOR shall be responsible for protecting existing environmental conditions and devices within the limits of work. Any damage to existing environmental conditions and devices resulting from construction activities shall be the responsibility of the CONTRACTOR to correct at no additional cost to the OWNER.

D. CONTRACTOR shall be solely responsible for proper excavation procedures including, but not limited to, safe slope angles. The presence of the ENGINEER and OWNER shall not relieve the CONTRACTOR of his responsibility to properly design and maintain safe slope angles.

E. The CONTRACTOR shall not stockpile any material without OWNER approval. Stockpile location shall be approved by the ENGINEER and OWNER.

1.04 REFERENCES

A. ASTM D6913 Standard Test Methods for Particle Size Distribution (Gradation) of Soils Using Sieve Analysis

B. ASTM D698 Laboratory Compaction Characteristics of Soil Using Standard Compaction Effort

C. ASTM D2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System)

D. ASTM D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

E. ASTM D422 Standard Test Method for Particle Size Analysis of Soils

F. ASTM D4318 Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.05 **TOLERANCES**

A. Grading tolerance for all fill and backfill shall be +0.1 feet.

1.06 **QUALITY ASSURANCE**

A. The CONTRACTOR shall be an experienced earthwork CONTRACTOR who has at least five years of experience. The CONTRACTOR shall have completed at least three projects with the same material and of similar scope as that indicated for this project with a successful installation and maintenance record of in-service performance.

B. The CONTRACTOR is required to demonstrate compliance to the above requirements to the satisfaction of the ENGINEER and OWNER.

C. The CONTRACTOR shall cooperate with the ENGINEER and the Owner's Representative in obtaining samples for testing, if required, and conducting in-situ tests during the construction period. The CONTRACTOR shall provide all necessary labor, equipment, and material to refill sample locations as directed.

D. If the tests conducted on a particular lift of the placed material do not meet required specifications, the CONTRACTOR shall be responsible for any expenses incurred performing additional tests following re-compaction of the material until passing test results are achieved.

PART 2 PRODUCTS

2.01 **MATERIALS**

A. All backfill and fill materials, unless otherwise specified, shall consist of suitable, selected, and approved (by the OWNER) soil from borrow areas.

B. No frozen earth shall be used for backfill and fill, and no fill or backfill shall be placed over frozen surfaces. All backfill and fill materials shall be free from all perishable and objectionable (as described below) materials. All fill shall be protected from frost if the ENGINEER or OWNER judges frost will prevent the material from performing as required.

C. All required fill materials shall be free from organic materials, wood, trash, and other objectionable materials which may be compressible or which cannot be properly compacted. It shall not contain rock fragments, broken concrete, masonry rubble, or other similar materials. It shall have physical properties such that it can be readily spread and compacted to the specified density. Snow, ice, and frozen soil shall be removed from fill material prior to placement.

D. Remediated contaminated soil shall not be permitted as backfill or fill material.

2.02 **SINKHOLE BACKFILL**

A. Limestone from a locally available quarry with greater than 80% being particles between 1 and 2 feet in diameter. If a local economic source can not be found, then a change in gradation may be made by the ENGINEER.

PART 3 EXECUTION

3.01 **PREPARATION**

A. The CONTRACTOR shall establish and identify required lines and levels.

B. The CONTRACTOR shall maintain benchmarks, monuments, and other reference points and reestablish them if disturbed or destroyed, at no cost to OWNER.

C. Before start of grading, the CONTRACTOR shall establish the location and extent of utilities in the work areas. The CONTRACTOR shall notify utilities to remove and relocate lines that are in the way of construction and are not to be relocated as a part of the work covered by these specifications.

D. The CONTRACTOR shall maintain, protect, reroute, or extend as required existing utilities to remain in place that pass through the work area.

E. The CONTRACTOR shall develop access to the construction area in accordance with the requirements of the drawings and ash conditions, per OWNER's approval.

F. The CONTRACTOR shall install silt fences as needed to prevent erosion immediately downslope of each area to be disturbed prior to the beginning of work in that area. The CONTRACTOR shall maintain the silt fences for the duration of construction. Accumulated sediment behind the silt fences shall be disposed of on-site by the CONTRACTOR in a manner approved by the OWNER.

G. Diversion ditches, either permanent or temporary, shall be constructed in accordance with the drawings and as necessary to control surface water. The CONTRACTOR shall be responsible for constructing diversion ditches as required to divert run-on around the construction area and maintain the diversions until approved by the OWNER and ENGINEER.

