Project Manual for the Construction of:

Allen Pond Amphitheater
3330 Northview Drive
Bowie, Maryland 20716

Project Number: 20668
Issue Date: August 1, 2025

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City of Bowie Allen Pond Amphitheater
Project No. 20668

Table of Contents

DOCUMENT 00 01 15

LIST OF DRAWINGS

GENERAL INFORMATION

A000 Cover Sheet

CIVIL DRAWINGS

C101 Civil General Notes
C201 Existing Conditions
C202 Site Plan
C301 Detail Sheet

ARCHITECTURAL

D101 Demolition Floor Plan
A101 Floor Plan
A201 Elevations
A202 Sections
A501 Details

STRUCTURAL

S101 Foundation Plans
S201 Sections
S301 General Notes and Typical Details

ELECTRICAL

E001 Electrical Legend and Abbreviations
ES101 Site Plan – New Work
E101 Floor Plan – New Work Power
E201 Floor Plan – New Work Lighting
E401 Electrical Details
E402 Electrical Details
E601 Electrical Schedules

END OF SECTION

SECTION 01 11 00

SUMMARY OF WORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Summary by References:
Work of Contract can be summarized by reference to the Contract, General Conditions, Supplementary Conditions, specifications sections as listed in the “Table of Contents” bound herewith, drawings as listed in “Drawings Index” bound herewith, addenda and modifications to the contract documents issued subsequent to the initial printing of this project manual, and including but not necessarily limited to printed matter referenced by any of these. It is recognized that work of Contract is also unavoidably affected or influenced by governing regulations, natural phenomenon including weather conditions, and other forces outside the contract documents.

B. Generally, without force or effect on the work of the contract, the work of the contract can be described to include, but is not limited to, the following:

1. Demolition of existing wood partitions, canopy structure, wood deck, doors, frames, and finishes.
2. Demolition of existing sound systems, lighting systems, and miscellaneous electrical systems and equipment.
3. New 1590 SF concrete stage, concrete pedestrian ramp, and concrete ADA ramp.
4. New pre-manufactured canopy purchased by the owner and installed by the contractor
5. New masonry walls and columns piers with decorative stone veneer.
6. New concrete sidewalk and concrete pavers.
7. New lighting and electrical systems.
8. Minor grading
9. New asphalt paving.

C. Related Work:
Contract Documents indicate the work of the Contract, and related provisions of the project which may include but are not necessarily limited to the following:
1. Existing site conditions and restrictions.
2. Alterations and coordination with existing work.
3. Alternates which are work of Contract, and alternates which are not work of Contract.
4. Pre-negotiated material/equipment orders assigned as work of Contract.

1.2 REFERENCED STANDARDS
Where reference is made to publications, tests, standard specifications, manufacturer's directions, data sheets, or other literature, latest edition published before date of specifications applies.

1.3 ABBREVIATED SPECIFICATIONS
Portions of specifications may be abbreviated or streamlined and include incomplete sentences. Omission of words or phrases such as "Contractor shall," "In conformity therewith," "shall be," "as noted on Drawings," "a," "an," "the," and "all" are intentional. Omitted words and phrases will be supplied by inference in the same manner as they are for notes on the Drawings.

PART 2 - PRODUCTS

NOT USED

PART 3 – EXECUTION

3.1 INITIAL SUBMISSIONS

A. Plan of Operations: Within 5 days following award of Contract, prepare rough draft of "Plan of Operations" and review with Owner and Architect for acceptance. After discussing rough draft with Owner and Architect, make any necessary changes, prepare final draft, and resubmit. Any later deviations from approved plan shall be discussed with and receive acceptance from Owner and Architect well in advance of proposed date for placing new plan in affect. Include following items in Plan of Operations:

1. Sequence of Operations;
2. Graphic schedule showing anticipated completion dates for various phases of work;
3. General information to assist Owner in planning arrangements for services and work not included in this Contract and in preparing for occupancy;
4. Other pertinent details that occur to Contractor, Owner, or Architect.

3.2 ARCHITECT'S ADMINISTRATIVE FORMS

A. Following forms published by American Institute of Architects shall be used in administration of contract.

TITLE	AIA DOCUMENT NO.
Change Order	G 701
Application and Certificate for Payment	G 702
Certificate of Substantial Completion	G 704
Contractor's Affidavit of Payment of Debts & Claims	G 706
Contractor's Affidavit of Release of Liens	G 706A
Consent of Surety to Final Payment	G 707
Consent of Surety to Reduction in or Partial Release of Retainage	G 707A

END OF SECTION

SECTION 01 14 00

WORK RESTRICTIONS

PART 1 - GENERAL

1.1 CONCURRENT OCCUPANCY

During the construction period, Allen Pond Park will remain open for regular / modified use. The Contractor and the owner (City) shall cooperate and communicate throughout the construction period to allow for continued public use of the park as best as possible throughout construction. Material storage areas, temporary fence locations, etc. shall be cooperatively discussed and determined at the pre-construction meeting to establish an efficient and safe construction zone. Certain areas will be occupied during the entire construction period for conduct of normal operations. Work shall be performed so as not to interfere with operations of occupied areas as best as possible. Ingress and egress for park goers, city staff, and facilities crew must be continuously maintained.

1.2 WORK RESTRICTIONS AND HOURS OF WORK

A. Work may be performed from 7:00 AM to 6:00 PM, Monday through Friday.

B. The City may authorize work outside regular working hours when such adjustments are necessary, for reasons other than the fault of the Contractor, to accomplish the work in a timely manner. Work must be authorized in advance in writing at least five (5) days in advance. The City will not pay any additional compensation to the Contractor on account of work performed outside of regular working hours.

1.3 WORK SITE PROTECTION

The Contractor shall take precautions necessary to protect interior and exterior property from damage during the prosecution of work and shall be liable to pay for any and all such damages that may occur.

1.4 SAFETY PROCEDURES

Contractor shall be responsible for complying with all requirements of the Federal Occupational Safety and Health Act of 1970 as amended thereto (hereinafter referred to as “OSHA”), as well as all Occupational Safety regulations (“MOSH”) promulgated by the Maryland Department of Labor, Division of Labor and Industry pursuant to the Labor and Employment Article of the Annotated Code of Maryland. Contractor shall submit a safety plan to the City’s Project Manager within 10 days of Notice to Proceed.

1.5 STORMWATER PERMIT NOTIFICATION

This project requires a NPDES permit for stormwater discharge from a construction site. Site work may not proceed until coverage under the State General Permit for Stormwater Associated with Construction Activity has been verified.

The City will submit the Notice of Intent (NOI) for permit coverage prior to project start. However, the permit authorization will be transferred to the Contractor prior to work start since the Contractor will be responsibility for directing work activities so that permit requirements are met. The City will transfer the permit authorization to the Contractor, normally, on the date of Notice to Proceed using the MDE on line system. Once authorization is transferred, the Contractor shall assume all responsibilities for permit compliance, to include inspections, and final permit close out.

END OF SECTION

SECTION 01 22 00

UNIT PRICES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for unit prices.

1.2 DEFINITIONS

A. A unit price is an amount proposed by the Contractor as part of the bid process to establish a price per unit of measurement for materials or services added to or deducted from the Contract Sum by incorporating the unit price stipulated in the Contractor's bid form, and multiplying the unit price by the amount of work completed (work that is subject to unit pricing) to arrive at the amount of compensation to be paid the Contractor for the unit price work.

1.3 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, labor, equipment, installation, insurance, applicable taxes, overhead, and profit.

B. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor.

C. A list of unit prices is included in Part 3. Specification sections referenced in the schedule contain requirements for materials described under each unit price.

D. The Owner reserves the right to withdraw the work described in the unit prices from the Work of the Contract and reduce the Contract stipulated fee by the dollar values assigned to the respective unit prices.

E. The Owner reserves the right to increase the Contract lump sum amount using the respective unit prices, if the measurement of the volume of unit price work exceeds the amount included in the Contract.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 LIST OF UNIT PRICES

A. General: Provide a cost for each unit price item on the Bid Form:

Unit Price # 1 Unsatisfactory soil conditions:

Removal of soils deemed to be unsatisfactory material, the off-site disposal of the material, and backfill with Engineered Fill in accordance with Specification Section "Earthwork". Payment will be made for the actual number of cubic yards of fill material in place. Estimated Quantity: 5 cubic yards.

Unit Price # 2- Rock excavation

Rock excavation in foundations and utility trenches; backfill with Engineered Fill in accordance with Specification Section "Earthwork." Payment will be made for the actual number of cubic yards of rock removed. Estimated Quantity: 5 cubic yards.

END OF SECTION

SECTION 01 23 00

ALTERNATES

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes alternate items of work quoted on Bid Form which will be accepted or rejected at the Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work as required.

1.2 ALTERNATES, GENERAL

A. Definitions: Alternates are defined as alternate products, materials, equipment, installations or systems for the work, which may at the Owner's option and under terms established by the Instructions to the Bidders, be selected and recorded in the Contract to either supplement or displace corresponding basic requirements of the Contract Documents.

B. Alternates may or may not substantially change scope and general character of the work; and must not be confused with "allowances", "unit prices", "change orders", "substitutions", and other similar provisions.

C. General Provisions: A "Schedule of Alternates" is included at the end of this section. Each alternate is defined by abbreviated language, recognizing that drawings and specification sections document the requirements. Coordination of related work is required to ensure that work affected by each selected alternate is complete and properly interfaced with work of alternates.

D. Notification: Immediately following award of Contract prepare and distribute to each entity to be involved in performance of the work, a notification of status of each alternate. Indicate which alternates have been: 1) Accepted, 2) Rejected, and 3) Deferred for consideration at a later date as indicated. Include full description of negotiated modifications to alternates, if any.

E. Alternate prices submitted with the contractor's bid shall be valid for the full term of the contract and shall become part of the contract scope of work at any time, at the sole discretion of the Owner.

1.3 ALTERNATE SCHEDULE

A. Add Alternate No. 1
The Contractor shall provide all labor, material, equipment and services necessary to construct concrete sidewalk as shown on the drawings in lieu of installation of new concrete pavers to match the existing.

END OF SECTION

SECTION 01 29 00

PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 INVOICING

A. Monthly Payments: If the work included in the contract is of an amount extending over a period of more than one month, the Contractor shall receive payment for monthly estimates based on the proportion of the contract completed, materials delivered to the site, and preparatory work done. Such estimates shall be for sums of not less than five hundred dollars ($500.00). The Contractor agrees that the allowance of a monthly estimate by the City does not constitute final acceptance of the work.

B. Unit Price Contracts

1. Quantities appearing in bid schedule are approximate only and are prepared for canvassing of bids. Payment to the Contractor will be made only for actual quantities of work performed or materials furnished following contract.
2. Invoices submitted by the Contractor shall be formatted to match the bid schedule and show quantities completed for the invoice period as well as quantities completed in total for each line item. Each invoice prepared by the Contractor shall be certified by the City's Project Manager and delivered to the City's Contract Specialist to process payment requests. Five percent (5%) of each estimate, plus the amount of any unsatisfied claims filed against the City for labor and materials, shall be deducted and held the project is complete. The final five percent (5%) retainer will be paid at final acceptance of the project after receipt of an approved invoice submitted by the Contractor.
3. Monthly estimates on invoices shall be considered as an approximation only, and before the final estimate is allowed and final acceptance made on this contract, the City's Project Manager may require the Contractor to furnish a list of all persons furnishing labor or materials, with satisfactory evidence that such persons have been paid in full.

C. Lump Sum Contracts

1. Schedule of Values: For those projects for which monthly payments will be made, the Contractor shall submit a schedule of values for the City's approval within 14 calendar days of contract award and prior to being granted notice to proceed. The Schedule of Values shall be in AIA or similar format approved by the City. AIA format – G702 Application and Certificate for Payment.
2. Invoices: Invoices shall be submitted using the approved schedule of values format. Each consecutive monthly estimate, as prepared by the Contractor, shall be submitted to and certified by the City's Project Manager or the Architect or record prior to payment. Five percent (5%) of each estimate, plus the amount of any unsatisfied claims filed against the City for labor and materials, shall be withheld and held until the project is project is 50% complete by value (including all change orders). No retainage will be assessed from subsequent progress payments. The final retainer, which will be 5% of the total contract value, will be paid at Final Acceptance of the project after receipt of an approved payment application submitted by the Contractor.
3. Unit Price Items within a Lump Sum Contract: Any contract line items identified as unit price items on the bid schedule shall be paid as described under "B. Unit Price Contracts" (only for quantities completed. For these unit price items, quantities shown on the bid schedule are approximate only and provided for bid canvassing.

D. Mobilization as a Pay Item (For Unit Price or Lump Sum Contracts): Mobilization shall consist of preparatory work and operations, including, but not limited to, those necessary

for the movement of personnel, equipment, supplies, and incidentals to the site; for the establishment of all offices, buildings, and other facilities necessary for the Work; and for all other work and operations which must be performed, or costs incurred, prior to beginning the Work, as well as all demobilization costs.

When the Contract or proposed Schedule of Values includes a separate item for mobilization, payment for mobilization will include full compensation for the furnishing of all labor, materials, tools, equipment, administrative costs, and incidentals for mobilization as described below.

1. The City will pay no greater than five percent (5%) of the total contract price as a separate pay item for mobilization. In the event the Contractor submits a mobilization pay item greater than five percent (5%) of the total contract price, the City will pay any excess mobilization amount with the final progress payment.
2. Payment for mobilization will be prorated as follows:
    a. When the progress payment request is five percent (5%) or more of the original total contract price (excluding mobilization), fifty percent (50%) of the contract item price for mobilization or two and one-half percent (2.5%) of the total contract price, whichever is less, will be paid for mobilization.
    b. When the progress payment request is ten percent (10%) or more of the original total contract price (excluding mobilization), seventy percent (70%) of the contract item price for mobilization or three and one-half percent (3.5%) of the total contract price, whichever is less, will be paid for mobilization.
    c. When the progress payment request is twenty percent (20%) or more of the original total contract price (excluding mobilization), ninety percent (90%) of the contract item price for mobilization or four and one-half percent (4.5%) of the total contract price, whichever is less, will be paid for mobilization.
    d. When the progress payment request is fifty percent (50%) or more of the original total contract price (excluding mobilization), one hundred percent (100%) of the contract item price for mobilization or five percent (5%) of the total contract price, whichever is less, will be paid for mobilization.
    e. After final acceptance of the contract, the amount, if any, of the Contract item price for mobilization in excess of five percent (5%) of the original total contract price will be included for payment in the final estimate.
3. The City will not pay additional mobilization compensation for work under a Contract Change Order. Payment for mobilization shall be subject to retention as specified in this section.

END OF SECTION

SECTION 01 29 73

SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Procedures for preparation and submittal of Schedule of Values.

1.2 FORMAT

A. Follow Table of Contents of Project Manual for listing component parts. Identify each line item by number and title of major Specifications Section.

B. Identification: Include the following Project identification on the Schedule of Values:
   1. Project name and location.
   2. Name of Architect.
   3. Architect and Owner's project number.
   4. Contractor's name and address.
   5. Date of submittal.

C. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
   1. Related Specification section or division.
   2. Description of work.
   3. Name of subcontractor.
   4. Name of manufacturer or fabricator.
   5. Name of supplier.
   6. Change Orders (numbers) that affect value.
   7. Dollar value
   8. Percentage of Contract Sum to nearest one-hundredth percent, adjusted total 100 percent.

1.3 CONTENT

A. List installed value of each major item of work and each subcontracted item of Work as a separate line item to serve as a basis for computing values for Progress Payments as extracted/determined from the cost loaded Progress Schedule. Round off values to nearest dollar. Indicate material cost separate from related labor cost.

B. For each major subcontract, list products and operations of that subcontract as separate line items.

C. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate. Include separate line items under required principal subcontracts for operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training.

D. Allowances Unit Prices and Alternates: Provide a separate line item in Schedule of Value for each allowance, Unit Price and Alternate. Show line-item value of unit prices, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract documents to determine quantities.

E. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
   1. Application for Payment forms with Continuation Sheets.
   2. Submittals Schedule.
   3. Contractor's Construction Schedule.
   4. List of subcontractors.
   5. Schedule of allowances.
   6. Schedule of alternates.
   7. List of products.
   8. List of principal suppliers and fabricators.

F. Component listings shall each include a directly proportional amount of Contractor's overhead and profit. Temporary facilities and other major cost items that are not direct cost of actual work-in-place shall be shown as separate line items in the Schedule of Values.

H. For items on which payments will be requested for stored products, list sub-values for cost of stored products.

I. The sum of values listed shall equal total Contract Sum.

1.4 SUBMITTAL

A. Submit 2 copies of the Draft Schedule of Values 15 calendar days prior to first Application for Payment to the Owner and two copies to the Architect. Form and content shall be acceptable to Owner.

B. Transmit under transmittal letter. Identify Project by title and number; identify Contract by number.

C. Schedule Updating: Update and resubmit the Schedule of Values before the next Application for Payment when change Orders or Construction change Directives result in a change in the Contract Sum.

1.5 SUBSTANTIATING DATA

A. When the Owner and/or the Architect/Engineer require substantiating information, submit data justifying line item amounts in question.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 CITY REPRESENTATIVES AND CONSULTANTS

A. Project Manager: The City shall designate a Project Manager who shall serve as the primary representative for the City in addressing matters related to the scope or work, the technical specifications, the schedule. Although correspondence shall be addressed to the Contract Specialist, the Project Manager will respond to, or coordinate response to all inquiries related to these matters, work coordination issues, requests for contract modifications, and payment certifications.

B. Contract Specialist: The City shall designate a Contract Specialist who will be responsible for administrative matters associated with the contract. Unless directed otherwise at the preconstruction conference, the Contractor shall submit all correspondence, submittals, requests for information (RFIs), and invoices to the Contract Specialist.

C. Inspector: The City shall designate a City Inspector responsible for evaluating the quality of work in place and the Contractor's adherence to contract requirements. The Contractor shall respond to all requests for documentation, site inspection visits, and other contract-related inquiries from the City's Inspector.

D. Architect/Engineer (A/E) or Engineer of Record: The City's A/E or Engineer of Record will be responsible for submittal reviews and responding to requests for information (RFIs) for those issues that are omitted or unclear in the construction documents. The City's Project Manager will coordinate A/E submittal and RFI reviews.

1.2 ACCESS TO SITE

The City's Project Manager and Inspector may, at any time, enter the work areas and inspect the work. The Contractor shall provide proper and safe facilities by means of ladders or otherwise to secure convenient access to all parts of the work areas.

1.3 PROSECUTION OF WORK

TIME IS OF THE ESSENCE. The execution of the work under this contract shall not be commenced until the Contractor has received a written Notice to Proceed, signed by the City. The work shall thereupon be started within ten (10) calendar days of the date of the Notice to Proceed (unless otherwise stated) and carried on continuously to completion. The progress of the work shall be at a rate sufficient to complete the contract in an acceptable manner within the time specified. Progress reports shall be provided regularly. If it appears that the rate of progress is such that the contract will not be completed within the time limit, or if the contract is not being executed in a satisfactory and workmanlike manner, the City may order the Contractor to take such steps as the City considers necessary to complete the contract within the time provided, or to prosecute the work in a satisfactory manner with no additional compensation.

1.4 PROJECT SCHEDULE AND TIME EXTENSIONS

A. Schedule: Prior to Notice to Proceed, the Contractor shall submit a critical path method ("CPM") schedule in electronic (Microsoft Project) and PDF formats for approval by the Project Manager. The CPM schedule shall contain sufficient detail to enable the City to adequately manage any City requirements that may include submittal reviews, inspections, public communications, work site coordination, progress meeting participation, and payment requisition review and certification. The schedule provided to the City shall be

Contractor's complete schedule database, including the late start, late finish, early start, early finish, and relationship for each schedule activity. The Contractor shall promptly notify the City of subsequent changes in the construction and submittal schedules and additional scheduling details.

B. Liquidated damages: Liquidated damages, if included in this contract, are identified in the Contract Agreement. Unless the contract is modified in writing, liquidated damages will be assessed at the rate identified in the agreement for each day beyond the required completion date until Substantial Completion is achieved.

C. Extension of Time of Contract: Extension to the Contract time may be granted by the City at the discretion of the City Manager. Reasons may include delays caused by unusually severe weather, modifications to contract requirements that require additional time, and delays caused by other extraordinary events outside the control of the Contractor. Time extensions will not be granted for delays or suspension of the work due to the fault of the Contractor. If during the progress of the work, it becomes apparent that an extension of time is necessary to complete the work the Contractor shall immediately submit for approval a request for such time extension. Requests for an extension of time in which to perform the contract requirements, shall be submitted in writing to the City's Project Manager for approval by the City. If approved, the time extension will be documented in a non-compensable contract modification.

1.5 ON SITE SUPERVISION

The Contractor shall maintain on the job site, at all times while work is in progress, an individual who represents the Contractor, who has authority to supervise the contract work on site, and who can communicate in English with City representatives.

Contractor warrants that all Contractor personnel engaged in the performance of Work under this Contract shall possess sufficient experience and/education to perform the services requested by the City. The City expressly retains the right to have any of the Contractor's or Subcontractor's personnel removed from performing services under this Contract. Contractor shall effectuate the removal of the specified Contractor or Subcontractor personnel from providing any services to the City of Bowie under this Contract within one business day of notification by City. The City shall submit the request in writing to the Contractor's Project Manager. The City shall not unreasonably move to request the removal of any of Contractor or Subcontractors' employees.

1.6 TEMPORARY SUSPENSION OF WORK

The City's Project Manager shall have authority to suspend the work wholly or in part for such period or periods as he or she may deem necessary due to unsuitable weather or such other conditions as are considered unfavorable for the prosecution of the work, or for such time as is necessarily due to the failure on the part of the Contractor to carry out orders given or to perform any or all provisions of the contract. The Contractor shall immediately comply with the written order of the City's Project Manager to suspend work wholly or in part. When under suspension, the work shall be put in proper and satisfactory condition, covered carefully and protected properly, as directed by the City's Project Manager. In all cases of suspension of construction operations, the work shall not resume again until written permission is given by the City's Project Manager.

END OF SECTION

SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 PROGRESS MEETINGS

A. Scheduling: The Contractor is required to schedule Progress Meetings throughout progress of the work at regular intervals, and at a minimum of one (1) per month(or more frequently depending upon the complexity of the project). The Contractor shall coordinate meeting schedules with the City's Project Manager.

B. Brief Progress Summary & Work Projection: The Contractor is required to provide a brief summary, in narrative form, of progress since the previous meeting and report on projected Work for a minimum of the next period.

C. Attendance Required: Project Superintendent, major subcontractors, and suppliers, the City's Project Manager, other City representatives as determined by the Project Manager, and the A/E, as appropriate to agenda topics for each meeting.

D. Agenda: Topics for discussion as appropriate to the status of the Project that may include:
   1. Schedule and Project Status
   2. Issues
   3. Requests for Information

1.2 PRECONSTRUCTION MEETINGS

A. Scheduling: Prior to the start of construction a "Preconstruction" meeting shall be scheduled by the City.

B. Attendance Required: The City's Project Manager and Inspector, the City's Contract Specialist, the Architect/Engineer's project representative, the Contractor's representative, and superintendent (and scheduler, if the Contractor desires), and representatives of the Contractor's major subcontractors.

C. Agenda: Agenda will include:
   1. Persons involved from each entity and their chain of authority including the names of persons authorized to sign Change Orders/Contract Modifications.
   2. Names, addresses, telephone numbers, e-mail addresses and FAX numbers to be used for Requests for Information (RFI), Requests for Clarification (RFC),, shop drawings, material submittals, and notices.
   3. Status of permits
   4. Monthly progress meetings
   5. The Contractor's proposed construction schedule and Owner's sequencing requirements, if any.
   6. Schedule of Values and payment application requirements and procedures.
   7. Procedures for shop drawings, product data and submittals.
   8. Procedures for the Contractor's request for time extension, if any.
   9. Construction Site requirements, procedures, and clarifications to include:
      a. Manner of conducting the Work
      b. Site specialties such as dust and erosion control, stormwater management, project signs, clean up and housekeeping, temporary facilities, utilities, security, and traffic
      c. Safety
      d. Layout of the Work

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e, Quality control, testing, inspections, and notices required
f. Site visits by the City
g. Project Inspector duties
h. As-Built Drawings
i. Contractor Daily Reports

10. Project Close-Out requirements and procedures

END OF SECTION

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SECTION 01 31 19

PROJECT MEETINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Scheduling and administration of progress meetings.

B. Preinstallation conferences.

1.2 PROGRESS MEETINGS

A. The Contractor shall schedule, administer, provide agenda, record, and attend Progress Meetings. On-site Contractor coordination meetings with subcontractors and installers shall be held every week for the duration of the Contract. The Contractor's project manager and/or superintendent shall attend all progress meetings.

B. The Contractor will correspond with the Owner for on-site arrangements, prepare agenda based on the last meeting, and establish and confirm each Progress Meeting to the Owner, Architect and other parties in advance of the next Progress Meeting date.

C. The Architect will preside and conduct the meetings, record minutes, and distribute copies after the Progress Meeting to participants, and to others affected by decisions made at the Progress Meetings.

D. Location of Meetings: Contractor’s on-site Conference Room.

E. Attendance: Owner, Architect, Contractor, and job superintendent. Subcontractors, and suppliers as appropriate to agenda; professional consultants shall attend as appropriate to agenda

F. Minimum Agenda:
1. Review of minutes of previous meetings.
2. Review of Work progress and on-site security.
3. Field observations, problems, and decisions.
4. Identification of problems that impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

1.3 PRE-INSTALLATION CONFERENCES

A. When required in individual Specification Section, the Contractor shall advise the Architect of a Preinstallation Conference at Work Site in writing a minimum of 14 calendar days prior to commencing work of the Section.

B. Require attendance of entities directly affecting, or affected by, work of the Section.

C. Contractor shall prepare agenda, preside at conference, record minutes, and distribute copies within 5 working days after conference to participants, with copies as required to Owner and Architect.

1.4 SITE COORDINATION MEETING

A. Conduct project coordination meetings at regular intervals convenient for all parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings.

B. Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved.

C. Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

D. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for the following:

1. Contract documents
2. Options
3. Related change orders
4. Purchases
5. Deliveries
6. Shop drawings, product data, and quality control samples
7. Review of mockups
8. Possible conflicts
9. Compatibility problems
10. Time schedules
11. Weather limitations
12. Manufacturer’s recommendations
13. Warranty requirements
14. Compatibility of materials
15. Acceptability of substrates
16. Temporary facilities
17. Space and access limitations
18. Governing regulations
19. Safety
20. Inspecting and testing requirements
21. Required performance results
22. Recording requirements
23. Protection

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 32 00

PRE-CONSTRUCTION MEETINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES
- A. Contractor participation in preconstruction conference.

1.2 PRECONSTRUCTION CONFERENCE
- A. Owner will schedule conference within 15 days after Notice of Award.
- B. Attendance: Owner, Architect/Engineer, and Contractor.
- C. Agenda:
  1. Submittal of executed bonds and insurance certificates.
  2. Execution of Owner-Contractor Agreement.
  3. Distribution of Contract Documents.
  4. Submittal of list of subcontractors, list of products, schedule of values, and progress schedule, and shop drawing submittal schedule.
  5. Designation of responsible personnel with emergency contact telephone numbers (three persons minimum).
  6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal requests, change orders, and Contract closeout procedures.
  7. Scheduling.
  8. Computer software programs SIF applicable, and distribution of computer generated reports to be utilized during construction.
  9. Documentation in support of payment.
  10. Equipment and material lists as specified.
  11. Use of premises by Owner and Contractor.
  12. Owner's requirements.
  13. Construction facilities and controls provided by Owner.
  14. Temporary utilities that may be provided by Owner and reimbursement procedures to Owner by Contractor.
  15. Site Security.
  16. Schedules.
  17. Procedures for testing.
  18. Procedures for maintaining record documents.
  19. Requirements for startup of equipment.
  20. Requisitions for Payment.
  21. Submittals.
  22. Testing services.
  23. Safety and housekeeping procedures.
  24. Survey and building layout.
  25. Progress photos
  26. Inspection and acceptance of utility systems and equipment placed into service during construction period.

END OF SECTION

SECTION 01 32 23

SURVEYS AND LAYOUT DATA

PART 1 - GENERAL

1.1 SECTION INCLUDES
- A. Field Engineering and Surveying Services.

1.2 QUALITY CONTROL
- A. Professional Surveyor: The Contractor shall provide a Registered Professional Land Surveyor or Property Line Surveyor of the discipline required for specific service on Project, licensed in the State of Maryland.

- B. Recover and use previously set control monuments in compliance with the Contract Drawings.

1.3 SUBMITTALS
- A. Survey Data: Submit name, address, and telephone number of Surveyor.

- B. On request, submit documentation verifying accuracy of survey work.

- C. Submit certificate signed by Surveyor certifying that elevations and locations of improvements are in conformance, or non-conformance, with Contract Documents.

1.4 PROJECT RECORD DOCUMENTS
- A. Maintain complete, accurate log of control and survey work as it progresses.

- B. Contractor shall conduct a monthly review of Record Documents. Contractor shall maintain these documents current and if not, payment may be withheld from the Contractor because documents are unacceptable during review by Architect.

- C. On completion of all site improvements, prepare a certified reproducible 24 inches by 36 inches, 4 mil mylar survey sheet showing topographic contours, dimensions, locations, angles, and elevations of constructed site work, utilities, and building locations with other pertinent data.

PART 2 – PRODUCTS

(Not Applicable)

PART 3 – EXECUTION

3.1 INSPECTION
- A. Verify locations of survey control points prior to starting work. Promptly notifying Architect of any discrepancies discovered.

3.2 SURVEY REFERENCE POINTS
- A. Protect survey control points prior to starting site work; preserve permanent reference points during construction. Make no changes without prior written notice to Owner and Architect.

- B. Promptly report to Owner and Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons. Replace dislocated survey control points, at no cost to the Owner, based on original survey control.

3.3 SURVEY REQUIREMENTS
- A. Establish a minimum of 2 permanent bench marks on the site, referenced to established

control points. Record locations with horizontal and vertical data on Project Record Documents.

B. Establish lines and levels, locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements, including pavements; stakes for grading, fill and topsoil placement; and utility locations, slopes, and invert elevations.
   2. Perimeter of building structures.

C. Periodically verify layouts by same means to maintain horizontal and vertical control.

END OF SECTION

SECTION 01 32 33

PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES
- A. Construction Photography.
- B. Submittals.

1.2 PHOTOGRAPHY SERVICES
- A. Provide to the Owner copies of all digital photographs, taken during the course of the work of the contract.

1.3 PHOTOGRAPH FORMAT
- A. Full color; minimum 16.0 mega pixel digital resolution photograph file; converted to JPG format for viewing.
- B. Identification: Provide an individual file number for each digital photograph. Provide a separate Microsoft Word file that lists the name of Project, phase, orientation of view, date and time of view, name and address of photographer, and photographer's numbered identification of exposure.

PART 2 - PRODUCTS

2.1 PHOTOGRAPH FILES
- A. Deliver digital file copies of photographs to Owner, at each Application for Payment submission. Catalog and index photograph files in chronological sequence; provide typed table of contents.
- B. Provide photographer's release of copyrights at job completion.

PART 3 - EXECUTION

3.1 TECHNIQUE
- A. Provide factual presentation of construction progress.
- B. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.

3.2 VIEWS
- A. Provide complete set of not less than (30) different views of the project, at the start of construction, one day each week during construction, and at Substantial Completion.
- B. Consult with Owner Representative or Architect as required for instructions on views required.

END OF SECTION

SECTION 01 33 00

SUBMITTALS PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Submittal procedures
   2. Proposed products list
   3. Shop drawings
   4. Product data
   5. Samples
   6. Manufacturers' instructions
   7. Manufacturers' certificates

1.2 SUBMITTAL PROCEDURES

A. Consecutively number all submittals.
   1. When material is resubmitted for any reason, transmit under a new letter of transmittal and with a new transmittal number.
   2. On re-submittals, cite the original submittal number for reference.

B. Accompany each submittal with a letter of transmittal showing all information required for identification and checking.

C. Identify Project, Contractor, subcontractor or supplier; pertinent Drawing sheet and detail number(s), and specification Section number, as appropriate.

D. The Contractor shall include a statement on all submittals indicating that "**Contractor has reviewed the submittal and coordinated this product with the work of the contract, and further certifies that this product complies in every aspect with the requirements of the Contract Documents**". Any deviations from the requirements of the Contract Documents or variation from the specified product shall be described in detail in writing in a cover letter to the submittal.

E. On at least the first page of each component of the submittal, and elsewhere as required for positive identification, show the submittal number in which the item was included.

F. Identify variations from Contract Documents and product of system limitations which may be detrimental to successful performance of the completed Work. Substitutions shall be clearly identified and shall comply with procedures for requesting a substitution.

G. Make submittals far enough in advance of scheduled dates for installation to provide time required for reviews, for securing necessary approvals, for possible revisions and resubmittals, and for placing orders and securing delivery.

H. In scheduling, allow at least ten (15) working days for review following receipt of this submittal.

I. Architect's review does not relieve the Contractor and subcontractor from responsibility for errors which may exist in the submitted data.

J. Revisions:
   1. Make revisions required.
   2. If the Contractor considers any required revision to be a change, the Contractor shall make notification as provided for in the General Conditions.
   3. Make only those revisions directed or approved.

K. Unless otherwise specified, make submittals in groups containing all associated items to assure that information is available for checking each item when it is received.
   1. Partial submittals may be rejected as not complying with the provisions of the Contract.
   2. The Contractor may be held liable for delays so occasioned.

L. Maintain an accurate submittal log for the duration of the Work, showing current status of all submittals at all times. Make the submittal log available to the Architect for his review upon request.

1.3 PROPOSED PRODUCTS LIST

A. Submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.4 SHOP DRAWINGS

A. Shop drawings shall not be reprints of the Contract Drawings.

B. All deviations from the contract documents shall be highlighted on the shop drawings and further enumerated in detail in writing on a separate cover letter to the submittal.

C. Scale and measurements: Make shop drawings accurately to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the Work.

D. Types of prints required: Submit Shop Drawings in digital form, electronically transmitted Adobe Acrobat PDF files.

E. The Architects review comments will be returned as an electronic transmission.

1.5 PRODUCT DATA

A. Submit digital, electronically transmitted, Adobe Acrobat PDF files

B. Mark each submittal to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this project.

C. After review, distribute as required.

D. **Safety Data Sheets, and the information provided therein, are not part of the Architect's review. The Contractor shall be responsible for the use and implementation of products that comply with safety standards.**

1.6 SAMPLES

A. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinated sample submittals for interfacing work.

B. Submit samples of finishes in color ranges specified, textures, and patterns for Architect selection.

C. Include identification on each sample, with full Project information. This identification shall be securely affixed to the sample.

D. One of each of the samples submitted as specified in individual specification Sections will be retained by Architect.

E. Reviewed samples which may be used in the Work are indicated in individual specification

Sections.

1.7 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, adjusting, and finishing, in quantities specified for Product Data.

B. Identify conflicts between manufacturers' instructions and Contract Documents.

1.8 MANUFACTURER'S CERTIFICATES

A. When specified in individual specification Sections, submit manufacturers' certificate to Architect for review, in quantities specified for Product Data.

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

C. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.

PART 2 - PRODUCTS

2.1 DEFINITIONS

A. Approved Equal

The term “Approved Equal” , as it is used in the Contract Documents, shall be interpreted as an opportunity for the Contractor to substitute a product that is equal to the specified product in all regards, subject to approval by the Architect of the substitution. The burden for researching the market place and finding an “Approved Equal” product shall be the sole responsibility of the Contractor. The use of the term “Approved Equal” shall in no way be interpreted to mean that an equal product is currently manufactured or available. The use of the term “Approved Equal” is intended to communicate to the contractor that the Architect has not conducted an exhaustive search to find equal products, but the Contractor has the opportunity to do so.

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 35 00

SPECIAL PROCEDURES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The types of minimum requirements for procedures and performance or control work of a general nature include but are not necessarily limited to the following categories:

1. General installation provisions
2. Coordination and meetings
3. Surveys and records
4. Limitations for use of site
5. Workmanship
6. Cleaning and protection
7. Conservation and salvage

1.2 OWNER'S OCCUPANCY OF THE SITE

The Owner will occupy the site during the work of the Contract. The Contractor shall allocate use of the site to allow the Owner's free use of the areas of the Owner's property outside the immediate Construction site. The Contractor shall at all times, without exception, maintain clear and un-obstructed exits and entrances from the building and the site for emergency vehicles.

1.3 EXISTING SITE CONDITIONS

The Owner makes no guarantee as to the accuracy of the data shown on the drawings as existing conditions. The Contractor shall verify all pre-existing conditions on the site prior to the start of work.

1.4 PERMITS AND INSPECTIONS BY AGENCIES HAVING JURISDICTION

A. Permits: The Owner will pay for the initial Building Permit application. The Building and Grading Permits will be obtained at the permit office by the Contractor prior to commencement of the Work. The Contractor shall be responsible for obtaining and paying for any and all extensions of the Building and Grading Permit should extensions become necessary. The Contractor shall be responsible for safeguarding the permit and shall pay all costs for replacement of the permit documents should it become lost, stolen, damaged or otherwise removed from the site. The Contractor shall be responsible for the expense of all trade permits (other than the initial Building Permit) and any other permits required by Agencies having jurisdiction.

B. Inspection by Agencies Having Jurisdiction: The Contractor shall be responsible for the timely scheduling of inspections of the Work by Agencies having jurisdiction. The Contractor shall be responsible for notification of the appropriate Agencies, coordination with the inspection procedures of the Agencies, and providing adequate access for inspectors

1.5 SMOKING

Smoking is strictly prohibited at the job site at all times.

PART 2 – PRODUCTS

NOT APPLICABLE

PART 3 – EXECUTION

3.1 LAYING OUT WORK

A. The Contractor shall lay out their own work and be responsible for all lines, elevations, and measurements of work they execute under the Contract. They must exercise proper

precaution to verify figures shown on Drawings before laying out work.

B. The Contractor shall take field measurements prior to preparation of shop drawings and fabrication, to ensure proper fitting of work.

3.2 MANUFACTURER'S DIRECTIONS

All manufactured articles, materials, equipment, fixtures, and accessories shall be handled, stored, applied, installed, connected, erected, used, cleaned, and conditioned as manufacturers direct, unless Architect otherwise indicates, specifies, or directs, in writing.

3.3 GENERAL INSTALLATION PROVISIONS

A. Manufacturer's Instructions:

1. Where installations include manufactured products, comply with manufacturer's applicable instructions and recommendations for installation, to the extent these are more explicit or more stringent than requirements indicated in the contract documents.
2. All manufactured articles, materials, equipment, fixtures, and accessories shall be handled, stored, applied, installed, connected, erected, used, cleaned, and conditioned as manufacturers direct, unless Architect otherwise indicates, specifies, or directs, in writing.
3. Inspect each item of materials or equipment immediately prior to installation, and reject damaged and defective items.
4. Provide attachment and connection devices and methods for securing work properly as it is installed; true to line and level, and within recognized industry tolerances if not otherwise indicated. Allow for expansions and building movements. Provide uniform joint widths in exposed work, organized for best possible visual effect. Refer questionable visual effect choices to the Architect for final decision.
5. Recheck measurements and dimensions of the work, as an integral step of starting each installation.
6. Install work during conditions of temperature, humidity, exposure, forecasted weather, and status of project completion which will ensure best possible results for each unit of work, in coordination with entire work. Isolate each unit of work from non-compatible work, as required to prevent deterioration.
7. Coordinate enclosure of work with required inspections and tests, so as to minimize necessity of uncovering work for that purpose.

B. Mounting Heights: Where mounting heights are not indicated, mount individual units of work at industry recognized standard mounting heights or ADA standards as applicable. Refer questionable mounting height choices to the Architect for final decision.

3.4 COORDINATION OF ALL WORK OF THE CONTRACT

A. General: Prepare, communicate and distribute to each entity performing work at the project instructions on required coordination activities, including required notices, reports and attendance at meetings. Take all necessary action to coordinate separate contractors where interfacing of work is required. The Contractor is responsible for reviewing all of the separate systems, equipment, finishes and appurtenances of the project in advance of their fabrication, delivery, and construction. The Contractor shall layout all work of the contract in advance of fabrication, delivery and construction, and shall resolve all interference between the separate systems, equipment, finishes and appurtenance components.

B. Coordination Drawings: Where work by separate entities requires off-site fabrication of products and materials which must be accurately interfaced and closely intermeshed to produce required results, prepare coordination drawings to indicate how work shown by separate shop drawings will be interfaced, intermeshed, and sequenced for installation. Comply with submittal requirements of "Submittals" section.

C. Responsibility for Quality Assurance: The Contractor is responsible for the timing and/or scheduling of the ordering, shipping, fabrication, delivery and installation of all materials at

all times throughout the contract. Payment by the Owner for stored materials shall not be an indication of acceptance of those materials with regards to the quality, size, fit or dimensional accuracy. The Owner does not waive the Owner's right to reject un-satisfactory, un-acceptable materials, by way of payment for stored materials.

3.5 LIMITATIONS FOR USE OF SITE

A. General: In addition to site utilization limitations and requirements shown on the drawings, and indicated by other contract documents, administer allocation of available space equitably among entities needing access and space, so as to produce best overall efficiency in performance of total work of project. Schedule deliveries so as to minimize space and time requirements for storage of materials and equipment on site.

3.6 TRADESPERSONS AND WORKMANSHIP STANDARDS

A. General: Investigate and maintain procedures to ensure that persons performing work at site are skilled and knowledgeable in methods and craftsmanship needed to produce required quality levels for workmanship in completed work. Remove and replace work which does not comply with workmanship standards as specified and as recognized in the construction industry for applications indicated. Remove and replace other work damaged or deteriorated by faulty workmanship or its replacement.

3.7 CLEANING AND PROTECTION

A. General: During handling and installation of work at the project site, clean and protect work in progress and adjoining work on a basis of perpetual maintenance. Apply suitable protective covering on newly installed work where reasonably required to ensure freedom from damage or deterioration at time of substantial completion; otherwise, clean and perform maintenance on newly installed work as frequently as necessary through remainder of construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

B. Limiting Exposures of Work: To the extent possible through reasonable control and protection methods, supervise performance of work in a manner and by means which will ensure that none of the work is subject to dangerous, damaging, or otherwise deleterious exposures during construction period. Such exposures include (where applicable, but not by way of limitation) static loading, dynamic loading, internal pressures, external pressures, high or low temperatures, thermal shock, high or low humidity, air contamination or pollution, water, ice, solvents, chemical, light, radiation, puncture, abrasion, heavy traffic, soiling, bacteria, insect infestation, combustion, electrical current, high speed operation, improper lubrication, unusual wear, misuse, incompatible interface, destructive testing, misalignment, excessive weathering, unprotected storage, improper shipping/handling, theft and vandalism.

3.8 CONSERVATION AND SALVAGE

It is a general procedural requirement for supervision and administration of the work that construction operations be carried out with maximum practical consideration for conservation of energy, water and materials; and with maximum practical consideration for salvaging materials and equipment involved in performance of the work but not incorporated therein. Refer to other sections for required disposition of salvage materials and equipment which are Owner's property.

END OF SECTION

SECTION 01 42 19

REFERENCE STANDARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Applicability of Reference Standards.

B. Provision of Reference Standards at Site.

C. Acronyms used in Contract Documents for Reference Standards. Source of Reference Standards.

1.2 QUALITY ASSURANCE

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

B. The date of the standard is that in effect as of the Bid Date, or date of Owner-Contractor Agreement when there are no bids, except when a specific date is specified.

C. When required by individual Specification Section, obtain copy of standard. Maintain copy at jobsite during submittals, planning, and progress of the specific work, until Substantial Completion.

1.3 SCHEDULE OF REFERENCES

AA Aluminum Association
1525 Wilson Blvd.
Arlington, VA 22209
703-358-2960

AABC Associated Air Balance Council
1518 K Street NW, Suite 503
Washington, DC 20005
202-737-0202

AASHTO American Association of State Highway and Transportation Officials
444 North Capitol Street, N.W.
Washington, DC 20001
202-624-5800

ACI American Concrete Institute
Box 19150
Reford Station
Detroit, MI 48219
248-848-3700

ADC Air Diffusion Council
230 North Michigan Avenue
Chicago, IL 60601
847-706-6750

ADA Americans with Disabilities Act
US Dept of Justice
950 Pennsylvania Ave. NW

Washington, DC 20530
800-514-0301

AGC Associated General Contractors of America
2300 Wilson Blvd., Suite 400
Arlington, VA 22201
703-548-3118

AI Asphalt Institute
2696 Research Park Drive
Lexington, KY 40511
859-288-4960

AISC American Institute of Steel Construction
One East Wacker Dr., Suite 700
Chicago, IL 60601
312-670-2400

AMCA Air Movement and Control Association
30 West University Drive
Arlington Heights, IL 60004
847-394-0150

ANSI American National Standards Institute
25 W. 43rd Street, 4th Floor
New York, NY 10036
212-642-4900

APA American Plywood Association
Box 11700
Tacoma, WA 98411
253-620-7400

AHRI Air-Conditioning Heating and Refrigeration Institute
2111 Wilson Blvd., Suite 500
Arlington, VA 22201
703-524-8800

ASHRAE American Society of Heating, Refrigerating and
Air Conditioning Engineers
1791 Tullie Circle, N.E.
Atlanta, GA 30329
404-636-8400

ASME American Society of Mechanical Engineers
3 Park Ave
New York, NY 10016
800-843-2763

ASTM American Society for Testing and Materials
100 Barr Harbor Drive
West Conshohocken, PA 19103
610-832-9500

AWWA American Water Works Association
6666 West Quincy Avenue
Denver, CO 80235

800-926-7337

AWPA American Wood-Preservers' Association
P.O. Box 361784
Birmingham, AL 35236
205-733-4077

AWS American Welding Society
550 LeJeune Road
Miami, FL 33135
800-443-9353

COMAR Codes for the State of Maryland
Division of State Documents
16 Francis Street
Annapolis, MD 21401
410-974-2486

CDA Copper Development Association
260 Madison Ave.
New York, NY 10016
212-251-7200

CLFMI Chain Link Fence Manufacturers Institute
10015 Old Columbia Rd, Suite B215
Columbia, MD 21046
301-596-2583

CRSI Concrete Reinforcing Steel Institute
933 Plum Grove Road
Schaumburg, IL 60195
847-517-1209

EJCDC Engineers' Joint Contract Documents Committee
American Consulting Engineers Council
1050 15th Street, N.W.
Washington, DC 20005
202-347-7474

FGMA Flat Glass Marketing Association
3310 Harrison
White Lakes Professional Building
Topeka, KS 6661

FM Factory Mutual
P.O. Box 9102
Norwood, MA 02062
781-440-8000

FS Federal Specification
General Services Administration
Specifications and Consumer Information
Distribution Section (WFSIS)
Washington Navy Yard, Bldg. 197
Washington, DC 20407

GA Gypsum Association
6525 Belcrest Road, Suite 480
Hyattsville, MD 20782

301-277-8686

IEEE Institute of Electrical and Electronics Engineers
3 Park Avenue, 17th Floor
New York, NY 10016
212-419-7900

IBC International Building Code
Latest Editions, as Published by the International Code Council (ICC)
500 New Jersey Avenue, NW, 6th Floor
Washington, DC 20001
888-422-7233

ICC International Code Council
500 New Jersey Avenue, NW, 6th Floor
Washington, DC 20001
888-422-7233

IMIAC International Masonry Industry All-Weather Council
International Masonry Institute
815 15th Street, N.W.
Washington, DC 20005

MDOT Maryland Department of Transportation
Maryland State Highway Administration
P.O. Box 548
Hanover, MD 21076
410-865-1000

MIL Military Specification
Naval Publications and Forms Center
5801 Tabor Avenue
Philadelphia, PA 19120

ML/SFA Metal Lath/Steel Framing Association
221 North LaSalle Street
Chicago, IL 60601

NAAMM National Association of Architectural Metal Manufacturers
800 Roosevelt Rd., Sldg C, Suite 312
Glen Ellyn, IL 60137
630-942-6591

NEBB National Environmental Balancing Bureau
8575 Grovemont Circle
Gaithersburg, MD 20877
301-977-3698

NEMA National Electrical Manufacturers' Association
1300 N. 17th Street, Suite 1752
Rosslyn, VA 22209
703-841-3200

NFPA National Forest Products Association
1619 Massachusetts Avenue, N.W.
Washington, DC 20036

NSWMA National Solid Wastes Management Association
4301 Connecticut Avenue, N.W., Suite 300
Washington, DC 20008
202-244-4700

NTMA National Terrazzo and Mosaic Association
PO Box 2605
Fredericksburg, TX 778624
800-323-9736

PCA Portland Cement Association
5420 Old Orchard Road
Skokie, IL 60077
847-966-6200

PCI Prestressed Concrete Institute
200 W. Adams Street, #2000
Chicago, IL 60606
312-786-0300

PS Product Standard
U.S. Department of Commerce
Washington, DC 20203

SDI Steel Deck Institute
Box 3812
St. Louis, MO 63122
847-458-4647

SDI Steel Door Institute
30200 Detroit Road
Westlake, OH 44145
440-899-0010

SIGMA Sealed Insulating Glass Manufacturers Association
401 N. Michigan Ave., Suite 2400
Chicago, IL 60611
312-644-6610

SJI Steel Joist Institute
1173B London Links Drive
Forest, VA 24551
434-525-7377

SMACNA Sheet Metal and Air Conditioning Contractors' National Association
4201 LaFayette Center Drive
Chantilly, VA 20151
703-803-2980

SSPC Steel Structures Painting Council
40 Twenty-Fourth Street, 6th Floor
Pittsburgh, PA 15222
877-281-7772

TAS Technical Aid Series
Construction Specifications Institute
110 S. Union Street, Suite 100

Alexandria, VA 22314
800-689-2900

TCNA Tile Council of North America, Inc.
100 Clemson Research Blvd.
Anderson, SC 29625
864-646-8453

UL Underwriters' Laboratories, Inc.
333 Pfingston Road
Northbrook, IL 60062
847-272-8800

WCLIB West Coast Lumber Inspection Bureau
Box 23145
Portland, OR 97223
503-639-0651

WSSC Washington Suburban Sanitary Commission
14501 Sweitzer Lane
Laurel, MD 20707
800-828-6439

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Quality assurance and control of installation.

