M.E.T. Quad
Site Improvements

Project Manual

For

Miami University
Physical Facilities Department
Coles Service Building, Room 121
Oxford, Ohio   45056

Prepared by

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April 1, 2013
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SECTION 011000 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Project information.
   2. Work covered by Contract Documents.
   3. Phasing and Coordination.
   4. Work under separate contracts.
   5. Access to site.
   7. Miscellaneous provisions.

B. Related Requirements:
   1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of University's campus.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.3 PROJECT INFORMATION

A. Project Identification: M.E.T. Quad Site Improvements

B. Owner: Miami University.

C. Landscape Architect: SmithGroupJJR, LLC., 201 Depot Street, Ann Arbor, MI 48104

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of the Project is defined by the Contract Documents and consists of the following:

B. The renovation of the Morris, Emerson, and Tappan Hall Quadrangle (M.E.T. Quad), construction of a new shared use path, and the installation of a new intramural recreation Field.

C. The project requires contractors with experience in the successful installation of site improvements including the proper installation of all associated earthwork, drainage, underground utilities, lighting, irrigation, masonry walls, concrete and brick paving, and landscape plantings.

1.5 PROJECT PHASING & COORDINATION

A. The successful completion of the proposed M.E.T. Quad Site Improvements project will require a highly efficient and tightly scripted approach to completing the work within the project limits during specific calendar dates. This work will commence on or about May 13, 2013, however there are areas within the site project limits that will need to be made available for use by the public and access maintained during the dates listed on the ‘Site Utilization Schedule’ as shown on drawing L2.0.

1. ‘Construction Area A’:
a. Site work in Construction Area A may commence on or about May 13, 2013 and proceed to completion over a 14 week period concluding no later than August 21, 2013. The contractor shall provide site access in this area to accommodate student orientation and conferences currently scheduled for the Morris, Emerson and Tappan dormitories during the following dates: June 2, 2013 through July 2, 2013 and July 16, 2013 through July 30, 2013. Limited site work may occur within Construction Area A during this time as outlined on Drawing L2.0. Work to be completed in Construction Area A includes the completion of the following benchmarks:

2. Construction Area A Benchmarks
   a. Completion of all sub-grade preparations including all mobilization, staging, selective demolition, earthwork, and subsurface utilities.
   b. Completion of all concrete and asphalt pavements, curbs, foundations, site lighting, site walls, railings, reinforced turf, irrigation, landscape plantings, turf seeding and restoration.
   c. De-mobilization activities including the installation of temporary barriers as required for pedestrian traffic control around seeded lawn areas.

3. Construction Areas B, C and D
   a. Site work in Construction Areas B, C, and D may commence on or about May 13, 2013 and proceed to completion over a 14 week period concluding no later than August 21, 2013 with the exception of incidental work to the Tappan Hall North Porch which shall be completed no later than September 20, 2013.
   b. Work to be completed within Construction Areas B and C includes the completion of the following benchmarks:

4. Construction Area B, C, and D Benchmarks
   a. Completion of all sub-grade preparations including all mobilization, staging, selective demolition, earthwork, and subsurface utilities.
   b. Completion of all concrete and asphalt pavements, curbs, steps, foundations, site lighting, site walls, railings, reinforced turf, irrigation, landscape plantings, turf seeding and restoration.
   c. De-mobilization activities including the installation of temporary barriers as required for pedestrian traffic control around seeded lawn areas.

5. Staging Notes and Assumptions:
   a. Contractors may stage equipment and lay-down within the parking area east of Emerson Hall as shown on Drawing L2.0.
   b. The contractor assumes all responsibility for maintenance of traffic and operations in accordance with all applicable state and local requirements.