H. The CONTRACTOR shall install barriers and other devices to protect areas adjacent to construction.

3.02 **GRADING**

A. Diversion Berm Structural Fill

1. Uniformly grade areas to a smooth surface, free of irregular surface changes. Provide a smooth transition between existing grades and new grades.

2. Unless otherwise specified, place backfill material in lifts of not more than nine inches in compacted depth for material compacted by heavy construction equipment, and not more than four inches in loose depth for material compacted by hand-operated tampers.

3.03 **FILL**

A. Diversion Berm Structural Fill

1. Construct stormwater diversion berm as shown on the construction drawings.

2. Place fill material in lifts no greater than nine inches compacted depth.

3. Compact fill material to a minimum percentage of the maximum dry density as determined by a standard Proctor (ASTM D698) as shown in the table below:

Material Type / Use	Compaction Requirement	Moisture Content
Fill	90%	-2% to +4%

4. Fill material in place, which does not meet the density requirements, shall be recompacted or removed and reworked to meet density objectives.

5. Do not place or compact fill material during sustained period of temperatures below 32°F.

6. Employ a professional land surveyor licensed in Arkansas to confirm elevations and locations.

B. Sinkhole Backfill

1. Backfill sinkhole with stone from ground surface using an excavator. Stone should be added until sinkhole is choked off and then backfilled to just above ground surface level.
2. May take several fillings.
3. CONTRACTOR should watch for signs of sloughing, settling, or other instability during backfilling.

3.04 **PROTECTION AND ACCEPTANCE**

A. Protect the finished surface from erosion, desiccation, or other damage.

B. Develop a contingency plan for responding to construction deficiencies due to inclement weather, defective materials, and construction inconsistent with the Technical Specifications. The plan shall provide a methodology for selecting and implementing corrective action.

C. Portions of the work damaged due to exposure shall be reworked to meet the Technical Specifications or, at the discretion of the ENGINEER and OWNER, removed and replaced with conforming material at no additional cost to the OWNER.

- - - END OF SECTION - - -

SECTION 31 09 13
INSTRUMENTATION AND MONITORING

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes furnishing, installing, and monitoring of geotechnical instrumentation, as well as repair, calibration and maintenance of the same, to monitor ground movements within, around, and above tunnel excavations.

B. Definition of Instrument Types

1. Crack Gauges – A crack gauge is used to monitor horizontal or vertical movement across a crack on a relatively flat surface via two planes that are attached on opposite side of the crack such that as the crack moves the planes move separate from one another.

2. Mechanical Extensometer – A mechanical extensometer (telltale) device measures the displacement or deformation in rock. It gives a visual indicator of displacement to provide information regarding the strata condition and includes a flashing indicator light once a defined threshold is reached. Spring anchors are used to locate a set of wires at different heights inside a borehole. The wires are connected to the visual indicator measurement mechanism. Any dilation or bed separation of the strata will appear to pull the indicators along their axis showing how much each anchor has moved.

1.02 SUBMITTALS

A. Submittal shall conform to Section 01 33 00 - Submittals

1.03 QUALITY ASSURANCE

A. Section 01 40 00 - Quality Control/Assurance

PART 2 PRODUCTS

2.01 MECHANICAL EXTENSOMETER

A. Trolex RMT Auto-Warning Telltalle (AWTT), or approved equivalent.

2.02 CRACK GAUGE

A. Humboldt Crack Gauge Plus, or approved equivalent.

PART 3 EXECUTION

3.01 MECHANICAL EXTENSOMETER INSTALLATION

A. Scaling: Prior to installation of instrumentation, carefully scale (remove) loose and unstable rock form the tunnel ribs and roof. Precautions

B. Install Mechanical Extensometers in strict accordance with manufacturer's instructions.

1. The installation should be carried out by a competent person.

2. Each installation should be considered with reference to local safety regulations and authorities.

3. The mechanical extensometer shall be mounted directly into the roof with the mining extensometer body being positioned in any degree of angle about the borehole center. Orientate as required for best scale visibility.

4. A single extensometer monitoring point will be placed at approximately 8 feet above the tunnel roof.

5. The trigger threshold shall be set at 5mm of travel.

6. Holes for mechanical extensometers shall be drilled radially to the cavern curvature or other orientation to best suite actual field conditions. Generally, holes shall be drilled perpendicular to the rock surface.
7. The hole for each mechanical extensometer shall be percussion drilled to uniform diameter of 1-3/8 inches for the entire length of the hole. Holes shall be cleaned of all drill cuttings, sludge, and debris prior to insertion of mechanical extensometer.