B. References.

C. Field samples.

D. Field Constructed Mock ups.

E. Inspection and testing laboratory services specified in Sections of Divisions 2 through 48 of these Specifications.

F. Manufacturers' field services and reports specified in Sections of Divisions 2 through 48 of these Specifications.

1.2 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply fully with manufacturers' instructions, including each step in sequence.

C. All manufactured articles, materials, equipment, fixtures and accessories shall be handled, stored, applied, installed, connected, erected, used, cleaned and conditioned, as directed by the manufacturers, unless otherwise indicated, specified, or directed by the Architect in writing. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect **before** proceeding.

D. 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.

E. Perform work by persons qualified to produce workmanship of specified quality.

F. Secure products in place with positive anchorage devices designed and sized to withstand stressed, vibration, physical distortion or disfigurement.

1.3 GENERAL WORKMANSHIP

A. Workmanship shall be neat, thorough, substantial and conform to the following, unless otherwise indicated or specified.

B. Units: Set level, plumb, or true to other lines indicated. Fit neatly and closely together and anchor firmly in place.

C. Surfaces:
1. Level, plumb, true to indicated plane;
2. Smooth, flat;
3. Uniform in color and texture;
4. Clean and neat in appearance.

D. Joints and seams: Conceal where possible, except where otherwise indicated or specified.

E. Joints and seams exposed to view:

1. Neat, straight, tight, flush, smooth, uniform, strong;
2. Plumb, level or otherwise true to line indicated;
3. Located where least conspicuous;
4. Construct to prevent opening;
5. Equally spaced;
6. Obtain Architect's written acceptance of joints and seams exposed to view, except where such exposure is shown or specified.

F. Coursing: Uniform, accurately spaced, modular unless otherwise noted.

G. Corners, straight square, sharp, neat, plumb, level or true to other lines indicated.

H. Anchors, fastenings, connections, accessories:
1. Provide anchors, fastenings, framing, supports, hangers, bracing, brackets, straps, angles, bolts, etc., adequate in size, design and quantity to set and connect work rigidly in place and to safely sustain stresses to which they will normally be subjected.
2. Conceal such work where possible, except where otherwise indicated or specified.
3. Such items exposed to view shall be equally spaced, located where least conspicuous and neat in appearance. Obtain Architect's written acceptance of exposed items except where such exposure is shown or specified.

1.4 REFERENCES

A. Where reference is made to publications, tests, standard specifications, manufacturer's directions, data sheets or other literature unless the date is stated, the latest edition published before date of specifications shall apply.

B. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

C. 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.

1.5 FIELD SAMPLES

A. Install field samples at the site as required by individual specifications Sections for review.

B. Acceptable samples represent a quality level for the Work.

C. Where field sample is specified in individual Sections to be removed, clear area after field sample has been accepted by Architect.

1.6 MOCK-UP

A. Assemble and erect specified items, with specified attachment and anchorage devices, flashings, seals, and finishes.

B. Full scale mock-ups of proposed construction are specified in individual sections. All mockups shall be full size, separately constructed samples that incorporate the relevant components of the feature being considered by the Owner’s representative as an assembly that complies with the contract requirements.

C. **Mock-ups shall be constructed on the project site, or constructed off-site and transported to the project site, by the Contractor. The mock-up shall remain on the site at an accessible location until the Owner’s representative approves the Contractor’s request to remove the mock-up. The Contractor shall protect and maintain the mock-up. Upon approval from the Owner’s representative, the Contractor shall remove the mock-up from the project site.**

1.7 INSPECTION AND TESTING LABORATORY SERVICES

A. Submit name and qualifications of independent testing agencies for approval by the Owner and Architect prior to commencement of the work.

B. The independent firm will perform inspections, test, and other services specified in individual specification Sections and as required by the Architect.

C. Reports will be submitted by the independent firm to the Architect, in triplicate, indicating observations and results of test and indicating compliance or non-compliance with Contract Documents.

D. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.
   1. Notify Architect 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.

E. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions from the Architect. The cost of re-testing shall be borne by the Contractor.

1.8 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. Submit qualifications of observer to Architect 30 days in advance of required observations. Observer subject to approval of Architect and Owner.

B. 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, test, adjust, and balance of equipment as applicable.

C. Contractor shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.

D. Submit report in duplicate to Architect for review, within 15 days of observation.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 45 29

TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Selection and payment.

B. Laboratory responsibilities.

C. Laboratory reports.

D. Limits on testing laboratory authority.

E. Contractor responsibilities.

F. Schedule of inspections and tests.

1.2 REFERENCES

A. ANSI/ASTM D 3740 - Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

B. ANSI/ASTM E 329 - Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

1.3 SELECTION AND PAYMENT

A. Contractor shall employ and pay for services of an independent testing laboratory to perform Certified Inspection and Testing Firm (CITF) when testing is indicated in the separate specification sections of these Contract Documents.

B. Employment of testing laboratory (CITF) shall in no way relieve Contractor of obligation to perform work in compliance with requirements of Contract Documents.

1.4 CERTIFIED INSPECTION AND TESTING FIRM (CITF) RESPONSIBILITIES

A. Perform testing on samples submitted by Contractor to testing laboratory.

B. Provide qualified personnel at site. Cooperate with Architect/Engineer and Contractor in performance of services.

C. Perform specified inspection, sampling, and testing of products in accordance with specified standards.

D. Ascertain compliance of materials and mixes with requirements of Contract Documents.

E. Promptly notify Contractor and Owner of observed irregularities or non-conformance of Work or products.

F. Perform additional inspections and tests required by Architect/Engineer.

G. Attend preconstruction conferences and progress meetings.

1.5 LABORATORY REPORTS

A. After each inspection and test, promptly submit 4 copies of laboratory report to Contractor, with 2 copies each to Architect/Engineer and Owner.

B. Include:
1. Data issued.
2. Project title and number.
3. Name of inspector.
4. Date and time of sampling or inspection.
5. Identification of product and Specification Section.
6. Location in the Project.
7. Type of inspection or test.
8. Date of test.
9. Results of tests.
10. Compliance with Contract Documents.

C. When requested by Architect/Engineer, provide interpretation of test results.

1.6 LIMITS ON CITF AUTHORITY

A. CITF may not release, revoke, alter, or enlarge on requirements of Contract Documents.

B. CITF may not approve or accept any portion of the Work.

C. CITF may not assume any duties of Contractor.

D. CITF has no authority to stop the Work unless life-threatening health or safety conditions exist.

1.7 CONTRACTOR RESPONSIBILITIES

A. Deliver to laboratory, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.

B. Cooperate with CITF personnel and provide access to the Project.

C. Provide incidental labor and facilities to provide access to Work to be tested, to obtain and handle samples at the site or at source of products to be tested, and to facilitate tests and inspections, storage and curing of test samples.

D. Notify CITF and laboratory 24 hours prior to expected time for operations requiring inspection and testing services.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF INSPECTIONS AND TESTS

The following list is not meant to be all inclusive. Refer to individual specification sections for testing requirements

A. Soils Testing:
1. Undisturbed footing excavations for bearing capacity.
2. Fill material classification.
3. Fill placement and compaction.

B. Cast-In-Place Concrete

C. Masonry Mortar and Grout

D. Structural Steel Framing

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes temporary facilities and controls needed for Work including, but not necessarily limited to:
   1. Temporary utilities such as heat, water, electricity, and telephone;
   2. Sanitary facilities;
   3. Enclosures such as tarpaulins, barricades, and canopies.
   4. Temporary access provisions

B. Exclusions from this Section:
   1. Equipment individual trades normally furnish to execute their own portions of Work are not part of this Section.
   2. Permanent installation and hookup of various utility lines are described in other Sections.

1.2 REQUIREMENTS

A. Specific administrative and procedural minimum actions are specified in this section, as extensions of provisions in the General Conditions and other contract documents. These requirements have been included for special purposes as indicated. Nothing in this section is intended to limit types and amounts of temporary work required, and no omission from this section will be recognized as an indication by the Architect that such temporary activity is not required for successful completion of the work and compliance with requirements of contract documents. The Contractor shall be responsible for all temporary facilities, equipment, materials, and services necessary and incidental to the completion of the work of the Contract.

B. Provisions of this section are applicable to, but not by way of limitation, utility services, construction facilities, security/protection provisions, and support facilities.

1.3 QUALITY ASSURANCE

A. General: In addition to compliance with governing regulations and rules/recommendations of franchised utility companies, comply with specific requirements indicated and with applicable local industry standards for construction work.

B. NFPA Code: Comply with NFPA Code 241 "Building Construction and Demolition Operations".

1.4 JOB CONDITIONS

A. General: Establish and initiate use of each temporary facility at time first reasonably required for proper performance of the work. Terminate use and remove facilities at earliest reasonable time, when no longer needed or when permanent facilities have, with authorized use, replaced the need.

B. Conditions of Use: Install, operate, maintain and protect temporary facilities in a manner and at locations which will be safe, non-hazardous, sanitary and protective of persons and property, and free of deleterious effects.

PART 2 - PRODUCTS

2.1 TEMPORARY UTILITY SERVICE

A. General: Where possible and reasonable, connect to existing franchised utilities for required services and comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services to minimize interference with construction operations.

B. Potable Water: Water connection (without charge) to Owner's existing potable water system is limited to one, ¾" pipe size connection, and a maximum flow of 10 GPM. Water usage shall be strictly limited to water required for on-site construction activities. Water required for the execution of the contract work, in volumes and pressure beyond that available at the site through the prescribed ¾" pipe at 10 gpm, shall be provided by the Contractor at no additional cost to the Owner.

C. Non-potable Water: Where non-potable water is used, mark each outlet with adequate health-hazard warning signs.

D. Temporary Power: Electrical power may be obtained by the Contractor from Owner's existing service in the building; but is limited to local 20-ampere rated circuits that are suited for small power tools. Any electrical power necessary to execute the work of the contract that is above and beyond the limits stated above shall be provided by the Contractor at no additional expense to the Owner.

2.2 TEMPORARY CONSTRUCTION FACILITIES

A. General: The types of temporary construction facilities required include, but not by way of limitation, the items listed below. Provide facilities reasonably required to perform construction operations properly and adequately.

B. Water Distribution: Pipe to each floor level and provide hose lengths sufficient to reach entire area of construction work, not less than 3/4" hose size. prevent freezing of water distribution by either prompt drainage after each use, or by suitable protection.

C. Enclosure: Provide temporary enclosure where reasonably required to ensure adequate workmanship and protection from weather and unsatisfactory ambient conditions for the work, including enclosure where temporary heat is used. Provide fire retardant treated lumber and plywood. Provide tarpaulins with UL label and flame spread of 15 or less.

D. Heating: Provide temporary heat to maintain temperatures required in each section of the Contract Documents. Heaters shall bear UL, FM approval labels appropriate for application.

E. Electrical Power: Provide weatherproof, grounded, power distribution system sufficient to accommodate construction operations requiring power, use of power tools, lighting, and start-up testing of permanent electric powered equipment prior to its permanent connection to electrical system. Provide overload protection. Locate multiple outlets (not less than 4 gang) at each story of construction, spaced so that entire area of construction can be reached by power tools on a single extension cord of 100' maximum length.

F. Lighting:

1. Provide sufficient temporary lighting to ensure proper workmanship everywhere; by combined use of daylight, general lighting, and portable plug-in task lighting. Provide

general lighting with local switching which will enable energy conservation during periods of varying activity.

2. Provide uniformly spaced general lighting equivalent to not less than one 200-watt incandescent lamp per 1000 square feet of floor area, and one 100-watt lamp per 50' of corridor and per flight of stairs.

G. Access Provisions:

1. Provide all necessary temporary access equipment including, but not limited to, stairs, ladders, scaffolding, cranes, platforms, man-lifts, and elevators. Provide access at all times for inspections of the Work by the Owner, Architect and agencies having jurisdiction.
2. Comply with reasonable requests of governing authorities performing inspections. When permanent stairs are available for access during construction, cover finished surfaces with sufficient protection to ensure freedom from damage and deterioration at time of substantial completion.

2.3 SECURITY AND PROTECTION PROVISIONS

A. General:

1. The types of temporary security and protection provisions required include, but not by way of limitation, the items listed in this section. These provisions are intended to minimize property loses, personal injuries and claims for damages at the project site.
2. Provide security/protection services and systems in coordination with activities and in a manner to achieve 24-hour, 7-day-per-week effectiveness.

B. Fire Extinguishers: Provide types, sizes, numbers, and locations as would be reasonably effective in extinguishing fires during early stages, by personnel at the project site. Provide type ABC dry chemical extinguishers at all locations; comply with recommendations of NFPA No. 10. Post warning and quick instructions at each extinguisher location, and instruct personnel at project site, at time of their first arrival, on proper use of extinguishers and other available facilities at project site. Post local fire department call number on each telephone instrument at project site.

C. Site Enclosure Fence: At earliest reasonable date enclose project site, or portion thereof sufficient to contain entire construction activity. Provide 6' high chain link steel fence with gates for both personnel and trucks, with locks held under strict security control.

D. Environmental Protection Procedures: Provide facilities, establish procedures, and conduct construction activities in a manner which will ensure compliance with environmental regulations controlling construction activities at the project site. Designate one person, the Construction Superintendent, to enforce strict discipline on activities related to generation of wastes, pollution of air/water/soil, generation noise, and similar harmful or deleterious effects which might violate regulations or reasonably irritate persons at or in the vicinity of the project site.

E. Excavations: Provide temporary covers over open excavations when the jobsite is un-attended. Keep excavations covered at all times when it is raining. Do not allow rainwater to accumulate in open excavations

2.4 MAINTENANCE AND PROTECTION OF TRAFFIC

A. Provide temporary traffic control devices, services, equipment and fixtures necessary to safely maintain and protect existing vehicular and pedestrian traffic adjacent to, and in anyway effected by, the work of the Contract.

B. Contractor shall provide manpower, barricades, flashing warning lights, flags, and traffic control personnel to effectively maintain safe conditions around the work, for occupants, pedestrians, vehicles and the public.

2.5 TEMPORARY SUPPORT FACILITIES

A. General: The types of temporary support facilities required include, but not by way of limitation, the items specified hereinafter, all as may be reasonably required for proficient performance of the work and accommodation of personnel at the site including Owner's and Architect's personnel. Locate temporary support facilities for convenience of users, and for minimum interference with construction activities.

B. Contractor's Storage: The Contractor shall provide any and all means and methods for temporary storage on the site, including, but not limited to, storage trailers for materials required in the construction. The Owner will not provide any space for storage of the Contractor's materials, equipment or tools. If the Contractor elects to store materials on the site in a temporary trailer, the storage units shall be enclosed in a fenced compound, constructed and maintained at the sole expense of the Contractor. The fence shall be a minimum 6' tall chain link fence with lockable gates.

C. Sanitary Facilities: At the Contractor option, provide either piped toilet facilities or self-contained toilet units of type acceptable to governing authorities, adequate for use of personnel at the project site. Provide separate facilities for male and female personnel when both sexes are working (in any capacity) at the project site.

D. Drinking Water: Provide drinking water, dispenser, cups and waste receptacles.

PART 3 - EXECUTION

3.1 MAINTENANCE AND REMOVAL

A. Maintain temporary facilities and controls as long as needed for safe and proper completion of Work.

B. Remove such temporary facilities and controls as rapidly as progress of Work will permit, or as Architect directs.

3.2 DE-WATERING

Provide temporary pumps, power source and accessories necessary to remove water from open excavations at all times.

END OF SECTION

SECTION 01 58 00

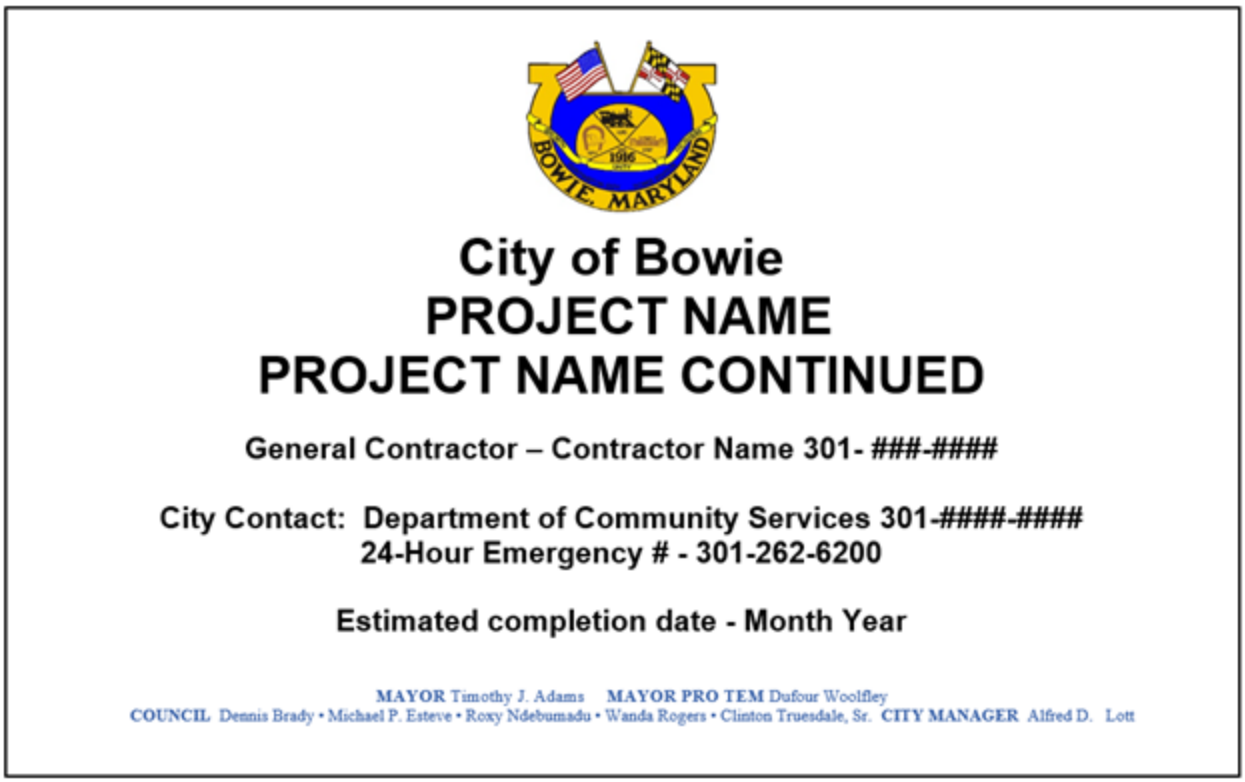
PROJECT IDENTIFICATION

PART 1 - GENERAL

1.1 PROJECT IDENTIFICATION SIGN

A. Large Project Information Sign

1. Provide 1 project identification signs mounted to the site barrier fence.
2. Signs shall be metal or marine grade plywood (weather resistant) 24” x 36” (or 4’x8’).
3. Post signs prior to the start of any work on site or as directed by City Project Manager.
4. Erect at location(s) as shown on the Site Drawings or as approved by the City.
5. Erect supports and framing on secure foundation, rigidly braced, and framed to resist winds of 50 miles/hr or as required by Prince George’s County codes.
6. Project signs must be submitted as a Shop Drawing and approved prior to fabrication.



1.2 NO PARKING SIGNS

A. Requirements

1. Provide no parking signs when work will require an area clear of vehicles including portions of the parking lot.
2. Provide notice to Project Manager in advance of placing signs.
3. Post signs 48 hours prior to scheduled work start.
4. Signs shall be weather resistant poster board of minimum size of 11” x 17”.

5. Attach signs to wooden stakes, and/or traffic barrels/cones in public parking area. Do not attach signs to utility poles, trees, light poles or signposts.

1.3 REMOVAL

Remove signs, framing, supports, and foundations at Substantial Completion of Project and restore the area.

END OF SECTION

SECTION 01 62 00

PRODUCT OPTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Product Options
2. Substitutions

1.2 PRODUCT OPTIONS

A. For products that are specified by reference standards or by description only the Contractor has the option to utilize any product meeting those standards or description.

B. For products specified by naming one or more manufacturers the Contractor has the option to utilize any of the manufacturers named and meeting the product specifications.

C. For products specified by naming one or more manufacturers along with a provision for substitutions, the Contractor has the option to utilize any of the manufacturers named and meeting the product specifications; or submit a request for substitution for any manufacturer and product not named.

1.3 SUBSTITUTIONS

A. Instructions to Bidders state time restrictions for submitting requests for substitutions during the bidding period.

B. Submit requests in accordance with requirements specified in this Section. Substitution acceptance, if any, will be stated by addenda issued prior to Bid Date.

C. Substitutions may be considered after award of Contract only when a product specified becomes unavailable through no fault of the Contractor.

D. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. **Documentation shall include point by point comparison of specified product to proposed substitution.**

E. A request constitutes a representation that the Bidder or Contractor:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other work which may be required for the Work to be completed with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.

F. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without prior separate written request, or when acceptance will require revision to the Contract Documents.

G. Substitution Submittal Procedure:

1. Submit Request for Substitution for consideration. Limit each request to one proposed substitution.
2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence through documentation that includes a point by point comparison

of the proposed substitution to the specified product.

3. The Architect will make notification in writing, of decision to accept or reject request.

I. Determination of Approved Equal:
The term “Approved Equal” , as it is used in the Contract Documents, shall be interpreted as an opportunity for the Contractor to substitute a product that is equal to the specified product in all regards, subject to approval by the Architect of the substitution. The burden for researching the market place and finding an “Approved Equal” product shall be the sole responsibility of the Contractor. The use of the term “Approved Equal” shall in no way be interpreted to mean that an equal product is currently manufactured or available. The use of the term “Approved Equal” is intended to communicate to the Contractor that the Architect has not conducted an exhaustive search to find equal products, but the Contractor has the opportunity to do so.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SUBSTITUTION REQUEST

TO: _____

PROJECT: _____

SPECIFIED ITEM:

Section	Page	Paragraph	Description

The undersigned requests consideration of the following:

PROPOSED SUBSTITUTION: _____

_____

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request. The data includes a point by point comparison of the characteristics and all components of proposed substitution product compared to the same characteristics of the specified product.

Attached data also includes a description of changes to the Contract Documents which the proposed substitution will require for its proper installation.

The undersigned certifies that the following paragraphs, unless modified by attachments, are correct:

1. The proposed substitution does not affect dimensions shown on drawings.
2. The undersigned will pay for changes to the building design, including engineering design, detailing and construction costs caused by the requested substitution.
3. The proposed substitution will have no adverse affect on other trades, the construction schedule, or specified warranty requirements.
4. Maintenance and service parts will be locally available for the proposed substitution.
5. All provisions of Section 01 62 00 apply to this substitution.

The undersigned further states that the function, appearance, and quality of the proposed substitution are equivalent or superior to the specified item.

SUBMITTED BY:

Signature _____ For use by the design consultant

Firm _____ [ ] Accepted [ ] Accepted as noted

Address _____ [ ] Not Accepted [ ] Received too late

_____ By _____

Date _____

Telephone _____ Remarks _____

Attachments:

END OF SECTION

SECTION 01 66 00

PRODUCT STORAGE & HANDLING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaging and Transportation.

B. Delivery and Receiving

C. Product Handling

D. Storage, General

E. Enclosed Storage

F. Exterior Storage

G. Maintenance of Storage

H. Protection of Finished Work

I. Repair and Replacement

PART 2 – PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 TRANSPORTATION AND HANDLING

A. Packaging and Transportation
   1. Require supplier to package finished products in boxes or crates for protection during shipment, handling, and storage. Protect sensitive products against exposure to elements and moisture.
   2. Protect sensitive equipment and finishes against impact, abrasion, and other damage.

B. Delivery and Receiving
   1. Arrange deliveries of products in accordance with construction progress schedules. Allow time for inspection prior to installation.
   2. Coordinate deliveries to avoid conflict with Work and conditions at site; limitations on storage space; availability of personnel and handling equipment; and Owner's use of premises.
   3. Deliver products in undamaged, dry condition, in original unopened containers or packaging with identifying labels intact and legible.
   4. Clearly mark partial deliveries of component parts of equipment to identify equipment and contents, to permit easy accumulation of parts, and to facilitate assembly.
   5. Immediately upon delivery, inspect shipment to assure:
      a. Product complies with requirement of Contract Documents and reviewed submittals.
      b. Quantities are correct.
      c. Accessories and installation hardware are correct.
      d. Containers and packages are intact and labels legible.
      e. Products are protected and undamaged.

C. Product Handling
1. Provide equipment and personnel to handle products, by methods to prevent soiling and damage.
2. Provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.
3. Handle product by methods to avoid bending or overstressing. Lift large and heavy components only at designated lift points.

3.2 STORAGE AND PROTECTION

A. General
1. Store products immediately upon delivery in accordance with manufacturer's instructions, with seals and labels intact. Protect until installed.
2. Arrange storage in a manner to provide access for maintenance of stored items and for inspection.
3. Stored materials must not conflict with work conditions. On-site storage methods and locations subject to Owner's approval.

B. Staging and Site Allocation of Storage Space:
The Contractor shall submit a plan to the Owner that illustrates the Contractor’s intended use of the site during construction of the work. The Contractor shall not proceed with any use or occupancy of the site without the Owner’s approval of the staging plan.

C. Enclosed Storage
1. Store products subject to damage by the elements in substantial weathertight enclosures.
2. Maintain temperature and humidity within ranges stated in manufacturer's instructions.
3. Provide humidity control and ventilation for sensitive products as required by manufacturer's instructions.
4. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.

D. Exterior Storage
1. Provide substantial platforms, blocking, or skids, to support fabricated products above ground; slope to provide drainage. Protect products form soiling and staining.
2. Products subject to discoloration or deterioration from exposure to the elements, cover with impervious sheet material. Provide ventilation to avoid condensation.
3. Store loose granular materials on clean, solid surfaces such as pavement, or on rigid sheet materials, to prevent mixing with foreign matter.
4. Provide surface drainage to prevent erosion and ponding of water.
5. Prevent mixing of refuse or chemically injurious materials or liquids.

E. Maintenance of Storage
1. Periodically inspect stored products on a scheduled basis.
2. Verify that storage facilities comply with manufacturer's product storage requirements.
3. Verify that manufacturer-required environmental conditions are maintained continually.
4. Verify that surfaces of products exposed to the elements are not adversely affected and that any weathering of finishes is acceptable under requirements of Contract Documents.

F. Maintenance of Equipment Storage
1. For mechanical and electrical equipment in long-term storage, provide manufacturer's service instructions to accompany each item, with notice of enclosed instructions shown on exterior of package.
2. Service equipment on a regularly scheduled basis, maintaining a log of services; submit as a Record Document.

G. Storage of Owner's Salvaged Furnishings and Equipment
Contractor shall provide temporary storage facilities for items to be salvaged and re-installed.

3.3 PROTECTION OF FINISHED WORK

A. Protect finished surfaces, including jambs and soffits of openings used as passageways, through which equipment and materials are handled.

B. Protect finished floor surfaces in traffic areas prior to allowing equipment or materials to be moved over such surfaces.

C. Keep finished surfaces clean, unmarred, and suitably protected until accepted by owner.

3.4 REPAIRS AND REPLACEMENTS

A. In event of damage, promptly make replacements and repairs at no additional cost to Owner.

B. Additional time required to secure replacements and to make repairs will not justify an extension in Contract Time of Completion, unless Owner authorizes such extension.

END OF SECTION

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included: This Section establishes general requirements pertaining to cutting, fitting, and patching of Work required to:

1. Make the several parts fit properly.
2. Remove and/or uncover existing finishes or structures to provide for installation or inspection of new work.
3. Patch existing finishes and structures in connection with new work.
4. Remove and replace work not conforming to requirements of Contract Documents.
5. Remove and replace defective work.

B. Related work:

1. In addition to other requirements specified, upon Architect's request uncover work to provide for Architect's inspection of covered work, and remove samples of installed materials for testing.
2. Do not cut or alter work performed under separate contracts without Architect's written permission.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in necessary crafts and who are completely familiar with specified requirements and methods needed for proper performance of the work of this Section.

1.3 SUBMITTALS

A. Request for Architect's consent:

1. Prior to cutting that affects structural safety, submit written request to Architect for permission to proceed with cutting.
2. Should conditions of Work or schedule indicate required change of materials or methods for cutting and patching, notify Architect and secure the Architect's written permission.

B. Notice to Architect: Submit written notice to Architect designating time Work will be uncovered, to provide for Architect's observation.

1.4 PAYMENT OF COSTS

A. Perform cutting and patching needed to comply with the Contract Documents at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. For replacement of items removed, use materials complying with pertinent Sections of these Specifications. If not identified in other sections of these specifications, provide material to match adjacent construction.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General
   1. Where cutting of any structural member is required and such cutting is not indicated or specified, first obtain Architect's written acceptance for each location. Also obtain written approval from local building officials, if required by local building code.
   2. Contractor shall locate and arrange for cutting of openings and chases through walls, floors, and ceilings in advance of need. Avoid unnecessary or excessive cutting. Where cutting of finished surface is required, make cuts neatly along true lines to avoid need for patching. Where possible, make holes and other cuts so they will be concealed by finished work and where they will be least conspicuous. Work in place damaged or defaced by cutting shall be restored to original conditions so such damage or defacement is undetectable upon completion.
   3. Do not cut and patch structural work in a manner resulting in reduction of load carrying capacity or load/deflection ratio. Do not cut and patch operational elements and safety related components in a manner resulting in decreased operational life, increased maintenance, or decreased safety. Do not cut and patch work which is exposed on the exterior or exposed in occupied spaces of the building, in a manner resulting in reduction of visual qualities or resulting in substantial evidence of cut and patch work, both as judged solely by the Architect. Remove and replace work judged by the Architect to be cut and patched in a visually unsatisfactory or otherwise objectionable manner.
   4. Where physical cutting action is required, cut work with sawing and grinding tools, not with hammering and chopping tools. Core drill openings through concrete work.
   5. Patch with seams which are durable and as invisible as possible. Comply with specified tolerances for the work.
   6. Restore exposed finishes of patched areas; and, where necessary extend finish restoration onto retained work adjoining, in a manner which will eliminate evidence of patching.
   7. Where patch occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing patch, after patched area has received prime and base coats.

B. Materials: Except as otherwise indicated or approved by the Architect, provide materials for cutting and patching which will result in equal or better work than work being cut and patched; in terms of performance characteristics and including visual effect where applicable. Use materials identical with original materials where feasible and where recognized that satisfactory results can be produced thereby.

C. Scope of Cutting and Patching Work: The Contractor shall perform all cutting and patching required and necessary to accomplish the construction of all improvements described in the Contract Documents, at no additional cost to the Owner.

3.2 TEMPORARY SUPPORT AND PROTECTION

A. Provide adequate temporary support for work to be cut, to prevent failure. Do not endanger other work. Provide adequate protection of other work during cutting and patching, to prevent damage; and provide protection of the work from adverse weather exposure.

3.3 SURFACE CONDITIONS

A. Inspection:
   1. Inspect existing conditions, including elements subject to movement or damage during cutting, excavating, patching, and backfilling.
   2. After uncovering work, inspect conditions affecting installation of new work.

B. Discrepancies:
   1. If uncovered conditions are not as anticipated, immediately notify Architect and secure needed directions.
   2. Do not proceed until unsatisfactory conditions are corrected.

END OF SECTION

SECTION 01 74 00

CLEANING AND WASTE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included: Throughout construction period, maintain buildings and site in standard of cleanliness as described in this Section.

B. Related work: In addition to standards described in this Section, comply with requirements for cleaning as described in pertinent other Sections of these Specifications.

1.2 QUALITY ASSURANCE

A. Conduct daily inspection, and more often if necessary, to verify that requirements for cleanliness are being met.

B. In addition to standards described in this Section, comply with pertinent requirements and standards.

1.3 SAFETY REQUIREMENTS

A. Standards: Maintain project in accordance with safety and insurance requirements and standards.

B. Hazard Control: Store volatile wastes in covered metal containers and remove from premises daily. Prevent accumulation of waste that creates hazardous conditions. Provide adequate ventilation during use of volatile or noxious substances.

C. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws. Do not burn or bury rubbish and waste materials on project site. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains. Do not dispose of wastes into streams or waterways.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS AND EQUIPMENT

A. Provide required personnel, equipment, and materials needed to maintain specified standard of cleanliness.

2.2 COMPATIBILITY

A. Use only cleaning materials and equipment compatible with surface being cleaned as manufacturer of material recommends.

PART 3 - EXECUTION

3.1 PROGRESS CLEANING

A. General:

1. Retain stored items in orderly arrangement allowing maximum access, not impeding traffic or drainage, and providing required protection of materials.
2. Do not allow accumulation of scrap, debris, waste material, and other items not required for construction of the Work.

3. At least twice each month, and more often if necessary, completely remove all scrap, debris, and waste material from job site.
4. Provide adequate storage for all items awaiting removal from job site, observing requirements for fire prevention and protection of ecology.

B. Site:
1. Daily, and more often if necessary, inspect site and pick up all scrap, debris, and waste material. Remove such items to place designated for their storage.
2. Weekly, and more often if necessary, inspect all arrangements of materials stored on site. Restack, tidy, or otherwise arrange to meet requirements of the contract documents.
3. Maintain site in neat and orderly condition at all times.
4. At reasonable intervals during progress of work, clean site and public properties, and dispose of waste materials, debris and rubbish. Clean mud, dirt, and debris resulting from building operation from drives, roads, and lots as required, and maintain access roads to site in good condition.
5. Provide on-site dumpster containers for collecting waste materials, debris, and rubbish. Remove snow and ice from public walkways and public access of buildings.
6. **Contractor shall inspect the site at the end of each work day and collect all deleterious objects and materials resulting from construction activities including, but not limited to, nails, screws, and other sharp objects.**

C. Structures:
1. Weekly, and more often if necessary, inspect structures and pick up all scrap, debris, and waste material. Remove such items to place designated for their storage.
2. Weekly, and more often if necessary, sweep interior spaces clean.
   a. "Clean," for purpose of this subparagraph, is interpreted as meaning free from dust and other material capable of being removed by reasonable effort and hand-held broom.
3. As required to prepare for installing succeeding materials, clean structures or pertinent portions thereof to degree of cleanliness recommended by manufacturer of succeeding material, using equipment and materials required to achieve necessary cleanliness.
4. Following installation of finish floor materials, protect and keep floor clean at all times.
5. Or clean daily while work is being performed in pace in which finish materials are installed.
   a. “Clean," for purpose of this subparagraph, is interpreted as meaning free from foreign material which, in Architect’s opinion, may injure finish floor material.

3.2 FINAL CLEANING

A. "Clean," for purpose of this Article, and except as may be specifically provided otherwise, shall be interpreted as meaning level of cleanliness generally provided by skilled cleaners using commercial-quality building maintenance equipment and materials.

B. Prior to completing Work, remove from job site all tools, surplus materials, equipment, scrap, debris, and waste.

C. Site: Unless Architect specifically directs otherwise, broom clean paved areas on site and public paved areas adjacent to site, where debris and dirt are the result of Contractor’s work.

D. Structures - Clean to remove debris and dirt caused by Work of Contract:
1. Exterior:
   a. Visually inspect exterior of surfaces and remove all traces of soil, waste materials, smudges, and other foreign matter.

b. Remove all traces of splashed materials from adjacent surfaces.
c. If necessary to achieve uniform degree of cleanliness, hose down exterior of structure.
d. In event of stubborn stains not removable with water, Architect may require light pressure washing or other cleaning at no additional cost to Owner.

E. Inspection and Schedule:
1. In preparation for substantial completion or occupancy, conduct final inspection of exposed interior and exterior surfaces and of concealed spaces.
2. Schedule final cleaning as approved by Architect to enable Owner to accept completely clean Work.

F. If Contractor fails to clean up at completion of work, Owner may do so and charge cost to Contractor.

END OF SECTION

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Administrative provisions for Substantial Completion and for Final Acceptance.

1.2 SUBSTANTIAL COMPLETION

A. Pre-requisites for substantial completion: The project is substantially complete when the Owner can take beneficial use and occupancy of the building, without interruption there of. As a minimum, the following components of the project must be complete for the work to be substantially complete.

1. The contractor shall have prepared and submitted a list of items to be completed and corrected (punch list), the value of items on the list and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
15. Final test reports for IT cabling.

B. Date of Substantial Completion: Contract duration minus 30 calendar days.

1.3 INSPECTION

A. Should Owner and Architect/Engineer inspection find Work is not substantially complete during the Substantial Completion Inspection, the Contractor shall be notified in writing, listing observed deficiencies.

B. Post Substantial Completion Inspection:

1. Contractor shall remedy deficiencies and send a second written notice of Substantial Completion.
2. The second inspection, and subsequent inspections, shall be backcharged against the Contract Sum at the established labor rates of the Architect/Engineer and include

all travel expenses.

3. Architect/Engineer will prepare a Certificate of Substantial Completion in compliance with provisions of the General Conditions when Work is determined to be substantially complete.

1.4 FINAL COMPLETION

A. Final Completion Date: Last day of Contract duration.

B. When Contractor considers Work is complete, the Contractor shall submit written certification of the following:
   1. Contract Documents have been reviewed.
   2. Work has been inspected for compliance with Contract Documents.
   3. Work has been completed in compliance with Contract Documents, and deficiencies listed with Certificate of Substantial Completion have been corrected.
   4. Equipment and systems have been tested, adjusted, and balanced, and are fully operational.
   5. Operation of systems has been demonstrated to Owner's personnel.
   6. Final Completion Inspection: Work is complete and ready for final inspection by Owner and Architect Engineer.

C. Should Architect/Engineer inspection find Work incomplete, the Contractor will be promptly notified in writing, listing observed deficiencies.

D. Contractor shall remedy deficiencies and send a second Certification of Final Completion.

E. Post Final Completion Inspection: When Owner and Architect/Engineer determine that work is complete, closeout submittals shall be considered.

1.5 REINSPECTION FEES

A. Should status of completion of Work require re-inspection by Architect/Engineer due to failure of Work to comply with Contractor's claims on initial, substantial and final completion inspections, Owner will deduct the amount of Architect/Engineer compensation for re-inspection services from final payment to Contractor.

1.6 CLOSEOUT SUBMITTALS

A. Evidence of Compliance with Requirements of Governing Authorities:
   1. Certificate of Occupancy.
   2. Certificates of Inspection required for mechanical and electrical systems.

B. Project Record Documents.

C. Operation and Maintenance Data:

D. Warranties and Bonds:

E. Evidence of Payment and Release of Liens: In accordance with Conditions of the Contract.

F. Consent of Surety to Final Payment.

G. Certificates of Insurance for Products and Completed Operations: In accordance with Supplementary Conditions.

1.7 STATEMENT OF ADJUSTMENT OF ACCOUNTS

A. Submit final statement reflecting adjustments to Contract Sum indicating:
   1. Original Contract Sum.
   2. Previous change orders.
   3. Changes under allowances.
   4. Changes under unit prices.

5. Deductions for uncorrected work.
6. Penalties and bonuses.
7. Deductions for liquidated damages.
8. Deductions for re-inspection fees.
9. Other adjustments to Contract Sum.
10. Total Contract Sum as adjusted.
11. Previous payments.
12. Sum remaining due.

1.8 APPLICATION FOR FINAL PAYMENT

A. Submit application for Final Payment in accordance with provisions of Conditions of the Contract after the Contractor has complied with Article "Closeout Submittals" of this Section.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 DESCRIPTION

A. As a condition of Substantial Completion submit to Architect 3 copies of complete Operation and Maintenance Data booklet.

B. Until Booklet has been approved for forwarding to Owner, this condition will not be considered fulfilled.

PART 2 - PRODUCTS (BOOKLET)

2.1 BOOKLET FORMAT

A. Booklet shall be bound in three-ring loose-leaf binder similar to "National" no. 3381 with following title lettered on front: Operation and Maintenance Data. No sheets larger than 8-1/2" x 11" shall be used, except sheets that may be neatly folded to 8-1/2" by 11" and used as a pull-out.

2.2 CONTENTS OF BOOKLET

A. Include:

1. List of all major subcontractors and major suppliers of products specified in Divisions 2-48.
2. Product numbers, names.
3. Maintenance and operating instructions for all equipment, hardware, systems, and finishes that are part of the project work as described in the contract documents.
4. Name, address, and phone number of local representative, Including after business hours emergency numbers.
5. Copies of warranties.
6. If there are any major revisions from Contract Drawings, (or not shown on Contract Drawings), provide "As-Built" of completed work.
7. Parts lists for all components together with pictural diagrams.
8. Schematic diagrams for all systems.
9. Maintenance schedule indicating the interval recommended by manufacturer for each maintenance process.

B. Site Utilities

1. Provide maintenance and operating instructions for all systems and components.
2. As-built diagram of all site utility values, manholes, access provisions, switches, handholes, tanks, interceptors, and backflow preventers.

C. Site Improvements: Provide operating and maintenance instructions for landscape materials (bushes, trees, ground cover, rooftop vegetation, grasses), site lighting, retaining walls, pavers, and site furniture.

D. Building Envelope: Provide operating and maintenance instructions for exterior caulking and sealants, flashing components including finish, roofing systems and accessories.

E. Electrical System:

1. Provide instructions pertaining to operation and maintenance of all low voltage, line voltage and high voltage systems and components.
2. Include product literature of all lighting fixtures, showing installation locations.
3. Include complete maintenance and operating instructions.
4. List name, address, and telephone number of local representative of each piece of equipment installed.

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 78 36

WARRANTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Preparation and submittal of warranties.

B. Schedule of submittals.

1.2 FORM OF SUBMITTALS

A. Bind in commercial quality 8-1/2-inch by 11-inch, three-ring "D" type ring binders, with hardback, cleanable plastic covers; 3-inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings and provide table of contents in each binder.

B. Label cover of each binder with typed or machine printed title WARRANTIES with title of Project, Project number, name, address, and telephone number of Contractor; and name of responsible principal.

C. 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.

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

1.3 PREPARATION OF SUBMITTALS

A. General: Verify with other specifications Sections for required warranties.

B. Obtain warranties, executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of Work. Except for items placed into service with Owner's permission, leave date for beginning of warranty time blank until the Date of Substantial Completion is accepted by the Architect and Owner.

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

D. Co-execute submittals, when required. Provide originals for each warranty. Photostatic copies are not acceptable.

E. Retain warranties until time specified for submittal.

1.4 TIME OF SUBMITTALS

A. Warranties for completed and accepted work shall be dated the same date as the Certificate of Substantial Completion.

B. For items of Work where acceptance is delayed beyond the Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included:

1. Throughout progress of Work, maintain accurate record of changes in Contract Documents.
2. Upon completing Work, transfer recorded changes to set of Record Documents.

1.2 QUALITY ASSURANCE

A. Delegate responsibility for maintenance of Record Documents to one person on Contractor's staff as approved by Architect.

B. Accuracy of records:

1. Thoroughly coordinate changes within Record Documents, making adequate and proper entries on each page of Specifications and each sheet of Drawings and other Documents where required to show change properly.
2. Keep accurate records. Future search for items shown in Contract Documents rely reasonably on information in approved Project Record Documents.

C. Make entries within 24 hours after receiving information that change has occurred.

1.3 SUBMITTALS

A. Architect's approval of current status of Project Record Documents may be a prerequisite to Architect's approval of requests for progress payment and request for final payment under Contract.

B. Prior to submitting request for final payment, submit final Project Record Documents to Architect and secure Architect’s approval.

1.4 PRODUCT HANDLING

A. Protect job set of Record Documents from loss or damage until Work is completed; transfer all recorded data to final Project Record Documents.

B. In event of loss of recorded data, use means necessary to again secure data to Architect's approval.

1. Such means shall include, if necessary in Architect’s opinion, removal and replacement of concealing materials.
2. In such case, provide replacements to standards Contract Documents originally required.

PART 2 – PRODUCTS

2.1 RECORD DOCUMENTS

A. Job Set: Promptly after receiving Owner's Notice to Proceed, Contractor shall print and assemble one complete set of all Documents comprising the Contract, that the Contractor will utilize as the job set.

B. Final Record Documents: At time nearing completion of Work, Contractor shall print and

assemble one complete set of all Drawings in Contract, that the Contractor will utilize in creating the final record document.

PART 3 - EXECUTION

3.1 MAINTENANCE OF JOB SET OF RECORD DRAWINGS

A. Preservation:
1. Contractor shall devise suitable method for protecting job set to Architect's approval.
2. Do not use job set for any purpose except for entering new data and for Architect's review, until start of transferring data to final Project Record Documents.
3. Maintain job set at site of Work.

B. Making entries on Drawings:
1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line, and note as required.
2. Date all entries.
3. Call attention to entry by "cloud" drawn around area or areas affected.
4. In event of overlapping changes, use different colors.

C. Make entries in pertinent other Documents.

D. Conversion of schematic layouts:
1. On Drawings in some cases, arrangements of conduits, circuits, piping, ducts, and similar items are detailed schematically and are not intended to portray precise physical layout.
   a. Contractor determines final physical arrangement subject to Architect's approval.
2. Show on Job set of Record Drawings, by dimension accurate to within one inch, centerline of each run of items such as described herein.
   a. Clearly identify item by accurate note such as "cast iron drain," "gal. water," and like.
   b. Show, by symbol or note, vertical location of item ("under slab," "in ceiling plenum," "exposed," and like).
   c. Sufficiently describe identification in order that it may be related reliably to Specifications.
3. Architect may waive requirements for conversion of schematic layouts where, in Architect's judgment, conversion serves no useful purpose. However, do not rely upon waivers being issued except as Architect specifically issues in writing.

3.2 FINAL PROJECT RECORD DOCUMENTS

A. Purpose of final Project Record Documents is to provide accuracy regarding all aspects of Work, both concealed and visible, and to enable future modification of Work without lengthy and expensive site measurement, investigation, and examination.

B. Approval of recorded data prior to transfer:
1. Prior to start of transfer of recorded data thereto, secure Architect's approval of all recorded data.
2. Make required revisions

C. Transfer of data to Drawings:
1. Carefully transfer data shown on Job set of Record Drawings to corresponding Final Set of Drawings, coordinating changes as required.
2. Clearly indicate at each affected detail and other drawing full description of changes made during construction, and actual location of items.
3. Call attention to each entry by drawing "cloud" around area or areas affected.

4. Make changes neatly, consistently, and with proper media to assure longevity and clear reproduction.

D. Transfer of data to other Documents:
   1. If Documents other than Drawings have been kept clean during progress of Work, and if entries thereon have been orderly and to Architect's approval, job set of those Documents will be accepted as final Record Documents.
   2. If any such Document is not approved by Architect, carefully transfer change data to new copy to Architect's approval.

E. Review and submittal:
   1. Submit completed set of Project Record Documents to Architect for review.
   2. Participate in review meetings as required.
   3. Make required changes and promptly deliver final Project Record Documents to Architect within (60) days after substantial completion.

3.3 CHANGES SUBSEQUENT TO ACCEPTANCE

A. Contractor has no responsibility for recording changes in Work subsequent to Final Completion, except for changes resulting from work performed under Warranty.

END OF SECTION

SECTION 02 20 01

CONSTRUCTION STAKEOUT

PART 1 GENERAL

1.1 DESCRIPTION

A. This work shall consist of furnishing, placing and maintaining construction layout stakes as specified in the Contract Documents or as directed by the Engineer.

B. Where limits of clearing are not shown in the Contract Documents, the limit of clearing will be the top of cut, toe of slope or limit of ditch excavation.

PART 2 PRODUCTS

2.1 MATERIALS

A. The material for flagging the clearing limits shall be a 3 in. international orange vinyl material with “CLEARING LIMIT” printed on it with 2 in. letters.

B. Grade Stakes shall be timber.

PART 3 EXECUTION

3.1 Line and Grade

A. The Contractor will be responsible for all utility and structure stakeout. Control points were set at the site.

3.2 Equipment and Personnel

A. The Contractor shall use competent personnel and state of the art equipment for all engineering work required to set and maintain the elevations and dimensions as specified in the Contract Documents.

3.3 Control Markers

A. The Contractor shall be responsible for preserving the baseline line and bench marks. When the baseline and bench marks are disturbed or destroyed, they shall be replaced by the Contractor at no additional cost to the Owner.