1.6 TYPE OF CONTRACT
   A. Project will be constructed under a Single prime contract.

1.7 WORK UNDER SEPARATE CONTRACT
   A. General: The University is undertaking other significant site work and building improvements at the same time as the construction of the M.E.T. Quad Site Improvements project will be on-going. Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

1.8 ACCESS TO SITE
   A. Reference drawing L 2.0 Overall Staging Plan for site access and phasing for construction.

1.9 WORK RESTRICTIONS
   A. Work Restrictions, General: Comply with restrictions on construction operations.
      1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
B. On-Site Work Hours: Limit work on site to 7:00 a.m. to dusk, Monday through Friday, except as otherwise indicated on Drawings to accommodate previously scheduled campus activities.
   1. Weekend Hours: Weekend work is permissible with prior notification and approval.
   2. Early Morning Hours: is permissible with prior notification and approval.

C. Existing Utility Interruptions: Shutdowns of existing systems shall be limited to a minimum time required and scheduled with other involved parties. Do not interrupt utilities serving facilities occupied by the University or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
   1. Notify Construction Manager and University not less than three (3) days in advance of proposed utility interruptions.
   2. Obtain Construction Manager's written permission before proceeding with utility interruptions.

D. Nonsmoking Site: Smoking is not permitted on University’s property.

E. Controlled Substances: Use of tobacco products and other controlled substances on University property is not permitted.

F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

1.10 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format and CSI/CSC's "MasterFormat" numbering system.
   1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
   1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Certain products are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include the following:
   1. Lump-sum.

C. The Contractor’s costs for unloading and handling on the site, overhead, profit, and any other developmental expenses required to complete the original allowance shall be included in the Contract Sum and not in the allowance.

D. Coordinate allowance work with related work to ensure that each selection is completely integrated and interfaced with related work.

E. Work will be completed only as directed by Owner. The establishment of a lump sum value in the Schedule of Allowances does not mean that the contractor will be paid the full amount of the lump sum. Payment will be made to the Contractor based on the actual amount of work completed, as verified by submittals noted below.

1.2 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Associate of the date when final selection and purchase of each product described by an allowance must be completed to avoid delaying the Work.

B. At Associate’s request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Associate from the designated supplier, if one is designated.

1.3 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance. Also, submit timesheet and payroll verification of labor hours and costs associated with installing the work, if installation is included.

1.4 TESTING AND INSPECTING ALLOWANCES

A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.

B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure.
C. Costs of services not required by the Contract Documents are not included in the allowance.

D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.5 UNUSED MATERIALS

A. Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
   1. If requested by A/E, prepare unused material for storage by Owner when it is not economically practical to return the material for credit. If directed by A/E, deliver unused material to Owner's storage space. Otherwise, disposal of unused material is Contractor's responsibility.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Promptly on delivery, examine for damage or defects products covered by an allowance. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related products and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Include as lump sum in base bid an allowance to provide all materials and installation of the Dry Laid Stone Wall (Detail 12, Drawing L3.6). Wall to be installed in locations within the project area as directed by Owner. Amount of allowance shall be $15,000.00.

B. Allowance No. 2: Include as lump sum in base bid an allowance to furnish and install miscellaneous signage and pavement marking as requested by the owner during construction. Amount of allowance shall be $5,000.

END OF SECTION
SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Special Conditions and other Division 1 Specification Sections, apply to Work of this Section.

1.2 SUMMARY

A. Refer to the Contract Documents for the definitions of units of work where the establishment of unit prices is required. It is recognized that unit price items are listed on the Bid Form, and that the Contractor Agreement records acceptance or rejection of each unit price, either as bid or as otherwise agreed upon by the date of the Agreement. It is further recognized that the utilization of unit prices is solely by means of Change Orders as specified in General and Special Conditions, and that established unit prices contain total costs as defined therein, and include each entity's margins for overhead and profit.

B. Related Documents and Sections include the following:
   1. Bid Form.
   2. Section 011000 – Summary of Work
   3. Section 012300 – Alternates

1.3 DEFINITIONS

A. A unit price is an amount proposed by bidders and stated on the Bid Form as a price per unit of measurement for materials of services that will be added to or deducted at the same amount from the Contract Sum by Change Order in the event the estimated quantities of work required by the Contract Documents are increased or decreased.