3.02 **CRACK GAUGE INSTALLATION**

C. Install Crack Gauges in strict accordance with manufacturer's instructions.

1. Fix the crack monitor over the crack with the vertical zero line on the calibration scale parallel with the crack to be monitored.
2. Use screws or approved non-toxic adhesive to attach the crack gauge pieces to either side of the crack.
3. Perform an initial reading, which should be zero movement, but may be different based on installation challenges.

3.03 **MECHANICAL EXTENSOMETER MEASUREMENT**

A. Measure Mechanical Extensometers in accordance with manufacturer's instructions.

1. During routine measurement, check convergence and confirm any movement using a laser distance meter or tape extensometer and convergence pins.

3.04 **CRACK GAUGE MEASUREMENT**

B. Measure the Crack Gauge in strict accordance with the manufacturer's instructions.

1. If the crack opens or closes the cursor moves relative to the calibration scale. The opening or closing of the crack can then be recorded on the record sheet on the reverse of these instructions.
2. Use digital or vernier calipers for measurements of ±0.1 millimeters.

3.05 **MAINTENANCE**

A. The maintenance of the product must only be carried out by a competent person. Maintenance shall be considered in reference to the local safety regulations and authorities.

B. Refer the manufacturers' instruction for the correct way to perform maintenance on the installed mechanical extensometer and/or crack gauge.

3.06 **PROTECTION AND CLEAN-UP**

A. Protection: Protect adjacent walls, windows, doors, other building surfaces, and natural Cavern environment from damage by fallen rock from drilling and installation activities.

1. Construct a sealed dust partition to confine debris and dust to immediate work area.
2. Immediately clean all debris, spilled adhesive, and excess materials and remove all scaled rock from site.

- - - END OF SECTION - - -

SECTION 31 33 13
GROUND SUPPORT WITH ROCK BOLTING AND GEOSYNTHETIC MESH

PART 1 GENERAL

1.01 DESCRIPTION

This section specifies the requirements for materials, proportioning, and application of ground support with rock bolting and geosynthetic mesh as shown on the Drawings, and/or as directed by the OWNER. Ground support measures are intended for support in underground caverns/excavations to maintain safe working conditions and control ground movements.

1.02 RELATED WORK

A. Section 01 45 29 – Testing Laboratory Services

B. Section 03 37 13 – Shotcrete

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittals.

B. At least 30 days prior to installation the following shall be submitted to the OWNER:

C. Working drawings and installation procedures and details of each element of the ground support system.

1. Qualification and at least one reference for foreman in charge of rockbolt installation.

D. At least 7 days prior to first use on site:

1. Manufacturer's certificates for rockbolts, hardware, resin grout, and geosynthetic mesh.
2. Calibration certificates for equipment to be used for rockbolt testing.
3. Description of proposed equipment for handling water in the tunnels.

1.04 QUALITY CONTROL

A. CONTRACTOR Qualifications.

1. The installation of ground support shall be under the direct supervision of an individual having at least five years' experience in similar installation of support in tunnels.
2. Installation of support elements shall be in accordance with the recommendations of the support element manufacturer as applicable.

1.05 PRECONSTRUCTION TESTING

A. Rockbolt Anchorage Pull Tests

1. The anchorage capacity of the rockbolts shall be determined in the field by rockbolt anchor pull testing. The anchorage tests will be performed before installation of production anchors. Pullout tests should be conducted in accordance with ASTM D4435. The test program shall be conducted in an area near the Cavern exit at a location designated by the OWNER.
2. All necessary torque wrenches, hydraulic jacks, dial gauges and related equipment shall be provided by the CONTRACTOR. All testing and measuring equipment must be calibrated by an independent testing laboratory operating under ASTM E329 not more than 30 days prior to their first use on site.

3. The length of the anchorage for resin anchored bolts shall be determined by a minimum of three anchor pull tests. Each of the tests shall use a different length of fast setting resin anchor.
4. Test rockbolts shall not be incorporated into any ground support.
5. Test rockbolts and end hardware shall be the same as used in the production rockbolts.