3.4 Control Stakes

A. The Contractor shall furnish, set and preserve stakes at each station along the utility. Additional stakes as needed for horizontal and vertical controls necessary for the correct layout of the work shall be set by the Contractor.

3.5 Layout

A. For structures as specified in 3.1, the Contractor shall proceed with the layout work. From these field layouts, the Contractor shall check the proposed span lengths by electronic distance measurement or chaining. When chaining is used, the measurements shall be compensated for temperature, sag, and horizontal alignment. The Contractor shall also check the location of the structure to affirm its correct location with relation to existing structures, utilities, and existing conditions that are to remain in their original positions. If any discrepancies are found, the Contractor shall notify the Engineer at once in writing, otherwise, it will be assumed that all planned dimensions, grades and field measurements are correct. All lines established on the ground shall be preserved or referenced, marked, and kept available at all times.

3.6 Subgrade, Subbase and Base Controls

A. The Contractor shall furnish for subgrade, subbase and base courses, a string line and grade with fixed controls having a maximum longitudinal and transverse spacing of 25 ft.

3.7 Flagging

A. In areas where trees are not to be disturbed, the Contractor shall individually flag those trees in a line along the clearing limits that are not to be moved or destroyed. If the clearing flagging has been destroyed and the Engineer determines that its use is still required, the Contractor shall reflag the areas.

B. If the Contractor does not replace destroyed flagging within 48 hours after notification by the Engineer that replacement flagging is needed, the Engineer may proceed to have the area reflagged. The cost of the reflagging by the Engineer will be charged to the Contractor and deducted from any monies due under the Contract.

C. At the completion of construction, the Contractor shall remove all flagging.

END OF SECTION

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes: Labor, equipment, materials, and accessories necessary for and reasonably incidental to completion of selective demolition and removals as shown on Drawings and as herein specified.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled work men who are thoroughly trained and experienced in necessary crafts and who are completely familiar with specified requirements and methods needed for proper performance of work.

B. Comply with standards specified and as required by all agencies having jurisdiction.

PART 2 - PRODUCTS

(No products are required in this Section)

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of Work prior to commencing Work. Do not proceed until unsatisfactory conditions are corrected.

B. Contractor shall accept site and buildings thereon and contents thereof in condition in which they may be when released to contractor. Any hazardous materials not included in the contract scope of work that might be discovered shall be responsibility of Contractor to notify the Owner immediately and request direction for further action.

3.2 PROTECTION

A. Proper precaution shall be taken at all times to protect vehicular and pedestrian traffic from any damage or injury which may be caused, either directly or indirectly by Work of this Section. Do not obstruct traffic.

B. Demolition will take place around occupied buildings. A method for control and scheduling of loud noises shall be developed and followed to assure minimum inconvenience to neighboring occupants. Protect improvements on adjoining properties as well as those on Owner's property.

3.3 SALVAGE AND RE-USE OF EXISTING CONSTRUCTION

A. If required, temporarily remove and reinstall existing items of construction scheduled to remain.

B. Carefully remove, tag, protect, and store existing materials and components scheduled or proposed for re-use. Obtain Architect's written approval of each component or batch of materials before such re-use is executed.

3.4 DEMOLITION

A. Remove existing construction as indicated on Drawings and as required to accommodate alterations and new construction indicated on Drawings.

B. Provide planking, bridges, fences, bracing, shoring, barriers, warning signs, and lights as

required to afford protection specified herein. Post easily readable warning signs in adequate number, conspicuously around all hazardous areas. Make periodic inventory of protective devices to insure continuous protection.

C. Shoring and bracing: When removing any structural supports, install shoring, struts, bracing, and other protection as required to prevent collapse of walls, floors or framing and to maintain safety for workmen and public. Use of salvaged material for shoring or bracing will not be permitted.

D. Execute work in quiet, careful, and orderly manner, with least possible disturbances. Perform demolition work in such manner as to avoid hazard to persons and property. Demolish masonry and concrete in small sections. Remove individually, and carefully lower structural members.

E. Exercise care when separating parts to be removed from those to remain, so that minimum of restoration will be required. Where cutting of finished surfaces is indicated, or required, make cuts neatly along true lines.

F. Exercise care when removing materials and equipment scheduled or proposed for re-use or to be retained by Owner and protect against damage or loss. Equipment and materials should be removed by trade involved.

G. Provide any patching and repairs required.

H. Regularly remove debris and refuse and legally dispose of it off site. Do not burn any material or debris on site.

I. **Contractor shall inspect the site at the end of each work day and collect deleterious objects and material resulting from demolition activities including, but not limited to, nails, screws, and other sharp objects.**

3.5 REPLACEMENTS

A. All construction to remain, which is damaged by demolition and removal operations under this Section, shall be restored and repaired to Architect's satisfaction at no additional cost to Owner. Where voids are created by removals or cutting, fill and repair such voids as required to provide sound, complete continuous surfaces.

B. Should any public or private property be disturbed or damaged as a result of Contractor's operation, contractor shall at contractor’s own cost and expense, restore such property to condition equivalent to that which existed before damage was done, to Architect’s satisfaction.

3.6 DISPOSAL

A. Except for materials and equipment scheduled for re-use or to be salvaged for Owner, assume ownership of all materials and equipment demolished and/or removed and legally dispose of same off-site.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

The extent of concrete work is shown on drawings.

1.2 QUALITY ASSURANCE

A. Codes and Standards:

Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:

1. ACI 301 "Specifications for Structural Concrete for Buildings".
2. ACI 318 "Building Code Requirements for Reinforced Concrete".
3. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
4. ACI 117- Latest Edition, Section 4.5.6 for Flatness and Level.

B. Concrete Testing Service:

1. Testing shall be performed by the Contractor at the Contractor’s expense. Retesting of rejected materials and installed work shall be done at the Contractor's expense.
2. Materials and installed work may require testing and retesting, as directed by Architect, at anytime during progress of work. Allow free access to material stockpiles and facilities.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items.

B. Mix Design: Submit mix design for each type of Portland Cement concrete indicated. Mix design data shall be presented in the same form and units of measure as specified herein under Part 2, "Products".

C. Material Certificates: Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

D. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test as specified.

E. Shop Drawings: Submit complete fabrication and erection drawings for concrete reinforceing. Re-prints of contract drawings are not acceptable.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete:

1. Unless otherwise indicated, construct formwork for exposed concrete surfaces with tempered concrete form grade hardboard, metal, plastic, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints or to conform to joint system where shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.
2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class I) or stainless steel protected (CRSI, Class 2).

3. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the smooth texture of the concrete surface shall not be used.

B. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

C. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

2.2 REINFORCING MATERIALS

A. Comply with following as minimums:
1. Bars: ASTM A615, grade 60 unless otherwise shown on Drawings, using deformed bars for number 3 and larger;
2. Welded wire fabric: ASTM A1064;
3. Bending: ACI 318.

B. Fabricate reinforcement to required shapes and dimensions, within fabrication tolerances stated in CRSI "Manual of Standard Practices."

C. Do not use reinforcement having any of following defects:
1. Bar lengths, depths, or bends exceeding specified fabricating tolerances;
2. Bends or kinks not indicated on Drawings or required for this Work;
3. Bars with cross-section reduced due to excessive rust or other causes.

D. Supports for Reinforcement:
1. Provide support for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations, unless otherwise acceptable.
2. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 CONCRETE MATERIALS

A. Portland Cement:
1. ANSI/ASTM C 150, Type I, unless otherwise acceptable to Architect.
2. Use one brand of cement throughout project, unless otherwise acceptable to Architect.

B. Normal Weight Aggregates: ANSI/ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.

C. Water: Potable

D. Air-Entraining Admixture: For Exterior Concrete ANSI/ASTM C 260

E. Water-Reducing Admixture:
1. ANSI/ASTM C494, Type A and contain not more than 1% chloride ions.
2. Subject to compliance with requirements, provide one of the following:
a. "Eucon WR-75"; Euclid Chemical Co.
b. "Pozzolith 322N"; Master Builders.
c. "Plastocrete 160"; Sika Chemical Corp.
d. "Chemtard"; Chem-Masters Corp.

F. Calcium Chloride: Not permitted

2.4 RELATED MATERIALS

A. Moisture Barrier: Where indicated on Drawings, provide moisture and vapor barrier consisting of 15-mil thick plastic sheeting, with all joints taped and sealed.

B. Waterstops: Provide flat, dumbbell type or centerbulb type waterstops at construction joints and other joints as shown. Size to suit joints. Provide rubber waterstop, shape to meet construction conditions, as manufactured by Greenstreak Inc., or approved equal.

C. Control Joints (Interior Concrete): Provide prefabricated plastic, single piece "Zip Cap" control joint as manufactured by Greenstreak, Inc. or approved equal, for all cross sectional and transverse control joints.

D. Construction Joints: Provide prefabricated continuous metal "key" profile.

E. Expansion Joints and Isolation Joints: Provide 1/2" expansion board with continuous, pull-off, plastic cap strip, Greenstreak “Expansion Board Cap” or equal.

F. Concrete Sealer: Euco "Diamond Hard" liquid densifier and sealer, or approved equal. Not to be used on polished concrete floors.

2.5 PROPORTIONING AND MIX DESIGNS

A. General:
1. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to the Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as that used for field quality control testing.
2. Submit written reports to the Architect of each proposed mix for each class of concrete at least 15 days prior to the start of the work. Do not begin concrete production until mixes have been reviewed by the Architect.

B. Design Mix for Normal Weight Concrete:
1. Provide normal weight concrete with the following properties, as indicated on the drawings and specified herein.
2. FLY ASH MAY BE SUBSTITUTED FOR NOT MORE THAN 15% OF THE MINIMUM REQUIRED CEMENT CONTENT.
3. Mix design for slabs to receive polished concrete flooring system. Fly Ash not approved.
4. Sidwalks, Curbs, Gutters: Maryland State Highway Standard Specifications and Details Mix No. 2, with 28-day compressive strength = 3,000 psi, minimum cement factor = 530 lbs/cubic yard, and air content= 6% +/- 1%
5. Interior Floor Slabs: Maryland State Highway Standard Specifications and Details Mix No. 2 – with 28-day compressive strength = 3,000 psi, minimum cement factor = 530 lbs/cubic yard, and no added air content.
6. Exterior Portland Cement Concrete Roadway Paving: Maryland State Highway Standard Specifications and Details Mix No. 6, with 28-day compressive strength = 4,500 psi, minimum cement factor = 6150 lbs/cubic yard, and air content= 6% +/- 1%
7. Structural Foundations and Footings: Maryland State Highway Standard Specifications and Details Mix No. 3, with 28-day compressive strength = 3,500 psi, minimum cement factor = 580 lbs/cubic yard, and air content= 6% +/- 1%
8. Miscellaneous Structures, Pads and Paving: Maryland State Highway Standard Specifications and Details Mix No. 2, with 28-day compressive strength = 3,000 psi, minimum cement factor = 530 lbs/cubic yard, and air content= 6% +/- 1%

2.6 CONCRETE MIXES

A. Ready Mix Concrete:

1. Comply with the requirements of ANSI/ASTM C 94, and as herein specified.
2. Delete all references for allowing additional water to be added to the concrete batch for material with insufficient slump. Addition of water to the batch shall not be permitted.
3. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ANSI/ASTM C 94 shall be required as follows:
4. When air temperature is between 85 degrees F and 90 degrees F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMS

A. General:

1. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.
2. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.
3. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
4. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
5. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
6. Chamfer exposed corners and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

B. Form Ties: Factory fabricated, adjustable length, removable or snapoff metal from ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.

C. Provisions for Other Trades: Provide formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.

D. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.

3.2 PLACING REINFORCEMENT

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

C. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric (WWF) in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.3 JOINTS

A. Construction Joints:

1. Construction joint layout shall be developed by the Contractor in advance of concrete placement. Construction joints shall be installed whenever concrete placement is interrupted, in addition to placement as otherwise specified.
2. Contractor shall provide construction joints for screeding concrete slabs such that the width for screeding operations is not more than 14'.
3. Locate and install construction joints so as not to impair strength and appearance of the structure, as acceptable to the Architect.
4. Provide keyways at least 1-1/2" deep in construction joints in walls, slabs and between walls and footings.
5. Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints.

B. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions.

C. Isolation Joints in Slabs-On-Grade: Construct isolation joints in slabs-on-grade at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams and elsewhere as indicated. Use isolation joint material as specified, removing cap strip after concrete is cured, and fill joint with traffic bearing sealant.

D. Expansion Joints in Slabs-on-Grade: Construct expansion joints in slabs to form panels of patterns shown, or if not shown, of panels not to exceed 400 square feet each. Use expansion material as specified, removing plastic cap strip after concrete is cured, and fill joint with traffic bearing sealant.

E. Control Joints in Slabs-on-Grade: Construct contraction/control joints in slabs-on-grade to form panels of patterns as shown, or if not shown, in a grid pattern of panels, each panel not to exceed 100 square feet. Saw cut control joints a minimum of ¼ of slab depth; cut joint after concrete achieves initial set, and before 7 days.

3.4 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.

B. Edge Forms and Screed Strips for Slabs: Set edge forms and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure

units sufficiently strong to support types of screed strips by use of strike off templates or accepted compacting type screeds.

C. Preparation of Form Surfaces:
1. Coat contact surfaces of forms with a form coating compound before reinforcement is placed.
2. Thin form coating compounds only with thinning agent of type, and in amount, and under conditions of form coating compound manufacturer's directions. Do not allow excess form coating material to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
3. Coat steel forms with a non-staining, rust preventative form oil or otherwise protect against rusting. Rust stained steel formwork is not acceptable.

3.5 CONCRETE PLACEMENT

A. Preplacement Inspection:
1. Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other trades to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.
2. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

B. General:
1. Comply with ACI 304, and as herein specified.
2. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.

C. Placing Concrete in Forms:
1. Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
2. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to the time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

D. Placing Concrete Slabs:
1. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
2. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
4. Maintain reinforcing in proper position during concrete placement operations.

E. Cold Weather Placing:
1. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.
2. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F, and not more than 80 degrees F at the point of placement.
3. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
4. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators.

F. Hot Weather Placing:
1. When hot weather conditions exist, place concrete in compliance with ACI 305 and as herein specified.
2. Cool ingredients before mixing to maintain concrete temperature at the time of placement below 90 degrees F. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing.
3. Cover reinforcing steel with water soaked burlap if it becomes hotter than the ambient air temperature immediately before embedment in concrete.
4. Wet forms thoroughly before placing concrete.

3.6 FINISH OF FORMED SURFACES

A. Rough Form Finish: For formed concrete surfaces not exposed to view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by the form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

B. Brush Finish: For formed concrete surfaces exposed to view, the concrete consistency shall maintain the shape of the structure without support after the extrusion. The surface shall be free of surface pits larger than 3/16 inch diameter. The concrete shall require no further finishing, other than light brushing with water only. Finishing with brush applications of grout is prohibited. Tie holes and defects shall be patched. All fins shall be completely removed.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.7 MONOLITHIC SLAB FINISHES

A. Floor Slab Flatness: The Contractor shall construct and finish concrete slabs in accordance with the following floor profile quality classifications per ACI 117 Latest Editions.
1. Concrete floors: Flat.

B. Scratch Finish:
1. Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.
2. After placing slabs, plane surface to a tolerance nor exceeding 1/2" in 10' when tested with a 10' straightedge. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms, or rake.
or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.

C. Non-Slip Broom Finish:
   1. Apply non-slip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.
   2. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.8 CONCRETE CURING AND PROTECTION

A. General:
   1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
   2. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
   3. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

B. Curing Methods:
   Provide moisture curing by the following methods:
   1. Keep concrete surface continuously wet by spraying with water and covering with polyethylene sheet, taped at joints and anchored at edges of concrete.
   2. Do not use curing compounds on slab surface.

C. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. After forms are removed, continue curing by methods specified above, as applicable.

3.9 SHORES AND SUPPORTS

Comply with ACI 347 for shoring and reshoring in multistory construction, and as herein specified.

3.10 REMOVAL OF FORMS

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees F (10 degrees C) for a minimum of 72 hours after placing concrete, provided concrete is sufficiently hard not to be damaged by form removal operations, and provided curing and protection operations are maintained. The Contractor is responsible to maintain forms in place for length of time required to ensure that, when stripped, the concrete has capacity to support its own dead load plus construction loads imposed upon it.

B. Formwork supporting weight of concrete, such as beam soffits, joints, slabs and other structural elements, shall not be removed in less than 14 days and until concrete has attained design minimum 28 day compressive strength. Determine potential compressive strength of inplace concrete by testing field-cured specimens representative of concrete location or members.

3.11 RE-USE OF FORMS

A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces.
   Apply new form coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints.

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with inplace construction. Provide other miscellaneous concrete filling shown or required to complete work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with
certified diagrams or templates of manufacturer furnishing machines and equipment.

D. Reinforced Masonry: Provide concrete grout for reinforced masonry lintels and bond beams where indicated on drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

3.13 PROTECTION FROM MECHANICAL INJURY

A. During curing period, protect concrete from damaging mechanical disturbances such as heavy shock, load stresses, and excessive vibration.

B. Protect finished concrete surfaces from damage from construction equipment, materials, and methods, by application of curing procedures, and by rain and running water.

3.14 REMEDIAL WORK

Repair or replace deficient work as Architect directs and at no additional cost to Owner.

3.15 CONCRETE TESTING

A. Mill Tests: Contractor furnishes at least 6 copies of certified mill tests for each heat number. Contractor also furnishes affidavit, in duplicate, stating that steel manufactured for this project meets requirements of these Specifications.

B. Submit design mixes for all classes of concrete to be used on job to the Architect for review, prior to placing any concrete.

C. Testing Agency: Contractor shall employ Independent Testing Agency to perform all testing and inspection of concrete.

D. Test Cylinders

1. Six (6) test cylinders are made for each class of concrete in any one day's operation, not less than one (1) set of six (6) cylinders for every 50 cubic yards of concrete. Two (2) of these cylinders are for seven (7) day tests and two (2) shall be for twenty-eight (28) day tests and two (2) reserved for additional testing as required. Submit Test reports to Architect immediately upon completion of each test. Test reports contain the following information:
    a. Exact mix, including quantities of admixture, etc.
    b. Date of pour
    c. Location of pouring building
    d. Slump
    e. Percentage of air entrained
    f. For 28 day test, give 7 day results for previous 2 cylinders tested. Report results, with both 7 and 28 day results indicated on same report.

E. Test cylinders to be molded and cured in accordance with ASTM C31-31.

F. Should strength shown by test specimens fall below required strength, Architect will require change in proportions to ensure adequate strengths in remainder of project and has right to test

concrete by coring, loading, or other means, or removal and replacement of that portion of construction covered by those tests, all costs of which are to be borne by Contractor.

G. Consistency shall be determined in the field by means of slump test in accordance with ASTM C143. Slump test is made at frequent intervals by Contractor, and as directed by Architect. Results of slump test appears on cylinder test reports.

H. All concrete cylinders shall be molded, stored, transported, and tested by s testing agency. Contractor provides all materials from which cylinders are made, and provides suitable storage facilities for cylinders at job site. It is Contractor's responsibility to notify testing agency before each pour so that they may properly schedule taking of test cylinders.

I. Test for flatness.

J. Test for moisture content.

3.16 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas:
   1. Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect.
   2. Cut out honeycomb, rock pockets, voids over 1/4 " in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.
   3. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before preceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

B. Repair of Formed Surfaces:
   1. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections or surface; and stains and other discoloration that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.
   2. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

C. Repair of Unformed Surfaces:
   1. Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high area as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having required slope.
   2. Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.
   3. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.
   4. Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete.

Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Architect.

5. Repair Defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
6. Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No.16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.
7. Use epoxy based mortar for structural repairs, where directed by Architect.

END OF SECTION

SECTION 04 20 00

UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Concrete masonry, and masonry accessories. The term “Concrete Masonry Unit” is abbreviated as “CMU” throughout this specification.

1.2 QUALITY ASSURANCE

A. Fire Performance Characteristics:
Where fire resistance ratings are indicated for unit masonry work, provide materials and construction which are identical to those of assemblies whose fire endurance has been determined by testing in compliance with ASTM E 119 by a recognized testing and inspecting organization or by another means, as acceptable to authority having jurisdiction.

B. Field Constructed Mock-Ups:
1. Prior to installation of masonry work, erect sample wall representative of completed masonry work required for the project with respect to qualities of appearance, materials and construction. Locate mock-ups on site in locations as directed by the Architect. Retain mock-ups during construction as the standard for judging completed masonry work. For the following types of masonry, build mock-ups which are approximately 6' long by 4' high, (unless otherwise noted) by full thickness including back-up wythes, if any. When directed, demolish mock-ups and remove from site.
   a. Typical exterior masonry wall. Provide full wall mock-up, including stone veneer, back-up wall system, studs, installation and all accessories.
   b. Reinforced, exposed to view, CMU wall.

1.3 SUBMITTALS

A. Product data:
1. Materials list of items proposed to be provided under this Section
2. Manufacturer's specifications and other data needed to prove compliance with specified requirements. Provide shop drawings for special shapes.

B. Samples:
1. Exposed exterior masonry units
2. Metal wall ties
3. Anchors
4. Mortar colors for selection by Architect
5. Concealed wall flashing

1.4 PRODUCT HANDLING

A. Store masonry and brick units on pallets and covered with impervious tarpaulins.

1.5 JOB CONDITIONS

A. Protection of Work:
1. During erection, cover top of walls with waterproof sheeting at the end of each days' work. Cover partially completed structures when work is not in progress.
2. Extend the cover a minimum of 2 feet down both sides and hold cover securely in place.
3. Do not apply uniform floor or roof loading for at least 24 hours after building masonry walls or columns.

4. Do not apply concentrated loads for at least 3 days after building masonry walls or columns.

B. Staining:
   1. Prevent grout or mortar or soil from staining the face of masonry to be left exposed or painted. Remove immediately grout or mortar in contact with such masonry. Protect base of walls from rain splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.
   2. Protect sills, ledges and projections from droppings of mortar.

C. Cold Weather Protection:
   1. Do not lay masonry units that are wet or frozen.
   2. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
   3. Remove all masonry determined by the Architect to be damaged by freezing conditions.
   4. For clay masonry units with initial rates of absorption which require them to be wetted before laying, comply the following requirements:
   5. For units with surface temperatures above 32 degrees F, wet with water heated to above 70 degrees F.
   6. For units with surface temperatures below 32 degrees F, wet with water heated to above 130 degrees F.
   7. Perform the following construction procedures while masonry work is progressing. Temperature ranges indicated below apply to air temperatures existing at the time of installation except for grout. For grout, temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintain mixing temperature selected within 10 degrees F.
      a. 40 degrees F to 32 degrees F:
         i. Mortar: Heat mixing water to produce mortar temperature between 40 and 120 degrees F.
         ii. Grout: Follow normal masonry procedures.
      b. 32 degrees F to 25 degrees F:
         i. Mortar: Heat mixing water and sand to produce mortar temperatures between 40 and 120 degrees F. Maintain temperature of mortar on boards above freezing.
         ii. Grout: Heat grout materials to 90 degrees F to produce in-place grout temperature of 70 degrees F at the end of the work day.
      c. 25 degrees F to 20 degrees F:
         i. Mortar: Heat mixing water and sand to produce mortar temperatures between 40 and 120 degrees F. Maintain temperature of mortar on boards above freezing.
         ii. Grout: Heat grout materials to 90 degrees F to produce in-place grout temperature of 70 degrees F at the end of the work day.
         iii. Heat both sides of walls under construction using salamanders or other heat sources.
         iv. Use windbreaks or enclosures when wind is in excess of 15 miles per hour.
      d. 20 degrees F and below:
         i. Mortar: Heat mixing water and sand to produce mortar temperatures between 40 and 120 degrees F.
         ii. Grout: Heat grout materials to 90 degrees F to produce in-place grout temperature of 70 degrees F at the end of each work day.
         iii. Masonry Units: Heat masonry units so that they are above 20 degrees F at the time of laying.
         iv. Provide enclosure and auxiliary heat to maintain an air temperature of at least 40 degrees F for 24 hours after laying units.

v. Do not heat water for mortar and grout to above 160 degrees F.
vi. Protect completed masonry and masonry not being worked on in the following manner. Temperature ranges indicated apply to mean daily air temperatures except for grouted masonry. For grouted masonry temperature ranges apply to anticipated minimum night temperatures.

e. 40 degrees F to 32 degrees F:
i. Protect masonry from rain or snow for at least 24 hours by covering with weather resistive membrane.

f. 32 degrees F to 20 degrees F:
i. Completely cover masonry with weather resistive insulating blankets or similar protection for at least 24 hours, 48 hours for grouted masonry.

g. 20 degrees F and below:
i. Except as otherwise indicated, maintain masonry temperature above 32 degrees F for 24 hours using enclosures and supplementary heat, electric blankets, infrared lamps or other methods proven to be satisfactory. For grouted masonry maintain heated enclosure to 40 degrees F for 48 hours.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Gravel or stone units with face dimensions of 8” high x 16” long, nominal, and thickness as shown and noted on the drawings. CMU noted as solid on the drawings shall have no voids or cores; filled cores are not acceptable as a substitution for “Solid CMU”. Provide CMU complying with the following:
1. Hollow Load bearing CMU: ASTM C-90, Grade N, Type I
2. Solid Load bearing CMU: ASTM C-145, Grade N, Type I
3. Hollow Non-Load bearing CMU: ASTM C-129, Type I, normal weight

B. Curing: Cure units in a moisture controlled atmosphere or in an autoclave at normal pressure and temperature to comply with ASTM C-90 Type I, C-129 Type I, C-145 Type I, and C-155 Type I.

C. Limit moisture absorption during delivery and until time of installation to the maximum percentage specified for Type I units for the average annual relative humidity as reported by the U.S. Weather Bureau Station nearest the project site.

D. Special Shapes: Provide where required for lintels, corners, jambs, sash, control joints, headers, bonding and other special conditions.

2.2 MORTAR MATERIALS

A. Masonry Cement: ASTM C91 Masonry Cement
1. Provide colored pigmented mortars for all exterior exposed masonry work. Use premixed colored masonry cements of formulation required to produce color indicated, or if not indicated, as selected from manufacturer's standard formulations. Use natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with record of satisfactory performance in masonry mortars.
2. Color shall be selected by Architect from manufacturer’s full range of standard colors.
3. Classification of Masonry Cement:
a. CMU Walls: Type S

B. Aggregate for Mortar: ASTM C 144, except for joints less than 1/4" use aggregate graded with 100% passing the No. 16 sieve.

C. Aggregate for Grout: ASTM C 404.

D. Water: Clean and Potable.

2.3 MASONRY ACCESSORIES

A. Horizontal Joint Reinforcing: Provide welded wire units prefabricated in straight lengths of not less than 10' with matching corner ("L") and intersecting ("T") units. Fabricate from cold drawn steel wire complying with ASTM A 82, into units with widths of approximately 2" less than nominal width of walls and partitions as required to position side rods for full embedment in mortar with mortar coverage of not less than 5/8" on joint faces exposed to exterior and not less than 1/2" elsewhere. Provide the following type of joint reinforcing unless otherwise indicated.

B. Wire Finish: Hot dipped galvanized after fabrication in accordance with ASTM – B153.

C. Single Wythe Concrete Masonry Unit Walls and Foundations:
Truss Type: Double side rod joint reinforcing with diagonal cross rods spaced not more than 16" on center made of 9-gage cross and side rods.

D. Double Wythe Concrete Masonry Unit Composite Walls and Foundations:
Composite Truss Tri-mesh Type: Triple side rod joint reinforcing with diagonal cross rods spaced not more than 16" on center made of 9-gage cross and side rods.

E. Individual Wire Ties for Masonry:
General: Fabricate from 3/16" cold drawn steel wire, ASTM A 82, unless otherwise indicated, of the length required for proper embedment in wythes of masonry. Fabricate from steel with 1.5 ounce hot dip zinc coating, ASTM A 153 class B-2, or fabricate steel wire with not less than 7-mil copper coating, ASTM B 227, Grade 30 HS.

F. Flashings for Masonry:
Provide concealed flashings as follows: Preformed 0.015" thick stainless steel through wall flashing made from ASTM 167A, type 304 stainless with no. 2D annealed finish, dead soft temper. Flashings shall be "3-Way" factory preformed units formed to provide a bond in the mortar in both vertical and horizontal directions. Form material with 3/16" high raised saw tooth ribs spaced 3 inches on center throughout the length of the flashing. At face of raised sawtooth portion provide indented keys for transverse bond. Lap joints shall be formed for interlocking to produce a total 1-1/2" interlock. Flashing shall be factory formed in widths required for wall thickness. Provide factory formed corners, shaped and soldered to fit job conditions. Fasteners shall be stainless steel. Solder shall be ASTM B32, 50% tin and 50% lead, used with a phosphoric acid flux.

G I. Miscellaneous Masonry Accessories:
Non-Metallic Expansion Joint Strips: Provide premolded, compressible, elastic fillers of foam rubber, neoprene, or extruded plastic.

H. Premolded Control Joint Strips: Solid rubber strips with a Shore A durometer hardness of 60 to 80, designed to fit standard sash block and maintain lateral stability in masonry wall, size and configuration as indicated

I. Molded Weep Hole Vents: Pre-molded, cellular plastic vent units, Heckman #85 cell vent or approved equal.

J. Mortar Deflector: Randomly woven polymer blanket, 10” tall, in 25 or 50 foot rolls, designed specifically to capture mortar droppings in cavity wall construction, and allow free flow of water moisture to weeps. Heckman model #84-1 for 1” cavities, and model #84-2 for 2” cavities, or approved equal.

2.4 MORTAR AND GROUT MIXES

A. General: Do not lower the freezing point of mortar by use of admixtures or anti-freeze agents. Do not use calcium chloride in mortar or grout.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification, for types of mortar required, unless otherwise indicated.
   1. Clay Brick Walls: Type N
   2. CMU Walls: Type S

C. Grout for Unit Masonry: Comply with ASTM C 476 for grout for use in construction of reinforced and non-reinforced unit masonry. Use grout of consistency indicated or if not otherwise indicated, of consistency (fine or coarse) at time of placement which will completely fill all spaces intended to receive grout.
   1. Admixes: No admixes will be permitted except where specified or without written authorization of Architect. No calcium chloride in any form will be permitted.

PART 3 – EXECUTION

3.1 INSTALLATION; GENERAL

A. Thickness:
   1. Build masonry construction to the full thickness shown, except, build single-wythe wall (if any) to the actual thickness of the masonry units, using units of nominal thickness shown or specified.
   2. Build chases and recesses as shown and as required for the work of other trades. Provide not less than 8" of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.
   3. Cut masonry units with motor-driven saw designed to cut masonry with a clean, sharp, unchipped edge. Cut units as required to provide pattern shown and to fit adjoining work neatly. Use full units without cutting wherever possible. Use dry cutting saws to cut concrete masonry units.

B. Wetting: Do not wet concrete masonry units.

C. Pattern Bond:
   1. Lay exposed masonry in the bond pattern shown, or if not shown, lay in running bond vertical joint in each course centered on units in courses above and below. Lay concealed masonry with all units in a wythe bonded by lapping not less than 2". Bond and interlock each course of each wythe at the corners, unless otherwise shown.
   2. Layout walls in advance for accurate spacing of surface bond patterns, with uniform joint widths and to properly locate openings, movement-type joints, returns and offsets. Avoid the use of less than half size units at corners, jambs and wherever possible at other locations.
   3. Lay-up walls plumb and with courses level, accurately spaced and coordinated with other work.

D. Stopping and Resuming Work: Rack back 1/2 masonry unit length in each course; do not tooth. Clean exposed surfaces of set masonry and remove loose masonry units and mortar prior to laying fresh masonry.

E. Built-In Work:
   1. As the work progresses, build in items specified under this and other sections of these specifications. Fill in solidly with masonry around built-in items.
   2. Fill space between hollow metal frames and masonry solidly with mortar.
   3. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

4. Fill CMU cores with grout 3 courses (24") under bearing plates, beams, lintels, posts and similar conditions unless otherwise indicated.

3.2 MORTAR BEDDING AND JOINTING

A. Lay brick and solid concrete masonry units with completely filled bed, head and collar joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.

B. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and foundation walls and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or to be filled with concrete or grout. For starting courses on footings where cells are not grouted, spread out full mortar bed including areas under cells.

C. Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not otherwise indicated, lay walls with 3/8" joints. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials. Tool exposed joints slightly concave using a jointer larger than joint thickness. Rake out mortar in preparation for application of caulking or sealants where shown.

D. Remove masonry units disturbed after laying; clean and relay in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar, and reset in fresh mortar.

E. Fill joints between wythes solidly with mortar. Fill collar joints after each course is laid.

3.3 HORIZONTAL JOINT REINFORCING

A. Provide continuous horizontal joint reinforcing as shown and specified. Fully embed longitudinal side rods in mortar for their entire length with a minimum cover of 5/8" on exterior side of walls and 1/2" at other locations. Lap reinforcement a minimum of 6". Do not bridge control and expansion joints with reinforcing, unless otherwise indicated. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend units as directed by the manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

B. Space continuous horizontal reinforcing 16" on center vertically.

C. For parapets, space reinforcing at 8" on center vertically, unless otherwise indicated.

D. Reinforce masonry openings greater than 1'-0" wide, with horizontal joint reinforcing placed in horizontal joints approximately 8" apart, both immediately above lintels and below sills. Extend reinforcing a minimum of 2'-0" beyond jambs of the opening, bridging control joints where provided.

3.4 ANCHORING MASONRY WORK

A. Provide anchoring devices of the type indicated. If not indicated, provide standard type for facing and back-up involved.

B. Anchor masonry to structural members where masonry abuts or faces such members to comply with the following:
   1. Provide an open space not less than 1" in width between masonry and structural member, unless otherwise shown. Keep open space free of mortar or other rigid materials.
   2. Anchor masonry to structural members with metal ties embedded in masonry joints and attached to structure. Provide anchors with flexible tie sections, unless otherwise indicated.

3. Space anchors as shown, but not more than 24" on center vertically and 36" horizontally.

3.5 CONTROL AND EXPANSION JOINTS

A. Provide vertical expansion, control and isolation joints in masonry where shown. Build-in related masonry accessory items as the masonry work progresses.

B. Build flanges of metal expansion strips into masonry. Lap each joint 4" in direction of flow. Seal joints below grade and junctures with horizontal expansion joints, if any.

3.6 FLASHING OF MASONRY WORK

A. Protection of Flashing Material: Contractor shall protect stainless steel flashing material from exposure to chlorides and muriatic acids at all times. Separate stainless steel from other metals while stored.

B. Flashing Installation:
Comply with manufacturer's written instructions.
1. Provide concealed flashings in masonry work at, or above, all floor levels, shelf angles, lintels, ledges and other obstructions to the downward flow of water in the wall so as to divert such water to the exterior. Prepare masonry surfaces smooth and free from projections which could puncture flashing. Place through-wall flashing on bed of mortar and cover with mortar.
2. Extend flashings the full length of lintels and shelf angles and minimum of 4" into masonry each end. Extend flashing from a line 1/2" in from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4", but not less than shown on the drawings, and through the inner wythe to within 1/2" of the interior face of the wall in exposed work. Where interior backup construction is framed walls or stud framing, turn flashing minimum 8" up the face of the wall and attach flashing minimum 16" on center using stainless steel screws. Interlock end joints of flashing by overlapping performed keys not less than 1-1/2". At heads and sills turn up ends not less than 2" to form a pan. Use only factory fabricated inside and outside mitered corners.

C. Weepholes: Provide weepholes in the head joints of the same course of masonry bedded in the flashing mortar. Construct weepholes such that the flashing is placed at the bottom of the weephole. **KEEP WEEPHOLES FREE AND CLEAR OF MORTAR AT ALL TIMES DOWN TO THE LEVEL OF THE FLASHING.** Insert pre-formed, cellular weep units with no mortar in the joint

3.7 REPAIR, POINTING AND CLEANING

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. During the tooling of joints, enlarge any voids or holes, except weepholes, and completely fill with mortar. Point-up all joints at corners, openings and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking or sealant compounds.

C. Post-Construction: Clean a 10 sq. ft. area of wall as directed below and leave for one week. If no harmful effects appear and after mortar has set and cured, clean masonry as follows:
1. Protect windows, sills, doors, trim and other work from damage.
2. Remove large particles with [stiff fiber brushes] [wood paddles] without damaging surface. Saturate masonry with clean water and flush off loose mortar and dirt.

3. Scrub with solution of 1 tsp. trisodium phosphate and 1 tsp. household detergent dissolved in 4 cups of clean water using stiff fiber brushes, then clean off immediately with clean water using hose.
4. Repeat cleaning process as often as necessary to remove mortar and other stains.

D. Use alternative cleaning solutions and methods for difficult to clean masonry only after consultation with masonry unit manufacturer.

E. Clean exposed CMU masonry by dry brushing at the end of each day's work and after final pointing to remove mortar spots and droppings. Comply with recommendations in NCMA Technical Bulletin No. 28.

END OF SECTION

SECTION 04 72 00

CAST STONE MASONRY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Architectural precast concrete lintels, sills, wall panels, cornices, and roof scuppers identified on the drawings as precast stone.

B. Supports, anchors, and attachments.

C. Grouting under sills.

1.2 DEFINITIONS

Cast Stone – a refined architectural concrete building unit manufactured to simulate natural cut stone.

Dry Cast – manufactured from zero slump concrete.

Vibrant Dry Tamp (VDT) casting method – Vibratory ramming of earth moist, zero-slump concrete against a rigid mold until it is densely compacted.

Machine casting method – Manufactured from earth moist, zero-slump concrete compacted by machinery using vibration and pressure against a mold until it becomes densely consolidated.

Wet Cast – Manufactured from measurable slump concrete.

Wet casting method – Manufactured from measurable slump concrete and vibrated into a mold until it becomes densely consolidated.

Specifier note: Slump, manufacturing method, and apparatus shall be selected by the manufacturer and not specified by the purchaser.

1.3 DESIGN CRITERIA

A. General: Design members in compliance with PCI Manual for Structural Design of Architectural Precast Concrete.

B. Design members to withstand total loads, including dead load of units, live loads due to positive and negative wind forces, and erection forces and loads.

C. Design component connections to accommodate building movement. Provide adjustment to accommodate misalignment of structure without permanent distortion, damage to components, wracking of joint connection, breakage of seals, or moisture penetration.

1.4 QUALITY ASSURANCE

A. General: Comply with requirements of Cast Stone Institute Manual for Structural Design of Architectural Precast Concrete and to ACI 318.

B. Precast Manufacturer and Erectors: Qualified in compliance with Cast Stone Institute.

C. Welding: AWS D1.1.

D. Manufacturer, Transportation, and Installation: Company specializing in providing

architectural precast products and services normally associated with precast concrete construction with high quality architectural finishes.

E. Tests: Testing shall be performed by Fabricator. Test three specimens per 500 cubic feet at random from plant production in accordance with referenced standards.

F. Water Absorption Tests: Comply with ASTM C 666.

G. Fabricator: Manufacturer specializing in the Work of this Section with a minimum of 5-years documented experience and be a Cast Stone Institute Certified Plant. Manufacturer shall have sufficient plant facilities to produce the shapes, quantities and size of Cast Stone required in accordance with the project schedule.

H. Standards: Comply with the requirements of the Cast Stone Institute Technical Manual and the project specifications. Where a conflict may occur, the contract documents shall prevail.

1.5 SUBMITTALS

A. Erection Drawings: Indicate locations, fabrication details, unit identification marks, reinforcement, connection details, dimensions, and relationship to adjacent materials.

B. Sample for color and finish.

C. Product Data: Manufacturer's printed surface cleaning instructions.

D. Concrete design mix.

E. Test results of Cast Stone made by the manufacturer on previous batches of cast stone

F. Shop Drawings: Submit manufacturers shop drawings including profiles, cross-sections, reinforcement, exposed faces, arrangement of joints (optional for standard or semi-custom installations), anchoring methods, anchors (if required), annotation of stone types and their location.

G. Warranty: Submit Cast Stone Institute Member Limited Warranty.

H. Certification: Submit valid Cast Stone Institute Plant Certification. Manufacturer shall submit a written list of projects similar in scope and at least three (3) years of age, along with the Owner, Architect and Contractor references.

1.6 MOCK-UP

A. Provide full size unit(s) for use in construction of sample wall. The approved mock-up shall become the standard for appearance and workmanship for the project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle precast members to position, consistent with their shape and design. Lift and support only from support points.

B. Lifting or Handling Equipment: Capable of maintaining units during manufacture, storage, transportation, erection, and in position for fastening.

C. Blocking and Lateral Support During Transport and Storage: Clean, non-staining, without causing harm to exposed surfaces. Provide temporary lateral support to prevent bowing and warping.

D. Protect edges of members to prevent staining, chipping, or spalling of concrete.

E. Mark units with date of production and final position in structure, in location not visible to

exterior view.

1.8 WARRANTY

A. Warranty period shall be 10 years, commencing on Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CAST STONE MATERIALS

A. Physical Properties: Provide the following:
   1. Compressive Strength, ASTM C 1194: 6500 psi minimum for products at 28 days.
   2. Absorption, ASTM C 1195: less than 6% maximum by the cold water method, or 10% maximum by the boiling method for products at 28 days.
   3. Air Content: ASTM C 231 or C 173, for wet cast product shall be 4% to 8%.
   4. ASTM C666 Procedure A as modified by ASTM C1364-07 freeze thaw maximum 5% mass loss after 300 freeze/thaw cycles.
   5. Linear Drying Shrinkage – ASTM C426: Test and report in accordance with ASTM C1364.

B. Raw Materials:
   1. Portland cement – Type I or III, white and/or gray, ASTM C 150.
   2. Coarse aggregates – Granite, quartz or limestone, ASTM C 33, except for gradation.
   3. Fine aggregates – Manufactured or natural sands, ASTM C 33, limestone washed masonry sand except for gradation.
   4. Colors – Inorganic iron oxide pigments, proprietary agent pigments, ASTM C 979.
   5. Admixtures – ASTM C 494.
   6. Water – potable.

C. Admixtures – Comply with the following:
   1. ASTM C 260 for air-entraining admixtures.
   2. ASTM C 494 for water reducing, retarding or accelerating admixtures.
   3. Other admixtures: Integral water repellents and other chemicals, for which no ASTM Standard exists, shall be previously established as suitable for use in concrete by proven field performance or through laboratory testing.
   4. ASTM C 618 mineral admixtures of dark and variable colors shall not be used in surfaces intended to be exposed to view.
   5. ASTM C 989 granulated blast furnace slag may be used to improve physical properties. Tests are required to verify these features.

2.2 COLOR AND FINISH

A. Match sample on file in architect's office.

B. Exposed surfaces, unless otherwise specified, shall exhibit a fine grained texture similar to natural stone. No bugholes or air voids will be permitted.

C. Variation:
   1. Must match color and finish of approved sample subjected to similar aging and weathering conditions when viewed in direct daylight at a 10 foot distance.
   2. ASTM D2244 color variation allowed – 2%, hue: 6% lightness, chroma and hue combined.

2.3 CURING AND FINISHING

A. Cure units in a warm curing chamber approximately 100˚F (37.8"C) at 100 percent relative humidity for approximately 12 hours, or cure in a 100 percent moist environment at a minimum 70˚F (21.1˚C) for 16 hours after casting. Additional yard curing at 95 percent relative humidity shall be 350 degree-days (i.e. 7 days @ 50˚F (10˚C) or 5 days @ 70˚F (21˚C)) prior to shipping. Form cured units shall be protected from moisture evaporation with curing blankets or curing compounds after casting.

2.4 REINFORCING (Within CAST STONE)

A. New Billet Steel Reinforcing Bars – ASTM A 615
   1. Reinforce units for safe handling and structural stress.
   2. Reinforcement shall be galvanized or epoxy coated when covered with less than 1-1/2" of material.
   3. Area of reinforcement in panels shall be not less than ¼ percent of the cross section area.
   4. Panels, soffits and similar stones greater than 24 in. (600 mm) in one direction shall be reinforced in that direction. Units less than 24 in. (600 mm) in both their length and width dimension shall be non-reinforced unless otherwise specified.
   5. Welded wire fabric reinforcing shall not be used in dry cast products.

2.5 FABRICATION

A. Maintain plant records and quality control program during production of precast units. Make records and access to plant available to Architect/Engineer on request.

B. Use rigid molds, constructed to maintain precast unit uniform in shape, size, and finish.

C. Maintain consistent quality during manufacture.

D. Embed reinforcing steel, anchors, inserts, plates, angles, and other cast-in items as indicated on shop drawings.

E. Fabricate connecting devices, plates, angles, inserts, bolts, and accessories. Fabricate to permit initial placement and final attachment. Perform welding in compliance with AWS D1.1 or D1.4, as applicable to Project requirements.

F. Locate hoisting devices to permit removal after erection.

G. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, surface cracking or bug holes and all pin holes.

H. Minor patching in plant acceptable, providing structural adequacy and appearance of units is not impaired.

I. Identify each precast unit with corresponding code on erection drawings, in location not visible in finish work.

J. Unless otherwise shown on contract drawings:
   1. Provide suitable wash on all exteriors sills, coping, projecting courses and pieces with exposed top surfaces.
   2. Provide drips as needed.

K. Testing
   1. Test compressive strength and absorption from specimens taken from every 500 cubic feet of product produced
   2. Perform tests in accordance with ASTM C1194 and C1195
   3. Have tests performed by an independent testing laboratory every six months.
   4. New and existing mix designs shall be tested for strength and absorption compliance prior to producing units.
   5. Retain copies of all test reports for a minimum of two years.

2.6 MANUFACTURING TOLERANCES

A. Cross section dimensions shall not deviate by more than ±1/8 inch (3 mm) from approved dimensions.

B. Length of units shall not deviate by more than length/360 or ±1/8 inch (3 mm), whichever is greater, not to exceed ±1/4 inch (6 mm).
   1. Maximum length of any unit shall not exceed 15 times the average thickness of such unit unless otherwise agreed by the manufacturer.

C. Warp, bow or twist of units shall not exceed length/360 or ±1/8 inch (3 mm), whichever is greater.

D. Location of dowel holes, anchor slots, flashing grooves, false joints and similar features – on formed sides of unit, 1/8 inch (3 mm), on unformed sides of unit, 3/8 inch (9 mm) maximum deviation.

2.7 MORTAR MATERIALS

A. Masonry Cement: ASTM C91 Masonry Cement
   1. Provide colored pigmented mortars for all exterior exposed masonry work. Use premixed colored masonry cements of formulation required to produce color indicated, or if not indicated, as selected from manufacturer's standard formulations. Use natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with record of satisfactory performance in masonry mortars.
   2. Color shall be selected by Architect from manufacturer's full range of standard colors.

B. Aggregate for Mortar: ASTM C 144, except for joints less than ¼" use aggregate graded with 100% passing the No. 16 sieve.

C. Aggregate for Grout: ASTM C 404

D. Water: Clean and potable

E. Mortar Mix: Type 'N' per ASTM C 270

2.8 RELATED MATERIALS

A. Anchors, dowels, hooks, plates and other anchoring devices and shims shall be stainless steel type 304.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify building structure, anchors, devices, and openings are ready to receive work of this Section.

B. Beginning of installation means acceptance of existing condition.

3.2 DELIVERY, STORAGE AND HANDLING

A. Mark production units with the identification marks as shown on the shop drawings.

B. Package Units and protect them from staining or damage during shipping and storage.

C. Provide an itemized list of product to support the bill of lading.

3.3 PREPARATION

A. Provide for erection procedures and induced loads during erection. Maintain temporary bracing in place until final support is provided.

B. Provide necessary hoisting equipment.

C. Installing contractor shall check Cast Stone materials for fit and finish prior to installation.

Unacceptable units shall not be set.

3.4 SETTING

A. Erect units without damage to shape or finish. Replace damaged precast units.

B. Erect members level and plumb within allowable tolerances.

C. Align and maintain uniform horizontal and vertical joints as erection progresses.

D. When members require adjustment beyond design or tolerance criteria, discontinue work and advise Architect.

E. Drench stones with clear, running water just prior to setting.

F. Fill all dowel holes and anchor slots completely with mortar or non-shrink grout.

G. Set all stones in a full bed of mortar. Leave head joints in coping and similar stones open for sealant.

H. Rake mortar joints ¾" for pointing. Sponge the face of each stone to remove excess mortar.

I. Tuck point stone joints to a slight concave.

J. Sealant joints – Prime the ends of stones, insert properly sized foam backup rod and gun-in sealant.

K. Protect stone while on ground (and after setting) from splashing, mortar and damage from other trades.

L. Touch-up scratched or damaged primed painted surfaces and galvanized surfaces.

3.5 JOINTING

A. Joint Size:
   1. At stone/brick joints – 3/8"
   2. At stone/stone joints in vertical position – 1/4"
   3. Stone/stone joints exposed on top side – 3/8"

B. Joint Material:
   1. Use a full bed of mortar at all bed joints.
   2. Flush vertical joints full with mortar.

C. Location of Joints:
   1. As shown on approved shop drawings.

3.6 INSTALLATION TOLERANCES

A. Comply with Cast Stone Institute Technical Manual (current edition).

B. Set stones 1/8" or less, within plane of adjacent unit.

C. Joints, +1/16", - 1/8".

D. Variation from Plane of Location: 1/8-inch in 10 feet and 3/8-inch in 100 feet maximum, non-cumulative.

E. Offset from True Alignment Between Two Connecting Members: 1/16-inch maximum.

F. Out of Square: 1/16-inch in 10 feet maximum, non-cumulative.

G. Variation in Dimensions Indicated on Shop Drawings: ± 1/16-inch.

H. Misalignment of Anchors, Inserts, Openings: 1/8-inch maximum.

I. Bowing of Units: Length of bow/360, maximum, for installed span.

J. Exposed Joint Dimension: 3/8-inch.

3.7 PROTECTION

A. Protect members from damage.

B. Provide non-combustible shields during welding operations.

3.8 CLEANING AND REPAIR

A. Clean stone by wetting with clear running water and applying a solution of detergent recommended by the manufacturer. Saturate units to be cleaned prior to applying an approved masonry cleaner. Consult with the manufacturer for appropriate cleaners.