B. The University reserves the right to reject the Contractor’s measure of work-in-place which involves the use of established unit prices, and at the University’s expense to have the work measured by an independent surveyor acceptable to Contractor.

1.4 UNIT PRICE DESCRIPTIONS

A. Regarding work at M.E.T. Quad:
   1. Item #U-1; Over excavation of existing subgrade, including off-site disposal.
   2. Item #U-2; Removal and disposal of existing concrete paving and base material.
   3. Item #U-3; Provide and install compacted Granular Base.
   4. Item #U-4; Provide and install compacted Aggregate.
   5. Item #U-5; Provide and install 6 inch Concrete Pavement, including Aggregate base
   6. Item #U-6; Provide and install Heavy Duty Concrete Pavement, including Aggregate base.
   7. Item #U-7; Provide and install brick paving on concrete base (“Bike Pad Pavement Section”)
   8. Item #U-8; Installation of Concrete Straight Curb.
   9. Item #U-9; Installation of Barrier Free Curb Ramp, including Aggregate base and Detectable Warning Plates.
   10. Item #U-10; Installation of ODOT Curb & Gutter (Type 2 or Type 3)
   11. Item #U-11; Installation of Grasspave Pavement.
   12. Item #U-12; Installation of Owner provided Bench.
   13. Item #U-13; Installation of Owner provided Armchair or Sidechair.
   14. Item #U-14; Installation of Owner provided Table.
15. Item #U-15; Installation of Owner provided Bike Rack.
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PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION
SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. A. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Deduct pedestrian lights east of Tappan and Emerson Hall as indicated in Drawings

B. Alternate No. 2: Deduct electrical outlets on the porches of Tappan and Morris Halls as indicated on Plans

C. Alternate No. 3: Add the Removal existing brick paving adjacent to curb along Maple Street and installation of 6 inch Concrete Pavement in the same place, as indicated on Drawings.

D. Alternate No. 4: Add the installation of Bike Pad Paving and Bike Racks in four(4) locations on the east side of Tappan Hall, west side of Emerson, and west side of Morris Hall, as indicated on Drawings.
E. Alternate No. 5: Deduct the 6 inch concrete Pavement, Barrier Free Ramp and related incidental work north of the Recreation Field on the west side of Patterson Avenue, where indicated on Drawings.

F. Alternate No. 6: Deduct to substitute a 14 In. Concrete Curb in lieu of a Limestone Curb, in all locations where a Limestone Curb is indicated, as indicated in the Site Details on the Drawings.

END OF SECTION
SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
   3. Requirements for Contractor to provide quality-assurance and -control services required by Landscape Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections include the following:
   1. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Landscape Architect.

C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.

D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
   1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

I. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Landscape Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Landscape Architect for a decision before proceeding.

1.5 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Description of test and inspection.
   3. Identification of applicable standards.
   4. Identification of test and inspection methods.
   5. Number of tests and inspections required.
   6. Time schedule or time span for tests and inspections.
   7. Entity responsible for performing tests and inspections.
   8. Requirements for obtaining samples.
   9. Unique characteristics of each quality-control service.

C. Reports: Prepare and submit certified written reports that include the following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.
   6. Description of the Work and test and inspection method.
   8. Complete test or inspection data.
   9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

G. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

H. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Landscape Architect.
2. Notify Landscape Architect five days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Landscape Architect's approval of mockups before starting work, fabrication, or construction.
   a. Allow five days for initial review and each re-review of each mockup.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. **Demolish and remove mockups when directed, unless otherwise indicated.**

1.7 **QUALITY CONTROL**

A. **Owner Responsibilities:** Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
   2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
   1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
   2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
   3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
   4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
   5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. **Manufacturer's Field Services:** Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. **Testing Agency Responsibilities:** Cooperate with Landscape Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
   1. Notify Landscape Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
   2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
   3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
   4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
   5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
   6. Do not perform any duties of Contractor.