1.06 CONSTRUCTION TESTING

A. Rockbolt Performance Tests

1. Performance tests of rockbolts will be completed to ensure that the CONTRACTOR's equipment and personnel on site are able to install rockbolts in a satisfactory manner in accordance with these Specifications and to ensure that production rockbolts met the required performance criteria. Pullout tests should be conducted in accordance with ASTM D4435.
2. The conditions requiring performance testing and the number of bolts to be tested shall be as follows:
   a. Three rockbolts will be performance tested prior to the installation of the first production bolts, these tests are in addition to the anchorage pull tests.
   b. Two of the first five rockbolts will be tested when new personnel are used for rockbolt installation.
   c. On the average, one rockbolt will be tested for every 50 rockbolts installed.
   d. the frequency of testing can be modified by the OWNER to one rockbolt for every 100 rockbolts upon successful demonstration of compliance with designated requirements.
3. Performance tests shall be completed under the direction of the OWNER. The OWNER shall determine which rockbolts will be tested.
4. Untensioned Rockbolts – This test will be performed on an untensioned rockbolt once all the resin (i.e. fast set and slow set) has set. The test entails tensioning the rockbolt to 80% of the yield strength of the bolt for a period of three minutes. During the three-minute period, the CONTRACTOR shall take continuous measurements of the load and displacement of the rockbolt head. An acceptable test shall be one in which the outward displacement of the head and the applied load remain constant, within the accuracy of the measuring instruments, over at least the last minute of the test period. This test will be used to verify the completed rockbolt installation.
5. After an acceptable test, the bolt shall be completed as a production rockbolt.
6. If any rockbolt fails to meet the requirements of an acceptable performance test due to poor workmanship, faulty material, or not following the manufacturer's recommendations, the CONTRACTOR will be required to replace the failed bolt at no cost to the OWNER. If any rockbolt fails due to poor rock conditions, the rockbolt will be paid for by the OWNER as an acceptable bolt.

1.07 DELIVERY, HANDLING, AND STORAGE

A. Resin grout used for installation of rockbolts shall be delivered in the manufacturer's original containers. Each container shall be marked with its expiration date. Once materials have reached the expiration date, they shall not be used and shall be removed from the site of the work. The resin shall be stored in the conditions recommended by the Manufacturer.

1.08 REFERENCES

A. American Society for Testing and Materials (ASTM):

B. ASTM A36 – Standard Specification for Structural Steel

C. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware

D. ASTM A325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength

E. ASTM A436 – Standard Specification for Austenitic Gray Iron Castings

F. ASTM A563 – Standard Specification for Carbon and Steel Alloy Steel Nuts

G. ASTM A615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

H. ASTM A706 – Standard Specification for Low Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

I. ASTM A775 – Standard Specification for Epoxy Coated Reinforcing Bars

J. ASTM D4463 – Rock Bolt Anchor Pull Out Test

K. ASTM E329 – Standard Specification for Agencies Engaged in Testing and/or Inspection of Materials Used in Construction

PART 2 PRODUCTS

2.01 MATERIALS

A. General: The installation of ground support shall be coordinated with the requirements specified in Section 03 37 13 – Shotcrete.

B. Steel Bar Type Bolts

1. Rockbolts shall be #5 (5/8-inch diameter), Grade 75 steel Jennmar or Dywidag threaded rebar, or approved equivalent, with minimum ultimate strength of 25 kips.

2. Rockbolts shall be the continuous thread bar type, conforming to the requirements of ASTM A615. Bars shall meet the minimum size and length requirements shown on the Drawings.

3. Bars shall be furnished full length. Splicing will not be permitted.

4. For permanent rockbolts, the entire bar shall be fusion-bonded epoxy coated conforming to the requirements of ASTM A775, with a coating thickness of 7 to 12 mils. The nut shall be threadable over the epoxy coated bar.

C. End Hardware for Steel Bar Type Rockbolts

1. Bearing plates shall be of steel conforming to the requirements of ASTM A36. Bearing plates shall not be less than the dimensions or properties shown on the Drawings. Bearing plates in drawings are typically 6-inch square domed steel face plates.

2. Beveled or spherical washers shall be steel or malleable iron. Flat washers shall be quenched and tempered steel and shall conform to the requirements of ASTM A436. Washers in drawings are typically #5 spherical washers.

3. Hex nuts shall develop an ultimate strength of not less than 125 percent of the minimum yield strength of the bar and conform to the requirements of ASTM A563. Hex nuts are typically #5 spherical nuts.

4. For permanent rockbolts, the end hardware shall be fusion-bonded epoxy coated in accordance with ASTM A775, with a coating thickness of 7 to 12 mils.