B. Repair obvious chips with touchup material furnished by the manufacturer.

3.9 INSPECTION AND ACCEPTANCE

A. Inspect finished installation according to Cast Stone Institute Technical Bulletin #36.

B. Do not field apply water repellent until repair, cleaning, inspection and acceptance is completed.

3.10 WATER REPELLENT

A. Apply water repellent in accordance with Cast Stone Institute Technical Bulletin #35 or water repellent manufacturer's. directions.

END OF SECTION

SECTION 04 73 00

MANUFACTURED MASONRY VENEER

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: Portland cement based manufactured stone veneer and trim.

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI A118.4 Specifications for Latex-Portland Cement Mortar.

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

1. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
2. ASTM C 67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
3. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar.
4. ASTM C 177 Standard Test Method for Steady-State Head Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
5. ASTM C 207 - Standard Specification for Hydrated Lime for Masonry Purposes.
6. ASTM C 270 - Standard Specification for Mortar for Unit Masonry.
7. ASTM C 482 - Standard Test Method for Bond Strength of Ceramic Tile to Portland Cement.
8. ASTM C 567 - Standard Test Method for Determining Density of Structural Lightweight Concrete.
9. ASTM C 847- Standard Specification for Metal Lath.
10. ASTM C 932 – Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering.
11. ASTM C 979 - Standard Specification for Pigments for Integrally Colored Concrete.
12. ASTM C 1032 - Standard Specification for Woven Wire Plaster Base.
13. ASTM C 1059 – Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete.
14. ASTM D 226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
15. ASTM C1063 –Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster
16. ASTM C1329 - Standard specification for Portland cement
17. ASTM C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
18. ASTM C1289 – Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
19. ASTM E2556/E2556M – Standard Specification for Vapor Permeable Flexible Sheet Water-Resistive Barriers Intended for Mechanical Attachment

C. Other Standards:

1. UBC Standard No. 14-1, Kraft Waterproof Building Paper
2. ICC AC38 Acceptance Criteria for Water Resistive Barriers
3. UU-B-790 Building Paper, Vegetable Based, Kraft, waterproofed, water repellent and fireproof

D. International Code Council (ICC):

1. ESR Report

E. Underwriter's Laboratory (UL): Building Materials Directory

1.3 SUBMITTALS

A. Reference Section 01 33 00 Submittal Procedures; submit following items:
   1. Product Data.
   2. Samples:
      a. Standard sample board consisting of small-scale pieces of veneer units showing full range of textures and colors.
      b. Full range of mortar colors.
   3. Verification Samples: Following initial sample selection submit "laid-up" sample board using the selected stone and mortar materials and showing the full range of colors expected in the finished Work; minimum sample size: 3 by 3 feet (1 by 1 m).
   4. Quality Assurance/Control Submittals:
      a. Qualifications:
         1) Proof of manufacturer qualifications.
         2) Proof of installer qualifications.
      b. Regulatory Requirements: Evaluation reports.
      c. Veneer manufacturer's installation instructions.
      d. Installation instructions for other materials.

B. Closeout Submittals: Reference Section 01 78 00□Closeout Submittals; submit following items:
   1. Maintenance Instructions.
   2. Special Warranties.

1.4 QUALITY ASSURANCE

A. Qualifications
   1. Manufacturer Qualifications: Eldorado Stone, LLC.
   2. Installer Qualifications: Experienced mason familiar with installation procedures and related local, state and federal codes masonry.

B. Certifications
   1. ICC Evaluation Service □ Evaluation Report ESR-1215.
   2. ICC ESR-1215, Florida Building Code Supplement
   3. ASTM C1670
   4. LARR – Research Report RR25589
   5. HUD □ Material Release Number 910F
   6. UL □ Classification listing in Building Materials Directory: UL 546T (F8002).

C. Field Sample:
   1. Prepare 4 by 4 foot (1200 by 1200 mm) sample at a location on the structure as selected by the Architect. Use approved selection sample materials and colors.
   2. Obtain Architect's approval.
   3. Protect and retain sample as a basis for approval of completed manufactured stonework. Approved sample may be incorporated into completed work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Reference Section 01 66 00 Product Storage and Handling Requirements.

B. Follow manufacturer's instructions.

1.6 PROJECT/SITE CONDITIONS

A. Environmental Requirements: When air temperature is 40 degrees F (4.5 degrees c C) or below, consult local building code for Cold-Weather Construction requirements.

1.7 WARRANY

A. Special Warranty: Manufacturer's standard warranty coverage against defects in materials when installed in accordance with manufacturer's installation instructions.

PART 2- PRODUCTS

2.1 MANUFACTURER

A. Eldorado Stone, LLC
   1. Address: 1370 Grand Ave., Bldg. B, San Marcos, CA, 92069
   2. Telephone: (800) 925-1491
   3. Fax: (760) 736-3840
   4. Email: customerservice@westlake.net
   5. Website: www.eldoradostone.com

B. Manufacturer's Distributer:
   1. Belair Road Supply Co Inc.
      a. Address: 7750 Pulaski Hwy, Baltimore, MD 21237
      b. Phone: (410) 687-4200
      c. Website: www.belairroadsupply.com

2.2 MATERIALS

A. Stone Veneer:
   1. Profile: Mountain Ledge. Include matching corner pieces.
   2. Color: Charleston

B. Veneer Unit properties: Precast veneer units consisting of portland cement, lightweight aggregates, and mineral oxide pigments.
   1. Compressive Strength: ASTM C 192 and ASTM C 39, 5 sample average: greater than 1,800 psi (12.4MPa).
   2. Shear Bond: ASTM C 482: 50 psi (345kPa), minimum.
   3. Freeze-Thaw Test: ASTM C 67: Less than 3 percent weight loss and no disintegration.
   4. Thermal Resistance: ASTM C 177: 0.473 at 1.387 inches thick
   5. Weight per square foot: 2012 IBC and 2012 IRC, ASTM C1670, 15 pounds, saturated.

C. Weather Barrier: Liquid-applied materials evaluated for compliance with ICC-ES AC212

D. Reinforcing: [ASTM C 847, 2.5lb/yd2 (1.4kg/m2) galvanized expanded metal lath] [ASTM C 847, 3.4lb (1.8 kg/m2) galvanized 3/8" rib lath] [ASTM C 1032, 17 gauge (1.3 mm) woven wire mesh] complying with code agency requirements for the type of substrate over which stone veneer is installed.

E. Mortar:
   1. Cement: Portland cement complying with ASTM C 1329.
   2. Lime: ASTM C 207.
   3. Sand: ASTM C 144, natural or manufactured sand.
   4. Color Pigment: ASTM C 979, mineral oxide pigments.
   5. Water: Potable.

6. Pre-Packaged Latex-Portland Cement Mortar: ANSI A118.4.

F. Water Repellent: Water based silane or siloxane masonry water repellent

2.3 MORTAR MIXES

A. Standard Installation Grouted Joints:
   1. Mix mortar in accordance with ASTM C 270,
   2. Polymer modified mortar complying with ANSI A118.4
      a. Add color pigment in grout joint mortar in accordance with pigment manufacturer's instructions not to exceed 10% by weight of cement.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates upon which work will be installed.

B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.

C. Commencement of work by installer is acceptance of substrate.

3.2 PREPARATION

A. Protection: Protect adjacent work from contact with mortar.

B. Surface Preparation: Prepare substrate in accordance with manufacturer's installation instructions for the type of substrate being covered.

3.3 INSTALLATION

A. Install and clean stone in accordance with manufacturer's installation instructions for Standard Installation Grouted Joint installation as specified above.

B. Apply repellent in accordance with repellent manufacturer's application instructions.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Manufacturer's Field Service Representative shall make two periodic site visits review of on-going installation process but is not responsible for any errors or omissions that are not observed or are previously completed. Contact – Technical Rep. Eldorado Stone. Dell Nolt 717-629-1216 or lnolt@westlake.com

3.5 CLEANING

A. Reference Section 01 74 00 Cleaning and Waste Management.

B. Remove protective coverings from adjacent work.

C. Cleaning Veneer Units:
   1. Wash with soft bristle brush and water/granulated detergent solution
   2. Rinse immediately with clean water

D. Removing Efflorescence:
   1. Allow veneer to dry thoroughly
   2. Scrub with soft bristle brush and clean water
   3. Rinse immediately with clean water; allow to dry
   4. If efflorescence is still visible, contact ES Customer Service for assistance

END OF SECTION

SECTION 05 52 00

METAL RAILINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES
Steel pipe handrails, balusters, and fittings for interior and exterior installations.

1.2 DESIGN REQUIREMENTS
A. General: Comply with Code loading requirements applicable to handrails and railings.
1. Design in compliance with IBC 2018 Code.

B. Design assembled components to include requirements of sizes and spacings as indicated on drawings.

C. Provide in the design of galvanized steel pipe assemblies, the following vent systems:
1. Vented full open internally in compliance with ASTM A 385-80 (reapproved 1986), Figure 6, "Handrail".

1.3 SUBMITTALS
A. Shop Drawings: Indicate profiles, sizes, joints and inter-sections, minimum bend radii, mounting brackets, connection attachments, anchorage, size and type of fasteners, and accessories.

B. Samples: Submit 2, 24-inch long samples of handrail with bracket, one bend, and end closure; as specified. Submit 1, railing termination and 90 degree corner composite sample full height as shown and specified.

C. Certification: Fabricator's certification to galvanizer, that fabrication to vent assembly specified under Article "Design Requirements" of this Section is present; is adequate to relieve destructive pressure during galvanizing; and is properly sized and fabricated to drain excess, molten galvanizing upon withdrawal from galvanizing tank.

1.4 QUALITY ASSURANCE
A. Verify all controlling dimensions by field measurement, prior to start of fabrication.

B. Do not field modify galvanized or shop-finished items, unless otherwise directed.

PART 2 - PRODUCTS

2.1 STEEL RAILING SYSTEM
A. Pipe: ASTM A 53, Type E, Grade B, Schedule as indicated on Drawings.

B. Pipe Diameters:
1. Toprail and post: 1-1/2 (1.66) inches, outside diameter.
2. Intermediate rails: 1-1/4 (1.315) inches.

C. Mounting: Brackets and flanges, with steel inserts for casting in concrete or with steel brackets for embedding in masonry.

D. Exposed Fasteners: Flush, countersunk-head, tamperproof type.

E. Splice Connectors: Steel welding collars.

2.2 FABRICATION

A. Fit and shop assemble components in largest practical sizes, for delivery to site.

B. Fabricate components with joints tightly fitted and secured.

C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

E. Continuously seal joined pieces by continuous welds.

F. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

G. Accurately form components to suit stairs and landings, to each other and to building structure.

H. Toe Plates: Where shown or required, supply toe plates at unprotected openings, edges, and stair landings. Fabricate from steel plate or bar stock. Install so as to provide protection to a height of 4 inches from horizontal surfaces with a maximum 1/2-inch gap between bottom of toe plate and protected surface. Weld plates to railing posts and other structural members.

I. Galvanizing: Where shown or directed, perform galvanizing as follows:
   1. Preparation:
      a. Remove all weld spatter, flash, and flux. Prepare surfaces to be galvanized in accordance with SSPC SP-6, Commercial Blast Cleaning.
      b. Prior to galvanizing, perform acid descaling (pickling) on fabricated steel pipe assemblies. Drain, neutralize, and rinse interior thoroughly before galvanizing.
   2. Hot-dip galvanize steel-pipe assemblies after fabrication in accordance with ASTM A 384, ASTM A 385, and ASTM A 386. Galvanize structural shapes, bars, plates in accordance with ASTM A 123.
   3. After galvanizing and prior to finishing, remove all sharp peaks, dross spikes, sharp protrusions, and make exposed surfaces safe for finger contact.

2.3 FINISHING

A. Clean surfaces to be finished of rust, scale, grease, and other contaminants in accordance with SSPC SP-1, SP-2, and SP-6, as well as the paint and coating manufacturer's published instructions.

B. After cleaning, apply shop primer and two coats of finish paint.

C. Where items are to be shop finished, provide temporary protection that will prevent damage to finishes during delivery.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Beginning of installation means erector accepts existing conditions.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry placed in partitions with setting templates, to appropriate Sections.

3.3 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Provide anchors, plates, or angles required for connecting railings to structure. Anchor railing to structure.

C. Field weld anchors as indicated on shop drawings. Touch-up welds with primer. Grind welds smooth.

D. Conceal bolts and screws whenever possible. Where not concealed, use security type flush countersunk fastenings.

E. After installation is complete, touch-up all abraded and damaged coatings and galvanizing using galvanizing repair compound, primer, and coatings specified, as required.

3.4 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4-inch per story, noncumulative.

B. Maximum Offset From True Alignment: 1/4-inch.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes:

1. Furnishing and installing rough carpentry, including rough hardware.
2. Rough carpentry consists of wood construction both temporary and permanent that is not exposed to view in completed building. Rough carpentry work includes proper installation of grounds, wood or metal, nailing strips, blocking, etc., necessary or required to produce an adequate and substantial base for support of finishes, material, fittings and equipment.
3. Rough carpentry includes carpentry work not specified as part of other sections and which is generally not exposed, except as otherwise indicated. Types of work in this section include rough carpentry for:
   a. Wood grounds, nailers, blocking and sleepers, including that required for roofing.

1.2 REFERENCES

A. Lumber Standards: Comply with PS 20 and with applicable rules of the respective grading and inspecting agencies for species and products indicated.

1. American Wood Preservers Bureau Standards
2. Western Wood Products Association Use Manual
3. American Plywood Association (APA) Design/Construction Guide

B. Plywood Product Standards: Comply with PS 1 (ANSI A 199.1) or, for products not manufactured under PS 1 provisions, with applicable APA Performance Standard for type of panel indicated.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for materials listed below:

1. Insulating sheathing
2. Underlayment
3. Plywood
4. Metal connectors

B. Material Certificates: Where dimensional lumber is provided to comply with minimum allowable unit stresses, submit listing of species and grade selected for each use, and submit evidence of compliance with specified requirements. Compliance may be in the form of a signed copy of applicable portion of lumber producer's grading rules showing design values for selected species and grade. Design values shall be as approved by the Board of Review of the American Lumber Standards Committee.

C. Wood Treatment Data:

1. Submit treatment manufacturer's instructions for proper use of each type of treated material.

2. Pressure Treatment: For each type specified, include certification by treating plant stating chemicals and process used, net amount of preservative retained and conformance with applicable standards.
3. Water-Borne Preservatives: For each type include statement that moisture content of treated materials was reduced to a maximum of 15% prior to shipment to the project site.

1.4 PRODUCT HANDLING

A. Protection:
1. Deliver material to job site and store, in safe area, out of way of traffic and shored up off ground surface.
2. Identify framing lumber by grades, and store each grade separately from other grades.
3. Protect metals with adequate waterproof outer wrapping.
4. Use extreme care in off loading of lumber to prevent damage, splitting, and breaking of materials.
5. Delivery and Storage: Keep materials dry at all times. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and plywood, and provide air circulation within stacks. Do not store materials directly on the ground.

1.5 JOB CONDITIONS

Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow proper attachment of other work.

PART 2 - PRODUCTS

2.1 LUMBER: GENERAL

A. Factory-mark each piece of lumber with type, grade, mill and grading agency, except omit marking from surfaces to be exposed with transparent finish or without finish.

B. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.

C. Provide dressed lumber, S4S, unless otherwise indicated.

D. Provide kiln-dried lumber 15% maximum moisture content at time of dressing.

2.2 MISCELLANEOUS LUMBER

A. Provide Construction Grade light framing size lumber of any species for support or attachment of other work including cant strips, bucks, nails, blocking, furring, grounds, stripping and similar members. Provide kiln-dried lumber with 15% maximum moisture content.

2.3 MISCELLANEOUS MATERIALS

A. Fasteners and Anchorages:
1. Provide size, type, material and finish as indicated and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommending nails.
2. Where rough carpentry work is exposed to the weather, in ground contact, or in area of high relative humidity, provide fasteners and anchorages made of stainless steel.

B. Rough Hardware
   1. Steel Items:
      a. Comply with ASTM A7 or ASTM A36.
      b. Use stainless steel at exterior locations.
   2. Machine bolts: Comply with ASTM A307.
   3. Lag bolts: Comply with Fed Spec FF-B-561.
   4. Nails:
      a. Use common except as otherwise noted.
      b. Comply with Fed Spec FF-N-1.
      c. Use stainless steel at exterior locations.

2.4 WOOD TREATMENT

A. Treatment Chemical Manufacturer's: Producer of chemical treatment products shall be recognized for production of wood preservation and fire retardant treatments. Specified products are based upon those manufactured by Wolman Arch Treatment Technologies, Inc. Alternative products from Treated Wood, Inc. will be acceptable subject to manufacturer's requirements for retention rate and proprietary chemical composition to meet AWPA use categories listed.

B. Treatment Applicator: The preservation treatment and fire retardant treatment application plants shall be licensed and approved by the treatment chemical manufacturer.

C. Preservative Treatment:
   1. Where lumber or plywood is indicated as preservative treated ('PT'), or is specified herein to be treated, comply with applicable requirements of AWPA Standards as follows:
      a. Standard P5, Waterborne Preservatives.
      b. Standard E13, Standard Method of Testing to Determine Water Repellents in Pressure Treated Lumber.
      c. Standard M4, Care of Preservative – Treated Wood Products.
      d. Standard U1, Use Category system.
   2. Preservative Treatment: Wolman E – Copper Azole; Arch Technologies Inc., dissolved (CA-C) Copper Azole.
   3. Retention Rates
      a. AWPA 'Use Category Designations' for above-grade uses; UC-1, UC-2, UC-3A and UC-3B; provide minimum retention of 0.06 lbs per cubic foot.
      b. AWPA 'Use Category Designations' for ground contact; UC-4A; provide minimum retention of 0.15 lb per cubic foot.
   4. Moisture Content: Dry lumber after treatment to 19% maximum moisture content.
   5. Warranty: Provide manufacturer's written 40-year warranty.
   6. Treated Material: Provide treated material that bears the Wolmanized trademark and the quality mark of an ALSC-recognized agency which maintains supervision, testing and inspection of the quality of the product. Quality marks shall be affixed to each piece and include the following:
      a. Identification of the inspection agency.
      b. Identification of the standard to which the material was treated.
      c. Identification of the treating facility.
      d. Identification of the preservative and retention.
      e. Identification of the end use for which the product is suitable.

2.5 OTHER MATERIALS

A. Contractor selects other materials, not specifically described but required for a complete and proper installation, subject to Architect's approval.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Discard units of material with defects which might impair quality of work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.
2. Set carpentry work accurately to required levels and lines, with members plumb and true and accurately cut and fitted.
3. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards. Countersink nail heads on exposed carpentry work and fill holes.
4. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.

B. Wood Grounds, Nailers, Blocking, and Sleepers:

1. Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
2. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise show. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
3. Provide solid wood blocking concealed within stud wall framing for all wall mounted toilet accessories, wall and ceiling mounted cabinets, and wall mounted shelving.
4. Provide permanent grounds of dressed, preservative treated, key beveled lumber not less than 1-1/2" wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

END OF SECTION

SECTION 07 92 00

JOINT SEALERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The applications for joint sealers as work of this section include the following:
   1. Pavement and sidewalk joints
   2. Concrete construction joints
   3. Floor joints (interior)
   4. Wall joints (exterior)

1.2 GENERAL PERFORMANCE REQUIREMENTS

Except as otherwise indicated, joint sealers are required to establish and maintain airtight and waterproof continuous seals on a permanent basis, within recognized limitations of wear and aging as indicated for each application. Failures of installed sealers to comply with this requirement will be recognized as failures of materials and workmanship.

1.3 REFERENCES

A. ASTM D 1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

B. ASTM D 1565 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam).

C. FS TT-S-001543 - Sealing Compound, Silicone Rubber Base.

D. SWRI (Sealant, Waterproofing & Restoration Institute) - Sealant and Caulking Guide Specification.

1.4 SUBMITTALS

A. Product Data: Manufacturer's printed data indicating sealant chemical characteristics, performance criteria, limitations, and color availability for each elastomeric product required.

B. Samples: Two samples, 2 inches by 2 inches in size illustrating colors selected.

C. Certificate: Manufacturer's certificate that products meet or exceed specified requirements.

D. Warranty: Include installed sealants and accessories against failure to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or not cure

1.5 JOB CONDITIONS

A. Weather Conditions: Do not proceed with installation of liquid sealants under unfavorable weather conditions. Install elastomeric sealants when temperature is in lower third of temperature range recommended by the manufacturer for installation.

1.6 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section with a minimum of 20 continuous years of documented experience.

B. Installer: Company specializing in installation of work in this Section with a minimum 5 continuous years of documented experience and approved by sealant manufacturer.

C. Comply with Sealant and Waterproofers Institute requirements for materials and installation.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install solvent curing sealants in enclosed buildings spaces without sufficient ventilation to maintain LTL solvent vapor levels.

B. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.8 WARRANTY

A. Provide 5-year warranty.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General: Manufacturers listed in this article include those known to produce the indicated category of prime joint sealer material, either as a nominally pure generic product or as an equivalent performance modification thereof or proprietary product.

B. Manufacturer:

Subject to compliance with requirements, provide products of one of the following:

1. Euclid Chemical
2. W.R. Meadows
3. Pecora Corp.
4. Sonneborn/Contech
5. Tremco, Inc.

2.2 SEALER MATERIALS

A. General Sealer Requirements: Provide colors indicated or, if not otherwise indicated, as selected by the Architect from the manufacturer's standard colors. Select materials for compatibility with joint surfaces and other indicated exposures, and except as otherwise indicated select modulus of elasticity and hardness or grade recommended by the manufacturer for each application indicated. Where exposed to foot traffic, select non-tracking materials of sufficient strength and hardness to withstand stiletto heel traffic without damage or deterioration of sealer system.

B. Single Component Self Leveling Polyurethane: Single component, traffic rated, pourable, semi-self leveling, gun grade, one-part moisture curing, low modulus polyurethane sealent; complying with ASTM C920, type S, grade P, class 50, use T, M, A, O, and I. Tremco “Vulkem 45SSL” or approved equal.

C. Single Component Polyurethane: Single component, gun grade, modified polyurethane sealant for exterior exposures meeting Federal Sepcification TT-S-00230C, Type II, Class A; CGSB 19-GP-13, and ASTM C920, type S, Grade NS, Class 25, Use NT, M, A, and O. Provide Tremco "Dymonic" or approved equal.

D. Multi Component Traffic Sealant: Multi component, self leveling polyurethane joint sealant specifically developed for sealing concrete expansion and control joints on vehicular surfaces, ASTM C920, Type M, Grade P, Class 25, Use T, M, A, O. Provide Tremco "THC-900" together with compatable primer.

E. Electrical Box Seal: Sheet caulking.

2.3 PRIMERS

A. Use only nonstaining primers that have been tested for durability on surfaces to be sealed and are specifically recommended for this installation by manufacturer of sealant used.

2.4 CELLULAR/FOAM JOINT FILLERS AND SEALANT BACKERS

A. Closed Cell Synthetic Rubber Joint Filler: Provide expanded synthetic rubber complying with ASTM D1056, class SC-E of 2 to 5 psi compression deflection; except provide 13 to 17 psi compression deflection where filler is applied under sealant exposed to traffic.

B. Fiber Expansion Joint: Preformed cellular fiber complying with ASTM D1751.

2.5 BOND-PREVENTATIVE MATERIALS

A. Use only one of following as best suited for application and as recommended by sealant manufacturer
   1. Polyethylene tape, pressure-sensitive adhesive, with adhesive required only to hold tape to construction materials as indicated.

2.6 MASKING TAPE

For masking around joints, provide masking tape complying with Fed Spec UU-T-106C.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 JOINT PREPARATION

A. Clean joint surfaces immediately before installation of gaskets, sealants or caulking compounds. Remove dirt, insecure coatings, moisture and other substrates which could interfere with seal of the gasket or bond of sealant or caulking compound. Etch concrete and masonry joint surfaces as recommended by sealant manufacturer. Roughen vitreous and glazed joint surfaces as recommended by the sealant manufacturer.

B. Prime or seal joint surfaces where indicated, and where recommended by the sealant manufacturer. Confine primer/sealer to areas of sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Concrete and ceramic tile surfaces:
   1. Install only on surfaces that are dry, sound, and well brushed, wiping free from dust.
   2. At open joints, remove dust by mechanically blown compressed air if required.
   3. Use solvent to remove oil and grease, wiping surfaces with clean rags.
   4. Where surfaces have been treated, remove surface treatment by sandblasting or wire brushing.
   5. Remove laitance and mortar from joint cavities.
   6. Where backstop is required, insert approved backup material into joint cavity to depth needed.

D. Steel surface:
   1. Steel surfaces in contact with sealant:

a. Clean metal surface with power tools as required to archive acceptable surface or bond.
b. Use solvent to remove oil and grease, wiping surfaces with clean rags.

2. Remove protective coatings on steel with power tools or by using solvent that leaves no residue.

E. Aluminum surfaces:
1. Aluminum surfaces in contact with sealant:
a. Remove temporary protective coatings, dirt, oil, and grease.
b. When masking tape is used for protective cover, install tape just prior to applying sealant.
2. Use only nonstaining solvents to remove protective cover, as recommended for that purpose by manufacturer of aluminum work.

3.3 INSTALLATION

A. Comply with manufacturer's printed instructions except where more stringent requirements are shown or specified, and except where manufacturer's technical representative directs otherwise.

B. Use only primer recommended by sealant manufacturer and approved by Architect for particular installation, applying in strict accordance with manufacturer's recommendations as approved by Architects.

C. Set joint filler units at depth or position in joint as indicated to coordinate with other work, including installation of bond breakers, backer rods and sealants. Do not leave voids or gaps between ends of joint filler units.

D. Install sealant backer rod for liquid applied sealants, except where shown to be omitted or recommended to be omitted by the sealant manufacturer for application indicated.
1. Use only backup material recommended by sealant manufacturer and approved by Architect for particular installation, compressing backup material 25% to 50% to achieve positive and secure fit
2. When using backup of tube or rod stock, avoid lengthwise stretching of material. Do not twist or braid hose or rod backup stock.

E. Install bond breaker tape where indicated and where required by the manufacturer's recommendations to ensure that liquid applied sealants will perform as intended.

F. Thoroughly and completely mask joints where appearance of sealant on adjacent surfaces would be objectionable.

G. Employ only proven installation techniques, which will ensure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete wetting of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

H. Install liquid applied sealant to depths as shown or, if not shown, as recommended by the sealant manufacturer but within the following general limitations, measured at the center section of beads.

I. Equipment:

1. Apply sealant under pressure with power-actuated or hand gun or other appropriate means.
2. Use guns with nozzle of proper size, providing sufficient pressure to completely fill joints as designed.

J. For sidewalks, pavements and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75% of joint width, but neither more than 5/8" deep not less than 3/8" deep.

K. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50% of joint width, but neither more than 1/2" deep nor less than 1/4" deep.

L. Do not allow sealants or compounds to overflow from confines of joints, or to spill onto adjoining work, or to migrate into voids of exposed finishes. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage.

3.4 SCHEDULE OF SEALANT APPLICATION

A. Exterior masonry joints: Single component Modified Polyurethane.

B. Exterior Concrete Sidewalk paving, Expansion Joints, Concrete expansion joints, and joints of dissimilar materials subject to pedestrian traffic: Single Component Self-Leveling Polyurethane.

C. Interior and Exterior Portland Cement Concrete Paving Joints subject to Vehicle traffic: Multi Component polyurethane

3.5 CLEANING UP

A. Remove masking tape immediately after joints have been tooled.

B. Clean Adjacent surfaces free from sealant as installation progresses, using solvent or cleaning agent sealant manufacturer recommends.

3.6 CURE AND PROTECTION

Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability. Replace or restore sealants which are damaged or deteriorated during construction period.

END OF SECTION

SECTION 09 91 00

PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Painting and finishing exterior and interior exposed surfaces of items provided under other Sections that are not factory-finish coated.

B. Related Work in other Sections: Priming or priming and finishing of certain surfaces may be specified to be factory performed or installer performed under other Sections.

C. Work not included:

1. Unless otherwise indicated, painting is not required on surfaces in concealed areas and inaccessible areas such as furred spaces, foundation spaces, utility tunnels, pipe spaces, and duct shafts.
2. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze, and similar finished materials will not require painting under this Section except if specified.
3. Do not paint moving parts or operating units, mechanical or electrical parts such as valve operators, linkages, sensing devices, and motor shafts, unless otherwise indicated.
4. Do not paint over required labels or equipment identification, performance rating, name, or nomenclature plates.
5. Do not paint concrete that has been sandblasted.

D. Definitions: "Paint," as used herein, means coating systems materials including primers, emulsions, epoxy, enamels, sealers, fillers, and other applied materials whether used as prime, intermediate, or finish coats.

1.2 QUALITY ASSURANCE

A. Paint coordination:

1. Provide finish coats compatible with prime coats actually used.
2. Review other Sections of these Specifications as required, verifying prime coats to be used and assuring compatibility of total coating system for various substrata.
3. Upon request, furnish information on characteristics of specific finish materials to assure that compatible prime coats are used.
4. Provide barrier coats over non-compatible primers, or remove primer and reprime as required.
5. Notify Architect in writing of anticipated problems in using specified coating systems over prime coatings supplied under other Sections.

1.3 SUBMITTALS

A. Product data:

1. Submit materials list of items to be provided under this Section if substitutions are proposed. If specified products are used, submittal is not required. Key material list to Articles of this Section.
2. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
3. Color and finish selection kits.

1.4 JOB CONDITIONS

A. Do not apply solvent-thinned paints when temperature of surfaces to be painted and surrounding air temperatures are below 45 degrees F, unless manufacturer's printed instructions permit otherwise as approved by Architect.

B. Weather conditions:
   1. Do not apply paint in snow, rain, fog, or mist; when relative humidity exceeds 85%; to damp or wet surfaces, unless manufacturers' printed instructions permit otherwise as approved by Architect.
   2. Applications may be continued during inclement weather only within temperature limits paint manufacturer specifies as suitable for use during application and drying periods.

PART 2 - PRODUCTS

2.1 COLORS AND FINISHES

A. General:
   1. Paint colors, surface treatments, and finishes, are indicated in schedules of the contract documents.
   2. Use representative colors when preparing samples for review.
   3. Final acceptance of colors will be from samples applied on the job.

B. Color Pigments:
   1. Pure, non-fading, applicable types to suit substrates and service indicated.
   2. Paint shall contain no lead.

C. Paint Coordination: Provide finish coats which are compatible with prime paints used. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information on characteristics of finish materials proposed for use, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and reprime as required. Notify the Architect in writing of any anticipated problems using specified coating systems with substrates primed by others.

2.2 MATERIAL QUALITY

A. Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not acceptable.

B. Proprietary names used to designate colors or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturers.

C. Federal Specifications establish minimum acceptable quality for paint materials. Provide written certification from paint manufacturer that materials provided meet or exceed these minimums.

D. Manufacturer's products which comply with coating qualitative requirements of applicable Federal Specifications, yet differ in quantitative requirements, may be considered for use when acceptable to the Architect. Furnish material data and manufacturer's certificate of performance to the Architect for any proposed substitutions.

E. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer, and use only within recommended limits.

F. Insofar as practicable, use undercoat, finish coat, and thinner material as parts of unified system of paint finish.

2.3 COLOR SCHEDULES

A. Architect will prepare color schedule for guidance in painting.

2.4 APPLICATION EQUIPMENT

A. For application of approved paint, use only such equipment recommended for application of particular paint by manufacturer and as approved by Architect.

B. Prior to use of application equipment, verify that proposed equipment is actually compatible with material to be applied and that integrity of finish will not be jeopardized by use of proposed equipment.

2.5 OTHER MATERIALS

A. Contractor selects other materials, not specifically described but required for complete and proper installation, subject to Architect's approval.

B. Paint Stripping Chemicals: Provide water based chemical stripping agent that is 100% biodegradable, pH neutral, zero VOC, and safe to use on wood, brick, stone, concrete, plaster, metal, plastic, glass, or fiberglass. Stripper product shall be capable of removing multiple layers of oil paint, latex paint, acrylics, varnishes, epoxies, urethanes and elastomerics. Product shall not require the use of a neutralizer after stripping is finished. Chemical stripper shall be "SmartStrip Pro" by Peel-Away, a Dumond Chemical company, or approved equal.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 MATERIALS PREPARATION

A. General:
   1. Mix and prepare paint materials in strict accordance with manufacturer's recommendations as approved by Architect.
   2. When materials are not in use, store in tightly covered containers.
   3. Maintain containers used in storage, mixing, and application of paint in clean condition, free from foreign materials and residue.

B. Stirring:
   1. Stir materials before application, producing mixture of uniform density.
   2. Do not stir into material any film that forms on surface, but remove film and, if necessary, strain material before using.

3.3 SURFACE PREPARATION

A. Manufactured items: Follow printed instructions of manufacturer of item being finished.

B. General:
   1. Prepare and clean in strict accordance with paint manufacturer's recommendations as approved by Architect.
   2. Remove removable items that are in place and not scheduled to receive paint finish, or provide surface applied protection prior to surface preparation and painting operations.

3. Following completion of painting in each space or area, reinstall removed items by using workmen skilled in necessary trades.
4. Clean each surface to be painted prior to applying paint or surface treatment.
5. Remove oil and grease with clean cloths and cleaning solvent of low toxicity and flash point in excess of 200 degrees F, prior to start of mechanical cleaning.
6. Schedule cleaning and painting so that dust and other containments from cleaning process will not fall onto wet, newly painted surfaces.

C. Preparation of metal surfaces:
1. Thoroughly clean surfaces until free from dirt, oil, and grease.
2. On galvanized surfaces, use solvent for initial cleaning and then treat surface thoroughly with phosphoric acid etch. Remove etching solution completely before proceeding.
3. Allow to dry thoroughly before application of paint.
4. Lightly sand shop applied primer on structural steel, miscellaneous exposed steel, hollow metal doors and frames, to remove burrs and un-even conditions.

F. Preparation of Existing Concrete Exterior Foundation Walls: Remove existing paint and contaminants by one of following methods at Contractor's option:
1. Dry Blasting:
   a. Use 16-30 mesh sand and oil-free air
   b. Remove all surface contamination (ref. ASTM D4258).
   c. Move nozzle at a uniform rate.
   d. Laitance must be removed and bug holes opened.
   e. Surface must be clean and dry (moisture check: ref. ASTM D4263) and exhibit a texture similar to that of medium grit sandpaper.
   f. Vacuum or blow down and remove dust and loose particles from the surface (ref. ASTM D4258).
2. Power Tool Cleaning:
   a. Use needle guns or power grinders, equipped with a suitable grinding stone of appropriate size and hardness, which will remove concrete, loose mortar, fins, projections, paint and surface contaminants.
   b. Vacuum or blow down to remove dust and loose particles from surface (ref. ASTM D4285).

3.4 PAINT APPLICATION
A. General:
1. Provide masking and protection of existing finishes and improvements from the paint application processes.
2. Touch-up damaged shop-applied prime coats, and touch-up bare area prior to applying finish coats.
3. Slightly vary color of succeeding coats. Do not apply additional coats until completed coat has been inspected and approved coats of paint will be considered in determining number of coats applied.
4. Sand and dust between coats to remove defects visible to unaided eye from distance of five feet.
5. On removable panels and hinged panels, paint back sides to match exposed sides.
6. Comply with printed instructions of manufacturer of factory-manufactured items.

B. Drying:
1. Allow sufficient drying time between coats, modifying period as material manufacturer recommends, to suit adverse weather conditions.
2. Consider oil-base and oleo-resinous solvent-type paint as dry for recoating when point feels firm, does not deform or feel sticky under moderate thumb pressure, and applying

another coat of paint does not cause undercoat to lift or lose adhesion.

C. Brush applications:
   1. Brush out and work brush coats onto surface in even film.
   2. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, and other surface imperfections are not acceptable.

D. Spray application:
   1. Where spray application is used, apply each coat to provide hiding equivalent of brush coats.
   2. Do not double back with spray equipment to build up film thickness of two coats in one pass.

E. Miscellaneous surfaces and procedures:
   1. Exposed mechanical items:
      a. Finish electric panels, access doors, conduits, pipes, ducts, grilles, registers, vents, and items of similar nature to match adjacent wall and ceiling surfaces, or as directed.
      b. Paint visible duct surfaces behind vents, registers, and grilles flat black.
      c. Wash metal with solvent, prime, and apply two coats of alkyd enamel.
   2. Primed hardware: Paint to match adjacent surfaces
   3. Interior enamel: Apply rolled finish.

3.5 COMPLETION AND CLEANING

A. Non-painted surfaces, including glass, are to be scraped clean of excess paint and putty applied as part of Work of this Contract.

3.6 PRODUCT AND SURFACE SCHEDULE

Provide following paint finishes as manufactured by the Sherwin Williams Paint company or approved equals. Substitutions submitted for approval shall include a comparison of the specified product with the substitute product.

Ptd 'A'; Metal handrails, gloss finish
Primer: DTM Acrylic primer B66
Finish: (2) coats SuperPaint Exterior latex high gloss A85

Ptd 'B': Exterior Concrete Foundation Walls. (Existing)
Primer: Loxon masonry primer
Finish: Ultra Crete Textured Masonry topcoat A44in 800 Series – Fine Texture

Ptd 'C': New Exterior Masonry Foundation Walls
[Primer: (1) coat Loxon Primer/Sealer
Finish: (2) coats of Loxon Self-Cleaning Acrylic]

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Refer to drawings for sign types, sign copy listing, and sign locations.

1.2 SUMMARY

A. Exterior die-raised aluminum signage.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.

B. Shop Drawings: Include plans, elevations, and large scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout spacing, reinforcement, accessories, and installation details.
   1. Provide message list for each sign, including large-scale details of wording, lettering, art work, and Braille layout.

C. Samples for Initial Selection: For each type of sign material indicated that involves color selection.

D. Samples for Verification: For each type of sign, include the following samples to verify color selected.

E. Qualification Data: For Installer.

F. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

G. Replacement Instructions: Provide in writing, instructions to Owner on how to replace name inserts, turn around time required, etc.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each sign type through one source from a single manufacturer.

B. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of signage and are based on the specific system indicated. Refer to Division 1 Section “Product Requirements”.
   1. Do not modify intended aesthetic effects, as judged solely by Architect, except with A/E or Designer’s approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.5 PROJECT CONDITIONS

A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION

A. For signs supported by or anchored to permanent construction, advise installer of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.
   1. For signs supported by or anchored to permanent construction, furnish templates for installation of anchorage devices.

PART 2- PRODUCTS

2.1 MANUFACTURER

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
   1. Basis-of-Design Product: The design for each sign is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 EXTERIOR DIE-RAISED SIGNAGE

A. Manufacturer:
   1. Subject to compliance with requirements, provide signs as manufactured by The Supersine Company, Division of Stamp-Rite, Inc., Detroit, Michigan 800-328-1988 or approved equal.
   2. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions.

B. Sign Construction:
   1. Plate material shall be .102” 3003 alloy H-14 aluminum sheet. The plate shall have smooth, even, level surfaces, constructed to remain flat under installed conditions within tolerance of plus or minus 1/16” measured diagonally.
   2. Signs shall be mechanically fabricated with smoothly finished square cut edges.
   3. Corners shall be (rounded to radius or square) as indicated on Sign Type Drawings.
   4. All characters, Braille, and graphics are to be raised 1/32” (0.032”) by a die-raised process. The character shoulder of the style indicated on the Sign Type Drawings shall be precisely formed, with sharp, well-defined edges, not rolled or embossed.
   5. The raised characters and graphics shall be masked to allow the background and Braille to be painted with smooth, acrylic enamel finish. The character and graphic portions of the signs shall be anodized, with a satin finish.
   6. Back-shields (if required) at all wall mounted location shall be cut from .102” H-14 aluminum, and painted.
   7. Back-shields at signs mounted on glass be cut from 1/32” thick acrylic sheet, with a reverse screen printed colored background.

C. Colors:
   1. Plate background and Braille: Black
   2. Raised characters and graphics: White
   3. Aluminum and acrylic back-shields: Custom color as selected by Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Locate sign units and accessories where indicated on Sign Location drawings, using vandal resistant mounting methods of the type in compliance with the manufacturers' instructions.
   1. Examine areas to receive signage; notify Building Contractor/Architect in writing of unacceptable substrate. Beginning work indicates acceptance of substrate.
   2. Install sign units level, plumb and at height indicated, with sign surface free from distortion or other defects of appearance.

3.2 CLEANING AND PROTECTION

At completion of the installation, clean soiled sign surfaces in accordance with manufacturer's instructions. Protect units from damage until acceptance by the Owner.

3.3 PANEL SIGN SCHEDULE

A. ADA Ramp with Universal Accessibility Symbol.

END OF SECTION

SECTION 260500
ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide complete, tested, and fully functional electrical systems as shown on the Drawings and as specified herein.

B. Electrical equipment and installed systems shall be suitable for the intended application, shall be safe for the intended use, shall be fully rated for the available fault current, and shall conform to local building codes and statutory requirements.

1.2 RELATED DOCUMENTS

A. The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Electrical requirements specified in this Section apply to electrical equipment and materials described in other Sections of Division 26.

1.3 SCOPE OF WORK

A. The work includes, but is not limited to, the following:
   1. Secondary electrical service
   2. Basic electrical materials and methods
   3. Grounding and bonding
   4. Seismic protection for electrical work
   5. Electrical identification
   6. Wire and cable
   7. Raceways, boxes, and fittings
   8. Wiring Devices
   9. Enclosed switches and circuit breakers
   10. Panelboards
   11. Interior lighting
   12. Thorough cleaning of all equipment prior to energization
   13. Acceptance testing of all equipment installed under this Section
   14. Protection of all equipment under this Division until the final acceptance of the job.
   15. Provide an inspection/testing plan as an electrical submittal.
      a. The contractor shall be responsible for determining and labeling all new electrical equipment.

B. Coordinate Division 26 requirements with work in other Divisions.

C. Submit preconstruction submittals, shop drawings, product data, samples, design data, test reports, certificates, manufacturer's instructions, manufacturer's field reports, operation and maintenance data, closeout submittals and other specified documents to the Engineer for review and approval as described in Division 1, in this Section, and in other Sections of Division 26. Provide an inspection/ testing plan as an electrical submittal.

D. Perform electrical acceptance tests described in other Division 26 Sections (Part 3).

E. The following principal items of work will be performed under other Sections unless otherwise noted:
   1. Finish painting of all exposed raceways, boxes, hangers, apparatus, etc., except as otherwise specifically mentioned herein.
   2. Cutting and patching referred to in Division 1.
   3. Motors for mechanical equipment will be furnished under other Divisions.
   4. Automatic temperature control system design, installation, and raceways, boxes & fittings, and control wiring and signal cable, is included in Division 25.

5. Variable frequency drives will be furnished and set in place under Division 23 and shall be wired, tested, and commissioned in accordance with Division 26 requirements for similar equipment.

1.4 PROJECT CONDITIONS

A. Ambient temperature, humidity, and elevation ranges: Equipment other than transformers shall be rated for continuous operation at full rated load without derating, under the following conditions:
   1. Ambient Temperature: 0 to 40° C.
   2. Humidity: Less than 90 percent (non-condensing).
   3. Altitude: Not exceeding 3300 feet (1000 m).

B. Product Selection for Restricted Space: Drawings show allowable space to scale for anticipated equipment sizes. Comply with NEC requirements for working clearances and with manufacturer's recommendations for access for maintenance. Notify the Engineer if insufficient space is available for available products.

1.5 DEFINITIONS

A. In addition to the Definitions in Specification Division 1, the following definitions apply to Division 16:
   1. AHJ: The statutory Authority Having Jurisdiction as defined in NEC Article 100 for enforcement of legally required compliance to local codes, standards, and ordinances.
   2. ANSI: American National Standards Institute
   3. AEIC: Association of Edison Illuminating Companies
   4. ASQ: American Society for Quality
   5. AWG: American Wire Gauge
   6. CFR: Code of Federal Regulations
   7. Cable: an assembly of insulated conductors
   8. Control panel: electrical enclosure housing control logic devices and an operator control interface
   9. Commissioning: the process of testing system performance after the sequential steps of installation, testing, energization, startup (including initial adjustment and de-bugging) and functional testing of individual pieces of equipment have all been completed
   10. Contract: as used in the Electrical Specification, includes all Contract documents including Specifications and Appendices, Drawings, Addenda, and Change Orders
   11. ICEA: Insulated Cable Engineers Association
   12. Equipment: a general term including materials, fittings, devices, appliances, fixtures, apparatus, and the like, used as part of, or in connection with, an electrical installation (OSHA Section 29 CFR 1910.399(46) definition)
   13. FM: Factory Mutual, Inc.
   14. Field wiring: on-site installation of raceways & conductors to connect equipment in accordance with approved drawings
   15. Field test: electrical test carried out on-site
   16. Fail-safe: selection of control devices and contacts in a manner which results in safe shutdown of the equipment whenever one of the following events occurs:
      a. Loss of remote/control RUN command (normal configuration: contacts close to run equipment)
      b. Intentional and unintentional disconnection of device (normal configuration: contacts open to shut down equipment)
      c. High contact resistance or high resistance connection
      d. Loss of 4-20mADC signal
      e. Definite-time sequence takes too long, e.g., reduced voltage motor starter fails to make transition from START mode to RUN mode after a reasonable time
      f. Defined sequence does not occur, e.g., there is no flow from a motor driven pump within a reasonable time after the motor starter contactor is energized.

17. Furnish and install: same as “Provide” below.
18. Functional testing: verification of the satisfactory performance of control logic, with due attention to equipment protective devices, for example, overload relays, temperature switches, pressure switches, flow switches, and similar devices, under actual operating conditions
19. IEEE: Institute of Electrical and Electronics Engineers, Inc.
20. ISO: International Standards Organization
21. Lineup: with respect to switchgear, switchboards, and motor control centers, a contiguous group of vertical sections with common main busbars, and including bus tie breaker sections and control sections
22. LV: low voltage, operating voltage under 600V (NEC definition)
23. Megger: insulation tester with megohm scale
24. NEC: NFPA 70, the National Electrical Code
25. NETA: InterNational Electrical Testing Association, Inc.
26. NICET: National Institute for Certification in Engineering Technologies
27. NFPA: National Fire Protection Association
28. NRTL: Nationally recognized testing laboratory as defined in 29 CFR 1910.7 as it applies to testing and inspecting for safety in the workplace (OSHA definition)
29. Nonconformity: The nonfulfillment of a specified requirement (ASQ definition)
30. “Or approved equal”: proposed “equal” product shall be in conformance with all specified requirements, shall be equivalent in materials of construction to specified manufacturers’ products, shall have equal or superior performance in the conditions anticipated for use of the product in this project, and shall be approved by the Engineer
31. OSHA: Occupational Safety and Health Act
32. Panel: with respect to circuit breaker and fuse power distribution centers, panel is equivalent to “distribution board”, e.g., lighting panel; with respect to control panels, refers either to the entire control panel itself or to a steel plate used for mounting devices inside the control panel
33. Provide: Throughout the Specification, use of this term includes project administration, quality assurance, human resources, tools & equipment, logistics and scheduling, submittals of shop drawings & samples for approval, managing suppliers, purchasing, manufacturing, factory testing, release for shipment, packing, delivery, storage, submittal of coordinated & dimensioned installation drawings for approval, installation, surface preparation & finishes, site testing, startup & commissioning, on-site supervision by equipment manufacturers’ representatives, spare parts & tools, Operations and Maintenance (O&M) Manuals, training, guarantees and warrantees, other work described in individual Sections of the Specification, and the Contractor’s duties, responsibilities, risks, and liabilities under the Contract.
34. Punch list: document containing detailed descriptions of non-conformities
35. Quality: conformance to specified requirements.
36. RMS: root mean square
37. Raceways: cable ladder and tray, conduit, duct, wireway, and associated boxes and fittings which enclose, support, and protect wires and cables
38. Shop drawings: a complete package of manufacturer’s equipment drawings, bill of materials, catalog data sheets, performance curves, calculations, and other data provided to demonstrate conformance to the equipment specification
39. Substitution: an alternative, nonconforming product proposed by the Contractor in lieu of a specified, conforming product
40. Substantial Completion: an electrical system may be considered substantially complete when the equipment has passed the specified tests required prior to energization, has been energized, has passed the Electrical Acceptance Tests, and all related Specification requirements have been met except for well-defined minor items which, in the opinion of the Engineer, may be repaired or replaced prior to Final Acceptance without adversely affecting process performance.