F. **Associated Services:** Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
   1. Access to the Work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.
   3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
   4. Facilities for storage and field curing of test samples.
QUALITY REQUIREMENTS

5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Landscape Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Landscape Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION
SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Sections include the following:
   1. Division 01 Section "Summary" for limitations on utility interruptions and other work restrictions.
   2. Division 01 Section "Execution" for progress cleaning requirements.

1.3 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to Owner's construction forces, Landscape Architect, testing agencies, and authorities having jurisdiction.

B. Water Service: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations. Contractor to monitor and be judicious with use of service through duration of project.

C. Electric Power Service: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations. Contractor to monitor and be judicious with use of service through duration of project.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

PART 2 - PRODUCTS

2.1 MATERIALS


B. Plastic Enclosure Fence: Orange, plastic safety fencing to clearly identify limits of access.
2.2 TEMPORARY FACILITIES

A. Field Offices, Contractor may at his option provide a field office and/or storage units.
   1. The Owner will make a space available for required progress meetings during the course of
      construction; however, the Contractor must provide for his/her own field office.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and
   classes of fire exposures.
   1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is
      prohibited.
   2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to
      authorities having jurisdiction, and marked for intended use.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with
   performance of the Work or daily operations of the University. Relocate and modify facilities as required by
   progress of the Work.
   1. Locate facilities as directed by the Owner.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.
   1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if
      necessary, to make connections for temporary services.

B. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction
   personnel. Comply with authorities having jurisdiction for type, number, location, operation, and
   maintenance of fixtures and facilities.

C. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing
   or drying of completed installations or for protecting installed construction from adverse effects of low
   temperatures or high humidity. Select equipment that will not have a harmful effect on completed
   installations or elements being installed.

D. Electric Power Service: Use of Owner's existing electric power service will be permitted, as long as
   equipment is maintained in a condition acceptable to Owner.
   1. Connect temporary service to Owner's existing power source, as directed by Owner.
   2. Contractor to provide any materials necessary to connect to temporary power.

E. Lighting: Provide temporary lighting with local switching that provides adequate illumination for
   construction operations, observations, inspections, and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without
      operating entire system.

F. At jobsite, post a list of important telephone numbers.
   1. Police and fire departments.
   2. Ambulance service.
   3. Contractor's home office.
5. Owner's office.
6. Principal subcontractors' field and home offices.

G. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
   1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
   2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
   1. Protect existing site improvements to remain including curbs, pavement, and utilities.
   2. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
   1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
   2. Remove snow and ice as required to minimize accumulations.

E. Project Identification and Temporary Signs: Provide Project identification sign. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
   1. Provide temporary, directional signs for construction personnel and visitors.
   2. Maintain and touchup signs so they are legible at all times.

F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.

G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
   1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

H. Walks: Provide temporary walks through areas of the project site that are open to the public. Such walks must be barrier free. Overlapping sheets of wood products (e.g., plywood) with a physical lip of greater than ¼ inch will not be acceptable. Temporary walks with sheets of wood product supported by a lumber frame and with smooth seams will be acceptable, as will be walks made of crushed and compacted road aggregate such as ODOT 304, assuming all other barrier free ADA guidelines are met.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
   1. Comply with work restrictions specified in Division 01 Section "Summary."
B. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Division 31 Section "Erosion and Sediment Control."

C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

E. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site.
   1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.

F. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
   1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
   2. At Substantial Completion, clean and renovate permanent facilities used during construction period.

END OF SECTION
SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
   2. Field engineering and surveying.
   4. Progress cleaning.
   5. Starting and adjusting.
   6. Protection of installed construction.
   7. Correction of the Work.

B. Related Sections include the following:
   1. Division 01 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.

1.3 SUBMITTALS

A. Qualification Data: For professional surveyor.

B. Certificates: Submit certificate signed by professional surveyor certifying that location and elevation of improvements comply with requirements.