D. Resin Grout

1. Resin grout shall be Minova or Jennmar J-Lokset type or approved equivalent with the following characteristics:

   a. 1-inch resin cartridge diameter.

   b. Use sufficient combination of cartridge length and number of cartridges to achieve full grout encapsulation and bond strength of 3,400 lbs per inch.

2. The resin grout shall be unaffected by mild acids or mild alkalis.

E. Geosynthetic Mesh

1. Geosynthetic mesh shall be installed with the following characteristics:

   a. Shall be Minegrid PET 80T as manufactured by Huesker Inc. or approved equal, with ultimate tensile strength greater than 6,500 lb/ft.

   b. Product shall be black geosynthetic.

F. Extra Stock: Deliver an extra ten (10) percent or a minimum of one full container of each kind and type of ground support material installed.

PART 3 EXECUTION

3.01 GENERAL

A. General: The installation of ground support shall be coordinated with the requirements specified in Section 03 37 13 – Shotcrete.

B. Scaling: Prior to installation of ground support, carefully scale (remove) loose and unstable rock from the tunnel ribs and roof. Precautions shall be taken to avoid damage to natural cavern formations, existing built elements, and environment from falling rock.

3.02 ROCKBOLTS

A. Drilling Holes

1. Holes for rock reinforcement shall be drilled radially to the cavern curvature or other orientation to best suit actual field conditions. Generally, holes shall be drilled perpendicular to the rock surface.

2. The hole for each reinforcement element shall be percussion drilled to a uniform diameter for the entire length of the hole. Holes for rockbolts shall be drilled to the design length of the bolt plus the additional length necessary to ensure complete encapsulation of the bolt by resin grout, typically 1-3/8-inch. Holes shall be cleaned of all drill cuttings, sludge, and debris prior to insertion of resin cartridges.

3. Hole diameters for rockbolts shall be as recommended by the manufacturer to ensure full encapsulation of the rockbolts with the resin grout.

B. Installation of Rockbolts

1. Prior to installation, inspect steel bars and end hardware for nicks, scratches, and other damage to the epoxy or galvanized coating. When the extent of coating damage exceeds two percent of the surface area of the coated steel in any one-foot length, the coated bar shall be rejected. When the extent of coating damage does not exceed two percent of the surface area in any one-foot length, all damaged coating shall be repaired with patching material.

2. Patching material shall be applied in strict accordance with the written instructions furnished by the patching material manufacturer.

3. Rockbolts shall be installed in a manner such that the rockbolts are completely encapsulated with resin grout. Sufficient resin grout shall be installed such that a small amount of grout extrudes from the collar of the hole to ensure that no voids are left around the steel bar.
4. Resin cartridges shall be inserted such that the cartridges are installed to the bottom of the hole and the maximum number of cartridges is installed in each hole. Rockbolts that do not have the correct number of cartridges installed will not be considered acceptable.
5. Rockbolts and resin cartridges shall be pushed into the drillhole while slowly rotating (~50 RPM) for approximately 5 seconds, then spun at increased speed (~300 RPM) for an additional 5 seconds to thoroughly rupture cartridges and mix resin. After spinning, rockbolts shall be pushed upward with maximum thrust available and held for an additional 60 seconds without rotation.
6. Nuts shall be torqued to 150 foot-pounds.
7. Rockbolts may be installed in geosynthetic mesh overlap zone.

3.03 **GEOSYNTHETIC MESH**

A. Installation of Geosynthetic Mesh

1. Geosynthetic mesh shall be overlapped a minimum of 1 foot with rockbolts penetrating the overlap.
2. Mesh shall be pinned tight against the roof using additional pin anchors, as needed.
3. Geosynthetic mesh shall be aligned transverse to the tunnel axis in the roof.

3.04 **SHOTCRETE**

A. Shotcrete for ground support shall be placed in accordance with the requirements of Section 03 37 13.

3.05 **PROTECTION AND CLEAN-UP**

A. Protection: Protect adjacent walls, windows, doors, other building surfaces, and natural Cavern environment from damage by fallen rock from scaling, rockbolting, mesh installation, and shotcreting.

1. Construct a sealed dust partition to confine debris and dust to immediate work area.
2. Immediately clean all debris, spilled resin, and excess materials and remove all scaled rock from site.

- - - END OF SECTION - - -

SECTION 32 92 19
SEEDING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish all labor, Construction Aids, Materials and Equipment and other incidentals required to establish seeding. This Work shall include maintenance of established vegetation until Demobilization. The CONTRACTOR shall be expected to provide and place all vegetative support soil necessary to complete the Work.