41. Terminal box: an electrical enclosure containing labeled terminal blocks for connection of wiring
42. UL: Underwriters Laboratories, Inc.
43. VFC: variable frequency controller
44. VFD: variable frequency drive, the combination of VFC and inverter-duty motor that drive mechanical loads using the principle of variable frequency motor control
45. Wiring: conductors and connections to equipment terminals. 'Wiring' and 'cabling' shall be considered equivalent terms. Fiber optic cables shall be included in the scope of electrical wiring.

1.6 REFERENCE STANDARDS

A. Notwithstanding revision dates shown in this and other Sections of Division 26, the codes and standards applicable to this project shall be those in effect at the time of bid submittal, except for NFPA 70 NEC, which shall be the version acceptable to the AHJ.

1.7 QUALITY ASSURANCE

A. In consultation with the equipment and materials Suppliers, the Contractor shall prepare and submit a Compliance Statement as described in "SUBMITTALS" below with each submittal requiring approval.
B. The Engineer's approval of a submittal shall not relieve the Contractor of any Contractor responsibilities under the Contract. Approval of a submittal that is incomplete, or one that has nonconformities that are not described in the Compliance Statement that is specified to be included with each submittal, followed by the discovery of unapproved nonconformities, will result in replacement of the non-conforming items at no additional cost to the Owner. Substitutions require the approval of the Engineer.
C. Manufacturers of electrical equipment shall have quality certification to ISO 9000:2000 or an equivalent Quality Management System acceptable to the Engineer.
D. Equipment, materials, and installation shall conform to NEC requirements and shall be NRTL-listed and labeled.
E. On-site testing prior to energization and electrical acceptance testing shall be performed as specified in other Sections.
F. Manufacturers, manufacturer's representatives, subcontractors, supervisors, installers, and testing agencies shall have qualifications and experience as described in other Sections of the Specification. Qualifications and experience submittals for firms and individuals shall be submitted, re-submitted, or updated whenever requested by the Owner's Representative.

1.8 SAFETY IN THE WORKPLACE

A. Electrical equipment and materials, and the Contractor's installation practices, shall conform to the following:
    1. Current edition of OSHA sections of the Code of Federal Regulations (CFR): Part 29 CFR 1910 for General Industry and Part 19 CFR 1926 for Construction Activities
    2. NFPA 70, the National Electrical Code
    3. Current edition of NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces
B. These regulations and standards impose obligations on equipment manufacturers to obtain NRTL certification, listing, and labeling to comply with OSHA (Occupational Safety and Health Act) and Department of Labor regulations.
C. All electrical equipment for which NRTL test procedures have been established shall be certified, listed, and labeled, or otherwise determined to be safe for its intended use, by a NRTL. The absence of a specific reference to NRTL-listing in other Sections shall not relieve the Contractor of the requirement to provide NRTL-listed equipment, and to obtain certification as required by the AHJ in cases where NRTL listing and labeling is not a manufacturer's standard offering for a particular product.
D. Equipment shall not be modified in any manner adversely affecting safety for the intended use, nor shall any equipment be modified on-site without the approval of the manufacturer.

E. Equipment sound levels shall not exceed limits established by reference standards and local regulations. In the absence of reference standards and local regulatory requirements, sound pressure levels shall not exceed 85 dB (A) measured three feet from the equipment.
F. Equipment with moving parts shall be fully guarded in compliance with OSHA rules and regulations.

1.9 WORKMANSHIP AND MATERIALS

A. Materials and equipment shall be new and undamaged, shall be marked by the manufacturer, and shall be delivered to the construction site in the original factory packaging.
B. Materials and equipment shall be installed in accordance with the Drawings, the Specification, and the manufacturer's installation, operation, and maintenance instructions. In the event of apparent conflicts or discrepancies, the Engineer shall be informed of the apparent conflict or discrepancy in writing and will instruct the Contractor how to proceed.

1.10 RESOURCES AND CONSTRUCTION SCHEDULE

A. The Contractor shall provide sufficient resources, including qualified and experienced project managers, electrical engineers, superintendents, technicians, supervisors, electricians, tools and construction equipment to complete the electrical work in accordance with the activity durations and sequences shown on the Construction Schedule for this project.
B. The construction schedule shall include the following activities and milestones, in realistic sequence, for each transformer, generator set, and fuse or circuit breaker panelboard in each building:
    1. Review of shop drawings
    2. Approval of shop drawings (milestone)
    3. Request for release of shipment documentation
    4. Shipping
    5. Delivery to site (milestone)
    6. Formwork ready for sleeves, openings, and inserts
    7. Room ceiling, wall, and floor finishing complete (ready for equipment installation)
    8. Equipment installation (including "remote" sites)
    9. Tests on completion of installation (prior to energization)
    10. Energization (milestone)
    11. Functional testing
    12. Acceptance testing
    13. Installation, testing, and commissioning complete (milestone)
C. The construction schedule shall include the following activities and milestones, in the following sequence, for electrical raceways and wiring in each building and structure:
    1. Review of Contractor's dimensioned layout and coordination drawings
    2. Approval of Contractor's dimensioned layout and coordination drawings (milestone)
    3. Materials delivery to site (milestone)
    4. Room ceiling, wall, and floor finishing complete (ready for exposed raceway installation)
    5. Surface raceway installation
    6. Wire & cable installation
    7. Tests on completion of installation (prior to energization)
    8. Wire and cable testing complete (milestone)

1.11 CONTRACT DRAWINGS

A. The Electrical Drawings provide scaled layouts of representative equipment and key building dimensions, for example, structural gridlines, but do not include "approved for construction" dimensions for equipment.

1.12 COORDINATION OF WORK

A. Work under this Division shall be performed in conjunction with the work of other trades. Coordinate electrical installation work with the overall construction schedule. Examine the plans and specifications prior to commencement of work and become familiar with all phases of work involved prior to commencing installation work.
B. The Contractor shall be responsible for coordinating dimensions of equipment and working clearances in accordance with NEC, and in all cases bring to the attention of the Engineer any discrepancies on the plans and in the specifications prior to installation. Any work that installed without proper coordination shall be removed and reinstalled at the Contractor's expense. The layout for sleeves, chases, openings, etc., must be arranged prior to construction in order to prevent unnecessary cutting. Examine Architectural drawings for doors swings, countertop heights, built-in furniture and casework, and other factors affecting electrical outlet locations prior to roughing-in raceways, boxes, fittings, and outlets.
C. Control and signal wiring requirements shall be coordinated with Division 25 Section "Automatic Temperature Controls."

1.13 COORDINATION DRAWINGS

A. Following approval of equipment shop drawings, the Contractor shall create dimensioned electrical equipment layout drawings, showing the relationships of approved electrical equipment with the building structural and architectural components, walls, floors, ceilings, doors, windows, louvers, access hatches, concrete equipment pads, and seismic anchors and bracing. One set of these Coordination Drawings shall be maintained at the construction site throughout the construction phase.

1.14 CODES AND STANDARDS

A. All equipment and materials shall be manufactured, tested, and installed in accordance with the National Electrical Code (NEC) and all applicable portions of local codes, in accordance with the requirements of the AHJ.
B. In addition, work shall be in accordance with the versions of the following referenced standards in effect at the time of bid opening:
    1. American Association for Laboratory Accreditation (A2LA)
    2. American Society for Testing and Materials (ASTM)
    3. American National Standards Institute (ANSI)
    4. Americans with Disabilities Act (ADA)
    5. Code of Federal Regulations (29 CFR 1903, 1910, and 1926)
    6. Factory Mutual Engineering & Research (FME&R)
    7. Illuminating Engineering Society of North America (IESNA)
    8. Insulated Cable Engineers Association (ICEA)
    9. International Organization for Standardization (ISO)
    10. National Electrical Manufacturers Associates (NEMA)
    11. Institute of Electrical and Electronic Engineers (IEEE)
    12. National Fire Protection Association (NFPA)
    13. Occupational Safety and Health Act (OSHA)
    14. Underwriters Laboratory, Inc. (UL) and other NRTL standards and test procedures

1.15 SUBMITTALS

A. Submittals shall conform to requirements described in Division 1 Section "Submittal Procedures".
B. Compliance Statement: with each submittal, include a Compliance Statement listing each Specification Section, and Part 1, 2, and 3 Sub-Sections, stating, paragraph-by-paragraph, compliance with the Specification, each minor nonconformity that is within the intent of the Specification, and proposed nonconformities. Provide short description of minor nonconformities, and detailed explanation of other nonconformities.
C. Submittal Format

1. Each submittal shall be accompanied by a transmittal letter showing the submittal category and Specification Section reference number(s). Submittals shall be 3-hole punched and neatly bound.
2. Submittals shall have a complete Table of Contents with tabs corresponding to the Table of Contents headings.
3. Submittal transmittal letters shall clearly identify the reason for submittal, e.g., for approval, as manufactured, or as-built / record.
4. Each page of each submittal shall be numbered. Page numbers shall be listed on the Table of Contents. Content shall be printed on 8½ x 11 inch paper, or 11 x 17 paper (folded). Larger size drawings shall be folded and placed in labeled individual clear plastic pockets.
5. Product Data shall be clearly marked to show which items are proposed for this project. Information that does not apply to this project shall be crossed out.

D. Submittal Categories:
1. Preconstruction Submittals, including proposed substitutions, supplier and manufacturer qualifications and experience, construction scheduling, preliminary harmonics analysis for variable frequency controllers
2. Shop Drawings, including equipment drawings, seismic bracing details, and Coordination Drawings
3. Product Data, marked to indicate precisely which items are proposed for this project
4. Samples, labeled by name, Specification Section and sub-clause, and mounted on sample boards
5. Design Data, including manufacturer's design calculations
6. Test Reports, including prototype tests, factory tests, field tests, acceptance tests, and functional tests
7. Certificates, including seismic qualification certification, welding certificates, factory training certificates for manufacturer's representatives
8. Manufacturer's Instructions, including unloading, hoisting, rigging, short term storage, long term storage, method of field assembly, and installation instructions
9. Manufacturer's Field Reports, including inspections and training records
10. Operation and Maintenance Manuals, including manufacturer's standard published literature and specially prepared descriptions of operation
11. Closeout Submittals, including black line paper copy of Record Drawings marked in red illustrating changes during construction.
12. Provide an inspection/testing plan as an electrical submittal
13. Spare Parts and Special Tools List
14. Provide an inspection/ testing plan as an electrical submittal

E. In the absence of contradictory instructions in Division 1 Section "Submittal Procedures", Shop Drawings and Coordination Drawings shall be marked with revision blocks to indicate status as follows:
1. FOR APPROVAL
2. AS MANUFACTURED (incorporates Engineer's comments)
3. AS BUILT / RECORD (incorporates on-site modifications)

F. Coordination Drawings: Submit dimensioned layout and coordination drawings of electrical equipment room(s), and electrical equipment area(s) for approval sufficiently in advance to allow for review by the Engineer prior to starting related work, in accordance with the Construction Schedule.

G. Product Data Sheets: Submit a list of manufacturers with catalog numbers and product data sheets for the following materials miscellaneous equipment and obtain approval before the items in question are ordered or installed.
1. Raceways, Boxes, and Fittings
2. Wire and Cable (600 V and less)
3. Miscellaneous equipment including enclosed disconnect switches, enclosed circuit breakers, individually mounted combination motor starters, and control and pushbutton stations.

H. Record Drawings: Maintain a full size paper set of “black-line” working drawings throughout the project, and shall carefully record in red ink the actual locations including dimensions to locate each piece of electrical equipment, raceways, boxes, & fittings, and electrical outlets. Upon Substantial Completion of the work, deliver the marked-up set of prints to the Engineer. The Engineer reserves the right to withhold final payment until "As-Built" drawings are received.

I. Operation and Maintenance Manuals: Prior to acceptance of the finished project, provide copies of electrical Operation and Maintenance Manuals in conformance with Division 1 Section “Operation and Maintenance Data”. O&M Manuals shall be organized according to Division 26 Section numbers. Each copy shall be bound in a durable, 3-ring hardback binder, with data sheets individually punched and reinforced to prevent tear out. Data sheets shall be grouped, and binder dividers shall be provided to match the Table of Contents. Each Manual shall have an identifying label on the spine and front cover and shall include the following:
   1. List of all O&M Manuals in the front of each manual.
   2. Table of Contents for each manual and each binder
   3. Copy of each of the following:
      a. Preconstruction Submittals
      b. Shop Drawings
      c. Product Data
      d. Design Data
      e. Test Reports
      f. Certificates
      g. Manufacturer’s Instructions
      h. Manufacturer’s Field Reports
      i. Operation and Maintenance Data
      j. Closeout Submittals
      k. Spare Parts and Special Tools
      l. Panelboard directories (as-built)

J. Spare Parts and Special Tools List: 90 days prior to the scheduled Substantial Completion date, submit a complete list of Spare Parts and Special Tools included in other Sections of Division 26 to the Owner, and request a time and location for delivery of the Spare Parts and Special Tools to the Owner.

1.16 ELECTRICAL SERVICE

A. Provide secondary electrical service as shown on the Drawings and specified herein.

1.17 OUTAGES

A. Electrical outages: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service if required by the Specification.
   1. Notify the Owner a minimum of 30 days in advance of proposed interruption of electrical service.
   2. Submit step-by-step sequence and schedule for proposed interruption, and if required, proposed method of providing temporary electrical service, to the Owner for approval.
   3. Confirm approved interruption of electrical service one week in advance of Owner-approved date.
   4. Do not proceed with interruption of electrical service without written permission from the Owner.

1.18 TEMPORARY LIGHTING AND POWER

A. Refer to Division 1.

B. The Contractor shall provide all temporary electric service for power and lighting including panels, feeders, lighting, outlets, branch circuits, etc.

C. The Owner’s electrical power shall not be used without permission of the Owner.

D. All temporary work shall be in accordance with the NEC, OSHA, and NFPA safety requirements and shall be completely removed upon completion of the project.

PART 2 - PRODUCTS AND EXECUTION

2.1 EQUIPMENT AND MATERIALS

A. Provide equipment and materials in compliance with other Sections of Division 26. The requirements in this Section apply to all Sections in Division 26.

2.2 ELECTRICAL IDENTIFICATION

A. Electrical equipment, raceways, boxes, fittings, wires and cables shall be marked in the field in accordance with Division 26 Section “Electrical Identification.”

2.3 ELECTRICAL ENCLOSURES

A. In the absence of other specified NEMA enclosure ratings in other Sections of the Specification, electrical enclosures shall have degree of protection ratings suitable for the intended application (e.g., watertight, dust-tight, explosion-proof) and environmental conditions. Electrical equipment enclosures shall have the following NEMA 250 ratings:
   1. NEMA 1 or 1A: Enclosures located in clean, dry, indoor Control Rooms and Electrical Rooms shall be NEMA 1 painted steel, except that switchgear, switchboards, and motor control centers in clean, dry electrical rooms shall have foam gaskets on covers and doors (NEMA 1A) to reduce dust intrusion.
   2. NEMA 3R: Electrical enclosures located outdoors in non-corrosive areas shall be NEMA 3R painted steel.
   3. NEMA 4X: Outdoor enclosures, including areas exposed to cooling tower mist, shall be NEMA 4X stainless steel.
   4. NEMA 12: Clean, mechanical equipment rooms
   5. NEMA 13: Pushbutton stations in mechanical equipment rooms
   6. Where different enclosure ratings and enclosure materials are specified in other Sections of the Specification, the Contractor shall submit a written request for clarification of the intent of the Specification to the Engineer.
   7. For motor enclosure requirements, refer to Division 22 and 23.

2.4 ELECTROMAGNETIC INTERFERENCE

A. Power conversion equipment, including variable frequency controllers, shall be fitted with EMI (electromagnetic interference), RFI (radio frequency interference) and telephone interference filters to limit interference effects on other equipment in the area in accordance with IEEE standards and recommendations applicable to the equipment.

2.5 DISSIMILAR METALS

A. Dissimilar metals shall not be connected, spliced, or joined except where specifically approved in writing by the Engineer. Copper busbars, aluminum busbars, and copper-to-aluminum busbar connections shall be tin-plated at joints and at cable lugs. Bolted electrical conductor connections shall be made with silicone-bronze bolts, nuts, and washers.

2.6 WARRANTIES

A. Warranties for equipment and materials shall conform to Division 2 “Product Requirements”.

B. Provide an on-site parts and labor warranty for a minimum period of one year after Substantial Completion for all equipment and materials. In cases where the manufacturer offers a longer warranty period, the longer warranty period shall apply as described by the manufacturer.

C. All components of electrical systems that are not fully functional at the time of Substantial Completion shall have warranties extended to provide minimum one year coverage of fully operational equipment unless otherwise approved by the Owner’s Representative.

PART 3 - EXECUTION

3.1 DELIVERY AND HANDLING

A. Equipment delivered to site shall be handled in accordance with manufacturer's recommendations by experienced riggers, crane operators, and fork lift truck operators.

3.2 STORAGE AND PROTECTION OF EQUIPMENT

A. All electrical equipment to be used in construction shall be properly stored and protected against the elements. General construction materials shall be stored in covered trailers. Switchgear, unit substations, motor controllers, panelboards, emergency lighting, solid state equipment, engine generator shall be stored in a clean, dry, indoor location, under cover, until the building is weathertight and the area where the equipment is to be installed has been completed to the satisfaction of the Engineer, including completion of overhead work by other trades.

B. Anti-condensation heaters shall be energized during storage. Long term storage instructions of the manufacturer shall be followed.

C. Equipment with anti-condensation heaters shall have the 120VAC anti-condensation heaters energized from temporary 120VAC supplies as soon the factory packaging has been opened.

D. Equipment enclosures exposed to construction damage such as paint spots, spackling, waterproofing, insulation etc. shall be covered and protected against damage.

3.3 INSPECTIONS PRIOR TO COVERING-UP

A. Raceways embedded below concrete or otherwise concealed shall be inspected in the presence of the Engineer's Representative and shall also include third party inspection as required by ANSI/NETA ATS prior to placement of concrete. Sufficient time shall be allowed to make corrections if required.

3.4 ON-SITE INSPECTIONS AND NONCONFORMITIES

A. Equipment shall be inspected on delivery to site for physical damage and for compliance with the Specification and approved equipment shop drawings.

B. Pre-energization inspecting and testing shall occur according to ANSI/NETA ATS, and the test report(s) shall include non-conformities.

C. Installed equipment, raceways, and wiring shall be inspected on completion of installation for compliance with the Specification and approved installation drawings.

D. A Punch List will be prepared by the Owner's Representative during inspections and testing and issued to the Contractor for corrective action.

E. Conform to Division 1 Section "Contract Closeout".

F. Repairs, replacement, and other corrective action that requires de-energizing any part of the Electrical Power Distribution and Control System shall be completed prior to the scheduled date for substantial completion of the project.

3.5 CUTTING AND PATCHING

A. Conform to Division 1 Section "Cutting and Patching".

3.6 PENETRATIONS AND SEALING

A. Sleeves and rectangular openings shall be provided for raceways provided under this Contract, and for raceways for future equipment where future equipment is shown on the Drawings. Sleeves and rectangular openings for the passage of raceways and conductors shall be sealed after the raceways and conductors have been installed. Spare sleeves and rectangular openings shall also be sealed.

B. Penetration of Waterproof Construction: Coordinate the work to minimize penetration of waterproof construction, including roofs and exterior walls. Where penetrations are necessary, provide sleeves and sealing fittings to make each penetration watertight. Conduit sleeves and openings shall be sealed watertight with mechanical seals. Water tightness shall not rely on caulking.

C. Penetration of Fire-Rated Construction: Sleeves and openings in fire-resistant walls and floors for electrical raceways, wires, and cables shall be sealed after installation of the raceways, wires, and cables with NRTL-certified fire penetration seals, sealant, and fire-rated foam filler products to the same degree of fire resistance (e.g., 1, 2, or 4 hours) as the adjacent walls and floors, and to the satisfaction of the AHJ. Where both fire sealing and water sealing is required, mechanical seals with NRTL-listed fire-resistant properties shall be used. Fire sealants shall be compatible with the cable jacket and wire insulation materials. Manufacturer's certification of compatibility shall be provided at the request of the Engineer. For additional requirements, refer to Division 26 Section "Raceways, Boxes, and Fittings".

3.7 ALTERATIONS AND REMOVAL OF EXISTING WORK

A. Conform to Division 1 Section "Selective Demolition".
B. Where the work specified under this Division connects to the existing electrical systems, the Contractor shall perform all necessary alterations to the existing work as required.
C. All work performed on the existing electrical systems shall be in accordance with the applicable provisions of the Specification. Visit the project site prior to submitting bids and examine the conditions in which work will be performed. Carefully document all existing conditions pertaining to removal and demolition work.
D. Contractor shall make connections to existing equipment where indicated on the Drawings.
E. All existing electrical materials not reused under this Division, and not indicated for handover to the Owner, shall become the property of the Contractor and shall be expeditiously removed from the project site.
F. While performing connections and alterations to existing electrical work, the Contractor shall take special care to protect all existing equipment from dirt, debris and damage. Damaged equipment shall be replaced at no additional cost to the Owner.
G. All removal work shall be performed in a neat and workmanlike manner and shall be executed with the least possible disturbance to the building and tenants. The scheduling of all removal work shall be coordinated with other trades and with the Owner's schedule and operation of the building.
H. Where removal work is performed, the Contractor shall repair all building surfaces damaged by such work. Cut back embedded conduits to 2 inches minimum below finished face of walls, floor, and ceilings, and fill in holes with appropriate patching material. Repair, re-tile, replace (in the case of ceiling panels) or re-paint to match existing adjacent surfaces.

3.8 ELECTRICAL SAFETY AND TEST EQUIPMENT

A. Maintain the following test instruments and calibration certificates less than 12 months old on-site as a minimum:
   1. True RMS digital volt-ohm meter with resistance scale
   2. Clamp-on ammeter with range from 1 to 600 Amps
   3. 500V DC battery-powered megger insulation tester
B. Provide electrical safety equipment, including personal protective equipment, hot sticks, HV gloves, electrical blankets, test instruments, lighting, ventilation, and instructions in the use of safety equipment, and perform the work under this Contract in accordance with applicable safety rules and regulations.
C. One numbered safety lockout padlock with an 'unlawful-to-duplicate' unique key shall be provided for each motor controller. Safety lockouts shall be used during testing and commissioning shall subsequently be handed over to the Owner in a lockable sheet metal key cabinet. The safety lockout padlock supplier shall be a specialist supplier with a registered key program.

3.9 CLEANING AND PAINTING

A. Conform to Division 1 Section "Closeout Procedures".
B. After installation and wiring work is completed, all dust and debris shall be removed from the interior and exterior of each electrical equipment enclosure and motor by vacuum-

cleaning with circuits de-energized. Do not use compressed air for cleaning. Vacuum cleaner wands and brushes shall be non-conducting. Anti-static protection shall be provided for static-sensitive devices.

C. Clean and remove all rust, scale, oil, grease, and dirt from panelboard enclosures, conduits, pull, junction and terminal boxes, fittings and hangers, leaving surfaces in condition for final surface preparation and painting under Division 9.

D. All ferrous materials that are concealed, or exposed in unfinished areas, including fittings, hangers, junction, pull and terminal boxes, that are not plated or painted with a factory-applied finish, shall be painted under this Section with one coat of zinc-chromate primer and one (1) finish coat of enamel paint approved by the Engineer. Nonferrous materials shall be cleaned only and left unpainted.

E. Equipment furnished with a factory finish coat shall have finish carefully touched-up where it is scratched or otherwise damaged. Touch-up work shall match the color and type of the original finish.

3.10 INSPECTION AND TESTING ON-SITE

A. The Contractor shall hire a NETA-certified or NICET-certified specialist electrical testing firm to perform on-site inspection and electrical testing.

B. Perform Electrical Acceptance Tests in accordance with NETA Acceptance Testing Standards as described in individual Division 26 Sections, Part 3.

C. Submit manufacturer-endorsed field test data sheets & procedures for approval, test equipment and materials on-site prior to site visit by manufacturer's factory-trained representative, test equipment on-site under the supervision of the Engineer and the equipment manufacturer's factory-trained representative(s) and submit manufacturer's statement of acceptance of installation prior to energization of equipment. Invite the Engineer's and Owner's representatives to witness field testing.

D. Electrical equipment shall not be energized without the approval of the Engineer.

E. A complete certified electrical test report shall be compiled by the electrical testing firm, checked for completeness, and submitted for the record.

F. The Contractor shall notify all parties whose presence is necessary for the test; and in all cases, the Engineer shall be notified at least two weeks prior to the actual test.

3.11 ELECTRICAL POWER DISTRIBUTION SYSTEM FUNCTIONAL TESTS

A. Conform to Division 1 Section "General Commissioning Requirements".

B. After testing and commissioning for equipment has been completed, the following functional tests of the electrical power distribution and control system shall be carried out by the Contractor's specialist electrical testing firm in the presence of the Engineer's or Owner's representative:

1. Demonstrate manual changeover of power supply for all equipment with dual supply.

C. Additional testing shall be carried out where recommended by equipment suppliers or requested by the Engineer.

3.12 DEMONSTRATION AND TRAINING

A. Conform to Division 1 Section "Demonstration and Training".

B. Upon completion of all work furnished and installed under Division 26, instruct and train the Owner's representatives in the operation and maintenance of all the various apparatus and equipment to the complete satisfaction of the Engineer. Training shall be as specified in each Section of Division 26 and shall start when the completed systems have been put in operational condition and tested as specified. A complete Training Course syllabus together with copies of the training materials shall be submitted with the Contractor's proposed schedule for instruction and training.

C. Submit qualifications and experience of manufacturer's proposed training personnel for approval.

D. Additional requirements for training are described in other Sections of the Specification.

END OF SECTION

SECTION 260505
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. This Section includes the following:
  1. Supporting devices for electrical components.
  2. Electrical identification.
  3. Concrete equipment bases.
  4. Electrical demolition.
  5. Cutting and patching for electrical construction.
  6. Touchup painting.

1.3 SUBMITTALS
- A. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 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.

1.5 COORDINATION
- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
  1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- C. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 8 Section Access Doors.
- D. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- E. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES
- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch-diameter slotted holes at a maximum of 2 inches o.c., in webs.
   1. Channel Thickness: Selected to suit structural loading.
   2. Fittings and Accessories: Products of the same manufacturer as channel supports.

D. Nonmetallic Channel and Angle Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch diameter holes at a maximum of 8 inches o.c., in at least one surface.
   1. Fittings and Accessories: Products of the same manufacturer as channels and angles.
   2. Fittings and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.

E. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

F. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

G. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.

H. Expansion Anchors: Carbon-steel wedge or sleeve type.

I. Toggle Bolts: All-steel springhead type.

J. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria is not indicated, arrange and install components and equipment to provide the maximum possible headroom.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 WIRING INSTALLATION

A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

B. Install wiring at outlets with at least 12 inches of slack conductor at each outlet.

C. Connect outlet and component connections to wiring systems and to ground. Tighten electrical connectors and terminals, according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.3 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

B. Dry Locations: Steel materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Selection of Supports: Comply with manufacturer's written instructions.
E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.4 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.
B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
F. Install 1/4-inch- diameter or larger threaded steel hanger rods, unless otherwise indicated.
G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
I. Simultaneously install vertical conductor supports with conductors.
J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.
K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
    1. Wood: Fasten with wood screws or screw-type nails.
    2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
    3. New Concrete: Concrete inserts with machine screws and bolts.
    4. Existing Concrete: Expansion bolts.
    5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
    6. Steel: Welded threaded studs or spring-tension clamps on steel.
        a. Field Welding: Comply with AWS D1.1.
    7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
    8. Light Steel: Sheet-metal screws.
    9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.5 FIRESTOPPING

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 Section Penetration Firestopping.

3.6 DEMOLITION

A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
D. Remove demolished material from Project site.
E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.7 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.8 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:
    1. Supporting devices for electrical components.
    2. Electrical identification.
    3. Electrical demolition.
    4. Cutting and patching for electrical construction.
    5. Touchup painting.

3.9 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section Painting.
    1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
    2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
    3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
    4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.10 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 260513
WIRE AND CABLE

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Provide a complete system of wiring and cabling, including wire and cable pulling, splicing, and termination accessories, as shown on the Drawings and in conformance with the requirements in this Section and Division 26 Section “Electrical General Provisions”.

B. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related requirements are also specified in the following Sections:

1. Division 26 Section "Basic Electrical Materials and Methods" for identification requirements.
2. Division 26 Section "Devices" for wiring devices installed in boxes.
3. Division 26 Section “Grounding and Bonding.

1.3 DEFINITIONS

A. In addition to the definitions in Division 26 Section “Electrical General Provisions”, the following definitions apply to this Section:

1. MTW: machine tool wire, 90 deg. C max in dry locations, 60 deg. C max in wet locations
2. NMC: non-metallic jacketed cable
3. RTD: resistance temperature detector
4. SE: service entrance cable
5. THHN: NEC and UL designation for flame-retardant and heat resistant thermoplastic insulation, gas and oil resistant nylon jacketed, suitable for dry locations only, 90 deg. C. max in dry locations
6. THW: NEC and UL designation for flame-retardant, moisture resistant thermoplastic insulation suitable for dry and wet locations, 75 deg. C. max
7. THWN: NEC and UL designation for flame retardant and moisture-resistant thermoplastic insulation, gas and oil resistant nylon jacketed, suitable for dry and wet locations, 75 deg. C. max in wet locations
8. XHHW: NEC and UL designation for (thermoset) cross-linked synthetic polymer-insulation suitable for dry and wet locations, 90 deg. C. max in dry locations, 75 deg. C max in wet locations

1.4 REFERENCE STANDARDS

A. Comply with the following standards in effect at the time of bid submittal:

1. ICEA P-51-432-1970 Copper Conductors, Bare & Weather Resistant
2. ICEA P-56-520-1984 Cable Tray Fire Test Report (Round Robin Project)
3. ICEA S-58-679-1996 Standard for Control Cable Conductor Identification
4. ICEA S-95-658 / NEMA WC70 Non-Shielded Power Cables Rated 2000 V or Less
5. ICEA T-29-520-1986 Vertical Cable Tray Flame Tests @ 210,000 Btu
6. ICEA T-30-520-1986 Vertical Cable Tray Flame Tests @ 70,000 Btu
7. ICEA T-33-655-1994 Low Smoke, Halogen-Free Polymeric Jackets
8. IEEE 576-2000 Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications
9. UL 4 Armored Cable

10. UL 44 Thermoset–insulated Wires and Cables
11. UL 62 Flexible Cord and Fixture Wire
12. UL 83 Thermoplastic-insulated Wires and Cables
13. UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
14. UL 486C Splicing Wire Connectors
15. ANSI/NETA ATS (2017)

1.5 SUBMITTALS

A. Product Data: For each type of product specified herein, including catalog data, technical specifications, evidence of UL listing, and evidence of manufacturer's certification to ISO 9000:2000 or an equivalent quality management system certification acceptable to the Engineer.
B. Qualifications and experience proposal for the electrical testing firm.
C. Operation and maintenance data is not required, however, approved shop drawing submittals are required to be included for the record in the Operation and Maintenance Manuals, as described in Division 26 Section "Electrical General Provisions".

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain all wire and cable of a particular type through one source from a single qualified manufacturer.
B. To be a qualified manufacturer, wire, cable, splice and termination components manufacturers shall have accreditation to ISO 9000:2000 or an equivalent quality management system acceptable to the Engineer and shall offer NRTL-listed and labeled products.
C. Testing firm shall be qualified as defined by OSHA in 29 CFR 1910.7, shall be a member of the InterNational Electrical Testing Association, shall be acceptable to the AHJ, and shall have supervision as follows:
    1. Testing Firm's Field Supervisor: Qualifications and experience for the person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
D. Wire and cable and accessories: Listed and labeled as defined in NEC Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 APPLICATIONS

A. Refer to Part 3 for wire and cable applications.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.3 BUILDING WIRE AND MULTI-CONDUCTOR POWER CABLES

A. Manufacturers:
    1. American Insulated Wire Corp.
    2. Belden Wire and Cable Co.
    3. General Cable Industries Inc.
    4. Okonite Co.
    5. Pirelli Cable Corp.
    6. Rome Cable Corp.
    7. Southwire Co.
B. Conductor Material: Copper, solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.

C. Building Wire and Multi-conductor Cable Insulation Types: Type THHN-THWN, XHHW, and MI.
D. Isolated power panel branch circuits: Type XHHW insulation with a dielectric constant less than 3.5 and insulation resistance constant greater than 20,000 megohm-feet. Submit manufacturer's certified test data in shop drawing for isolated power panel wiring.
E. Phase conductors shall be factory color coded or have field applied color coded tape at each splice and termination in accordance with the following schedules:

208/120V Systems Phase - Color	**480/277V Systems Phase - Color**
A - Black	A- Brown
B - Red	B - Orange
C - Blue N - White Grd - Green	C - Yellow N- Gray Grd - Green

F. Multiconductor Power Cables:
   1. Armored cable shall utilize all copper conductors with THHN insulation and shall include a separate green grounding conductor. Flexible armor shall be steel with a continuous bond wire for redundant ground as required by NEC 517. Flexible armor using aluminum is not acceptable.
   2. Armored cable shall be utilized only for the final connection to lighting fixtures and the length shall not exceed 6'-0".

2.4 CONTROL AND INSTRUMENTATION WIRE AND CABLE
A. Manufacturers:
   1. Belden Wire and Cable Co.
   2. Clifford of Vermont / TVC
   3. General Cable Co., Inc.
   4. Okonite Co.
   5. Rome Cable Corp.
   6. Southwire Co.
B. Control wire: 600V type THWN insulated stranded copper conductors in conduit, minimum size #14 AWG, UL listed and suitable for installation in conduit.
C. Instrumentation cable for 4-20 mA DC circuits: Polyethylene insulated #18 AWG stranded tinned copper twisted pair, with #20 AWG or larger stranded tinned copper drain wire, overall aluminum-on-mylar shield, with chrome PVC outer jacket. UL listed and suitable for installation in conduit and cable tray.

2.5 ARMORED CABLE FITTINGS
A. Manufacturers:
   1. AFC Cable Systems, Inc
   2. Burndy
   3. Hubbell/Anderson
   4. O-Z/Gedney, EGS Electrical Group LLC
   5. Thomas and Betts
B. Armored cable fittings shall be fabricated from stainless steel, and galvanized steel components, with mechanical compression gland, and shall be NRTL-listed as a type suitable for grounding the metal cable sheath to the electrical box or enclosure.

2.6 WIRE AND CABLE CONNECTORS AND SPLICES
A. Manufacturers:
   1. 3M Company, Electrical Products Division
   2. AMP Incorporated / Tyco International
   3. Burndy
   4. Square D
   5. Thomas and Betts
B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
C. Wirenuts: Spring type rated for copper wire, sized for the actual number of wires connected.
D. Splices: Tin-plated copper compression type. Pre-insulated crimp-on connectors may be used for #14 AWG control wires. Long barrel splices shall be used for #1/0 AWG and larger.
E. Connections at molded case circuit breakers, disconnect switches, and other equipment provided with wire termination lugs: NRTL-listed, suitable for use with the copper wire size to be connected.
F. Connection lugs: Tin-plated copper compression type with NEMA drilling. Long-barrel lugs shall be used for #1/0 AWG and larger wire.

PART 3 - EXECUTION

3.1 INSPECTION

A. Ensure that conduits, and pull boxes are clean and clear of construction debris prior to installation of wire and cable. The contractor shall provide a pre-enerigization inspection and tests according to ANSI/NETA ATS (2017).

3.2 DELIVERY, STORAGE, AND HANDLING

A. Deliver wire and cables to construction site and unload in accordance with manufacturer's recommendations.
B. Store and transport reels in compliance with manufacturer's printed instructions.
C. Wire and cable ends shall be taped watertight until terminations and splices are completed.

3.3 WIRE AND CABLE APPLICATIONS

A. Feeders: Type XHHW, single conductors in raceway, Type THHN-THWN, single conductors in raceway.
B. Emergency Feeders: Type XHHW, single conductors in raceway,
C. Branch Circuits (normal power): Type THHN-THWN, single conductors in raceway, Type XHHW, single conductors in raceway, Type HCF cable.
D. Branch Circuits (emergency power): Type THHN-THWN, single conductors in raceway, Type XHHW, single conductors in raceway.
E. Fire Alarm Circuits: Type THHN-THWN, in raceway, size and type acceptable to the AHJ and in accordance with the fire alarm system manufacturer's recommendations.
F. NEC Class 1 Control Circuits: Type THHN-THWN, in raceway.
G. NEC Class 2 and 3 Control Circuits: Type THHN-THWN, in raceway, power-limited cable, concealed in building finishes.

3.4 CABLE LAYING AND PULLING

A. Feeders and branch circuits shall have a ground conductor.
B. Each branch circuit shall have an individual neutral conductor. Increasing the neutral conductor size, or "super neutral," is not allowed for multiple branch circuits.
C. Install cables in accordance with manufacturer's installation instructions, IEEE 576 and AEIC CG5-90.
D. Run wires and cables in raceways as shown on the Drawings and as specified in Division 26 Section "Raceways, Boxes, and Fittings".
E. Install no more than 3 phase wires in any feeder or branch circuit conduit.
F. Run armored and metal-clad cable assemblies in concealed, in accordance with the following requirements:
    1. Run cables without raceways parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
    2. Do not obstruct access to equipment for operation and maintenance.
    3. Coordinate cable runs with the work of other trades. Plan cable runs to avoid lighting fixtures, and leave space for easy access to HVAC equipment, motors, and duct access hatches and doors.
    4. Route cables around doors, windows, hatches, louvers, and other building openings, and around range and fume hoods.
    5. Observe manufacturer's recommendations for the minimum cable bending radius for each type and size of cable provided for this project.
    6. Support unarmored, armored and metal-clad cable assemblies without raceways in accordance with Division 26 Section "Basic Electrical Materials and Methods."
G. Use cable manufacturer approved water-based wire pulling lubricant for pulling in wire and cables in conduit. Lubricant shall be UL-listed and shall be suitable for the conductor insulation. Use water-based products only.
    1. Pulling compound shall NOT be used on isolated power panel branch wiring. Conductors shall be pulled dry.
H. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

I. Pull wire and cables in accordance with the manufacturer's installation recommendations and requirements, with emphasis on the following:
   1. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values
   2. Lubricate cables with pulling compound or lubricant that is approved by the cable manufacturer and shall not deteriorate conductor or insulation materials of construction.
   3. Follow cable manufacturer's recommendations for attaching pulling means to cables, including fish tape, cable, rope, and basket-weave cable grips. Do not attach to cable jacket alone for pulling.
   4. Rig pulleys and use pull ropes for pulling cables into raceways.
   5. Use tension indicators and electric-motor driven capstan rollers for pulling cables that are too large for pulling by hand.
   6. Observe manufacturer's recommendations for the minimum wire and cable bending radius for each type and size of wire and cable provided for this project.

J. Emergency circuit wires and cables shall be routed and protected from fire and other hazards in accordance with local codes, in a manner acceptable to the AHJ.

K. Seal around cables penetrating fire-rated elements according to Division 7 Section "Penetration Firestopping."

3.5 VOLTAGE DROP CONSIDERATIONS

A. Minimum wire size is #12 AWG. Use the following table for increased wire sizes on 20 Amp circuits:

LENGTH (FT)	**WIRE SIZE (AWG)**
120 Volt Circuits:	
61-95	#10
96-145	#8
240 Volt Circuits:	
0-135	#12
136-225	#10

3.6 WIRE AND CABLE CONNECTIONS AND TERMINATIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. For compression lugs and splices, use the lug manufacturer’s compression tools and comply with the manufacturer’s written instructions.

C. Control wires shall be run from terminal to terminal without splices, and no more than two wires under a terminal screw.

D. Splices and terminations shall be insulated with boots, heat shrink tubing, or tape to 600 volts in accordance with the insulation product manufacturer’s written instructions.

E. Feeder taps shall be made with cast bronze 2-bolt or 4-bolt connectors with built-in conductor spacer, suitable for the run and tap conductor sizes. Split bolt connectors shall not be used unless approved by the Engineer.

F. Wiring at Device Outlets: Install conductor at each outlet, leaving 8 inches of wire coiled in the box for connection to wiring devices. Wiring devices that are suitable for solid wire only shall be pigtailed to stranded wire with solid wire 6 inches long using wirenuts.

G. Install a green insulated NEC-sized grounding jumper from a green ground screw in the outlet box to the receptacle or switch green ground screw.

H. Wiring to terminals at transformers and bus bars shall be connected with tin-plated copper compression connectors and insulated for 600 volts with tape, boots, or heat-shrink tubing rated for the temperature specified by the equipment manufacturer. Two hole lugs shall be used for power cable terminations # 1/0 AWG and larger.

I. Building wire connections to flexible motor leads shall be made with compression connectors bolted back-to-back with silicone-bronze bolts and insulated for 600 volts. For motors with bus bar connections, connections shall be made with tin-plated copper lugs and silicone bronze bolts.

J. Multi-conductor cables shall be installed and terminated in accordance with the cable manufacturer’s installation instructions. Armored and metal clad cables shall be terminated with fittings suitable for grounding.

K. Shielded cable conductors shall be terminated with insulated crimp-on connectors suitable for the terminals provided with the equipment or tinned for connection to terminals which are not suitable for crimp-on connectors. A minimum two inch length of heat shrink tubing shall be applied over each insulated conductor and the insulated portion of the crimp-on connector, and a separate piece of larger diameter heat shrink tubing shall cover the end of the cable jacket and cut shield, and overlap the individual conductor heat shrink tubing. Connect drain wire to the ground bus.

END OF SECTION

SECTION 260526
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Provide a complete system of grounding electrodes, grounding electrode conductors, main bonding jumpers, equipment grounding conductors, and bonding in accordance with NEC requirements, in conformance with this Section and Division 26 Section “Electrical General Provisions”, and as shown on the Drawings.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 26 Section “Wire and Cable” for wire connector and equipment grounding conductor requirements.
2. Division 26 Section “Raceways, Boxes, and Fittings” for grounding bushing requirements.

1.3 SUMMARY

A. This Section includes requirements for grounding electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.4 DEFINITIONS

A. Refer to NEC for definitions of grounding terms used in this Section.

1.5 QUALIFICATIONS

A. Manufacturer’s Factory Qualifications: Manufacturing facilities shall have accreditation to ISO 9000:2000 or an equivalent quality management system acceptable to the Engineer. The manufacturing company shall be listed in a published NRTL directory of companies offering NRTL-listed and labeled products.

B. Testing Firm Qualifications: An independent firm, with experience and capability to conduct specified tests, and is a member company of NETA or is an NRTL as defined by OSHA in 19 CFR 1910.7, acceptable to the AHJ.

C. Testing Firm’s Field Supervisor Qualifications: person currently certified by NETA or NICET to supervise on-site testing specified in Part 3.

1.6 REFERENCE STANDARDS

A. Comply with the following standards:

1. IEEE 81.2-1991 Guide for Measurement of Impedance and Safety Characteristics of Large Extended or Interconnected Grounding Systems (Part 2)
2. IEEE 118-1978 (R1992) Standard Test Code for Resistance Measurements
3. IEEE 142-1991 Recommended Practice for Grounding of Industrial and Commercial Power Systems (IEEE Green Book)
4. IEEE 1100-1999 IEEE Recommended Practice for Powering and Grounding Electronic Equipment. (IEEE Emerald Book)
5. NFPA 70 The National Electrical Code
6. ANSI/NETA ATS (2017(

1.7 SUBMITTALS

A. Qualification Data: For firms and persons specified in "Qualifications" in Part 1 of this Section.
B. Acceptance Test Reports: Submit written test reports to include the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

4 Contractor shall provide a pre-enerigization inspection and tests according to ANSI/NETA ATS (2017).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with the requirements described in this Section, provide products by one of the listed manufacturers in the Sub-Sections below.

1. Grounding electrode connectors:

a. Copper compression type:

1) Dossert Corp.
2) Framatome Connectors / Burndy
3) Harger Lightning and Grounding, Inc.
4) ILSCO
5) O. Z. Gedney / EGS Electrical Group
6) Panduit Corp.

2.2 GROUNDING ELECTRODE CONDUCTORS

A. Grounding Electrode Conductors: Solid for #6 AWG and smaller, Class A stranded for #4 AWG and larger, bare copper conductor, size(s) as indicated on the Drawings. Class B stranding is not acceptable for conductors in contact with earth.

B. Comply with the following:

1. Solid Conductors: ASTM B 3.
2. Assembly of Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

2.3 BONDING JUMPERS

A. Main Bonding Jumpers: copper or tin-plated copper, furnished with the service equipment by the equipment manufacturer. Panelboards up to 225 amps may use a bonding screw.

B. Equipment Bonding Jumpers: insulated copper building wire, sized to match the largest equipment grounding conductor in the associated conduits.

C. Bonding Jumper: insulated copper wire, protected by conduit where exposed to physical damage

D. Electrical and telephone room ground bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.4 EQUIPMENT GROUNDING CONDUCTORS

A. Equipment Grounding Conductors: Insulated building wire in accordance with Division 16 Section “Wire and Cable”. #6 AWG and smaller shall have green insulation, #4 AWG and larger shall have green insulation or shall be marked with green tape at each end.

B. Isolated Ground Conductors: same type as equipment grounding conductors, tagged in each box with a string and cardboard tag with the legend ”ISOLATED GROUND”.

2.5 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467.Products shall be NRTL-listed and shall be suitable for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure type silicone bronze connectors for test joints at ground rods with test (access) wells, and two-hole long barrel tin-plated copper compression type at equipment busbars and bonding connections to structural steel.

C. Grounding clamps for metal water pipe connections: all cast bronze parts with silicone bronze bolts.

D. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

E. Wirenuts: for use only for branch circuit wiring in switch and receptacle outlet and junction boxes containing #10 AWG and smaller wires.

PART 3 - EXECUTION

3.1 INSTALLATION – GENERAL

A. Install grounding electrodes, grounding electrode conductors, main bonding jumpers, equipment grounding conductors, equipment bonding jumpers, and bonding, in accordance with NEC requirements and as shown on the Drawings.

B. Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.2 INSTALLATION: GROUNDING ELECTRODES

A. Remove paint and surface corrosion from structural steel and metal water pipes at grounding connection points down to bright metal, and coat dissimilar metals with anti-corrosion compound after making grounding connections wrench-tight.

3.3 INSTALLATION: GROUNDING ELECTRODE CONDUCTORS

A. Grounding Electrode Conductors: Route along shortest and straightest paths possible, unless otherwise indicated on the Drawings. Avoid obstructing access or placing conductors where subject to strain, impact, or damage.

B. Connect grounding electrode conductor(s) to the service equipment ground bus.

C. For connections to structural steel, provide exothermic-welded connections.

3.4 INSTALLATION: EQUIPMENT GROUNDING CONDUCTORS

A. Provide separate insulated equipment grounding conductors in raceways, boxes, and fittings, as shown on the Drawings and specified herein.

3.5 INSTALLATION: EQUIPMENT BONDING JUMPERS

A. At sheet metal junction, pull and outlet boxes, and electrical enclosures, use conduit hubs bolted to enclosure or double locknuts to bond enclosure to conduit, and connect grounding bushings to equipment grounding conductors. Install equipment bonding jumpers between conduit bushings entering and leaving boxes, using the lugs provided with the grounding bushings.

B. At cast enclosures, connect equipment grounding conductors together with a mechanical connector. Use mechanical connectors in conformance with Division 16 Section “Wire and Cable.” Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

3.6 INSTALLATION: BONDING JUMPERS

A. Bonding Straps and Jumpers: Install so equipment vibration is not transmitted to rigidly mounted equipment support structure. Use long-barrel tin-plated compression connectors and galvanized steel or silicone bronze hex head cap screws in drilled and tapped holes to bond miscellaneous equipment to equipment grounding conductors.

3.7 CONNECTIONS

A. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

B. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

3.8 ACCEPTANCE TESTING

A. Testing: Engage a qualified testing agency to perform the following field quality-control testing and testing shall conform to ANSI/NETA (2017):

B. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test ground resistance.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests using the fall-of-potential method according to IEEE 81.
3. Grounding resistance shall be 5 ohms or less. If resistance to ground measured at the service equipment with all grounding electrodes connected together is more than 5 ohms, proceed as described in the paragraph below.

END OF SECTION

SECTION 260533
RACEWAYS, BOXES, AND FITTINGS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Provide a complete system of raceways, including conduit, fittings, duct banks, pull boxes, junction boxes, outlet boxes, hangers, supports, and accessories, as shown on the Drawings and in conformance with the requirements in this Section and Division 26 Section “Electrical General Provisions”.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Raceways, boxes, and fittings components and related requirements are also specified in the following Sections:

1. Division 7 Section "Penetration Firestopping" for fire-stopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
2. Division 26 Section "Interior Lighting" for special application lighting fixture outlet boxes, including lighting plug-in outlets and ball hanger fittings for fixture stems.
3. Division 26 Section "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
4. Division 26 Section "Devices" for devices installed in boxes and for floor-box service fittings.
5. Division 26 Section “Grounding and Bonding”.