1.4 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
   1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
   a. Description of the Work.
   b. List of detrimental conditions, including substrates.
   c. List of unacceptable installation tolerances.
   d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

3. Examine exterior walls for suitable conditions where products and systems are to be installed.

4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.


3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Landscape Architect promptly.

B. General: Engage a professional surveyor to lay out the Work using accepted surveying practices.
   1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
   2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
   3. Inform installers of lines and levels to which they must comply.
   4. Check the location, level and plumb, of every major element as the Work progresses.
   5. Notify Landscape Architect when deviations from required lines and levels exceed allowable tolerances.

C. Site Improvements: Locate and lay out site improvements, walls and ramps, including pavements, grading, fill and topsoil placement.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Landscape Architect.
3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
   1. Do not change or relocate existing benchmarks or control points without prior written approval of Landscape Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Landscape Architect before proceeding.
   2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
   1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
   2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
   3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb and make horizontal work level.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.
3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection, security, and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION
SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Inspection procedures.
   2. Warranties.
   3. Final cleaning.

B. Related Sections include the following:
   1. Division 01 Section "Execution" for progress cleaning of Project site.
   2. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
   3. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   4. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
   1. Prepare 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, Final Completion construction photographs, 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 change-over in security provisions.
   8. Complete startup testing of systems.
   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.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect/Owner Representative will either proceed with inspection or notify Contractor of unfulfilled
requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
   1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
   2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training videotapes if applicable.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect or Owner Representative will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1.6 WARRANTIES

A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
   1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
   1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
      a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
      b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
      c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
      d. Remove tools, construction equipment, machinery, and surplus material from Project site.
      e. Clean exposed exterior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
      f. Remove labels that are not permanent.
      g. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
      h. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
      i. Leave Project clean and ready for occupancy.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION
SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Operation and maintenance documentation directory.
   2. Operation manuals for systems, subsystems, and equipment.
   3. Maintenance manuals for the care and maintenance of products, materials, systems and equipment.

B. Related Sections include the following:
   1. Division 01 Section "Closeout Procedures" for submitting operation and maintenance manuals.
   2. Division 01 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
   3. Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

A. Initial Submittal: Submit 2 draft copies of each manual at least 14 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return one copy of draft and mark whether general scope and content of manual are acceptable.

B. Final Submittal: Submit one copy of each manual in final form at least 14 days before final inspection. Architect will return copy with comments within 7 days after final inspection.
   1. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 14 days of receipt of Architect's comments.

1.5 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:
   1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
   1. Title page.
   2. Table of contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of Owner.
   4. Date of submittal.
   5. Name, address, and telephone number of Contractor.
   6. Name and address of Architect.
   7. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
   1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
   1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
      a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
      b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
   1. System, subsystem, and equipment descriptions.
   2. Performance and design criteria if Contractor is delegated design responsibility.
   3. Operating standards.
   4. Operating procedures.
   5. Operating logs.
   6. Wiring diagrams.
   7. Control diagrams.
   8. Piped system diagrams.
   9. Precautions against improper use.
  10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:
   1. Product name and model number.
   2. Manufacturer's name.
   3. Equipment identification with serial number of each component.
   4. Equipment function.
   5. Operating characteristics.
   6. Limiting conditions.
   7. Performance curves.
   8. Engineering data and tests.
   9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:
   1. Startup procedures.
   2. Equipment or system break-in procedures.
   3. Routine and normal operating instructions.
   4. Regulation and control procedures.
   5. Instructions on stopping.
   7. Seasonal and weekend operating instructions.
   8. Required sequences for electric or electronic systems.
   9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.
2.4 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:
   1. Product name and model number.
   2. Manufacturer's name.
   3. Color, pattern, and texture.
   5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
   1. Inspection procedures.
   2. Types of cleaning agents to be used and methods of cleaning.
   3. List of cleaning agents and methods of cleaning detrimental to product.
   4. Schedule for routine cleaning and maintenance.
   5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
   1. Standard printed maintenance instructions and bulletins.
   2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   3. Identification and nomenclature of parts and components.
   4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
   1. Test and inspection instructions.
   2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training videotape, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
1. Do not use original Project Record Documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared Record Drawings in Division 01 Section "Project Record Documents."

F. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION
SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents including the following:
   1. Project Record Document Submittals
   2. As-built Construction Drawings
   3. Record Specifications
   4. Record Product Data
   5. Certificates and Warranties

B. Related Sections include the following:
   1. Section 011000 –Summary of Work
   2. Section 017700 – Closeout Procedures
   3. Divisions 2-49 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

A. Refer to General Conditions for requirements for Project Record Document Submittals. In addition to those requirements and prior to close out of the project, the Contractor shall provide the following items to the Architect for approval, which may include, but is not limited to the following:
   1. An affidavit to certify that the Contractor has complied with all requirements of Chapter 4115, ORC, “Wages and Hours on Public Work”.

B. As-built Construction Drawings: Submit one set of marked up As-built Record Prints

C. Record Specifications: Submit one copy of Project’s Specifications, including addenda and contract modifications.

D. Record Product Data: Submit one copy of each Product Data submittal. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as in insert in manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 AS-BUILT CONSTRUCTION DOCUMENTS

A. The Contractor shall maintain As-Built Construction Documents on a separate set of the Construction Documents set aside especially for this purpose on the job. Changes in the Work shall be recorded in the As-Built Construction Documents at the time the changes occur.
   1. Accurately record information in an understandable technique.
   2. Record and check markup prior to enclosing concealed installations.
B. The Contractor shall maintain at the jobsite one copy of Drawings, Project Manual, addenda, final shop drawings, change orders, field orders, other contract modifications, and other documents submitted by the Contractor, in compliance with various Sections of the Project Manual.

C. The Contractor shall clearly mark its As-Built Construction Documents. Mark these drawings to show the actual installation where the installation varies from the installation shown. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later. The Contractor shall require entities marking the prints to sign and date each mark-up. The Contractor shall bind prints in manageable sets, with durable paper covers, appropriately labeled. Contractor application for payments may be recommended to be withheld pending review and approval of record drawings being kept by the Contractor. Items required to be marked include, but are not limited to, the following:
   1. Dimensional changes to the Drawings.
   2. Significant detail not shown in the original Contract Documents including Change Orders.
   3. The location of underground utilities and appurtenances dimensionally referenced to permanent surface improvements.
   4. The location of internal utilities and appurtenances concealed in structures, referenced to visible and accessible features of the structures.
   5. When elements are placed exactly as shown on Drawings, so indicate; otherwise show changed location.
   6. Revisions to details shown on the Drawings.
   7. Revisions to routing of piping and conduits.
   8. Revisions to electrical circuiting.
   9. Actual equipment locations.
   10. Changes made following the Architect’s written orders.
   11. Details not on original Contract Drawings.
   12. For sitework, the Contractor shall provide an As-Built topography by a licensed engineer.

D. Do not permanently conceal work until the required information has been recorded. Mark record prints of Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where shop drawings are marked, show cross reference on Contract Drawings location.
   1. Mark record sets with red, or color that may be photo-copied, colored pencil. Use other colors to distinguish between changes for different categories of the work at the same location.
   2. Note, alternate numbers, Change Order numbers, and similar identification.

E. During the construction period, maintain one copy of the Project Manual, including addenda and modifications issued, for record purposes.
   1. Mark the Specifications to indicate the actual installation where the installation varies from that indicated in Specifications and modifications issued. Note related project record-drawing information, where applicable. Give particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later.
   2. In each Specification Section where products, materials, or units of equipment are specified, indicate whether record product data has been submitted in maintenance manual instead of submitted as record product data.