B. CONTRACTOR shall revegetate all areas disturbed by his operations. All areas disturbed or not having sufficient vegetation to prevent erosion shall be revegetated.

1.02 RELATED SECTIONS

A. Section 01 33 00 – Submittals

B. Section 01 57 13 – Temporary Erosion and Sediment Control

C. Section 31 00 00 – Earthwork

1.03 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

1.04 MAINTENANCE DATA

A. Submit maintenance data for continuing OWNER maintenance.

B. Include maintenance instructions

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver seed in original containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging and location of packaging. Damaged packages are not acceptable.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and manufacturer’s name.

C. Deliver all products in sufficient quantity and time to maintain approved construction schedule, as amended.

D. Store all products off the ground, in a dry location, out of way of construction operations. Provide protection to prevent damage until installed.

E. Follow manufacturer's recommendations for handling.

1.06 WARRANTY

A. CONTRACTOR shall provide a two-year warranty on all permanent seeding. If after a two-year period, an acceptable coverage of mature stand of vegetation is not established to the satisfaction of the OWNER, the CONTRACTOR shall be responsible for re-top soiling, fertilizing, seeding, and mulching any denuded areas at no additional cost to the OWNER. At which time, another one-year warranty shall be provided to the OWNER by the CONTRACTOR on the repaired areas.

1. "Acceptable coverage” is defined as mature vegetation covering approximately eighty-five percent (85%) of the surface area of the Project Site.

2. “Mature stand” is defined as vegetation that is germinating and reached a minimum height of 3 inches above the ground surface.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 GENERAL

A. Areas to be seeded include all areas disturbed during construction and the stormwater diversion berm.

B. Verify that prepared soil base is ready to receive the Work.

3.02 FERTILIZER AND LIME

A. A soil test shall be performed prior to fertilizer application.

B. If soil test shows it to be acceptable, fertilizer shall be applied at a rate of 270 lbs of fertilizer nutrients per acre at a 1:1:1 ratio as follows

1. 90 lbs/acre Nitrogen
2. 90 lbs/acre Phosphorus
3. 90 lbs/ acre Potassium

C. Lightly water to aid the dissipation of fertilizer and lime.

3.03 SEEDBED PREPARATION

A. Prepare seedbed to a depth of three inches with a disk, tiller or other equipment approved by the ENGINEER.

B. The prepared surface shall be relatively free from weeds, clods, stones, roots, sticks, rivulets, gullies, crusting and caking.

C. Remove loose rocks more than 2 in. in largest dimension, roots, and other obstructions so that they will not interfere with the establishment and maintenance of vegetation.

3.04 TEMPORARY SEEDING

A. Provide temporary seeding on any cleared, non-vegetated, or sparsely vegetated soil surface where vegetative cover is needed for less than one year or when seeding dates will prevent the establishment of vegetative cover if permanent seeding is attempted.

B. Seed in accordance with the following application rate:

Seeding Mixture Species and Application Rate
Perennial Ryegrass at 50 lbs/acre Spring Oats at 64 lbs/acre

C. Fertilize according to Section 3.02 of this Specification.

D. Mulch will be applied (Method 1) within 24 hours of seed placement, on slopes steeper than 3H:1V, mulch shall be applied the same day as seeded. Mulch shall be uniformly placed at a rate of 2 tons/acre. The mulch shall be loose enough to permit air to circulate but compact enough to reduce erosion. If baled mulch material is used, care shall be taken that the material is in a loosened condition and contains no lumps or knots of compacted material.

E. Re-fertilize if growth is not fully adequate.

F. Reseed, re-fertilize, and mulch immediately following erosion or other damage.

3.05 PERMANENT SEEDING

A. Propose native species seed mix and submit to OWNER for approval.

B. If acceptable, seed in accordance with the proposed mixture.

C. Fertilize according to Section 3.02 of this Specification.

D. Mulch will be applied within 24 hours of seed placement, on slopes steeper than 3H:1V, mulch shall be applied the same day as seeded. Mulch shall be uniformly placed at a rate of 2 tons/acre. The mulch shall be loose enough to permit air to circulate but compact enough to reduce erosion. If baled mulch material is used, care shall be taken that the material is in a loosened condition and contains no lumps or knots of compacted material.

E. Re-fertilize in the second year. Reseed, re-fertilize, and mulch damaged areas immediately.

--- END SECTION ---