1.3 DEFINITIONS

A. In addition to the definitions in Division 26 Section “Electrical General Provisions”, the following definitions apply to this Section:

1. Clamp-back: spacer used with conduit one-hole strap to provide air gap between surface and conduit
2. EMT: Electrical metallic tubing (NEC definition)
3. Equipment bonding jumper: suitable for connecting sections of conduit used for equipment grounding conductor (see NEC definition)
4. FMC: Flexible metal conduit (NEC definition)
5. ID: inside diameter
6. IMC: Intermediate metal conduit (NEC definition)
7. LFMC: Liquidtight flexible metal conduit (NEC definition)
8. Lighting fixture whips: NEC maximum length of flexible conduit run from junction boxes in fixed raceways to lighting fixtures, to allow movement of the lighting fixtures for initial installation and for maintenance
9. NPT: National pipe thread
10. OD: outside diameter
11. RGS: Rigid galvanized steel conduit
12. RMC: Rigid metal conduit (NEC definition)

1.4 REFERENCE STANDARDS

A. Comply with the following standards in effect at the time of bid submittal:

1. NEMA Standards applicable to raceways, boxes, and fittings.
2. UL Standards applicable to raceways, boxes, and fittings. Each raceway, box, and fitting shall be NRTL-listed and labeled.
3. ANSI and ASTM standards mentioned in this Section and included in the UL and NEMA Standards applicable to raceways, boxes, and fittings.

1.5 ENVIRONMENTAL CONDITIONS

A. Provide raceways, boxes, and fittings fabricated from materials resistant to corrosion and suitable for the application in the locations where installed, including NEC requirements for installation in “damp”, “wet”, and hazardous classified areas.

1.6 SUBMITTALS

A. Product Data: For all raceways, boxes, and fittings proposed to be installed for this project. Mark out inapplicable catalog data.

B. Detail Drawings for raceway trapeze hangers and bracing: Sealed and signed by a qualified professional engineer.

1. Design Calculations: Calculate requirements for selecting seismic restraints. Structural calculations for worst case loading of each type of proposed channel assembly, including description of design criteria and industry standard safety factors, stress and deflection analysis with vector diagrams, and bill of materials indicating manufacturer’s part numbers with brief description of part name and materials of construction.
2. Detail assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.

C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:

1. Ceiling suspension assembly components.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for suspended ceilings.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.7 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.

1.8 COORDINATION

A. Coordinate layout and installation of raceways, boxes, fittings, hangers, enclosures, cabinets, and supports with other construction, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists of manufacturers, provide products in conformance with this Section produced by the listed manufacturers.

2.2 RIGID METAL CONDUIT (RMC)

A. Manufacturers:

1. Allied Tube and Conduit Div. / A TYCO International Ltd. Company
2. LTV Steel Tubular Products Company
3. Wheatland Tube Co.
4. Robroy Industries
5. Perma-Cote

B. Rigid Galvanized Steel Conduit (RGS): hot dip galvanized exterior and interior to ANSI C80.1, threads hot dip galvanized after fabrication, for use in accordance with NEC Article “Rigid Metal Conduit: Type RMC”, NRTL-listed and labeled under UL 6. Threads shall be hot dip galvanized after fabrication.

C. PVC-Coated Rigid Galvanized Steel Conduit, Boxes, and Fittings: Rigid galvanized steel conduit with 40 mil exterior coating, 2 mil urethane interior coating. Certified test results shall be available to confirm coating adhesion under the following conditions:
   1. Conduit immersed in boiling water with a minimum mean time to adhesion failure of 200 hours. (ASTM D870)
   2. Conduit and conduit body exposure to 150°F (65°C) and 95% relative humidity with a minimum mean time to failure of 30 days. (ASTM D1151)
   3. The interior coating bond shall be confirmed using the Standard Method of Adhesion by Tape Test (ASTM D3359).
   4. No trace of the internal coating shall be visible on a white cloth following six wipes over the coating that has been wetted with acetone (ASTM D1308).
   5. The exterior coating bond shall be confirmed using the methods described in Section 3.8, NEMA RN1. After these tests the physical properties of the exterior coating shall exceed the minimum requirements specified in Table 3.1, NEMA RN1.

D. Provide locknuts, bushings, fittings, conduit bodies, junction boxes, pull boxes, and outlet boxes as follows:
   1. Locknuts: galvanized steel. Locknuts on outside of NEMA 12 sheet metal enclosures shall be sealing O-ring type, except stainless steel within 50’ of a cooling tower.
   2. Bushings: galvanized steel or malleable iron, insulated throat grounding type, with thermoset plastic insulation insert, complete with mechanical ground lug for connection to ground wire
   3. Fittings: ANSI 80.4, hot-dip galvanized cast steel or malleable iron. PVC-coated conduit fittings shall be PVC-coated to same thickness as the conduit and shall have sleeves and collars to overlap the joint. Conduit hubs or similar approved fittings shall be provided for conduit entry to water and dust-resistant enclosures.
   4. Expansion and deflection couplings: UL 467 and UL 514B. Suitable for the anticipated amount of movement and direction(s) of movement. Materials of construction: galvanized steel, bronze, stainless steel. Non-metallic components shall be neoprene.
   5. Sealoff fittings: galvanized cast steel or malleable iron, suitable for horizontal or vertical installation. For concealed conduit runs requiring sealoffs, install sealoff fittings in flush-mounted galvanized steel boxes with blank flush covers.
   6. Conduit bodies: galvanized, cast steel, or malleable iron Form 8 with oil-resistant gasket and galvanized cast steel or malleable iron cover. Provide mogul bodies for fittings in trade sizes 2 inch and larger. When PVC-coated conduit is used, conduit bodies shall be PVC-coated to same thickness and shall have sleeves to overlap the conduit. Where RTRC conduit is used, provide fiberglass conduit bodies.
   7. Junction boxes: NEMA enclosure type in accordance with Part 3 of this Section
   8. Pull boxes: NEMA enclosure type in accordance with Part 3 of this Section
   9. Outlet boxes: Type FS or FD for exposed locations in non-hazardous areas, NEMA enclosure type in accordance with Part 3 of this Section

2.3 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
   1. Allied Tube and Conduit, a Division of TYCO International.
   2. LTV Steel Tubular Products Company
   3. VAW of America, Inc.
   4. Western Tube & Conduit Corp
   5. Wheatland Tube Co.

B. EMT: galvanized steel interior and exterior to ANSI C80.3, for use in accordance with NEC Article “Electrical Metallic Tubing, Type EMT”, NRTL-listed and labeled under UL 797

C. Provide couplings and connectors, locknuts, bushings, fittings, conduit bodies, junction boxes, pull boxes, and outlet boxes as follows:
   1. Zinc coated steel compression type couplings and connectors, ANSI C80.4, UL 514B, suitable for use as grounding fittings. Cast zinc fittings are not acceptable.
   2. Locknuts: galvanized steel

3. Bushings: galvanized steel or malleable iron, insulated throat grounding type, with thermoset plastic insulation insert, complete with mechanical ground lug for connection to ground wire
4. Expansion and deflection couplings: UL 467 and UL 514B. Suitable for the anticipated amount of movement and direction(s) of movement. Couplings shall have flexible metal braid for ground continuity, sized for use as NEC equipment grounding conductors.
5. Conduit bodies: aluminum with oil-resistant gasket and galvanized sheet steel cover.
6. Junction boxes: NEMA enclosure type in accordance with Part 3 of this Section
7. Pull boxes: NEMA enclosure type in accordance with Part 3 of this Section
8. Outlet boxes: cast metal for exposed locations in non-hazardous areas, NEMA enclosure type in accordance with Part 3 of this Section

2.4 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
   1. AFC Cable Systems, Inc.
   2. Alflex Inc.
   3. Anamet Electrical, Inc.; Anaconda Metal Hose.
   4. Electri-Flex Co.

B. Flexible Metal Conduit (FMC): Galvanized steel, for use in accordance with NEC Article “Flexible Metal Conduit, Type FMC”, NRTL-listed and labeled under UL 1.

C. Fittings: Screw-in connectors, NEMA FB 1, same material as conduit, and suitable for use as grounding fittings, UL 514B

2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
   1. AFC Cable Systems, Inc.
   2. Alflex Inc.
   3. Anamet Electrical, Inc.; Anaconda Metal Hose.
   4. Electri-Flex Co.

B. Liquidtight flexible metal conduit (LFMC): Flexible steel type UA conduit with PVC jacket, for use in accordance with NEC Article “Liquidtight Flexible Metal Conduit: Type LFMC”, NRTL-listed and labeled under UL 360. Non-UL listed LFMC is not acceptable.

C. Fittings: Insulated-throat screw-in connectors, NEMA FB 1, UL 514B, galvanized malleable iron or steel. Connectors shall be suitable for use as grounding fittings. Provide fittings with bonding jumper connections for exterior bonding jumpers at motors.

2.6 BOXES

A. Manufacturers:
   1. Bell
   2. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
   3. Emerson/General Signal; Appleton Electric Company.
   4. Erickson Electrical Equipment Co.
   5. Hubbell, Inc./ Killark Electric Manufacturing Co.
   6. O-Z Gedney; Unit of General Signal
   7. RACO; Division of Hubbell, Inc.
   8. Spring City Electrical Manufacturing Co.
   9. Thomas & Betts Corporation.

B. Sheet Metal Outlet and Device Boxes: Stamped galvanized steel, NEMA OS 1, UL 50, UL 514A.

C. Cast Metal Outlet and Device Boxes: galvanized and epoxy- or polyester-coated malleable iron NEMA FB 1, Type FD, with gasketed cover, UL 50, UL 514A.

D. Small Sheet Metal Pull and Junction Boxes: zinc coated steel, NEMA OS 1, UL 50, UL 514A.

E. Sheet Metal Pull and Junction Boxes: NEMA 250, Type 1 galvanized or painted steel, 3R painted steel, 4X stainless steel, with continuous hinged cover and flush latch.

F. Surface-Mounted Enclosures for terminal blocks and electrical equipment and components: NEMA 250, Type 1 painted steel, 3R painted steel, 4 painted steel, 12 painted steel, with continuous hinged cover and flush latch.
G. Freestanding Enclosures for electrical equipment and components: NEMA 250, Type 1 painted steel, 3R painted steel, 4 painted steel, painted steel 12, electrical enclosure with hinged door and removable sheet steel interior panel painted white. Painted cabinets shall be finished inside with white paint. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.7 METAL WIREWAYS
A. Manufacturers:
1. Hoffman.
2. Square D.
3. Hubbell / Wiegmann
B. Materials of Construction: Sheet metal, with enclosure NEMA rating in accordance with Division 26 Section “Electrical General Provisions”.
C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match with wireways as required for a complete raceway system. All changes in direction shall be made with factory-fabricated fittings.
D. Wireway Covers: Screw-cover type.
E. Finish: Manufacturer's standard epoxy powder coat or polyester paint finish for painted steel enclosures. Stainless steel, polyester, and fiberglass enclosures shall not be painted.
F. Hardware: Hardware shall be corrosion-resistant. Plain steel is not acceptable.

2.8 SINGLE CONDUIT HANGERS
A. Manufacturers:
1. Appleton
2. Crouse-Hinds
3. Erico International Corporation (Caddy)
4. Killark
5. Thomas and Betts (Kindorf, Steel City)
6. Unistrut
B. Single RMC and IMC attachment to structural steel: galvanized malleable iron PC (parallel clamp), EC (edge clamp), and RC (right angle clamp) type conduit-to-structural-steel clamps, or galvanized steel clevis hangers on galvanized steel threaded rods attached to galvanized malleable iron beam clamps. Bolts shall be galvanized steel.
C. Single RMC and IMC attachment to concrete and masonry surfaces: galvanized malleable iron one-hole clamp and galvanized malleable iron clamp-back, or galvanized steel clevis hangers on galvanized steel threaded rods attached to galvanized steel rod hanger fitting bolted to concrete with expansion bolts. Bolts shall be galvanized steel.
D. PVC-coated rigid galvanized steel conduit hangers shall be same as specified for RMC except with epoxy or PVC coating, and 316 stainless steel bolts.
E. Single EMT attachment to structural steel: galvanized malleable iron beam clamp with hardened set screw and threaded hole for galvanized steel single-bolt conduit hanger or threaded rod and clevis hanger. Bolts shall be plated steel.
F. Single EMT attachment to concrete and masonry surfaces: galvanized steel one-hole clamp and galvanized steel clamp-back, or plated steel single-bolt hangers on plated steel threaded rods attached to galvanized steel rod hanger fitting bolted to concrete with expansion bolts. Single piece combination one-hole clamp and clamp-back hangers are also acceptable. Bolts shall be plated steel.

2.9 MULTIPLE CONDUIT HANGERS (CHANNEL SUPPORTS)
A. Manufacturers:
1. Thomas & Betts (Kindorf)

2. Unistrut
3. Cooper B-Line
4. GS Metals Inc.

B. Steel channel and associated hardware and fittings:
1. 1-1/2 x 1-1/2 inch nominal size, minimum. UL 5B listed and labeled. Thickness as required for the application, minimum 0.071 inches.
2. Deflection of individual support channels shall not exceed 1/128th of span when loaded with conduit plus 200 pounds.
3. Electrogalvanized: Electrolytically zinc coated conforming to ASTM B633 Type III SC1.
4. Pregalvanized: Zinc coated by hot-dip process prior to roll forming. Zinc weight shall be G90 conforming to ASTM A 653.
5. Hot-dip galvanized after fabrication: Zinc-coated after all manufacturing and forming operations are completed. Zinc coating conforming to ASTM A 123 or A 153.
6. Clean dry indoor areas unless otherwise noted: painted, electro-galvanized.
7. Mechanical rooms: electro-galvanized.
8. Outdoors: hot dip galvanized after fabrication, type 304 stainless, PVC-coated hot-dip galvanized, epoxy-coated hot dip galvanized after fabrication.
9. Bolts: Grade 3 or better. Finish and materials to match channel, except that electroplated bolts shall be used with painted and electroplated steel channel, and stainless steel bolts shall be used with epoxy coated channel.

2.10 CONDUIT SLEEVES AND SEALING FITTINGS

A. Manufacturers:
1. Appleton
2. Crouse-Hinds
3. Spring City Electric
4. Thomas & Betts
5. O.Z. Gedney

B. Wall and Floor Sleeves:
1. Hot-dip galvanized steel, stainless steel pre-fabricated conduit sleeves with welded water-stop ring.
2. Galvanized steel sleeves that are part of a manufacturer's standard wall seal assembly are also acceptable, subject to compliance with the fire resistant rating of the related walls and floors.

C. Conduit-to-Sleeve Sealing Fittings:
1. Synthetic elastomeric gland with galvanized steel or stainless steel compression plates sized for the conduit OD and sleeve ID, or a manufactured assembly of hot-dip galvanized or stainless steel pressure plates, neoprene sealing grommets, and cast or malleable iron sealing bodies with zinc-rich epoxy coating, with factory-assembled galvanized steel, PVC, or polyethylene pipe sleeve. Segmented seals are also acceptable for conduits 4 inch trade size and larger.
2. Sealing fittings for wall penetrations with water or soil on one side shall have seals installed at both ends of the conduit sleeve or core-drilled hole.
3. Where single conductors shall not pass through a single sleeve.
4. Provide ground wire attachment bolts for manufactured sleeve assemblies.
5. Seals shall have fire ratings equal to the fire-resistant rating of the wall.

2.11 CONDUIT INTERIOR SEALING FITTINGS

A. Manufacturers:
1. Crouse-Hinds
2. O.Z. Gedney
3. Thomas & Betts

B. Conduit-to-Cable Sealing Fittings:
1. For exposed conduit ends without pull and junction boxes: Conduit fitting with synthetic elastomeric sealing gland with galvanized or stainless steel compression

plates drilled for the conduit ID and cable(s) OD, retained by threaded collar at the end of the conduit.

2. For exposed conduit ends entering pull or junction box: Conduit fitting suitable for installation of locknuts at conduit entry to sheet metal box and bushing with synthetic elastomeric sealing gland with galvanized or stainless steel compression plates drilled for the conduit ID and cable(s) OD, retained by threaded collar at the end of the conduit.
3. Seal shall be watertight at 50 feet of water pressure.
4. Where bare stranded copper conductors pass through sealing fittings, place an exothermic weld in the stranded cable to prevent water from leaking through the strands.

2.12 CONDUIT EXPANSION AND DEFLECTION FITTINGS

A. Manufacturers:
   1. Crouse-Hinds
   2. Spring City Electric
   3. O.Z. Gedney
   4. Thomas & Betts
B. Conduit expansion and deflection fittings:
   1. Suitable for the anticipated expansion joint elongation and deflection at each expansion joint.
   2. Materials of construction: Hot dip galvanized ductile iron body, neoprene sealing sleeve, stainless steel clamps, tinned flexible copper equipment bonding jumper.

2.13 FACTORY FINISHES

A. Finish: For painted steel enclosures, provide manufacturer's standard commercial and industrial coating in ANSI 61 light grey color, or different color when required by the NEC.
B. Field painting will be required for uncoated cast iron, steel, galvanized, zinc-coated, and factory primed surfaces. Products shall be degreased and made suitable for field painting prior to packaging for shipment.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Deliver raceways, boxes, and fittings to jobsite in factory packaging.
B. Store in clean, dry, weatherproof locations.
C. Handle in accordance with manufacturer’s recommendations.

3.2 RACEWAY APPLICATIONS

A. Indoor raceways, boxes, and fittings:
   1. Exposed interior: IMC.
   2. Exposed exterior: rigid galvanized steel conduit.
   3. Concealed: electrical metallic tubing, flexible metal conduit.
   4. Connections to motor-driven equipment subject to leaks such as pumps, vibrating equipment subject to leaks, and equipment subject to leaks requiring position adjustment, e.g., rail-mounted motors: liquidtight flexible metal conduit.
   5. Connections to transformers, motors and vibrating equipment in dry locations such as air handling equipment, and dry equipment requiring position adjustment, e.g., rail-mounted motors: flexible metal conduit.
   6. Lighting fixture whips: flexible galvanized steel conduit.
   7. Damp or Wet Locations: rigid galvanized steel conduit.
   8. Boxes and fittings: as described in each raceway sub-section and recommended as suitable for the particular application by the manufacturer.
   9. Enclosures: NEMA 250, Type 1, 4X, unless otherwise specified in Division 26 Section “Electrical General Provisions”.

B. Minimum Raceway Size: 3/4-inch trade size.

3.3 INSTALLATION – GENERAL

A. Install raceways, boxes, and fittings in accordance with manufacturer's installation instructions and NEC requirements as a minimum and comply with the additional requirements described in this Section.

B. Conduits shall be electrically and mechanically continuous, and suitable for use as an equipment grounding conductor. Make up threaded joints wrench tight.

C. When coordination drawing submittals are specified in Part 1 of this Section, do not commence work until coordination drawings for the entire building are approved.

D. Install and route emergency system raceways independently of other raceways systems, except where specific exceptions are permitted by the NEC.

E. Fasten boxes in wet and damp areas using external mounting feet. Do not drill through boxes.

F. Comply with NEC requirements for sizing outlet and junction boxes to accommodate wires, splices, and devices.

G. Bends and offsets between pull points shall not exceed a cumulative total of 270 degrees unless otherwise approved by the Engineer. Maximum distance between pull points in conduit systems inside buildings shall be 100 feet unless otherwise approved by the Engineer.

H. Raceways shall be routed in accordance with the following guidelines:
   1. Run conduits exposed, concealed, and underground as indicated on the Drawings.
   2. The preferred location for horizontal conduit runs is just below the ceiling structural supports.
   3. Do not obstruct access to equipment for operation and maintenance. Coordinate conduit runs with the work of other trades. Plan conduit runs to avoid lighting fixtures, and leave space for easy access to HVAC equipment, motors, and duct access hatches and doors.
   4. Route conduits around doors, windows, hatches, louvers, and other building openings, and around range and fume hoods.
   5. Group conduits on horizontal trapeze hangers or on wall-mounted steel channel where long horizontal runs are required.
   6. Do not run conduits through stairwells unless required for connection to equipment located in the stairwell.
   7. Maintain eight feet minimum clearance above finished floor wherever it is physically possible to do so. Comply with OSHA requirements for minimum headroom.
   8. Comply with raceway, boxes, and fittings details shown on the Drawings.
   9. Provide seals and flashings at roof penetrations in accordance with the recommendations of the roofing system supplier, or as shown on the Drawings.
   10. Where conduits enter the top of electrical equipment enclosures and control panels, install conduit interior sealing fittings to prevent entry of water and condensation from conduit.

I. Cut conduits square with roller-wheel pipe cutter. Hacksaw cuts are acceptable only if the entire conduit is swabbed clean after cutting and threading is completed. Conduits cut in the field shall be threaded with sharp, standard NPT dies to achieve a fully cut tapered thread with a minimum of five full tapered threads at the end of the conduit. Running threads are not acceptable. Over- and under-threading are not acceptable. After threading, ream conduit ends, remove cuttings and debris from inside and outside of conduit, degrease, and apply cold spray-on zinc-rich paint.

J. Conduit bends shall be made with conduit bending tools manufactured for the purpose. Comply with conduit and bending tool manufacturers' instructions. Use specially sized shoes in bending tools for PVC-coated rigid galvanized steel conduits.

K. Do not cut or drill holes in structural beams and columns, or other structural members. Do not weld raceway supports to structural steel.

L. Join raceways with fittings designed and approved for that purpose and make joints wrench tight. Comply with NEC requirements for minimum thread engagement in Hazardous Classified areas.
M. Provide expansion, deflection, or expansion & deflection couplings at building expansion joints. Expansion and deflection fittings shall comply with UL 467 and UL 514B, and shall be suitable for the anticipated amount of movement and direction(s) of movement.
N. Three-piece (Erickson) couplings shall be used where it is not possible to turn conduits to make up threaded joints. Threadless fittings are not generally acceptable. Application for permission to use threadless fittings at particular locations shall be made in writing to the Engineer, and threadless fittings shall not be used unless approved.
O. Complete raceway installation before starting conductor installation.
P. Support raceways as specified in Division 26 Section "Basic Electrical Materials and Methods."
Q. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Penetration Firestopping".
R. Boxes and poke-through assemblies in fire-rated floors and walls shall be UL-listed for the application. Comply with UL and manufacturer's requirements for installation.
S. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
T. Terminations:
    1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box. Install bushings wrench-tight.
    2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
    3. Install temporary closures to prevent foreign matter from entering raceways.
U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
V. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
    1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
    2. At hazardous classified locations and where otherwise required by the NEC.
W. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate equipment bonding jumper across flexible connections.
X. PVC Coated Rigid Galvanized Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.
Y. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
Z. Seismic Areas: Brace conduit supports to the building structure where required to provide seismic protection.

3.4 INSTALLATION – EXPOSED RACEWAYS, BOXES AND FITTINGS
A. Install raceways, boxes, and fittings exposed as indicated on the Drawings.
B. Install exposed raceways parallel or at right angles to nearby surfaces or structural members.

1. Run raceways together in groups on common supports wherever possible.
2. Do not use mechanical piping or ceiling supports to support conduit runs.

C. Make concentric bends in parallel exposed conduit runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

D. Surface-mounted channel supports shall be 1-1/2 inch x 1-1/2 inch channel bolted to wall or ceiling with expansion anchors.

E. Suspended (trapeze) channel supports shall be 1-1/2 inch x 1-1/2 inch channel suspended from minimum 3/8 inch threaded rod. Fasten rods to structural steel with beam clamps or channel assemblies designed specifically for each application. Fasten threaded rods to concrete with expansion bolts and threaded rod hanger, or concrete channel inserts

F. Keep raceways at least 6 inches away from parallel runs of flues and mechanical piping (including insulation). Install horizontal raceway runs above water and steam piping.

G. Install electrical enclosures and cabinets plumb. Support at each corner.

H. At building interior floor and roof penetrations, provide floor sleeves 2 inches above finished floor level with fire-rated conduit sealing fittings. Provide flashing at roof penetrations in accordance with roofing system manufacturer's recommendations.

3.5 INSTALLATION – CONCEALED RACEWAYS, BOXES AND FITTINGS

A. Install raceways, boxes, and fittings concealed, including above suspended ceilings, in partitions, and within or below floor slabs, as indicated on the Drawings.

B. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

3.6 PROTECTION DURING CONSTRUCTION

A. Provide final protection and maintain conditions that ensure coatings and finishes without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.7 CLEANING & PAINTING

A. Swab conduits clean after installation and plug ends until conductors are installed.

B. Remove dust, construction debris, plaster and paint spatters from raceways, boxes, and fittings after all trades have completed their work, and prior to painting.

C. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes, touch up damage, and prepare for finish painting in accordance with Division 9 Section "Painting and Finishing". Exposed conduit in interior finished areas and exterior finished areas shall be painted to match the wall surface.

3.8 IDENTIFICATION

A. Identify raceways, boxes, and fittings as described in Division 26 Section "Electrical Identification."

END OF SECTION

SECTION 262416
PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. This Section includes the following:
  1. Distribution panelboards.
  2. Lighting and receptacle branch-circuit panelboards.

1.3 DEFINITIONS
- A. EMI: Electromagnetic interference.
- B. RFI: Radio-frequency interference.
- C. RMS: Root mean square.
- D. SPDT: Single pole, double throw.

1.4 SUBMITTALS
- A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage surge suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
     a. Enclosure types and details for types other than NEMA 250, Type 1.
     b. Bus configuration, current, and voltage ratings.
     c. Short-circuit current rating of panelboards and overcurrent protective devices.
     d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  2. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces. Include the following:
  1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
     a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: For testing agency. Pre-energization inspection and tests shall be completed per ANSI/NETA (2017).
- E. Field quality-control test reports including the following:
  1. Test procedures used.
  2. Test results that comply with requirements.
  3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Panelboard Schedules: For installation in panelboards.
G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE
A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
C. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
D. 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.
E. Comply with NEMA PB 1.
F. Comply with NFPA 70.

1.6 PROJECT CONDITIONS
A. Environmental Limitations: Rate equipment for continuous operation under the following conditions:
   1. Ambient Temperature: Not exceeding 104 deg F.
   2. Altitude: Not exceeding 6600 feet.
B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
   1. Ambient temperatures within limits specified.
   2. Altitude not exceeding 6600 feet.

1.7 COORDINATION
A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.8 EXTRA MATERIALS
A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Keys: Two spares for each type of panelboard cabinet lock.
   2. Key all panelboards alike.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
      a. Square D (Basis of Design).
      b. Eaton Corporation; Cutler-Hammer Products.
      c. ABB.

2.2 MANUFACTURED UNITS

A. Enclosures: Surface-mounted cabinets. NEMA PB 1, Type 1.
   1. Hinged Front Cover: Hinged to box and with standard door within hinged trim cover. Provide hinged trim feature with full height piano hinge on panelboard trim. The trim shall hinge open with the removal of a few screws.
   2. Provide corrosion proof flush tumbler lock and catch on all panelboards. Key all boards alike.
   3. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
   4. Directory Card: Removable with transparent protective cover, mounted in metal frame, inside panelboard door.
   5. The manufacturer's nameplate shall be of corrosion resistant metal such as stainless steel and have the pertinent ratings embossed in raised letters and numerals, so as to be visible even if painted. The pertinent ratings shall include at least the following; amperage, voltage, phase, wires, AIC, manufacturer and model number.

B. Phase and Ground Buses:
   1. Material: Hard-drawn copper, 98 percent conductivity.
   2. All busing shall be constructed of the same material.
   3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
   4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

C. Conductor Connectors: Suitable for use with conductor material.
   1. Main and Neutral Lugs: Mechanical type.
   2. Ground Lugs and Bus Configured Terminators: Compression type.
   3. Feed-Through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
   4. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

D. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I^2t response. Provide only where indicated on the drawings.
   4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

5. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
   1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
   3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
   5. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
   6. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.

2.6 ACCESSORY COMPONENTS AND FEATURES
   A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
   B. Furnish portable test set to test functions of solid-state (electronic) trip devices without removal from panelboard.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install panelboards and accessories according to NEMA PB 1.1.
   B. Mount top of trim 74 inches above finished floor, unless otherwise indicated.
   C. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
   D. Install overcurrent protective devices and controllers.
      1. Set field-adjustable switches and circuit-breaker trip ranges.
   E. Install filler plates in unused spaces.
   F. Stub four 1-inch empty conduits from recessed panelboards into accessible ceiling space or space designated to be ceiling space in the future.
   G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION
   A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."
   B. Create a directory to indicate installed circuit loads. Indicate panelboard name, and the name of the upstream panelboard that feeds this panelboard with the words “Fed From Panel _____.” Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Provide a copy of each directory, 1 per page, as part of the Operation and Maintenance Manual.
   C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS
   A. Ground equipment according to Division 26 Section "Grounding and Bonding."
   B. Connect wiring according to Division 26 Section "Wire and Cable."

3.4 FIELD QUALITY CONTROL
   A. Prepare for acceptance tests as follows:
      1. Test continuity of each circuit.

B. Infrared Scanning: After occupancy, but not more than 6 months after Final Acceptance, perform an infrared scanning of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.
   1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
   2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   3. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action. Provide a color photo along side an infrared photo of each panelboard in the report.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 262726
DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

1.2 SUMMARY
- A. Section Includes:
  1. Receptacles and associated device plates.
  2. Wall-switch and interior occupancy sensors.

1.3 SCOPE
- A. The requirements of Section 260500 Electrical General Provisions shall apply to all work specified under this Section.
- B. The work includes all labor, materials, equipment, and services necessary for the installation of a complete system.
- C. Provide wiring devices for each outlet and location indicated on the drawings. All devices shall be the product of the same manufacturer unless a specified type approved for the purpose is required.
- D. Check all door swings and be responsible for installing all room light switches associated with doors on the striking side of all doors. If switches are indicated otherwise, the Contractor shall contact the Architect for clarification before installation.

1.4 DEFINITIONS
- A. EMI: Electromagnetic interference.
- B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- C. RFI: Radio-frequency interference.
- D. TVSS: Transient voltage surge suppressor.

1.5 SUBMITTALS
- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.6 COORDINATION
- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS AND EXECUTION

2.1 QUALITY ASSURANCE
- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Manufacturers: Firms regularly engaged in manufacture of electrical wiring devices, of types, sizes and ratings required, whose products have been in satisfactory use in similar

service not less than three years. Provide wiring devices produced by a manufacturer listed as an Acceptable Manufacturer in this section.

C. Standards Compliance: Comply with requirements of applicable local codes, NEC, UL, NEMA, and IEEE Standards pertaining to wiring devices. Provide wiring devices which are U.L. listed and labeled. Provide device plates which are U.L. listed.

D. The manufacturer's catalog numbers specified represent the minimum standards required. Only those manufacturers and their respective model numbers are approved for the given application.

2.2 ACCEPTABLE MANUFACTURERS

A. For wiring devices and device plates:
   1. Hubbell, Inc.
   2. Arrow-Hart Division - Crouse Hinds Co.
   3. Bryant
   4. Leviton

2.3 WALL SWITCHES

A. Single- and Double-Pole Switches: Heavy duty, toggle, quiet type, back and side wired fully enclosed in composition case with ground lug. Comply with DSCC W-C-896F and UL 20.

B. Rating: 20 Amp, 120/277 Volt.

C. Switches as follows, unless otherwise indicated:

		Hubbell	Arrow-Hart	Bryant	Leviton
1.	Single pole	1221	2221	4901	1221-2
2.	Three-way	1223	2223	4903	1223-2
3.	Four way	1224	2224	4904	1224-2
4.	Pilot light switches of equivalent rating and grade to above switches:	1201-PL & 1222-PL	Approved Equal		
5.	Illuminated switches of equivalent rating and grade to above switches.	1201-PL & 1222-PL	Approved Equal		

2.4 RECEPTACLES

A. Straight-Blade-Type Receptacles: Heavy duty, wide body design, one piece triple wipe brass power contacts, grounding type, one piece mounting strap without the use of rivets and with integral ground contacts, back and side wired, enclosed in composition, or nylon case, impact resistant nylon face. Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.

B. Rating: 20Amp, 125 Volt, NEMA 5-20R.

C. Receptacles as follows unless otherwise indicated.

	Hubbell	Arrow-Hart	Bryant	Leviton

1. Duplex	5362 5352	5352 5352	5362 5352	5362 5352
2. Single	5361	5351 5351	5361	5361

D. Special Application Receptacles:
1. 15 amperes, clock hanger, NEMA 5-15R: Hubbell 5235 or approved equal.
2. 20 amperes, 125 volt single, twist-lock, NEMA L5-20R: Hubbell 2310 or approved equal.
3. 30 amperes, 125 volt single, twist-lock, NEMA L5-30R: Hubbell 2610 or approved equal.
4. 20 amperes, 250 volt, single, twist-lock, NEMA L6-20R: Hubbell 2320 or approved equal.
5. 30 amperes, 250 volt, single, twist-lock, NEMA L6-30R: Hubbell 2620 or approved equal.

2.5 DEVICE COLOR:
A. Switches and receptacles connected to normal power: Ivory.
B. Receptacles connected to emergency power: Red.
C. Switches connected to emergency power: Red.
D. Switch pilot light: Red.
E. Receptacles on UPS power: Orange.

2.6 SWITCH AND RECEPTACLE PLATES
A. Material and Finish:
1. Stainless steel type 302/304: Hubbell S Series – Satin finish.

PART 3 - EXECUTION

3.1 MULTI-GANG COVERPLATES
A. Provide multi-gang switch cover plates where two or more switches or receptacles are indicated adjacent on the drawings.

3.2 RECEPTACLE IDENTIFICATION
A. Receptacle coverplate shall be identified with panel and circuit designation in accordance with Division 16 Section, Electrical Identification.

3.3 GROUNDING
A. Provide minimum #12 AWG green insulated ground wire from device ground lug to device box ground lug.

END OF SECTION

SECTION 262813
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
  1. Fusible switches.
  2. Nonfusible switches.
  3. Molded-case circuit switches.
  4. Molded-case switches.
  5. Enclosures.

1.3 DEFINITIONS
- A. HD: Heavy duty.
- B. RMS: Root mean square.
- C. SPDT: Single pole, double throw.

1.4 SUBMITTALS
- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
  1. Enclosure types and details for types other than NEMA 250, Type 1.
  2. Current and voltage ratings.
  3. Short-circuit current rating.
  4. UL listing for series rating of installed devices.
  5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that enclosed switches and circuit breakers, accessories, and components will withstand seismic forces defined in Section, "Seismic Protection for Electrical Work." Include the following:
  1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
     a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control test reports including the following:
  1. Test procedures used.
  2. Test results that comply with requirements.
  3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
  4. Pre-energization inspection and tests shall be completed per ANSI/NETA (2017).

E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Sections “Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 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. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 PROJECT CONDITIONS
   A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
      1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
      2. Altitude: Not exceeding 6600 feet.

1.7 COORDINATION
   A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
         a. Eaton Corporation; Cutler-Hammer Products
         b. Square
         c. ABB

2.2 FUSIBLE AND NONFUSIBLE SWITCHES
   A. Manufacturers:
      1. Eaton Corporation; Cutler-Hammer Products.
      2. Square D/Group Schneider.
   B. General: Comply with federal specification WS-865C and NEMA KS1-M83.
   C. Fusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
   D. Nonfusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
   E. Switch Operation:
      1. Horsepower rated, with a quick make, quick break operating mechanism, with number of poles, fuses, NEMA type, and capacities indicated.
      2. Voltage Ratting: 600 volts for 480 volt systems, 240 volts for 240 or 208 volt systems.
   F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic Trip-Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I^2t response.
   4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
   5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
   6. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.

C. Molded-Case Circuit-Breaker Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
   3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
   4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

D. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 IDENTIFICATION
A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26, “Electrical Identification."
B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26, "Electrical Identification."

3.4 FIELD QUALITY CONTROL
A. Prepare for acceptance testing as follows:
1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.
4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.

3.5 ADJUSTING
A. Set field-adjustable switches and circuit-breaker trip ranges.

3.6 CLEANING
A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION

SECTION 262815
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. This Section includes the following:
  1. Interior lighting fixtures with LED's, lamps and ballasts.
  2. Exit signs.
  3. Accessories, including fluorescent fixture dimmers and occupancy sensors.

1.3 DEFINITIONS
- A. BF: Ballast factor. Ratio of light output of a given lamp(s) operated by the subject ballast to the light output of the same lamp(s) when operated on an ANSI reference circuit.
- B. CRI: Color rendering index.
- C. CU: Coefficient of utilization.
- D. LER: Luminaire efficiency rating, which is calculated according to NEMA LE 5. This value can be estimated from photometric data using the following formula:
  1. LER is equal to the product of total rated lamp lumens times BF times luminaire efficiency, divided by input watts.
- E. RCR: Room cavity ratio.

1.4 SUBMITTALS
- A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  1. Physical description of fixture, including dimensions and verification of indicated parameters.
  2. Fixture photometric performance data.
- B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
- C. Wiring Diagrams: Power, signal, and control wiring.
- D. Product Certificates: For each type of ballast for dimmer-controlled fixtures, signed by product manufacturer.
- E. Source quality-control test reports.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
  1. Catalog data for each fixture. Include the diffuser, ballast, and lamps installed in that fixture.
- H. Warranties: Special warranties specified in this Section.

1.5 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. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Lamps: 5 for every 100 of each type and rating installed. Furnish at least one of each type.
   2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
   3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
   4. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 FIXTURES AND COMPONENTS, GENERAL

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
C. Metal Parts: Free of burrs and sharp corners and edges.
D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.
   4. Laminated Silver Metallized Film: 90 percent.
G. Plastic Diffusers, Covers, and Globes:
   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      a. Lens Thickness: At least 0.125 inch minimum unless different thickness is scheduled.
      b. UV stabilized.
   2. Glass: Annealed crystal glass, unless otherwise indicated.

2.3 LIGHTING FIXTURES

A. Fixtures shall be as indicated in “LIGHTING FIXTURE SCHEDULE” on drawings.

2.4 EXIT SIGNS

A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.
B. Internally Lighted Signs:
   1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp life.

2.5 LED

A. Lamps: LED, 45W, 3300 lumens, 4000 Kelvin, 82 CRI, no mercury lamps. LED supplied by fixture manufacturer and shipped installed. LED shall be rated L80 at 50,000 hours. Rated life of LED is 50,000 hours.
B. Driver: AccuDrive, 120 – 277 Volt, UL listed, CSA certified, sound rated A+. Maximum input Watts shall be 45 at 120 Volts or 45 at 277 Volts. Driver shall be suitable for full-range dimming. Rated life factor shall be 90% or greater.
C. Lamps: LED: 38W, 1867 delivered lumens. LED supplied by fixture manufacturer and shipped installed. LED shall be rated L80 at 50,000 hours. Rated life of LED is 50,000 hours.
D. Driver: Philips Xitanium, 120-277V, 50/60Hz, RoHS compliant. Certified by UL Class 2 for use in a dry or damp location. Class A sound rating. Min Power Factor >0.9. Operating temperature 0°F-135°C.

2.6 FIXTURE SUPPORT COMPONENTS
A. Comply with Division 26 Section "Basic Electrical Materials and Methods" for channel- and angle-iron supports and nonmetallic channel and angle supports.
B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated, 12 gauge.
E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
F. Rod Hangers: 3/16-inch- minimum diameter, cadmium-plated, threaded steel rod.
G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
H. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.7 FINISHES
A. Fixtures: Manufacturers' standard, unless otherwise indicated.
1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
2. Metallic Finish: Corrosion resistant.

2.8 INDOOR OCCUPANCY SENSORS
A. Basis-of-Design Product: Subject to compliance with requirements, provide Watt Stopper or a comparable product by one of the following:
1. Hubbell Lighting.
2. Leviton Mfg. Company Inc.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Novitas, Inc.
5. Sensor Switch, Inc.
B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Additional Operation: All occupancy sensors shall have separate dry contactors for connection to BAS system.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
4. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
5. Mounting:
a. Sensor: Suitable for mounting in any position on a standard outlet box.

b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
7. Bypass Switch: Override the on function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.

C. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

2.9 SOURCE QUALITY CONTROL
A. Provide services of a qualified, independent testing and inspecting agency to factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.
B. Factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from fixture corners.
2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

C. Suspended Fixture Support: As follows:
1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Adjust aimable fixtures to provide required light intensities.

3.2 CONNECTIONS
A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
B. Verify normal operation of each fixture after installation.
C. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.
D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
E. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

END OF SECTION

SECTION 31 10 01

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 DESCRIPTION

A. This work shall consist of clearing and grubbing of the wooded areas within the limits specified in the Contract Documents.

1.2 Definitions.

A. Clearing. Clearing within the construction area includes removing and disposing of trees, brush, shrubs, vegetation, rotten wood, rubbish, fences and structures not specified in the Contract Documents for removal and disposal. Clearing outside the construction area is the removing and disposing of rubbish.

B. Grubbing. Grubbing is removing from the ground and disposing of all stumps, roots and stubs, brush and debris.

C. Limits. Limits of clearing and grubbing include the wooded construction area and all ditch areas and stream or channel change areas.

D. Disturbed Area. Any erodible material exposed by construction activities.

E. Stabilization. Providing vegetation or structural measures (seed, temporary or permanent mulch, soil stabilization matting, riprap, stone aggregate, and paving by asphalt or concrete) that will prevent erosion. The placement of one or more of these temporary or permanent stabilization measures as directed by the Engineer shall satisfy the requirements to proceed with the next grading unit or operation.

F. Stabilized. An area covered with erosion resistant material such as grass cover, seed and mulch, soil stabilization matting, riprap, stone aggregate, or paving by asphalt or concrete.

PART 2 PRODUCTS

2.1 MATERIALS

Not applicable.

PART 3 EXECUTION

3.1 Erosion and Sediment Control

A. A grading operation is defined as the Contractor's ability to provide adequate resources to perform the grading in a timely manner and provide and maintain the proper erosion and sediment control measures. The Engineer will be the final authority in this determination

3.2 Vegetation

A. The Engineer will designate and mark any trees, shrubbery and plants that are to remain in place, and the Contractor shall protect them from any damage. Branches of trees overhanging the roadway shall be cut and properly trimmed to maintain a vertical clearance of 16 ft. All trimming shall be done under the supervision of a tree expert employed by the Contractor and licensed by the State of Maryland, including trimming of trees by the Contractor for any other reason.

3.3 Fences

A. All fences within the Limits of Disturbance shall be removed and disposed of unless otherwise specified in the Contract Documents.

3.4 Grubbing.

A. Excavation Areas. Within areas to be excavated, all embedded stumps and roots shall be removed to a depth of not less than 3 ft below the subgrade or slope surfaces. All depressions made below the subgrade or slope surfaces by the removal of stumps shall be refilled with materials suitable for embankment and shall be compacted as specified in under item xx (Embankment)

B. Low Embankments. Areas where the total depth of the embankment is less than 3 ft shall be grubbed.

C. High Embankments. Areas where the embankment is 3 ft or more in depth, trees and stumps shall be cut off as close to the ground as is practical but shall not exceed 1 ft above the ground surface. Near the toe of embankment slopes, stumps or trees are prohibited within 1 ft of the slope surfaces.

3.5 Disposal.

A. Burning. Will not be permitted

B. Disposal Locations. Materials and debris that cannot be burned and perishable materials shall be removed from the limits of disturbance and disposed of by the Contractor. The Contractor shall make all necessary arrangements to obtain suitable disposal locations and shall furnish the Engineer with a copy of resulting agreements.

C. Wood Disposal. Disposal of wood to the general public shall be accomplished off the job site. Any plan for disposal in this manner shall be submitted to and approved by the Engineer prior to beginning the clearing and grubbing operation.

3.6 Destroying Trees Beyond Clearing Limits

A. The Contractor shall not damage nor destroy any trees that exist beyond the clearing limits specified.

B. The Contractor shall be responsible for all damage to trees located beyond the clearing limits due to the Contractor's operations. The Contractor shall restore, to the satisfaction of the Engineer, any trees that have been damaged or destroyed at no additional cost to the Owner.

C. Replacement trees shall be of the same species as those damaged or destroyed unless otherwise directed by the Engineer. The replacement size shall be the same as the damaged or destroyed trees when the trees measure less than 4 in. diameter at breast height (DBH). Damaged trees 4 in. DBH or greater shall be replaced with 2 in. caliper trees in conformance with the following:

SIZE OF DAMAGED OR DESTROYED TREES in. DBH	NUMBER OF 2 in. CALIPER REPLACEMENT TREES
4	5
6	8
8	10
10	13
12	15
16	20
20	25
24	36
32	48
40	80
60	135
80	200
120 or Greater	360

NOTE: DBH shall be measured at 4.5 ft above the ground.
Caliper shall be measured at 6 in. above the ground.

D. Replacement trees shall be planted within the limits of the project whenever possible, as determined by the Engineer. If not possible, a suitable location will be determined by the Engineer.

E. In case of failure on the part of the Contractor to restore or replace the damaged tree at the start of the next appropriate planting season, the Contractor will have 48 hours to begin corrective action, after notification by the Engineer. If the Contractor has not taken the corrective actions within the specified time, the Engineer may proceed with corrective measures. The cost of the corrective measures will be deducted from any monies due under the Contract.

END OF SECTION

SECTION 31 14 13

TOPSOIL AND SUBSOIL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work shall consist of salvaging topsoil and subsoil, placing salvaged topsoil and subsoil, and placing furnished topsoil and subsoil as specified in the Contract Documents or as directed by the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS.

A. Salvaged Topsoil. Salvaged topsoil shall be that surface material to be salvaged from the project which has been classified as topsoil as specified in the Contract Documents.

B. Furnished Topsoil. Furnished topsoil shall be natural, friable surface soil uniform in color and texture and not supplied from the project. Topsoil shall be free from any parts of Johnsongrass, Canada Thistle, or Phragmites.
Topsoil shall have an organic content between 1.5 to 10.0 percent by weight when tested as specified in T 194. Furnished topsoil shall have a corrected pH value of not less than 6.0 nor more than 7.5.
Grading analysis shall be as follows:

SIEVE SIZE	MINIMUM PERCENT PASSING BY WEIGHT
2 in.	100
No. 4	90
No. 10	80

Topsoil shall be analyzed for sand, silt, and clay as specified in T 88.
Textural analysis shall be as follows:

SOIL PARTICLE SIZES mm	PERCENT PASSING BY WEIGHT
Sand (2.0 – 0.050)	20 – 75
Silt (0.050 – 0.002)	10 – 60
Clay (less than 0.002)	5 – 30

C. Salvaged Subsoil. Salvaged subsoil shall be material salvaged from the project that has been classified as subsoil as specified in the Contract Documents.

D. Furnished Subsoil. Furnished subsoil shall be natural, friable subsurface soil uniform in texture and not salvaged from the project. Subsoil shall be free from any parts of Johnsongrass, Canada Thistle, or Phragmites. The Contractor shall submit a source of supply for the material to the Engineerfor approval, prior to use. Material shall conform to MSHA 916 with the following exceptions:

1. The use of recycled portland cement concrete or recycled HMA pavement is prohibited.
2. The corrected pH value shall be 5.0 to 7.5.
3. The organic matter content shall be 0.1 to 5.0 percent.

Grading analysis shall be as follows:

SIEVE SIZE	MINIMUM PERCENT PASSING BY WEIGHT
2 in.	100
No. 4	85
No. 10	60

Material shall be analyzed for sand, silt and clay as specified in T 88.
The textural analysis shall be as follows:

SOIL PARTICLE SIZES mm	PERCENT PASSING BY WEIGHT
Sand (2.0 – 0.050)	20 – 85
Silt (0.050 – 0.002)	10 – 60
Clay (less than 0.002)	5 – 40

E. Agricultural Limestone. Refer to MSHA 920.02

F. Miscellaneous Landscaping Items. Refer to MSHA 920.08.

PART 3 - EXECUTION

3.1 GENERAL

A. When soil or weather conditions are unsuitable, the Contractor shall cease topsoil and subsoil operations until directed by the Engineer to resume.

3.2 SALVAGING TOPSOIL AND SUBSOIL.

A. Evaluation. Topsoil and subsoil infested with any parts (seed, rhizomes, stolons, roots, etc.) of Johnsongrass, Canada Thistle, or Phragmites will be evaluated by the Engineerprior to the salvaging operations to determine the severity of the infestation. The evaluation will determine how the topsoil and subsoil are to be used and to establish a means of preventing the spread of these weeds.

B. Removal. Topsoil and subsoil shall be removed from selected areas specified in the Contract Documents or as directed by the Engineer. Prior to removing topsoil and subsoil, the Contractor shall mow or remove all vegetation over the areas where topsoil and subsoil are to be salvaged. Topsoil and subsoil shall be removed to the depth as directed by the Engineer. The topsoil and subsoil shall be transported and stockpiled in separate storage piles and kept separated from other materials.

C. Storage. Storage areas for topsoil and subsoil shall be constructed on well drained land, away from live streams, and in conformance with MSHA 308. Prior to placing piles, the Contractor shall install silt fence around the perimeter of the stockpile area and maintain the silt fence until vegetation is established. Topsoil and subsoil shall be kept in neat and separate piles separated from other excavated material. The piles shall be seeded with temporary seed immediately after final shaping of the pile. Temporary seeding shall conform to MSHA 704.

D. Excess topsoil and subsoil will become the property of the Owner and any removal will require written approval from the Engineer.

3.3 PLACING SALVAGED TOPSOIL AND SUBSOIL.

A. Evaluation. The Engineer will reevaluate salvaged topsoil and subsoil infested with any parts (seed, rhizomes, stolons, roots, etc.) of Johnsongrass, Canada Thistle, or Phragmites prior to placing, to establish a means of preventing the spread of these noxious weeds.