F. During the construction period, maintain 3 copies of each product data submittal for Project Record Document purposes.
   1. Mark product data to indicate the actual product installation where the installation varies finally from that indicated in project data submitted. Include significant changes in product delivered to the site and changes in manufacturer’s instructions and recommendations for installation.
   2. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   3. Note related Change Orders and markup of record drawings, where applicable.
   4. Where record product data is required as a part of maintenance manuals, submit marked up product data as an insert in the manual instead of submittal as record product data.
G. Record Sample Submittal: Immediately prior to date of Final Completion, meet with the A/E and University’s personnel at the site to determine which of the samples maintained during the construction period shall be transmitted to the University for record purposes. Comply with the Architect’s instructions for packaging, identification marking, and delivery to the University’s samples storage space. Dispose of other samples in a manner specified for disposing samples and waste materials.

H. Prior to final payment on the Project, submit through the Construction Manager to the A/E the "As-Built Construction Documents" for changes recorded for the Work of Divisions 2 through 16.
   1. Each drawing shall be labeled "As-Built Construction Document," dated, and signed by the Contractor.

2.2 CERTIFICATES AND WARRANTIES

A. Submit all executed warranties, maintenance bonds, certificates, etc. as required by the Technical Sections of Work in the quantities outlined in the division one “Submittals” section.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect’s and Construction manager’s reference during normal working hours.

END OF SECTION
SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.

1.3 SUBMITTALS

A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

B. Qualification Data: For instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

E. Demonstration: Submit two copies within seven days of end of each training module.
   1. Identification: On each copy, provide an applied label with the following information:
      a. Name of Project.
      b. Name and address of photographer.
      c. Name of Architect and Construction Manager.
      d. Name of Contractor.
   2. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding videotape. Include name of Project and date.

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Pre-instruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
   1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, and content.

C. Coordinate content of training modules with content of approved operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
   1. Equipment, including irrigation system.
   2. Lighting equipment and controls.
   3. Documentation: Review the following items in detail:
      b. Maintenance manuals.
      c. Project Record Documents.
      d. Identification systems.
      e. Warranties and bonds.
      f. Maintenance service agreements and similar continuing commitments.

4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
   m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.

6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning

8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation. Assemble training modules into a combined training manual.

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
   2. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

END OF SECTION
SECTIO 033000 - CAST-IN PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 SUBMITTALS

A. Design Mixtures: For each concrete mixture.

B. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.

C. Welding certificates.

D. Material certificates.

E. Material test reports.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

F. Preinstallation Conference: Conduct conference at jobsite.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

B. Normal-Weight Aggregates: ASTM C 33, graded.
   1. Maximum Coarse-Aggregate Size: 1 1/2 inch nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.


2.4 ADMIXTURES


B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 FIBER REINFORCEMENT

A. Synthetic Micro-Fiber: Fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.

2.6 VAPOUR RETARDERS

A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.8 RELATED MATERIALS


2.9 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

C. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing or high-range water-reducing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete and concrete with a water-cementitious materials ratio below 0.50.

D. Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4000 psi for foundations and poured sidewalks and service drives at 28 days.
   2. Maximum Water-Cementitious Materials Ratio: 0.50 for foundations and walls, 0.45 for slabs.
   3. Slump Limit: 5 inches typical, 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture admixture admixture admixture admixture admixture, plus or minus 1 inch.
   4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
   5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
   6. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd. Retain strength from five options in first subparagraph below or revise to suit Project.

2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Chamfer exterior corners and edges of permanently exposed concrete in walls.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
   1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces. Provide smooth trowelled border on joints as indicated on Drawings.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

E. Waterstops: Install in construction joints and at other joints indicated according to manufacturer's written instructions.
3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

C. Cold-Weather Placement: Comply with ACI 306.1.

D. Hot-Weather Placement: Comply with ACI 301.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces exposed to public view.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
   1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces 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.

3.8 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated. Refer to specification Section 32 13 00 Concrete Pavement from more detail on broom finishing of pavements.