B. Surface Preparation. The Contractor shall completely prepare and finish the surface of all areas to be covered with topsoil and subsoil as specified in the Contract Documents. Immediately prior to being covered with topsoil, the prepared surface shall be in a loose condition and be free from stones or other foreign material 3 in. or greater. When topsoil is placed on a prepared surface material that blends with the topsoil or subsoil, the Contractor shall work the topsoil or subsoil into that material by means acceptable to the Engineer. When topsoil or subsoil will not blend with the prepared surface material, the Contractor shall roughen the surface to provide a bond for the topsoil or subsoil.

C. Loading and Hauling. Prior to the start of the hauling operations, all grass, weeds, brush, stumps, and other objectionable material shall be removed from the surface of stockpiles.

D. Placing and Spreading Topsoil. Topsoil shall be placed, spread, and maintained over the areas designated to the depth, that after settlement, the completed work shall be in conformance with the thickness, lines, grades, and elevations specified in the Contract Documents. Stones and other foreign material larger than 3 in. shall be removed and disposed of by the Contractor. Slopes 4:1 to 2:1 shall be tracked with cleated tract type equipment operating perpendicular to the slope.

E. Placing, Spreading, and Compacting Subsoil. Subsoil shall be placed, spread, and compacted in maximum layers of 8 in. to produce a uniform firm layer of subsoil. The completed work shall be in conformance with the thickness, lines, grades, and elevations specified in the Contract Documents. Stones and other foreign material larger than 4 in.

shall be removed and disposed by the Contractor. Slopes 4:1 to 2:1 shall be tracked with cleated tract type equipment operating perpendicular to the slope.

3.4 PLACING FURNISHED TOPSOIL AND SUBSOIL

A. Refer to 3.3 and the following:

B. Contractor Responsibility. The Contractor shall make all arrangements and assume all responsibility for consents, agreements, and payments with property owners involved in topsoil and subsoil operations.

C. Soil Test Reports. Limestone and soil amendments shall be added as specified in the soil test reports and MSHA 705.03.01(d) and 705.03.02(b).

D. Storage. If the material is stockpiled upon delivery for future use on the project, the stockpiling shall conform to 3.2C.

END OF SECTION

SECTION 31 23 16

EXCAVATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work shall consist of the excavation and grading for buildings roadways and their appurtenances to the lines and grades specified in the Contract Documents. The Contractor shall use all suitable materials from excavation in the construction of embankments throughout the limits of the work as directed by the Engineer.

1.2 CLASSIFICATION

A. All excavation will be unclassified.

1.3 EXCAVATION

A. Excavation shall include the following:

1. Cut areas within the boundary faces of the proposed cross sections specified in the Contract Documents, including ditches within the cut sections, and excavation for entrances, approach roads, streets, intersections, gutters, ditches, berm ditches, and flumes.
2. Topsoil to be salvaged within the limits of excavation as specified in the Contract Documents or as directed by the Engineer.
3. The removal and disposal of existing pavement, sidewalks, curb and combination curb and gutter, when within the limits of any excavation.
4. The removal and disposal of below grade structures other than as specified “Removal and Disposal of Existing Buildings”.

PART 2 - PRODUCTS

2.1 MATERIALS

PART 3 - EXECUTION

3.1 USE OF EXCAVATED MATERIALS

A. No excavated material shall be wasted without prior approval of the Engineer. Borrow shall not be used unless provisions have been made for utilizing all available suitable excavated material in embankments. Refer “Borrow Excavation”

B. Rights in and use of materials found on the project. The Contractor, with the approval of the Engineer may use on the project any excavated stone, gravel, sand or other material conforming to the requirements of the Contract Documents.

C. The Contractor shall not excavate nor remove any material which is not within the limits of excavation, as indicated by the slope and grade lines, without written authorization from the Engineer.

3.2 BROKEN PAVEMENT MATERIAL

A. Existing pavement, sidewalks, gutter, curb or combination curb and gutter materials from the excavation may not be used in embankments.

3.3 ROCK EXCAVATION.

A. Boulders and Rock

1. Boulders and rock from the excavation may be broken and used in embankment provided the materials conform to the following:
    a. Rock may be used in embankments, provided that individual pieces do not exceed of 24 in. in any dimension. Larger size rocks may be wasted with the approval of the Engineer.

B. Blasting

1. Blasting will not be allowed.

3.4 FROZEN MATERIAL

A. Frozen material is prohibited from being placed in embankments. It shall be stockpiled outside the construction limits and reserved for future use. Any material that is wasted shall be replaced. Rehandling of excavated material and replacement of wasted material shall be at no additional cost to the Owner.

3.5 SERRATED SLOPES

A. Serrated cut slopes are defined as slopes having continuously benched faces. Slopes that are to be serrated and the width and height of benches shall be as specified in the Contract Documents or as directed by the Engineer. The benches shall be constructed parallel to each other, and they shall be level, not graded to drain, and shall be constructed as the excavation progresses.

3.6 DRAINAGE

A. All drainage shall conform to Erosion and Sediment Control requirements. During construction of the roadway, the roadbed shall be maintained in a well drained condition at all times. Excavated material is prohibited from being deposited or left within 3 ft of the edge of the ditch or channel or be permitted to obstruct normal surface drainage into the ditch or channel. Ditches draining from cuts to embankments or otherwise shall be constructed to avoid damage to embankments by erosion. All drainage necessary to provide free and uninterrupted flow of the surface and underground water shall be installed before surfacing is placed. When stabilized side and outlet ditches provide the principal means for drainage, the cutting and stabilization of ditches for the disposition of surface water shall be the first work in the grading operation.

3.7 EXCAVATION BEYOND SPECIFIED LIMITS

A. The widening of cut or excavation sections beyond the limits on the Contract Documents is prohibited except by written authorization from the Engineer. When authorized by the Engineer the procurement of additional materials for embankments, unless otherwise specified under Borrow Excavation, shall conform to the following:

1. Finished Excavation. The widening of cuts or excavation sections shall be finished so that completed flat and slope areas shall be uniform in appearance. The slopes shall not be steeper than the cut slopes specified in the Contract Documents or as directed by the Engineer.
2. Excavation Limits.
    a. If the Engineer directs the Contractor to excavate beyond the limits on the plans, all material within the limits will be Unclassified Excavation.
    b. If the Contractor, with approval of the Engineer, elects to obtain material by widening cuts beyond the limits of the plans and within the right-of-way or easement, the excavation of the materials will be Unclassified Excavation.
3. Borrow Excavation Beyond Specified Limits. If the Engineer directs the Contractor to excavate beyond the limits of the plans originally proposed after the Contractor has substantially completed the excavation in a cut section, all material removed beyond the limits of the plans will be classified as Borrow Excavation.

3.8 UNSUITABLE MATERIAL

A. Unstable or other unsuitable material encountered at or below the subgrade specified in the Contract Documents shall be removed to the extent directed by the Engineer and will be taken to be Unclassified Excavation. In rock areas the limit of measurement for excavation will be at the bottom of the pavement section. All voids created by the removal of unsuitable material, except when rock is encountered at subgrade, shall be backfilled to the lines and grades with the material specified in the Contract Documents.

B. Backfill material shall conform to the following:

1. All borrow excavation shall be a soil or soil aggregate mixture and shall conform to the “Borrow Excavation”.

3.9 WIDENING EXCAVATION LIMITS

A. The area to be excavated for widening shall be limited to the extent that the excavated area can be backfilled within the same working day using the excavated material or common borrow to form a temporary wedge. The 4:1 or flatter fill slope shall be maintained. The material shall be compacted as directed by the Engineer and remain in place until placement of the graded aggregate base course.

END OF SECTION

SECTION 31 23 33

TRENCHING AND BACKFILLING

PART 1 GENERAL

1.1 DESCRIPTION

A. Section includes requirements for excavation, backfill, grading, and related items for pipeline construction.

1.2 DEFINITIONS

A. Trench Zones.

1. Pipe Embedment Zone: Area surrounding pipe in trench, consisting of Bedding Zone, Haunching Zone, and Initial Backfill Zone defined herein.
    a. Bedding Zone: Area from pipe bottom to firm subgrade, extending full width of trench and providing support for pipe shown in WSSC standard details.
    b. Haunching Zone: Area from pipe bottom up to as far as spring line and extending full width of trench shown in WSSC standard details.
    c. Initial Backfill Zone: Area from top of Haunching Zone up to as far as 1 foot above top of pipe and extending to full width of trench shown in WSSC standard details or specified herein.
2. Final Backfill Zone: Area from top of Pipe Embedment Zone to finished grade, extending full width of trench shown in WSSC standard details.
3. Additional Excavation: Excavation below trench bottom to remove unsuitable material such as rock, cobble, soft or organic soil, when Contract Manager determines that material is unsuitable to support pipe.

B. Backfill Material.

1. Trench Backfill: Native or Borrow Material placed in trench excavation and meeting specifications herein.
2. Borrow Material: Suitable material used for Trench Backfill provided from locations outside limits of trench excavation and meeting specification requirements herein.
3. Structural Fill: Compacted Trench Backfill meeting specification requirements herein, to minimize future settlement and provide support or bearing for structures to be constructed upon or within fill.

C. Pipe.

1. Rigid Pipe: Reinforced Concrete Pipe (RCP), Cast Iron Soil Pipe, Cast Iron Pipe, Prestressed Concrete Cylinder Pipe (PCCP), Asbestos Cement Pipe, Vitrified Clay Pipe, and Concrete Sewer Pipe.
    a. Pipes relying primarily on inherent strength to support external vertical load.
2. Flexible Pipe: Ductile Iron Pipe (DIP), Polyvinyl Chloride (PVC) Pipe, and Type K Copper Pipe, Steel Pipe, and High Density Polyethylene (HDPE) Pipe.
    a. Pipe deriving its supporting strength primarily from passive pressures induced as pipe flexes outward against material in Pipe Embedment Zone.

D. Controlled Blasting: Blasting method used to fracture and excavate rock to required limits for trench while minimizing overbreak and fracturing.

E. Paved Areas: Areas over which paving exists or is to be placed under this Project or areas designated on Drawings to receive future paving.

F. Wetland Areas: Non-tidal Wetlands and Non-tidal Wetlands Buffer Zones.

1.3 QUALITY ASSURANCE

A. Inspection and Testing.

1. Field Density Compaction Tests shall be in accordance with ASTM D1556, ASTM D2922, or ASTM D2937 at minimum rate of 1 test for each 200 feet of fill and at every structure and valve box in Type I areas.
   a. Test fill to minimum depth of 5.0 feet from the surface on sewer main and sewer service connections. Test fill on water main, water service connections, pressure sewer and pressure sewer service connections to minimum depth of 3.0 feet from surface or 1.5 feet above the top of the pipe, whichever is greater.
   b. When field-testing indicates differences in soil types, reference and/or verify test results using one-step field proctors or laboratory proctors following AASHTO T99.
   c. Re-excavate and recompact failed test areas, at 25 foot intervals, the entire trench depth and length until retests meet above referenced standards.
2. Placing Trench Backfill and earthwork is subject to continuous inspection by OWNER.
   a. Allow time for OWNER to perform tests after completion of each layer of fill in designated area.
   b. Provide safe access and equipment to cut out smooth-surfaced spot locations designated by Contract Manager for testing.
   c. OWNER may perform gradation and other tests on Trench Backfill.

B. Finished Grade Settlement Limitations.

1. Guarantee backfilled trench excavation areas designated on Drawings will not pond or settle in excess of following limitations.

Designations	Settlement Limitations	Locations
Type I	0.05 foot	Paved areas and public rights of way
Type II	with positive drainage	Unimproved areas
Type III	0.10 foot	Nonpaved improved areas
Type IV	0.00 foot	Wetlands or wetlands buffer

.

2. Remove and replace Trench Backfill which settles in excess of above limitations with suitable material
3. Remove and replace piping, structures, paving, landscaping, and other site improvements damaged by settlement or repair.

1.4 SUBMITTALS

A. Submit following Section 01 33 00.

1. Working drawings and data to show blasting design and monitoring, for information only.
   a. Submit request and obtain written permission from Contract Manager before using explosives.
2. Working drawings showing sheeting and shoring, and method of dewatering, for structure excavations deeper than 8 feet and larger than 400 square feet.
3. Samples of Borrow Material, except for Borrow Aggregate.
   a. Size: Minimum of 30 pounds in sturdy cloth or plastic bags.
   b. In addition to sample identification required in Section 01 33 00, clearly label each sample showing type and material designation, intended use, name and address of supplier, and location where material is mined or manufactured.

B. Delivery of Borrow Material.
   1. Submit prior notification of source, designation, quantity, and intended use for all Borrow Material.
   2. Submit delivery tickets with each load of Borrow Material.
      a. Name and location of supplier.
      b. Type and amount of material delivered, including ASTM's and the Owner's material designations.

C. Submit following Section 01 45 00.
   1. Certificate of Compliance: When recycled concrete is used, submit letter from governing jurisdiction approving its use.
   2. Certified Test Reports: Borrow Aggregate.
      a. In addition to requirements of Section 01 45 00, include information showing type and material designation, intended use, name and address of supplier, and location where material is mined or manufactured.

D. Flowable Fill: See MSHA 314.02.

E. Submit Soil's Compaction Reports as follows:
   1. Certified by Professional Engineer registered in State of Maryland.
   2. Field Density Compaction Test Results.
   3. Owner Project Number.
   4. Soils Technician's Name and Employer.
   5. Owner's name and owner's Contractor.
   6. Test Number.
   7. Date of Test.
   8. Location of Test (sewer and/or water station, lot number and street name).
   9. Retest results of previous tests (and number), if required.
   10. Depth of Test.
   11. Dry Density.
   12. Moisture Content.
   13. Maximum Density/Optimum Moisture Curve Relationship Chart following ASTM D698.
   14. Test Results.
   15. One Step Proctor Determination (when taken).
   16. Additional Comments.
   17. Submit test results to the Contract Manager within 2 weeks of test.

PART 2 PRODUCTS

2.1 MATERIALS

A. Detectable Warning Tape.
   1. Description.
      a. Size: Six inch width, minimum 5 mils thickness.
      b. Printing: Two lines, minimum 3/4 inch high lettering on each line, repeated continuously along length of tape at intervals no greater than 3 feet.
         1) Water: CAUTION - WATER LINE BURIED BELOW
         2) Sewer: CAUTION - SEWER LINE BURIED BELOW
         3) Cathodic Protection: CAUTION – CATHODIC PROTECTION
      c. Colors.
         1) Tape: Blue for water. Green for sewer. Yellow for cathodic protection.
         2) Lettering: Black.
   2. Approved Manufacturers:
      a. Lineguard, Inc, Type III Detectable Tape.

b. Pro-Line Safety Products, No. 5012 (Type A Double Safe).
c. Reef Industries, Terra Tape D.
d. Empire Level Manufacturing Corporation, Magnatec.

B. Trench Backfill.
1. General Trench Backfill Requirements.
a. Outside Wetland Areas: Free of organic or frozen material, waste metal products, unsightly debris, toxic material, or other deleterious materials and at moisture content permitting compaction to density specified.
b. Within Wetlands Areas: Previously excavated native material which can include organic matter, but free of frozen material, waste metal products, unsightly debris, toxic material, or other deleterious materials.
c. Material Excavated from Trench and Meeting These Requirements: Use when approved by Contract Manager; otherwise excavate, haul, and place Borrow Material.
2. General Borrow Material Requirements .
a. Outside Wetland Areas: Meet General Trench Backfill Requirements for Outside Wetland Areas, stated herein.
b. Within Wetland Areas: Soil material meeting requirements of ASTM D2488, material classification types SM, SC, ML, CL, OL and PT, which can include organic matter, but be free of frozen material, waste metal products, unsightly debris, toxic material, or other deleterious materials.
c. Acceptance of Borrow Material from any location outside limits of trench excavation, shall not be construed as approval of entire Borrow Material site, but only insofar as material continues to meet specified requirements, herein.
3. Borrow Aggregate.
a. Standard Sizes of Aggregate: ASTM C33, coarse aggregate.
b. Dry Concrete Sand: ASTM C33, fine aggregate.
c. Surge Stone: 3 inch to 7 inch stones.
d. Crushed stone, crusher run (CR-6), or bank run gravel.
1. Aggregate Test Requirements: Maximum Sodium Sulfate Soundness (ASTM C88): 12 percent. Maximum Los Angeles Abrasion (ASTM C131): 50 percent. Maximum Flat and Elongated (ASTM D4791) for crushed stone only: 15 percent.
2. Gradations: Conform to Table of Borrow Aggregate Gradations.

Borrow Aggregate Gradations

(BasedonTable“901-A”,January2001MSHAStandardSpecificationsfor Construction and Materials)

3.

Sieve Size	Percent Passing Each Sieve by Weight				
	[1]BankRun Gravel Number 1	[2]BankRun Gravel Number 2	[3]CrushedStone Number 3		[4]Crusher Run Number 4 (CR-6)
			Design Value	Tolerance	Design Value
2-1/2 inch	100	100			
2 inch			100	-2	100
1-1/2 inch			95-100	□5	90-100
1 inch	85-100	90-100			
3/4 inch			70-92	□8	60-90
1/2 inch	60-100	60-100			
3/8 inch			50-70	□8	
Number 4			35-55	□8	30-60
Number 10	35-75	35-90			
Number 30			12-25	□5	
Number 40	20-50	20-55			
Number 200	0. 3-20	5-25	0-8	□3	0-15

[1]MSHA- Base Bank Run Gravel

[2]MSHA- Subbase Bank Run Gravel

[3]MSHA - Base GradedAggregate

[4]MSHA - CrusherRun Aggregate

PART 3 EXECUTION

3.1 EXCAVATION

A. General: Excavate to lines and grades indicated on Drawings.
On-grade Slabs and Pavements: Sufficient to allow for fills, base, and waterproofing materials.

1. Planting Areas: Sufficient to allow for topsoil.
2. Formed Concrete: Sufficient to allow for convenient construction and removal of forms, and for application of waterproofing and curing materials.

B. Test Pit Excavation: Perform with caution and to prevent damage to facility.
Before pipe installation:
   a. Dig test pits to determine size, type, and exact location of existing pipe to which proposed pipe will connect.
   b. Excavate sufficient trench in advance and test pit all existing underground utilities or structures, whether shown on Drawings or visually identified in the field, to:
      1) Verify actual locations.
      2) Make reasonable changes in line and grade to resolve conflicts, with Contract Manager's approval.
   c. Furnish Contract Manager location and elevation information when previously unknown or different underground utilities or structures are encountered.
2. Perform additional work made necessary because of failure to take above precautions.
3. See Section 31 10 00 for additional information on test pits.

C. Material Storage and Disposal of Unsuitable Material.
1. Separate and protect excavated material which is suitable Trench Backfill from contamination by unsuitable excavated material or by other sources.
2. Stockpile suitable materials in location to avoid contamination and prevent erosion.
3. See Section 01 11 00 for off-site disposal of excess excavated material and unsuitable material.
4. See Section 31 10 00 for site clearing and storage of existing top soil.

D. Unauthorized Excavation: Where excavations are made below indicated elevations under slabs, footings, pipes, structures, or outside maximum trench pay widths, restore to proper elevations with materials specified herein at Contract Manager's direction.

E. Trench Excavation.
1. Excavate trenches to width and depth following WSSC Standard Details, Drawings, or specified herein.
   a. Sides of trenches within Pipe Embedment Zones: Practically plumb.
   b. Trench widths within Pipe Embedment Zone for Rigid Pipe shown on Drawings are maximum widths.
2. Remove rock, when encountered, to minimum depth of 6 inches below pipe barrel and pipe bell and structures.
   a. Excavate trench bottom to conform with shape and dimensions of proposed pipe or structure.
   b. Excavate bell holes in trench bottom to permit proper assembling of joints.
   c. Support pipe or structure uniformly and continuously, upon specified material.
3. Where material not meeting requirements of Trench Backfill and deemed unsuitable by Contract Manager is encountered either contiguous to or within proposed limits of excavation, Contract Manager may direct additional excavation and removal of unsuitable material.
   a. Depth and extent of additional excavation at Contract Managers determination.
4. Perform excavation in immediate vicinity of adjacent and crossing facilities by means that will not damage facility.
   a. Excavate within 1 foot of existing pipelines or conduits by hand.
   b. Repair or replace damage caused to existing facilities, pipelines, or conduits.
5. Unless otherwise authorized by Contract Manager, proceed with trench excavation no more than 75 feet in advance of placing of Trench backfill.
   a. Contract Manager may require backfilling and subsequent re-excavation on trenches left open in advance of pipe installation.

b. Protect or enclose trenches left open overnight, or during periods when Contractor's personnel are not present and mark to prevent danger to public or others.

6. Excavate sides of trenches in improved public areas and adjacent to other utilities or structures practically plumb.
   a. When crossing under existing pipes or conduits, plumb sides of trench from 1 foot above top of existing pipes or conduits to bottom of trench.
   b. With Contract Manager's permission, sides of trenches in other areas may be sloped from 1 foot above top of pipe to finished grade.
7. Trench Sheeting, Shoring, and Bracing: Place so as not to interfere with construction work and be entirely independent of footings and structures.
   a. Method, design and adequacy of sheeting, shoring and bracing: Meet requirements of MOSH.
      1) Repair damage related or caused by excavation.
      2) Sheeting, shoring, and bracing: Before placement, use means acceptable to Contract Manager for its removal as backfill progresses.
   b. Sheet and shore as required to assure safe working conditions, maintain required excavation dimensions for proper construction, and to prevent accidents, cave-ins, and damage to adjacent structures, facilities, and surfaces.
      1) In excavations over 4 feet in depth, where the Owner personnel are required to enter, sheeting and shoring shall meet requirements of MOSH for Type "C" soil conditions.
   c. Remove sheeting, shoring, bracing and wood forms concurrently with backfilling operations, except in Pipe Embedment Zone and where sheeting is used as 1 side of form for concrete.
      1) Accomplish removal in manner that precludes settlement of backfill, cave-in of excavation sides, and prevents damage to adjacent surfaces.
      2) Promptly fill voids left or caused by removal.
      3) Compact contiguous areas concurrent with removal of trench sheeting.
   d. Follow WSSC Standard Details where sheeting is used for trench width between interior faces of sheeting.
   e. Sheeting may be left in place, provided that following are met:
      1) Positive verification that no voids exist between sheeting and trench wall.
      2) Upper wales and horizontal braces are removed or excavation is backfilled with sand.
      3) Existing voids are filled following Trench Backfill requirements.
      a) Sheeting left in place: Cut off minimum of 1-1/2 feet below finished grade or at Contract Manager's direction.
8. Trench Boxes or Mules: Use of trench boxes will be permitted in areas where excavation sidewalls are suitable and where sheeting, shoring, and bracing are not required to maintain excavation dimensions.
   a. Structural box design: To withstand pressures imposed thereon.
      1) Trench boxes and steel plates and their use: Meet requirements of MOSH.
   b. Location:
      1) Do not extend trench box below top of Pipe Embedment Zone during or after placement of Pipe Embedment Zone material.
      2) Remove steel plates used below trench box in Pipe Embedment Zone simultaneously with placement of Pipe Embedment Zone material and before its compaction.
   c. Box size:
      1) Height: Sufficient to assure safe working conditions.
      2) Length: To accommodate size and lengths of pipe being installed.

3) Width: For trench opening not more than maximum permitted in WSSC standard details.

F. Rock Excavation.

1. When blasting, control fly rock and material to prevent injury or damage to persons or properties.
   a. Use blasting mats in areas where overburden has been removed before blasting, or as required to control fly rock.
   b. Equipment used for drilling holes shall have positive means of dust control and meet OSHA and other applicable regulations and agencies requirements in asbestos-bearing rock area.
2. Blasting unless otherwise directed by Contract Manager:
   a. No closer than 10 feet to existing water, gas, sewer or conduit utilities unless such facilities have been completely exposed, definitely located, and then backfilled before blasting.
   b. No closer than 2 feet from definitely located existing utilities, 10 inch or smaller diameter.
   c. No closer than 5 feet from utilities larger than 10 inch diameter.
3. Use controlled blasting techniques.
   a. Modify blasting round as necessary to achieve best obtainable results and to keep air blast over pressure, vibrations, and noise within limits herein specified.
      1) Exercise care in drilling and blasting operations to minimize over break and blast damage of adjacent unexcavated ground.
      2) Produce satisfactory excavated surface by determining proper relationships of burden, spacing, depth of charge, amount and type of explosive, hole size and delay pattern, and other necessary considerations to achieve required results.
4. Vibration and Air Blast Control.
   a. Control operations to ensure:
      1) Peak particle velocity will not exceed 2 inches per second measured adjacent to any structure in vicinity of blasting operations or following limits for concrete:

Inches Per Second	Age of Concrete
0.25	12 - 24 hours
0.5	24 - 48 hours
1.0	48 hours - 5 days
2.0	5 plus days

      2) Impact or impulsive noise from blasting operations will not exceed 140 db peak sound pressure level measured at nearest structure or property line.
   b. Peak particle velocity definition: Maximum of 3 velocity components of a vibration measured at any point in 3 mutually perpendicular directions by Contract Manager approved seismograph, capable of producing permanent record and capable of internal dynamic calibration.
   c. Furnish seismograph instruments, qualified personnel to operate instruments, interpret results for all blasting operations, and submit copy of results to Contract Manager.
   d. Record air blast over pressure with peak impact recording instrument having linear frequency response, and submit copy of results to Contract Manager.
5. Repair or replace facilities damaged by blasting operations.
6. Replace rock which is not broken to meet backfill requirements with suitable Trench Backfill, as specified herein.

G. Dewatering and Drainage.

1. If water is encountered in excavation, install and maintain dewatering system of sufficient capacity to remove it during excavation, pipe placement, and backfill.
    a. For structures:
        1) Until concrete footings have been poured and cured,
        2) Walls or other portions of structure are erected to grade,
        3) Or until excavation has been backfilled.
    b. Do not allow sediment-laden water to flow into watercourses, drainageways, or over land without first filtering it through approved desilting device. See Section 01570.
2. Choose methods of dewatering excavations including, but not limited to, sump pumps, wellpoints, deep wells, drainage blankets, and tight sheeting.
    a. Continuously inspect dewatering system to ensure it is functioning properly.
    b. Ensure system does not disturb or degrade final subgrade for new pipe or structure and does not cause damage or settlement to adjacent surfaces or structures.
    c. Modify system as required, and repair or restore damage or disturbance caused by system.
    d. Install necessary temporary surface drainage and keep it operating, until permanent drainage or finish grading has been completed.
    e. Do not allow damming or ponding of water in gutters or storm drains.
3. Remove dewatering devices upon completion of work.

3.2 BACKFILL OPERATIONS

A. Placing Trench Backfill.

1. Backfill trench excavations with soils material excavated therefrom, provided this material meets requirements of Trench Backfill herein and at Contract Manager's approval.
2. Do not place, spread, or compact frozen or thawing material or place specified materials upon frozen or thawing ground or during unfavorable weather conditions.
    a. When work is interrupted by rain, do not resume backfill operations until field tests indicate moisture content and density of materials are within specified limits.
    b. Rework and recompact after thawing compacted layers which have been frozen before next layer is placed.
3. Mix each lift before compaction to ensure uniform distribution of water content and distribute rocks of permissible sizes through material.
4. Place Trench Backfill and utilize compaction equipment that will not damage structures, pipe, and appurtenances.
    a. Place and compact Trench Backfill around pipe and structures evenly to preclude unbalanced pressure.
    b. Compaction with large rollers or heavy equipment will not be permitted within 5 feet of structures.
    c. Repair damage done during backfill operations or replace at Contract Manager's direction.
5. Place Trench Backfill in uniform lifts of 8 inches maximum in uncompacted thickness, unless otherwise specified herein.
    a. Spread each layer uniformly and evenly.
    b. Perform compaction using compacting rollers, pneumatic or vibratory compactors.
6. When Borrow Material is utilized, place in uniform lifts of 8 inches maximum in uncompacted thickness.
    a. Backhoe buckets permitted for gravel compaction.

7. Backfill Structural Fill areas in uniform lifts of 8 inches maximum in uncompacted thickness and compact to not less than 95 percent of maximum dry density, following ASTM D698, at moisture content within 2 percent optimum for material.
8. Meet following conditions when flowable fill is used instead of Trench Backfill material when specified herein for Type I areas under existing paved areas and for circular precast or cast-in-place concrete manholes.
    a. Prevent floatation during placement of flowable fill.
    b. Install 12 inches minimum of Trench Backfill material around valves, valve boxes, and fire hydrants.
    c. Place flowable fill at maximum of 10 foot lifts.
        1) Cure flowable fill at least 4 hours before placing additional lift of flowable fill.
        2) Cure final lift at least 24 hours before placing additional compacted Trench Backfill material or paving.
    d. For circular precast or cast-in-place concrete manholes, when specified herein, place flowable fill equally around entire manhole from 1 foot above uppermost pipe entering manhole.
        1) Backfill trench with flowable fill from top of Pipe Embedment Zone to below pavement base course.
        2) Outside Type I areas backfill minimum 12 inches Trench Backfill material above flowable fill.

B. Placing Trench Backfill for Pipes.
1. In new subdivision work where water and sewer service connections are to be placed in same trench at different times, backfill and compact above sewer service connection as specified up to proposed finished grade.
    a. When installing water service connection, re-excavate as required, install water pipe, backfill, and compact as specified.
2. Detectable Warning Tape
    a. Use blue detectable warning tape for water mainline and water service connections.
    b. When water and sewer are installed in same trench use only blue detectable tape.
    c. Use green detectable warning tape for gravity sewer mainline, gravity sewer service connections, and pressure sewer piping for both grinder pump systems and force mains.
        1) Detectable warning tape will not be required when both manholes in gravity sewer mainline reach are within limits of existing or proposed paved areas.
    d. Place tape directly over centerline of pipe, between 18 to 30 inches below finished surface and with minimal number of splices.
        1) Overlap tape minimum 6 inches at splices and intersections.
3. On steep slopes, place trench erosion checks following Standard Details, at locations shown on Drawings or at Contract Manager's direction.
4. When pipelines cross under existing utilities, place and compact Trench Backfill around and between existing pipelines or conduits, using manual tampers to ensure proper compaction and to avoid damage to pipes or conduits.
    a. When indicated on Drawings, place and compact Borrow Aggregate to limits following Standard Detail.
    b. Flowable fill may be used instead of Borrow Aggregate specified herein.
5. When connecting to existing pipelines, backfill under and around excavated and undermined existing pipes with Trench Backfill compacted as structural fill:

a. Backfill existing Rigid Pipe to pipe spring line with Borrow Aggregate ASTM C33, coarse aggregate size number 67, or same Borrow Aggregate as used at connecting or adjacent pipe.
b. Backfill existing Flexible Pipe to 1 foot above top of pipe:
   1) DIP 24 inch and smaller and Type K Copper Pipe: Trench Backfill.
   2) DIP larger than 24 inch: Borrow Aggregate.
      a) Bank run gravel, gradation number 1,
      b) Or crushed stone, gradation number 3.
   3) PVC Gravity Sewer Pipe:
      a) Borrow aggregate, ASTM C33.
      b) Coarse aggregate, size number 67 or size number 8.
   4) PVC AWWA C900/905 PVC Pipe:
      c) Pipe with 10 feet or less cover:
      (1) Trench Backfill containing no rock or gravel larger than 3/4 inch.
      (2) Or Borrow Aggregate meeting ASTM C33, coarse aggregate size number 67 for Bedding Zone.
      d) Pipe with greater than 10 feet cover:
      (1) Borrow Aggregate meeting ASTM C33, coarse aggregate size number 67 for Bedding Zone.

6. Place and compact specified Trench Backfill in following Zones to width and depth following Standard Details and Drawings, unless otherwise specified.
   a. Additional excavation area below Pipe Embedment Zone: Place as Trench Backfill and compact as Structural Fill.
   b. Pipe Embedment Zone: Place and compact Trench Backfill as Structural Fill.
      1) DIP, 24 inch and smaller and PVC AWWA C900/905: If additional excavation below trench bottom is required to remove unsuitable material, install minimum 6 inches of compacted Trench Backfill between pipe and additional excavation material.
      2) PVC Pipe: Compact using manual tampers.
      3) All sizes of DIP with polyethylene encasement: Place Trench Backfill around pipe without damaging pipe coating and polyethylene encasement.
         a) Do not drop Trench Backfill directly on pipe; use deflecting boards or other temporary protection.
         b) Do not permit workers to walk on or place tools on pipe.
      4) Sewer pipe connections to manholes or structures: Bentonite when required, following Section 02530, Standard Details or Drawings.
      5) Pipe Embedment Zone within Wetland Areas: Extend from trench bottom to 6 inches above pipe, full width of trench.
      6) Pipe to have concrete encasement: Place concrete around pipe within Pipe Embedment Zone, to limits shown on Standard Details.
   c. Final Backfill Zone: Place Trench Backfill and compact following these designation types.
      1) In Type I areas under existing paved areas:
         a) Compact to not less than following percents of maximum dry densities at moisture content within 2 percent of optimum for material, as determined by listed ASTM method.
         (1) MSHA highways: 92 percent, except for top foot will be 95 percent following ASTM D1557.
         (2) All other paved areas: 95 percent, except for top foot will be 100 percent following ASTM D698.
      2) In Type I areas under future paved areas and within public rights of way: Compact to not less than 95 percent of maximum dry density following

ASTM D698 at moisture content within range where density can be obtained based on moisture density curves taken on existing soil.

3) In Type II: Compact in layers to form thoroughly dense refill free of voids and to preclude settlement within limits specified herein.
4) In Type III areas: Place in 12 inch maximum lifts and compact to not less than 90 percent of maximum dry density, following ASTM D698, at moisture content within range where density can be obtained.
5) In Type IV areas: Place in 12 inch lifts.

C. Placing Trench Backfill for Structures.
1. Place and compact specified backfill material to width and depth following Standard Details, Drawings, and specified herein.
a. Additional excavation area, below Granular Bedding: Place and compact Trench Backfill as Structural Fill.
b. Granular Bedding, under structure: Place and compact specified herein.
c. Place and compact Trench Backfill as Structural Fill to top of structure or to finished grade, following Drawings or Standard Details.

D. Finished Grade.
2. Slope surface to drain, to provide positive drainage in Type I, II, and III areas.

3.3 RESTORATION
A. Restore and restabilize surface features and facilities damaged or destroyed during construction at least to condition existing before construction, following Section 01770, and other applicable Specification Sections.

END OF SECTION

SECTION 31 25 13

EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work shall consist of the application of erosion and sediment control measures throughout the life of the project to control erosion and to minimize the sedimentation in rivers, streams, lakes, reservoirs, bays, and coastal waters as specified in the Contract Documents or as directed by the Engineer.

B. Erosion and sediment control measures shall be applied to all disturbed areas. In addition, the Contractor shall identify all staging and stockpile areas and apply erosion and sediment control measures as approved by the Engineer and the Maryland Department of the Environment.

C. The Contractor shall assign an employee to the project to serve in the capacity of Erosion and Sediment Control Manager (ESCM).

1.2 STANDARDS AND SPECIFICATIONS

A. The erosion and sediment control measures and devices shall be constructed in conformance with the latest Maryland Standards and Specifications for Soil Erosion and Sediment Control published by the Maryland Department of the Environment, Water Management Administration and all revisions thereof including the additions and modifications specified herein or in the Contract Documents. The Contractor shall keep a copy of the latest Maryland Department of the Environment (MDE) Standards and Specifications for Soil Erosion and Sediment Control on the site at all times.

PART 2 - PRODUCTS

2.1 MATERIALS.

A. Riprap. Shall conform to MSHA 901.03

B. Stone for gabions. Shall conform to MSHA 901.05

C. Hot Mix Asphalt. Shall conform to MSHA 904

D. Pipe. Shall conform to MSHA 905

E. Gabion Wire. Shall conform to MSHA 906

F. Steel Plate. Steel for miscellaneous use shall conform to A 36 or A 709, Grade 36.

G. Welding Material. Welding materials shall conform to AASHTO AWS D1.5.

H. Fence Fabric for Super Silt Fence. Chain link fencing fabric shall be 2 in. mesh woven from coated No. 9 gauge wire. The ends shall have a knuckled selvage at the bottom and a barbed selvage at the top. The fabric shall conform to M 181. Type I fabric shall conform to Class C coating. The mesh shall be 42 in. in height.

I. Seed, Mulch, Fertilizer, Soil Conditioner, Soil Stabilization Matting, and Other Materials for seeding and soil stabilization shall conform to the follows:
   1. Seed. Refer to MSHA 920.04
   2. Mulch. Refer to MSHA 920.05
   3. FERTILIZER. Refer to MSHA 920.03
   4. Soil Stabilization Matting. Refer to MSHA 920.06

J. Straw Bales. Straw bales for erosion and sediment control shall conform to the Contract Documents and shall be approximately 14 X 18 X 36 in.

K. Geotextile, Class as specified. Geotextile shall conform to the MSHA 921.092 to 3 in. Stone. Stone shall conform to M 43, No. 2.

L. 3/4 to 1-1/2 in. Stone. Stone shall conform to M 43, No. 4.

M. No. 57 Stone. Stone shall conform to M 43, No. 57.

N. Soil Stabilization Matting will replace Erosion Control Matting, and Geotextile Class SE will replace Filter Cloth and Geotextile Class C where they appear in the latest Maryland Standards and Specifications for Soil Erosion and Sediment Control.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to MSHA 402.03.01 for excavated material.

3.2 CONTRACTOR RESPONSIBILITIES

A. The Contractor shall construct all erosion and sediment control measures in conformance with 1.2. The Contractor shall have all control measures inspected and approved by the Engineer and PGSCD prior to beginning any other land disturbances. The Contractor shall ensure that all runoff from disturbed areas is directed to the sediment control measures. The Contractor shall not remove any erosion or sediment control measure without the approval of the Engineer and PGSCD.

3.3 EROSION AND SEDIMENT CONTROL PLAN (E & S PLAN) AND SEQUENCE OF CONSTRUCTION

A. The Contractor shall implement the E & S Plan and Sequence of Construction as approved by PGSCD. Minor adjustments to the sediment control locations may be made in the field with the approval of the Engineer and PGSCD. Major revisions, deletions, or substitutions to the E & S Plan will require a formal review and approval by the Engineer and PGSCD. Changes to the approved E & S Plan shall be submitted to the Engineer in writing at least 14 days prior to implementing the change. The Contractor shall obtain Engineer and PGSCD approval for changes to the E & S Plan or Sequence of Construction prior to implementing the change.

3.4 EROSION AND SEDIMENT CONTROL MANAGER (ESCM)

A. At least 10 days prior to beginning any work, the name and credentials of the ESCM shall be submitted to the Engineer for approval. Any substitutes for the ESCM will be subject to the approval of the Engineer. The substitution shall be timed to ensure that an ESCM is assigned to the project at all times. The Engineer reserves the right to request a reassignment of the ESCM duties to another individual for any reason.

B. The ESCM shall be thoroughly experienced in all aspects of construction and have satisfactorily completed an Erosion and Sediment Control Training Program either

conducted or authorized by PGSCD pursuant to the appropriate article published in the Annotated Code for the State of Maryland. The ESCM shall have primary responsibility and authority for the implementation of the approved erosion and sediment control plans, schedules and methods of operation for both on-site and off-site activities.

C. The ESCM's duties shall include:

1. Inspect the erosion and sediment controls on a daily basis to ensure that all controls are in place at all times and to develop a list of activities and schedules to ensure conformance with the Contract Documents.
2. Maintain a daily log of these inspections, including actions taken, and submit a written report to the Engineer at the end of the work day.
3. Conduct after storm inspections with the Engineer both during and beyond normal working hours/days and submit a written report to the Engineer.
4. Be assigned the authority by the Contractor to mobilize crews to make immediate repairs to the controls during working and nonworking hours.
5. When requested, accompany the Engineer on Quality Assurance Inspections and inspections made by the regulating agencies.
6. Coordinate with the Engineer to ensure that all corrections are made immediately and that the project is in compliance with the approved plan at all times.

3.5 SCHEDULE

A. Within 14 days after the Notice of Award, the Contractor shall submit for approval to the Engineer, an Erosion and Sediment Control Schedule to implement the E & S Plan. The schedule shall indicate the sequence of construction, implementation and maintenance of controls, temporary and permanent stabilization, and the various stages of soil disturbance. The schedule shall include the following:
   1. Clearing and grubbing of areas necessary for installation of perimeter controls specified in the Contract Documents.
   2. Construction of perimeter controls specified in the Contract Documents.
   3. Remaining clearing and grubbing.
   4. Roadway grading (including off-site work).
   5. If applicable, utility installation and whether storm drains shall be used or blocked after construction.
   6. Final grading, landscaping, and stabilization.
   7. Removal of perimeter controls.

B. No work shall be started, on-site or off-site until the Erosion and Sediment Control schedules and methods of operation have been accepted by the Engineer.

3.6 PRECONSTRUCTION CONFERENCE

A. At the Preconstruction Conference, the Contractor shall present a general overview of how erosion and sediment control measures will be implemented on the project.

3.7 MEETINGS

A. At least seven working days prior to the start of work, the Engineer will initiate and conduct an Erosion and Sediment Control Field Meeting. The meeting shall be attended by the ESCM, and representatives of the Engineer.

B. In addition to the initial Erosion and Sediment Control Field Meeting, periodic in-field Erosion and Sediment Control Meetings will be held to review and evaluate the effectiveness of measures already installed, and to plan for the implementation of necessary controls proposed for succeeding areas of soil disturbance.

3.8 INITIAL CONTROLS

A. All perimeter controls such as silt fence, earth dikes/swales, check dams, traps, basins, etc., shall be installed prior to the clearing and grubbing operation.

B. If the Engineer determines that the clearing area has been disturbed and a potential for sediment runoff or erosion exists, the Engineer will direct the Contractor to install the controls at that time.

3.9 STABILIZATION REQUIREMENTS

A. Areas flatter than 3:1 and stockpile areas shall be permanently or temporarily stabilized as soon as possible, but not later than fourteen days after grubbing and grading activities have ceased in the area. Trap embankments and slopes, earth dikes, temporary swales, perimeter dike/swales, ditches, and slopes 3:1 or steeper shall be permanently or temporarily stabilized as soon as possible, but not later than seven days after grubbing and grading activities have ceased in the area. The seven and fourteen day requirements mean that the stabilization operation is complete within the applicable seven or fourteen day time frame.

B. When the excavation or embankment reaches the bottom of the subgrade, those areas in which paving will be placed are exempt from the stabilization requirements. Areas between temporary berms, except median areas, need not be stabilized during incremental stabilization. When permanently stabilized areas are disturbed by the Contractor's grading operation or other activities not specifically approved by the Engineer, the restabilization will be at no additional cost to the Owner. Stabilization requirements may be reduced to less than seven days for sensitive areas. Maintenance shall be performed as necessary to ensure continued stabilization.

C. All slopes shall be tracked within five days of establishment with cleated type equipment operating perpendicular to the slope.

3.10 MAINTENANCE

A. All erosion and sediment control devices shall be maintained during the construction season, the winter months, and other times when the project is shut down. Access shall be maintained to all erosion and sediment controls until the controls are removed. Lack of maintenance by the Contractor will be considered as noncompliance with the E & S Plan and grounds for a shutdown of the project.

B. Controls shall be inspected immediately following storm events. The Contractor shall repair controls when damaged and clean out controls as necessary as the first order of business after a storm event.

C. Any pumping activity, including dewatering sediment traps and basins, shall be directed through a dewatering device approved by PGSCD.

D. Perimeter controls shall be inspected daily, repairs shall be made immediately.

3.11 WASTE AREAS

A. Off-site waste areas require PGSCD approval. All other off-site waste areas shall be approved by the appropriate local authority. All waste areas and stockpile areas shall be protected by erosion and sediment control measures and stabilized within the seven or fourteen day stabilization requirement.

3.12 PGSCD INSPECTIONS

A. PGSCD will conduct frequent field inspections relative to erosion and sediment control compliance. If they determine that noncompliance with erosion and sediment control provisions are found, their representative will immediately notify the Engineer relative to corrective action. This corrective action may require a shutdown of construction activities until the noncompliance is satisfactorily corrected, and no claims against the Owner will be considered due to a shutdown of the grading operations or the entire project.

3.13 SIDE OR BERM DITCHES AND CULVERTS

A. As a first order of work, the Contractor shall construct the side ditches in fill areas and berm ditches in cuts including lining. These linings shall be protected from sediment deposits. Silt fence shall be placed along the banks of existing streams as shown in the Contract Documents prior to any culverts being placed. To avoid sedimentation during the construction of culverts, the streams shall be diverted around the location of the culvert until the proposed culvert and channel have been stabilized.

3.14 REMOVAL OF CONTROLS

A. No erosion and sediment control measures shall be removed until all previously disturbed areas are vegetated with a minimum 3 in. growth of grass, and the removal has been approved by the Engineer and PGSCD. The sediment controls shall be backfilled, graded, and stabilized as specified in the Contract Documents.

B. All control devices shall be removed, except where an attempt to remove a particular control may severely disturb an area that has been stabilized. When a sediment trap or stone outlet structure is placed at the bottom of a fill greater than 8 ft, the controls may be left in place as determined by the Engineer. Sediment traps left in place shall be stabilized by placing soil stabilization matting over a permanent seed mix.

3.15 EROSION AND SEDIMENT CONTROL ORIGINAL EXCAVATION

A. The Contractor shall excavate, construct embankments, grade, and backfill for sediment traps, sediment basins, and other sediment controls as specified in the Contract Documents, or as directed by the Engineer.

B. Excavation and embankments shall be to the dimensions for each sediment control as specified in the Contract Documents. Excavated material shall be stockpiled and used for backfill when the sediment controls are removed.

3.16 EROSION AND SEDIMENT CONTROL CLEANOUT EXCAVATION

A. The Contractor shall remove accumulated sediment from sediment controls or other areas during routine maintenance of sediment controls, or as directed by the Engineer.

B. Sediment traps shall be cleaned out as necessary to have a minimum of 50 percent of the wet storage capacity available at all times. Riprap outlet sediment traps shall have at least 75 percent of the wet storage capacity available at all times. Silt fence, super silt fence, stone outlet structures, stone check dams, and straw bales shall have sediment removed when it reaches 50 percent of the height of the control device.

C. Sediment removed from control devices shall be placed in an approved waste site either on or off the project. Material stored on-site may be reused once it is dried and it conforms to PGSCD requirements for embankment.

3.17 EARTH DIKE

A. Stabilization using sod is prohibited.

3.18 PIPE SLOPE DRAIN

A. Interceptor berms shall be constructed to direct flow into the flared end section when slope drains are placed on grade. The geotextile apron shall be keyed into a 4 X 4 in. trench.

3.19 TEMPORARY RISER MODIFICATION FOR SEDIMENT BASIN

A. See Item 3030 Temporary Riser Modification for Sediment Basin.

3.20 SILT FENCE

A. The geotextile shall be embedded a minimum of 8 in. vertically into the ground and extend a minimum of 22 in. above ground. The fence post shall be driven a minimum 16 in. into the ground and extend a minimum 26 in. above the ground.

B. Silt fence shall be removed and reset when and as directed by the Engineer. All of the requirements for the original placement of the silt fence shall be strictly adhered to when the fence is reset.

3.21 STABILIZED CONSTRUCTION ENTRANCE

A. Stabilized construction entrances shall be located as specified in the Contract Documents or as directed by the Engineer.

B. Rehabilitate stabilized construction entrance shall consist of periodic top dressing with additional aggregate, replacement of pipe, or other repairs to the entrance and sediment trapping devices as needed or as directed by the Engineer.

3.22 SUPER SILT FENCE

A. The construction requirements for the placement of the chain link fence shall be as specified in MSHA 607.03 with the following exceptions:
   1. Drive anchors shall be used when and as directed by the Engineer.
   2. The lower tension wire, brace and truss rods, post caps, 1 in. ground clearance, and concrete footings shall not be used.

B. Geotextile shall be embedded a minimum of 8 in. into the ground and extend a minimum of 33 in. above ground.

C. Super silt fence shall be removed and reset when and as directed by the Engineer. All of the requirements for the original placement of the super silt fence shall be strictly adhered to when the fence is reset.

3.23 TEMPORARY ASPHALT BERM

A. When a storm drain system outfall is directed to a sediment trap, or sediment basin, and the system is to be used for temporarily conveying sediment laden water, all storm drain inlets in nonsump areas shall have temporary asphalt berms constructed as directed by the Engineer at the time of base paving to direct gutter flow into the inlets to avoid surcharging and overflow of inlets in sump areas.

3.24 STONE FOR SEDIMENT CONTROL

A. The Contractor shall place No. 57 stone, 3/4 to 1-1/2 inch stone, 2 to 3 inch stone, 4 to 7 inch stone and riprap for sediment control as specified in the Contract Documents or as directed by the Engineer.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 DESCRIPTION

A. This work shall consist of constructing base courses using one of the following as specified in the Contract Documents or as directed by the Engineer:

1. Graded aggregate without a stabilizing agent.
2. Plant mixed graded aggregate with a portland cement stabilizing agent.
3. Bank run gravel.
4. Sand aggregate.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Graded Aggregate for Base Course — See MSHA 901.01

B. Bank Run Gravel for Base Course — See MSHA 901.01

C. Sand Aggregate Base Course

Coarse Aggregate	See MSHA 901.01, Size No. 57
Fine Aggregate	See MSHA 916.01.01

D. Portland Cement — See MSHA 902, Type I or IA

E. Emulsified Asphalt:

Emulsified asphalts shall conform to M 140 or M 208 with the following exceptions:

1. Cement mixing tests are waived.
2. Grade SS-1 viscosity shall be 50 to 400 seconds at 77 F.
3. Maximum of 3.0 percent by volume of oil distillate.
4. The sieve test requirement for field samples shall be a maximum of 0.4 percent.

F. Production Plant — See MSHA 915

G. Water

1. Water shall conform to the pH requirements of T 26, Method B and shall be clear. If questionable quality is suspected, the water shall conform to the limits of the comparison tests with distilled water as specified in T 26. The chloride concentration of water used in mixing and curing of portland cement concrete shall be determined in conformance with D 512 and shall not exceed 1000 ppm

G. Moisture and Dust Control Agents: — See MSHA 921.02

PART 3 EXECUTION

3.1 CONSTRUCTION

A. At least 30 days prior to the start of constructing the base course, the Contractor shall submit the proposed plants, equipment, and material sources to the Engineer for approval.

B. The Contractor shall protect the subgrade and base against damage from all causes. Any part of the subgrade or base that is damaged shall be repaired or replaced by the Contractor in a manner acceptable to the Engineer at no additional cost to the Owner.

C. Excavation for widening shall be limited to an area which can be backfilled the same working day using graded aggregate base course. The temporary graded aggregate base wedge shall be maintained with a 4:1 or flatter fill slope. The material shall be compacted as directed by the Engineer. The graded aggregate base wedge shall remain in place until placement of the hot mix asphalt base.

3.2 EQUIPMENT

A. All equipment, including the production plant and on-site equipment, shall be subject to approval by the Engineer. The plant shall be ready for inspection by the Engineer at least 48 hours prior to the start of construction operations.

3.3 WEATHER RESTRICTIONS

A. Temperature and Surface Conditions: Graded aggregate stabilized with portland cement shall be placed only when the ambient air and surface temperature is at least 40 F and rising. Graded aggregate, bank run gravel and sand aggregate base shall be placed only when the ambient air and surface temperature is at least 32 F and rising. Placing material on a frozen subgrade is prohibited.

B. Cold Weather Protection: The plant mixed graded aggregate stabilized base shall be protected from freezing during the seven day curing period.

C. Precipitation: Construction during precipitation is prohibited. When precipitation has occurred during the previous 24 hours, the Engineer will determine if the subgrade is sufficiently dry. Any material en route from the plant to the job site may be placed at the Contractor's risk

3.4 SUBGRADE PREPARATION

B. The approved subgrade set to final line and grade shall be completed at least 500 ft ahead of the base course or as directed by the Engineer before the base course construction begins. The foundation shall be constructed as specified in MSHA 204 and MSHA 208, the Contract Documents, and as approved by the Engineer. If traffic, including construction equipment, is allowed to use the subgrade foundation or preceding layer, it shall be distributed over the entire width of the course to aid in obtaining uniform and thorough compaction. If ruts are formed, they shall be removed by reshaping and recompacting the affected area as specified in MSHA 204.

3.5 STABILIZED GRADED AGGREGATE BASE MIX

A. The amount of portland cement shall be determined as specified in Maryland Standard Methods of Tests 321.

3.6 BANK RUN GRAVEL BASE MIX

C. The Contractor will be permitted to mix or blend materials using chemical additives approved by the Engineer.

3.7 SAND AGGREGATE BASE MIX

A. The mixture shall contain 35 to 40 percent coarse material as measured by dry weight of the total mix.

3.8 TRANSPORTATION

A. Mixed base materials shall be handled and transported in a manner that minimizes segregation and loss of moisture. All loads shall be covered in conformance with State laws unless hauling is off road and is approved by the Engineer. Dumping into piles, hauling over the completed base course, and stockpiling of material on the job site is prohibited unless approved by the Engineer.

3.9 SPREADING

A. The base material shall be uniformly spread without segregating the coarse and fine particles, in layers of approximately equal thickness, to provide the specified planned depth. Shoulders or berms not less than 2 ft wide shall be built up on each side of the base to the top elevation of each uncompacted layer unless the base is placed against concrete curbs or gutters.

3.9.1 GRADE OR FINISHED SURFACE CONTROL

A. The surface of the base material shall be shaped to the required lines, grades and cross section specified in the Contract Documents. Grades shall be set longitudinally and transversely with fixed controls having a maximum spacing of 25 ft. The surface material shall be compacted and smoothed over its full width using a smooth faced steel wheeled roller or, if rolling is not feasible, by mechanical tampers and vibratory compactors as approved by the Engineer. The finished grade shall not deviate more than 1/2 in. from the established grade.

3.10 COMPACTION

A. Immediately after placement, the base material shall be compacted to the required density. During compaction operations, the moisture content of the material shall be maintained within 2 percent of the materials optimum moisture. The optimum moisture content and maximum dry density shall be determined as follows:

1. Sand Aggregate Base and Bank Run Gravel Base: T 180
2. Graded Aggregate Base and Graded Stabilized Aggregate Base: Maryland Standard Method of Tests 321

B. Graded aggregate for base, bank run gravel base, and sand aggregate base shall be compacted to a minimum density of 97 percent of the maximum dry density. Graded stabilized aggregate base shall be compacted to a minimum dry density of 95 percent of the maximum dry density. In place density shall be measured as specified in Maryland Standard Method of Tests 350 or 352.

C. Compaction operations, except on superelevated curves, shall begin at the sides of the course, overlap the shoulder or berm at least 1 ft and progress toward the center parallel to the center line of the roadway. Superelevated curve compaction shall begin at the low side of the superelevation and progress toward the high side. The compaction operation shall continue until all compaction marks are eliminated.

3.11 GRADED STABILIZED AGGREGATE BASE PROTECTION AND CURING

A. When graded stabilized aggregate base is used, the spreading, compacting and shaping shall be completed within three hours after the mixing water, cement and aggregate have come in contact. Any section not conforming to these requirements shall be reconstructed as directed by the Engineer at no additional cost to the Owner. The surface of the

stabilized aggregate base course shall be maintained in a moist condition until the emulsified asphalt seal coat is applied. The emulsified asphalt shall be applied by distributing equipment as specified in MSHA 503.03.01 at the rate of 0.2 gal/yd^2. Ponding of the emulsified asphalt shall be avoided. If ponding occurs, the Contractor shall use a sand blotter or an equivalent method as approved by the Engineer.

B. The stabilized aggregate base course shall be allowed to cure for a period of seven days. During this period the base course shall be closed to all traffic. Any portion of the base course seal coat that is damaged shall be repaired at no additional cost to the Owner.

3.12 MOISTURE AND DUST CONTROL AGENTS

A. When specified in the Contract Documents or as directed by the Engineer, calcium or magnesium chloride shall be added at the plant or applied to the surface of the graded aggregate, bank run gravel, or sand aggregate base at the project site. Calcium chloride shall be applied at the rate of 1 lb/yd^2. Magnesium chloride shall be applied at the rate of 1 lb/yd^2 or as a solution at the rate of 1/2 gal/yd^2.

3.13 MAINTENANCE

A. During construction and after completion of the base course, the base shall be maintained by the Contractor until the surface course is placed. Unacceptable work that cannot be repaired shall be replaced for the full depth of the base at no additional cost to the Owner.

END OF SECTION

SECTION 32 12 16

HOT MIX ASPHALT PAVEMENT

PART 1 GENERAL

1.1 DESCRIPTION

A. This work shall consist of constructing hot mix asphalt (HMA) pavement as specified in the Contract Documents.

PART 2 PRODUCTS

2.1 MATERIALS.

A. Performance Graded Asphalt Binders and Hot Mix Asphalt: MSHA 904.02
B. Tack Coat: MSHA 904.03
C. Hot Mix Asphalt (HMA): MSHA 904.04.

a. Aggregates. Aggregates shall conform to the following, and AASHTO MP2 with the exception that the aggregate retained on the 4.75 mm sieve shall be tested for flat and elongated particles in conformance with D 4791. When recycled asphalt pavement is used in an HMA mix as defined in Maryland Standard Method of Tests 412, it shall be considered an aggregate source.

Grading requirements are outlined in Tables A and B; physical properties in MSHA 901 B and MSHA 901 D. Force drying may be used in the preparation of samples for grading tests conducted in the field. Steel slag may be used.

b. Mix Design. The Contractor shall develop a Superpave mix design in conformance with AASHTO PP 28. HMA Superpave mixes shall conform to the specification for Superpave Volumetric Mix Design, AASHTO MP 2, and shall be designed for the Equivalent Single Axle Loading (ESAL) range specified in the Contract Documents.

The Contractor may elect to use crushed, recycled asphalt pavement (RAP) material or a maximum of 5 percent roofing shingles from manufacturing waste. The allowable percentage and its suitability for use shall be determined in conformance with Maryland Standard Method of Tests 412. When using 15 percent or less of RAP, binder viscosity adjustments are not required.

The use of RAP may be considered for applications where higher polish value aggregates are required. Approval for use will be on an individual project basis. Documentation of RAP stockpile quality and traceability shall be submitted to the Engineer for approval prior to use.

Crushed glass shall not be used in surface mixes. RAP and roofing shingles from manufacturing waste shall not be used in gap-graded mixes, surface mixes requiring high polish aggregate, or mixes requiring elastomer type polymer binder.

c. Mix Design Approval. Documents containing the data from the Contractor's laboratory study shall be submitted to the Engineer for tentative approval at least two weeks prior to paving operations using Engineer's approved AASHTO software, and shall include the following:

1) Mix designation.

2) Source and percentage of aggregate.
3) Source, percentage, and grade of performance graded asphalt binder.
4) Anticipated gradation and proportion of each component aggregate.
5) Combined cold feed grading, extracted grading, or ignited grading.
6) Plant where the HMA mix will be produced.
7) Plant target mixing temperature based on viscosity of 0.22 Pa·s.
8) Percent passing No. 200 sieve removed by dust collecting system.
9) Ratio of dust to binder material on effective asphalt.
10) Maximum specific gravity at the target binder content.
11) Mix design grading plotted on 0.45 power gradation chart.
12) Tensile strength ratio and worksheets.
13) The gyratory compaction curve for N_{max}.
14) The bulk specific gravity at N_{design} gyrations.
15) The air void content (percent Va) at $N_{initial}$, N_{design}, and N_{max} gyrations.
16) The voids in the mineral aggregate (percent VMA) and the voids filled with asphalt (percent VFA) at N_{design} gyrations (TP4).
17) The slope of the gyratory compaction curve.
18) All consensus and source properties.
    a) Coarse aggregate angularity.
    b) Flat and elongated.
    c) Sand equivalent.
    d) Uncompacted void content of fine aggregate.
    e) Bulk and apparent specific gravity of coarse and fine aggregate.
    f) Absorption of coarse and fine aggregate.

Mix designs submitted to the Engineer for approval shall be accompanied by a quantity of job mix formula aggregate and appropriate amount of required PG binder for ignition oven calibration.

If previous construction or performance experience has shown the proposed mix design to be unsatisfactory, the Engineer may require the Contractor to submit a more suitable design.

If the Contractor proposes to change the source of aggregate used in the mix, a revised mix design shall be submitted with the information required above and in 2.1 A 4 b. The conditions set forth above relative to initial submission shall apply. If a change in the Performance Grade binder source becomes necessary, a stripping test shall be conducted in conformance with Maryland Standard Method of Tests 410, prior to approval. The Engineer may require an antistripping additive test in conformance with D 4867 before giving the final approval.

Field Verification of Mix Design. After receiving the tentative approval for the mix design from the Engineer, the Contractor shall conduct a field verification of the mix at the beginning of production in each plant. Field verification shall be performed by the certified personnel as specified in Part 4. The verification samples shall be prepared as specified in PP28. The Contractor shall notify the Engineer at least two working days in advance of the scheduled verification.

Verification Evaluation.

1) Initial verification shall consist of four samples tested for the parameters listed in Maryland Standard Method of Tests 730, Table 3. These samples shall be randomly drawn from the first day's production. If the first day of production is less than 1000 tons, the Contractor may choose to spread verification testing over the number of days needed to

accumulate 1000 tons. The verification testing shall be completed on the day when production has reached the 1000 tons. The Contractor shall evaluate the verification tests results as specified in Maryland Standard Method of Tests 730. All tonnage up to and including the final day of verification will not be subject to a price adjustment if individual test data is within the allowable control limits specified in Table C.

2) If the mix produced by the plant conforms to the parameters listed in Maryland Standard Method of Tests 730, Table 3 with the Percent Within Specification Limit (PWSL) a minimum of 85, production may proceed without any changes. If the Contractor has submitted mixes with identical aggregate combinations and differing asphalt contents associated with changes in ESAL loads, verification will be limited to volumetric analysis at the Engineer's discretion.

3) If the mix produced by the plant does not conform to the parameters listed in Maryland Standard Method of Tests 730, Table 3 with PWSL a minimum of 85, then an adjustment to the asphalt content or gradation may be made to bring the mix design requirements within acceptable levels.

Permissible adjustment limitations between the approved Mix Design and Adjusted Mix Design are as follows:

TEST PROPERTY	PERMISSIBLE ADJUSTMENT % (*)
Larger than 1/2 in. (12.5 mm) sieve	± 5
1/2 in. (12.5 mm) thru No. 4 (4.75 mm) sieves	± 4
No. 8 (2.36 mm) thru No. 100 (1.50 μm) sieves	± 3
No. 200 (75 μm) sieve	± 1.0
Binder Content	± 0.20

*The permissible adjustment for all mixes shall establish a job mix formula having targets outside the restricted zone. Additionally, Superpave mixes shall be within control points.

When an adjustment is made to the mix design, a second verification shall be performed to ensure that the modified mix conforms to all design requirements. The time and tonnage limitations shall be as specified in 1) above. Material produced during this verification will be subject to a price adjustment if it does not conform to Specifications.

If the adjusted mix conforms to the PWSL, production may proceed. If the mix does not conform to these requirements, production for the mix shall be suspended and a new mix design shall be submitted to the Engineer for approval. The new mix shall be designed as specified in Maryland Standard Method of Tests 412 or AASHTO PP28.

4) Subsequent designs submitted due to nonconformance will be subjected to the price adjustment during the required field verifications. If the mix does not conform to 2) above during the initial verification, production for the mix shall be suspended until corrective action is taken as approved by the Engineer.

d. Antistripping Additives. HMA shall have a minimum Tensile Strength Ratio (TSR) of 0.85 when tested in conformance with D 4867. The freeze-thaw conditioning cycle is required. HMA mixes not conforming to the minimum TSR requirement shall include an antistripping additive.

When an antistripping additive is needed, the exact quantity shall be determined by the producer in conformance with D 4867 based on a minimum TSR of 0.85.

When a heat stable antistripping additive is used, the minimum dosage rate shall be 0.20 percent of the total weight of asphalt. The additive shall be introduced at the plant by line blending, metering, or otherwise measuring to ensure accurate proportioning and thorough mixing.

When hydrated lime is used, it shall be added in slurry form at the rate of 1.0 to 1.5 percent by weight of total aggregate. The hydrated lime shall conform to C 1097. Lime slurry shall be sprayed uniformly on the damp, cold aggregate on the feed belt prior to entry into the HMA plant dryer.

Plant control and acceptance of the mix shall be based on Maryland Standard Method of Tests 410 with respect to its stripping potential.

e. Plant Control. The following tolerances shall apply:

TABLE C – MIX TOLERANCES

PHYSICAL PROPERTY	TOLERANCE (b)
Passing No. 4 (4.75 mm) sieve and larger, %	± 7
Passing No. 8 (2.36 mm) thru No. 100 (150 μm) sieve, %	± 4
Passing No. 200 (75 μm) sieve, %	± 2
Asphalt content, %	± 0.4
Ratio of dust to binder material	0.6 to 1.6 (a)
Mix temperature leaving plant versus mix design temperature, F	± 25
Deviation of maximum specific gravity per lot versus design maximum specific gravity	± 0.030
Voids, total mix, (VTM), %	3.5 ± 1.2
Voids, total mix, 4.75mm mix (VTM), %	3 ± 2
Voids in mineral aggregate, (VMA), %	± 1.2 from design target
Voids filled asphalt (VFA), %	Within spec
Bulk specific gravity, G_{mb}, %	± 0.022
G_{mb} at N_{max}, %	+ 0.5

(a) Not applicable to 4.75 mm.
(b) For mixes other than Gap Graded HMA.

PWSL computations shall be performed for maximum specific gravity, voids in the total mix, voids in the mineral aggregate, and voids filled with asphalt. This computation shall be performed as specified in 4.3 using the moving average of the last three consecutive test values for each parameter. If the PWSL for the three test values fall below 85, corrective action shall be taken to bring the PWSL to at least 85. If the PWSL drops below 68, production shall be suspended until corrective action is taken as approved by the Engineer.

B. Crack Filler. Joint sealer and crack filler shall conform to D 3405 as modified by Maryland Standard Method of Tests 404. The manufacturer shall furnish certification. This certification shall be a document which verifies that the material and work complies with the applicable specifications and includes the actual test results to confirm the statement. The contents of the certification shall be on the Contractor's/vendor's/manufacturer's letterhead or approved document and shall be duly signed by a company officer. Manufacturer's recommendations regarding heating and pouring temperatures will be used when testing these materials. If a range of temperatures is recommended, the midpoint will be used as the pour point.

1. Silicone Joint Sealer And Crack Filler.
   a. Silicone joint sealer and crack filler shall be low modulus, one component compound which may or may not require a primer for bonding to concrete. If a primer is required, it shall be as recommended by the sealant manufacturer and shall be placed on the joint faces following the insertion of the backup material.
   b. Silicone material, when tested at 73 $\pm$ 3 F and 45 to 55 relative humidity, shall conform to the following:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Shore A Hardness, at 7 days	D 2240	10-25
Tensile Strength at 150 % Elongation, psi max	D 412 Die C	45
Elongation, % min	D 412 Die C	700
Adhesion in Peel, lb/in. min	Federal Spec TT-S-00230	20
Flow, 0.01 in. max	T 187	0.3
Tack-Free Time, minutes	D 2377	20-75

   c. Each container of silicone sealer and crack filler shall have a minimum shelf life of six months. Material more than six months old shall be retested.

C. Production Plant shall be certified by MSHA in accordance with MSHA 915.

PART 3 - EXECUTION

3.1 GENERAL

A. Quality Control Plan. At least 30 days prior to the placement of any HMA pavement, the Contractor shall submit in writing a plant Quality Control Plan to the Engineer and a field Quality Control Plan to the Engineer for approval. The Quality Control Plans shall contain a statistically based procedure of random sampling and shall show how the Contractor proposes to control the equipment, materials, production and paving operations to ensure conformance with these Specifications. A master plant Quality Control Plan may be submitted for this prior approval. If a master plant quality control plan is submitted and approved, an addendum shall be submitted for each specific Contract.

The plan shall contain production plants, location of plants with respect to the project site, personnel qualifications, inspection and record keeping methods, and minimum frequencies of sampling and testing as specified in Maryland Standard Method of Tests 730, Table 3. The plan shall also detail when and how corrective action will be taken for unsatisfactory construction practices and deviations from the material Specifications. Additionally, the plan shall include a Quality Control Plan for the plant which addresses all elements necessary for quality control.

B. Plan Administrator and Certified Technicians . The Quality Control Plan shall designate a Plan Administrator. The Plan Administrator shall have full authority to institute any action necessary for the successful operation of the Plan. The Plan Administrator may supervise the Quality Control Plan on more than one project if that person can be in contact with the job site within one hour after being notified of a problem.

The Quality Control Plan shall also designate a Certified Plant Control Technician, Field Control Technician and Certified Materials Tester, if used, as specified in Maryland Standard Method of Tests 731.

C. Records. The Contractor shall maintain complete records of sampling, testing, actions taken to correct problems and quality control inspection results and shall make them available to the Engineer upon request. Copies of the reports shall be provided when requested by the Engineer.

Linear control charts shall be maintained by the Contractor. Control charts shall be maintained in the Quality Control laboratory in a manner satisfactory to the Engineer and shall be current. As a minimum, the control charts shall identify the mix design number, each test result and the upper and lower specification limits applicable to each test.

D. Acceptance. The Engineer will provide acceptance by:
1. Periodically observing tests performed by the producer.
2. Monitoring required control charts.
3. Directing the producer to take additional samples at any time and location.
4. Monitoring the Contractor's conformance with the Quality Control Plan.
5. Evaluating quality control sampling and testing by an independent assurance program.

A. The Contractor shall protect the pavement against damage from all causes. Any part of the pavement that is damaged shall be repaired or replaced by the Contractor at no additional cost to the Owner.

B.

3.2 EQUIPMENT

All equipment, including the production plant and paving equipment, shall be subject to approval by the Engineer. The plant shall be ready for inspection by the Engineer at least 48 hours prior to the start of construction operations.

A. Hauling Units. Refer to 2.1 C 2 a 6. Due regard shall be given to the safety and convenience of the public while applying and maintaining the tack coat. Provisions shall be made to minimize hauling trucks from tracking tack coat onto the adjacent pavement.

B. Pavers. Pavers will be inspected and approved by the Engineer based upon the manufacturer's specification manual (copy to be provided by the Contractor). The paver shall be a self-contained, self-propelled unit capable of spreading the mixture true to line, grade and cross slope. The paver shall be equipped with a screed or strike off assembly that will produce a finished surface of the required smoothness and texture without tearing, shoving or gouging the mixture. The paver shall have automatic controls for transverse slope and grade. Controls shall be capable of sensing grade from an outside reference line or ski and sensing the transverse slope of the screed to maintain the required grade and transverse slope within plus or minus 0.1 of the required slope percentage.

Manual operation will be permitted in the construction of irregularly shaped and minor areas, or where directed by the Engineer.
Whenever a breakdown or malfunction of any automatic control occurs, the equipment may be operated manually for the remainder of the work day as directed by the Engineer.

Reference lines or other suitable markings to control the horizontal alignment shall be provided by the Contractor, subject to the approval of the Engineer.

C. Rollers. Rollers shall be self-propelled, reversible, and steel wheeled or pneumatic tired. Rollers may be vibratory or nonvibratory, and they may be operated in the vibratory mode as long as the Engineer determines that the roller is not cracking or damaging the aggregate in the mix. Rollers shall not be used in the vibratory mode on bridge decks. Pneumatic tire rollers shall have multiple tires of equal size with smooth tread. Wheels shall be arranged to oscillate in pairs, or they may be individually sprung. Tires shall be uniformly inflated at the operating pressure approved by the Engineer. The Contractor shall furnish the Engineer a manufacturer's table showing this data. The difference in tire pressure between any two tires shall not be greater than 5 psi. The Contractor shall provide a means for checking the tire pressure on the job at all times.

3.3 WEATHER RESTRICTIONS

A. HMA material shall only be placed on roadway surfaces when the ambient air and surface temperature is at least 40 F and rising for surface mixes and at least 32 F and rising for base mixes. The pavement surfaces shall be clean and dry and approved by the Engineer before HMA paving begins. Placing HMA material on a frozen graded aggregate base is prohibited. When weather conditions differ from these limits, material en route from the plant to the job site may be used at the Contractor's risk. If placement of the material is stopped by the Engineer, all material en route shall be wasted at no additional cost to the Owner.

3.4 FOUNDATION PREPARATION

A. Prior to placement of paving material, the foundation shall be constructed as specified in the Contract Documents and approved by the Engineer. When paving over existing pavement, all excess crack filling or patch material shall be removed and all spalls and potholes shall be cleaned, tack coated, filled and tamped with HMA before placement. Manholes, valve boxes, inlets, and other appurtenances within the area to be paved shall be adjusted to grade as directed by the Engineer.

3.5 TACK COAT

A. Prior to application of the tack coat, the surface shall be cleaned of all loose and foreign materials. The tack coat shall be uniformly applied to the surface by full circulation spray bars that are laterally and vertically adjustable and provide triple fanning and overlapping action so that the resulting coating shall be residual asphalt applied at a rate of 0.01 to 0.05 gal/yd^2 as directed by the Engineer.

3.6 HOT MIX ASPHALT PLACEMENT

A. HMA shall be placed by the paver. Delivery of the mixture by the hauling units and placement shall be continuous. The temperature of the mixture shall be a minimum of 225 F at the time of placement. Broadcasting of loose mixture over the new surface is prohibited.

3.7 COMPACTION

A. Immediately following placement of the HMA, the mixture shall be compacted by rolling to an in place density of 92.0 to 97.0 percent of the maximum density. In place compaction shall be completed before the mixture cools below 185 F, as determined by a probe type surface thermometer, supplied by the Contractor and approved by the Engineer. Price adjustment due to noncompliance with the required density will be as specified in 4.3. Probe type surface thermometer shall remain the property of the Contractor at the completion of the project.

B. Rolling shall consist of six separate operations in the following sequence:
   1. Transverse joint.
   2. Longitudinal joint.
   3. Edges.
   4. Initial breakdown rolling.
   5. Second or intermediate rolling.
   6. Finish rolling.

C. Steel wheel rollers shall be used for the first rolling of all joints and edges, the initial breakdown rolling, and the finish rolling.

D. Rollers shall start at the sides and proceed longitudinally toward the center of the pavement, except on superelevated curves. The rolling shall begin at the low side and progress toward the high side. Successive trips of the roller shall overlap by at least half the width of the roller, and alternate trips shall not end at the same point. When base widening is too narrow to permit the use of conventional rollers, a power driven trench roller shall be used. When the trench must be excavated wider than the proposed width of the widening, an earth berm or shoulder shall be formed against the loose HMA as soon as it is placed. The two materials shall be rolled and compacted simultaneously. Roller marks shall not be visible after rolling operations.

E. After rolling is completed, no traffic of any kind will be permitted on the pavement until the pavement has cooled to less than 140 F or as directed by the Engineer.

3.8 JOINTS

A. Both longitudinal and transverse joints in successive courses shall be staggered so that one is not above the other. Transverse joints shall be staggered by the length of the paver. Longitudinal joints shall be staggered a minimum of 6 in. and shall be arranged so that the longitudinal joint in the top course shall be within 6 in. of the line dividing the traffic lanes.

B. Joints shall be constructed to provide a continuous bond between the old and new surfaces.

C. Joints shall be coated with tack coat as directed by the Engineer. When placing a surface course, the edge of the existing pavement shall be cut back for its full depth at transverse joints to expose a fresh surface which shall be coated with tack coat material as directed by the Engineer. Before placing the mixture against curbs, gutters, headers, manholes, etc., all contact surfaces shall be coated with tack coat.

3.9 EDGE DROPOFF

A. Where HMA paving is being applied to highways carrying traffic, all pavement courses exceeding 2-1/2 in. in depth shall be matched with the abutting lane or shoulder on the same working day. Where pavement courses of 2-1/2 in. or less are placed, the Contractor shall have the option of paving the abutting lane or shoulder on alternate days. The abutting lane or shoulder shall be paved regardless of the depth of pavement course prior to weekends and temporary shutdowns. When uneven pavement joints exist, the Contractor shall provide advance warning traffic control devices in conformance with the Contract Documents.

3.10 TIE-IN

A. Where HMA paving is being applied to the traveled way carrying traffic, the Contractor shall construct a temporary tie-in a minimum of 4 ft in length for each 1 in. of pavement depth before traffic is allowed to cross the transverse joint.

B. The final tie-in shall include the removal of a transverse portion of the existing pavement to a depth so the design thickness of the final surface course is maintained. The length of the final tie-in shall be equal to the posted speed per 1 in. depth of the design thickness of the final course with a minimum length of 25 ft per 1 in. depth and a maximum length of 50 ft per 1 in. depth.

3.11 SAMPLING AND TESTING FOR DENSITY

A. Density testing shall be performed before allowing traffic or construction equipment on the in place material and before placement of the next layer.

1. Compaction for Quality Control. A lot shall not exceed 1000 tons. A sublot shall not exceed 200 tons. Five consecutive 200 ton sublots shall equal one lot. A lot may contain only one sublot that is less than 200 tons.

   On any paving day when production does not end in a multiple of 1000 tons, the remaining fraction shall be considered another lot. A paving day shall begin with a new lot and sublots. Control strips shall be divided into five equal sublots.

   On Contracts requiring less than 500 tons of HMA or when HMA is used in nontraffic areas or on bridge decks, acceptance will be determined by the use of a thin layer nuclear density gauge, when tested in conformance with the manufacturer's recommendations. When the HMA courses are compacted to 1 in. or less, a control strip shall be constructed on the first day of paving. Readings shall be taken with a thin layer nuclear density gauge to determine roller patterns and the number of coverages to obtain optimum density. Optimum density is defined as when the average density does not change by more than 1.0 percent between successive coverages of a 400 to 500 ft area. This optimum density shall be used to determine HMA acceptance after approval by the Engineer. Any lot average 2.0 percent or more below optimum
   density shall require a new control strip be constructed and tested before paving continues.

   The Contractor may use the core or the combined nuclear/core method of testing on Contracts requiring 500 tons or more.

The Contractor shall secure samples and perform tests as follows:

1) Core Method. When the core method is used, the Contractor shall take samples as specified in Maryland Standard Method of Tests 451, Method B, for each sublot of material placed. Core sample locations will be randomly determined by the Engineer in conformance with Maryland Standard Method of Tests 418.

Two core samples shall be taken from each sublot no later than the next day after compaction. The size diameter cores shall be 4 or 6 in. cores for 9.5 mm, 12.5 mm, and 19.0 mm mixes; and 6 in. cores for 25.0 mm and 37.5 mm mixes. These cores shall represent the day's production and shall be taken prior to placement of the next layer.

Core samples shall be tested in conformance with Maryland Standard Method of Tests 452. The specific gravity of the samples shall be expressed as a percentage of the maximum specific gravity determined for each lot of material. The in place density of each mixture in each lot shall be 92.0 to 97.0 percent. The two core results from each sublot shall be averaged and compliance will be determined on the basis of all sublots tested for each material. Results shall be made available by the Contractor no later than the following work day.

2) Nuclear/Core Method. The nuclear gauge shall be calibrated in conformance with Maryland Standard Method of Tests 417. A daily validation and standard count shall be performed as specified in the manufacturer's recommendations. A log of these validations and counts shall be with the gauge at all times.

Two one-minute special calibration nuclear tests shall be conducted on each sublot as specified in Maryland Standard Method of Tests 418 no later than the next work day after compaction. A special calibration nuclear test is defined as an average of a minimum of two special calibration readings taken at the same location after rotating the gauge 180 degrees. Two tests per sublot; a minimum of four readings (2 tests X 2 readings/test = 4) shall be taken. Likewise, a 1000 ton lot shall have a minimum of 20 readings (5 sublots X 2 tests/sublot X 2 readings/test = 20).

The results of the two nuclear tests in each sublot shall be averaged and conformance will be determined on the basis of all sublots tested for each material.

Three cores for each lot of material shall be sampled; one at each of three different nuclear test locations determined by the Engineer. The average of the three core results and the average of the three corresponding nuclear tests shall be within 3.0 lb/ft^3. When the difference between nuclear test results and core test results is greater than 3.0 lb/ft^3, the Contractor shall use the core method of testing. The Contractor may return to the nuclear/core method of testing when all calibration criteria are met. If the Contractor's nuclear test results again fail to conform to the 3.0 lb/ft^3 maximum requirement, the core method of density determination shall be used for the remainder of the project.

2. Acceptance Testing.

a. Core Method. Acceptance testing will be performed on a minimum of three cores per 6000 tons when the core method of control is used. If the specific

gravity difference on each of the three cores is within 0.030, all the lots will be evaluated individually using the test results of quality control samples as specified in 4.3. If the difference is greater than 0.030, the Engineer will conduct tests on the remainder of the quality control samples since the last acceptance and all the lots will be evaluated individually using the Engineer's test results.

b. Nuclear/Core Method. When the nuclear/core method is used, the Engineer will witness the Contractor's testing and coring and will perform acceptance testing on three verification cores from any one lot since the last acceptance. If the density difference between the average of three verification cores and the average of three corresponding nuclear tests is within 3.0 lb/ft^3, all the lots will be evaluated individually using nuclear quality control test results as specified in 4.3.

If the difference is greater than 3.0 lb/ft^3, the Engineer will test the remainder of the verification cores since the last acceptance. All lots will be evaluated for the 3.0 lb/ft^3 difference. Lots not conforming to the 3.0 lb/ft^3 difference will be evaluated individually as specified in 4.3 using verification core test results. Lots conforming to the 3.0 lb/ft^3 difference will be evaluated individually.

3.12 CONTROL STRIP

A. The Contractor may opt to construct a control strip for guidance in determining roller patterns to achieve optimum density. When a control strip is constructed, it shall be placed on the first workday in which HMA is placed and shall be between 400 and 500 ft in length. Based on the Contractor's evaluation of the initial control strip, paving may continue at the Contractor's risk.

B. The Contractor will not be assessed a density pay adjustment for the amount of material required for construction of the control strips. Should the removal of any control strip be necessary, it shall be removed by the Contractor at no additional cost to the Owner.

C. The Engineer may require the Contractor to construct a control strip any time during placement of HMA based on the evaluation of compaction results.

3.13 PAVEMENT SURFACE CHECKS

A. The Contractor shall have available, at all times, a 10 ft straightedge approved by the Engineer. After final compaction of each course, the surface of each pavement course shall be true to the established line and grade and shall be sufficiently smooth so that when tested with a 10 ft straightedge placed upon the surface parallel with the center line, the surface shall not deviate more than 1/8 in. The transverse slope of the finished surface of each course when tested with a 10 ft straightedge placed perpendicular to the center line, the surface shall not deviate more than 3/16 in.

B. Transverse joints on each course shall be checked with a 10 ft straightedge immediately after the initial rolling. If the surface of each course varies more than 1/8 in. from true, the Contractor shall make immediate corrections acceptable to the Engineer so that the finished joint surface shall comply.

3.14 CURBS, GUTTERS, ETC.

Where permanent curbs, gutters, edges, and other supports are planned, they shall be constructed and backfilled prior to placing the HMA, which shall then be placed and compacted against them.

3.15 SHOULDERS

Shoulders abutting the HMA surface course of any two lane pavement that is being used by traffic shall be completed as soon as possible after completion of the surface course on that lane. Shoulder construction shall be as specified in the applicable portions of the Specifications and the Contact Documents.

END OF SECTION

SECTION 32 14 13

CONCRETE PAVERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes
1. concrete pavers.
2. Crushed stone bedding material.
3. Open-graded subbase aggregate.
4. Open-graded base aggregate.
5. Bedding and joint/opening filler materials.
6. Edge restraints.

B. Related Sections
1. Section 32 11 23: Gravel Base Course.
2. Section 31 23 16: Earthworks/excavation/soil compaction.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)
1. C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
2. C 136, Method for Sieve Analysis for Fine and Coarse Aggregate.
3. C 140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
4. D 448, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
5. C 936, Standard Specification for Solid Concrete Pavers.
6. C 979, Specification for Pigments for Integrally Colored Concrete.
7. C 1781, Standard Test Method for Surface Infiltration Rate of IUnit Pavement Systems
8. D 698, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 5.5-lb (2.49 kg) Rammer and 12 in. (305 mm) drop.
9. D 1557, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 10-lb (4.54 kg) Rammer and 18 in. (457 mm) drop.
10. D 2922 Standard Test Methods for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).
11. D 4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
12. D 6758, Standard Test Method for Measuring Stiffness and Apparent Modulus of Soil and Soil-Aggregate In-Place by Electro-Mechanical Method
13. E 2835, Standard Test Method for Measuring Deflections using a Portable Impulse Plate Load Test Device

B. Concrete Pavement Institute (ICPI)
1. Concrete Pavement manual.

1.03 SUBMITTALS

A. In accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Paver manufacturer's/installation subcontractor's drawings and details: Indicate perimeter conditions, junction with other materials, expansion and control joints, paver layout, patterns, color arrangement, installation and setting details. Indicate layout, pattern and relationship of paving joints to fixtures, and project formed details.

C. Sieve analysis of aggregates for subbase, base and bedding materials per ASTM C 136.

D. Project specific or producer/manufacturer source test results for void ratio and bulk density of the base and subbase aggregates.

E. concrete pavers:
   1. Paver manufacturer's catalog sheets with product specifications.
   2. Representative full-size samples of each paver type, thickness, color, and finish. Submit samples indicating the range of color expected in the finished installation.
   3. Accepted samples become the standard of acceptance for the work of this Section.
   4. Laboratory test reports certifying compliance of the concrete pavers with ASTM C 936.

1.04 QUALITY ASSURANCE

A. Paver Installation Subcontractor Qualifications:
   1. Utilize an installer having successfully completed concrete paver installation similar in design, material and extent indicated on this project.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 1 Product Requirement Section.

B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged container packaging with identification tags intact on each paver bundle.
   1. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.
   2. Deliver concrete pavers to the site in steel banded, plastic banded, or plastic wrapped cubes capable of transfer by forklift or clamp lift.
   3. Unload pavers at job site in such a manner that no damage occurs to the product or existing construction

D. Storage and Protection: Store materials in protected area such that they are kept free from mud, dirt, and other foreign materials.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not install in rain or snow.

B. Do not install frozen bedding materials.

1.07 MAINTENANCE

C. Pavers shall be from the same production run as installed materials.

PART 2 - PRODUCTS

2.01 PAVING UNITS

D. Sidewalk Paver Manufacturer: Belgard
   1. Contact Phone: 1-254-772-3440 www.Belgard.com

E. Concrete Paver Units:
   1. Sidewalk Paver Type: 3”x6”x2.375”, 6”x6”x2.375”, 9”x6”x2.5”, 9”x9”x2.375””
      a. Material Standard: Comply with ASTM C 936.
      b. Color: Bella Blend Antique

2.02 PRODUCT SUBSTITUTIONS

A. Substitutions: Permitted for gradations for crushed stone jointing material, base and subbase materials. Base and subbase materials shall have a minimum 0.32 void ratio. All substitutions shall be approved in writing by the project engineer.

2.03 CRUSHED STONE FILLER, BEDDING, BASE AND SUBBASE MAINTENANCE

A. Crushed stone with 90% fractured faces, LA Abrasion < 40 per ASTM C 131.

B. Do not use rounded river gravel for vehicular applications.

C. All stone materials shall be washed with less than 2% passing the No. 200 sieve.

D. Joint/opening filler, bedding, base and subbase: conforming to ASTM D 448 gradation as shown in Tables 1, 2 and 3 below:

Table 1

ASTM No. 8 Grading Requirements Bedding and Joint/Opening Filler	
Sieve Size	Percent Passing
12.5 mm (1/2 in.)	100
9.5 mm (3/8 in.)	85 to 100
4.75 mm (No. 4)	10 to 30
2.36 mm (No. 8)	0 to 10
1.16 mm (No. 16	0 to 5

Table 2

Graded Aggregate Base Grading Requirements	
Sieve Size	Percent Passing
2”	100
1.5”	95 to 100
¾”	70 to 92
No. 4	35 to 55
No. 30	12 to 25
No.200	0 to 8

2.04 ACCESSORIES

E. Provide accessory materials as follows:
   1. Edge Restraints (parking lot pavers) concrete curb or apron
   2. Edge Restraints (sidewalk pavers only)
      a. Manufacturer: Hanover Architectural Products
      b. Material: UV resistant 100% recycled plastic, Hanover Edge 100.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Acceptance of Site Verification of Conditions:
   1. General Contractor shall inspect, accept and certify in writing to the paver installation subcontractor that site conditions meet specifications for the following items prior to installation of concrete pavers.
      a. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
      b. Provide written density test results for soil subgrade to the Owner, General Contractor and paver installation subcontractor.
      c. Verify location, type, and elevations of edge restraints, utility structures, and drainage pipes and inlets.
   2. Do not proceed with installation of bedding and concrete pavers until subgrade soil conditions are corrected by the General Contractor or designated subcontractor.

3.02 PREPARATION

A. Verify that the soil subgrade is free from standing water.

B. Stockpile joint/opening filler, base and subbase materials such that they are free from standing water, uniformly graded, free of any organic material or sediment, debris, and ready for placement.

C. Edge Restraint Preparation:
   1. Install edge restraints per the drawings [at the indicated elevations].

3.02 INSTALLATION

A. General
   1. Any excess thickness of soil applied over the excavated soil subgrade to trap sediment from adjacent construction activities shall be removed before application of the subbase materials.
   2. Keep area where pavement is to be constructed free from sediment during entire job. Base and bedding materials contaminated with sediment shall be removed and replaced with clean materials.
   3. Do not damage drainpipes, overflow pipes, observation wells, or any inlets and other drainage appurtenances during installation. Report any damage immediately to the project engineer.

B. Bubbase and base
   1. Moisten, spread and compact the base layer in one 4 in. (100 mm) thick lift.
      On this layer, make at least two passes in the vibratory mode then at least two in the static mode with a minimum 10 t (8 T) vibratory roller until there is no visible movement of the stone. Do not crush aggregate with the roller.

2. Compaction
    a. Use a smooth dual or single smooth drum, minimum 10 t (8 T) vibratory roller or a minimum 13,500 lbf (60 kN), reversible vibratory plate compactor with a compaction indicator without crushing the aggregate base.
    b. Compact aggregates without crushing them.

C. The surface tolerance the compacted base should not deviate more than. ±1 in. (25 mm) over a 10 ft (3 m) straightedge.

D. Bedding layer
1. Moisten, spread and screed the No. 8 stone bedding material.
2. Fill voids left by removed screed rails with No. 8 stone.
3. The surface tolerance of the screeded No. 8 bedding layer shall be ±3/8 in (10 mm) over a 10 ft (3 m) straightedge.
4. Do not subject screeded bedding material to any pedestrian or vehicular traffic before paving unit installation begins.

E. concrete pavers and joint/opening fill material
1. Lay the paving units in the pattern(s) and joint widths shown on the drawings. Maintain straight pattern lines.
2. Fill gaps at the edges of the paved area with cut units. Cut pavers subject to tire traffic shall be no smaller than 1/3 of a whole unit.
3. Cut pavers and place along the edges with a [double-bladed splitter or] masonry saw.
4. Fill the openings and joints with [No. 8] stone.
5. Remove excess aggregate on the surface by sweeping pavers clean.
6. Compact and seat the pavers into the bedding material using a low-amplitude, 75-90 Hz plate compactor capable of at least 5,000 lbf (22 kN). This will require at least two passes with the plate compactor.
7. Do not compact within 6 ft (2 m) of the unrestrained edges of the paving units.
8. Apply additional aggregate to the openings and joints if needed, filling them completely. Remove excess aggregate by sweeping then compact the pavers. This will require at least two passes with the plate compactor.
9. All pavers within 6 ft (2 m) of the laying face must be left fully compacted at the completion of each day.
10. The final surface tolerance of compacted pavers shall not deviate more than ±3/8 (10 mm) under a 10 ft (3 m) long straightedge.
11. The surface elevation of pavers shall be 1/8 to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.

3.04 FIELD QUALITY CONTROL

A. After sweeping the surface clean, check final elevations for conformance to the drawings.

B. Lippage: No greater than 1/8 in. (3 mm) difference in height between adjacent pavers.

C. The surface elevation of pavers shall be 1/8 to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.

D. Bond lines for paver courses: ±½ in. (±15 mm) over a 50 ft (15 m) string line.

E. Verify the surface infiltration at a minimum of 100 in./hour using test method C 1781.

3.02 PROTECTION

A. After work in this section is complete, the General Contractor shall be responsible for protecting work from sediment deposition and damage due to subsequent construction activity on the site.

B. PICP installation contractor shall return to site after 6 months from the completion of the work and provide the following as required: fill paver joints with stones, replace broken or cracked pavers, and re-level settled pavers to initial elevations. Any additional work shall be considered part of original bid price and with no additional compensation.

END OF SECTION

SECTION 32 92 23.01

TURF ESTABLISHMENT

PART 1 GENERAL

1.1 DESCRIPTION

A. This work shall consist of soil preparation, seeding, fertilizing, liming, mulching, overseeding, refertilization and mowing all areas designated for turf establishment as specified in the Contract Documents or as directed by the Engineer.

1.2 SEEDING SEASONS AND SEED MIXES

A. Refer to the plans for the permanent and temporary seeding mixes.

PART 2 PRODUCTS

2.1 MATERIALS

A. Mulch Binder shall conform to MSHA 904.02 (Asphalt Binder) or the following:

1. Wood cellulose fiber shall be a processed wood product having uniform fiber characteristics, which will remain in uniform suspension in water under agitation and will blend with seed, fertilizer and other additives to form homogeneous slurry. The fiber shall perform satisfactorily in hydraulic seeding equipment without clogging or damaging the system. The slurry shall contain a green dye that provides easy visual inspection for uniformity of application.

2. The manufacturer shall furnish certification (A certification is a document which verifies that the material and work complies with the applicable specifications and includes the actual test results to confirm the statement). The contents of the certification shall be on the Contractor's/vendor's/manufacturer's letterhead or approved document and shall be duly signed by a company officer) showing conformance to the following:

WOOD CELLULOSE FIBER REQUIREMENTS	
Particle Length, inch	Approximately 1/2
Particle Thickness, inch	Approximately 1/16
Net Dry Weight Content	Minimum as stated on bag
TAPPI* T 509, pH	4.0 – 8.5
Ash Content, TAPPI* Standard T 413, % max	7.0
Water Holding Capacity, % min	90

* Technical Association of Pulp and Paper Industry

3. The material shall be delivered in packages of uniform weight, which shall not exceed 75 lb net weight and shall bear the name of the manufacturer, the net weight and a supplemental statement of the net weight content.

B. Agricultural Limestone shall contain not less than 85 percent calcium and magnesium carbonates. Dolomitic (magnesium) limestone shall contain at least 10 percent magnesium as magnesium oxide and 85 percent calcium and magnesium carbonates. Limestone shall conform to the following gradation:

SIEVE SIZE	MINIMUM PERCENT PASSING BY WEIGHT
No. 10	100
No. 20	98
No. 100	50

C. Fertilizer shall conform to MSHA 920.03.01.

D. Seed shall conform to notes the plans

E. Straw Mulch shall conform to MSHA 920.04.01.

F. Water. Water used in the planting, establishing or caring for vegetation shall be free from any substance that is injurious to plant life.

PART 3 EXECUTION

3.1 GENERAL

A. Seeding shall be performed when the temperature is above 32° F and the ground is not frozen.

3.2 Seeding Areas with less than 4 inches of topsoil. seeding shall consist of soil preparation, liming, seeding, fertilizing and applying and securing mulch.

A. Preparing Soil. Areas to be seeded shall conform to the specified finish grades and be free of any weed or plant growth. All areas (except serrated cut slopes) shall be loosened by discing, harrowing, raking or by other approved methods immediately prior to seeding, unless otherwise directed by the Engineer. The area shall be free of all clods, stones and other foreign materials larger than 3 inches. On and adjacent to commercial and residential properties, the size of stones and other foreign material shall not be larger than 1 1/2 inches. All gullies, washes or disturbed areas that develop subsequent to final dressing shall be repaired prior to seeding. On slopes less than 3:1 and on flat areas, the final seedbed shall be prepared so there is an even and uniform germination of seed and final stand of turf. To conserve moisture, a cultipacker may be run over the seedbed before or after seeding, but before mulching. The seed beds shall be as follows:

1. Slopes Less than 3:1. The topsoil shall be loosened to a depth of 2 inches and all track marks shall be removed.
2. Slopes 3:1 and Steeper. The subsoil shall be loosened to a depth of 1 inch.
3. Serrated Cut Slopes. The subsoil shall not be loosened. The areas shall be seeded and mulched in 50 ft maximum vertical increments.

B. Application Equipment. Equipment shall consist of spreaders, drills, hydroseeders or other equipment approved by the Engineer for applying materials either in a wet or dry form. All equipment shall be calibrated before application to the satisfaction of the Engineer so that materials are applied accurately and evenly to avoid misses and overlaps.

1. Hydroseeders shall display maximum capacity in gallons and be equipped with an agitation system capable of keeping all the solids in a state of suspension.
2. The mixture shall be directed upward into the air so droplets will fall in a uniform spray to avoid erosion or runoff.
3. Mechanical seeders shall be capable of placing seed at the specified rate.
4. Use of hydroseeders and spinner spreaders is prohibited during periods of high winds when the materials could land on sensitive areas or on sensitive structures.

3.7 Application Rates. Tractor Mowing. Mowing shall consist of using a minimum 5 ft flail or rotary tractor mower as directed by the Engineer. The vegetation shall be cut to 5 inches high before it reaches 20 inches high.

3.8 Hand Mowing. Mowing shall consist of using a minimum 19 inch hand mower as directed by the Engineer. Vegetation shall be cut to 3 to 4 inches high before it reaches 15 inches high.

3.9 Repairing Damaged Areas. Before final acceptance the Contractor shall repair or replace any seeding or mulching that is defective or damaged due to the Contractor's negligence at no additional cost to the Owner. When the Contractor elects to perform out of season work, the Contractor shall establish a good stand of grass of uniform color and density as approved by the Engineer. When it is not possible to make an adequate determination of the color, density and uniformity of the stand of grass, acceptance of the areas will be delayed until seeding requirements are in conformance.

END OF SECTION