3.9 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply
according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
      a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
   4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION
SECTION 042113 - BRICK MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Face brick.
   2. Stone trim units.
   3. Mortar and grout.
   4. Ties and anchors.
   5. Embedded flashing.
   6. Miscellaneous masonry accessories.

B. Related Sections:
   1. Section 03 30 00 "Cast-in-Place Concrete"
   2. Section 04 43 00 "Limestone"
   3. Section 32 14 00 "Unit Paving"
   4. Section 32 32 00 "Concrete Wall, Steps, and Structures"

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:
   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
   2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
   3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:
   1. Face brick in the form of straps of five or more bricks.
   2. Mortar. Make Samples using same sand and mortar ingredients to be used on Project.
   3. Flashing. Minimum sample size 10 inches square.

1.4 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
   1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Material Certificates: For each type and size of the following:
   1. Masonry units.
      a. Include data on material properties indicating compliance with specifications.
b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
c. For exposed brick, include test report for efflorescence according to ASTM C 67.
d. For surface-coated brick, include test report for durability of surface appearance after 50-cycles of freezing and thawing per ASTM C 67 or a list of addresses of buildings in Project's area where proposed brick has been used successfully and with a history of durability.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Anchors, ties, and metal accessories.

C. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockup of typical wall area as shown on Drawings.
2. Build mockups for each type of exposed unit masonry construction in sizes approximately 60 inches long by 24 inches high by full thickness, including accessories.
   a. Include a sealant-filled joint at least 16 inches long in mockup.
   b. Include through-wall flashing as indicated on Drawings.
3. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
4. Clean exposed faces of mockups with masonry cleaner as indicated.
5. Protect accepted mockups from the elements with weather-resistant membrane.
6. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
   a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
   b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
7. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.  
1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.  
1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface. 
2. Protect sills, ledges, and projections from mortar droppings. 
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings. 
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.  
1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.


PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 BRICK

A. Regional Materials: Brick shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.

2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.

3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.

4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

5. Provide kerfed brick for splitting brick in two, as required for laying Flemish bond.

C. Face Brick: Facing brick complying with ASTM C 216

1. Products: Subject to compliance with requirements, provide the following:
   a. Facing brick as manufactured by the Bowerston Shale Company, P.O. Box 199, Bowerston OH, 44695. Telephone (740) 269-2921.

2. Grade: SW.

3. Type: FBS

4. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.

5. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."

6. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet.

7. Size (Actual Dimensions): Modular size, 3-1/2 to 3-5/8 inches wide by 2-1/4 inches high by 7-1/2 to 7-5/8 inches long.

8. Color and Texture: “Miami Blend 5”

9. No substitutions will be accepted for the brick as specified herein.

2.3 MORTAR MATERIALS

A. Regional Materials: Aggregate for mortar, cement, and lime shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

C. Hydrated Lime: ASTM C 207, Type S.

D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

E. Masonry Cement: ASTM C 91.

1. Products: Subject to compliance with requirements, provide masonry cement from one of the following manufacturers:
   b. Cemex S.A.B. de C.V
   c. Essroc, Italcementi Group
   d. Holcim (US) Inc.
   e. Lafarge North America Inc.;
   f. Lehigh Cement Company;
   g. National Cement Company, Inc.

F. Mortar Cement: ASTM C 1329.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following: 
a. Lafarge North America Inc.; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement

G. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Davis Colors; True Tone Mortar Colors.
   b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
   c. Solomon Colors, Inc.; SGS Mortar Colors.

H. Colored Cement Product: Packaged blend made from portland cement and hydrated lime mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
1. Colored Portland Cement-Lime Mix:
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
      4) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
   2. Pigments shall not exceed 10 percent of portland cement by weight.
   3. Pigments shall not exceed 5 percent of mortar cement by weight.

I. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

2.4 TIES AND ANCHORS
A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

B. Corrugated Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.060-inch- thick, steel sheet, galvanized after fabrication.

2.5 MISCELLANEOUS ANCHORS
A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.

B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034-inch, galvanized steel sheet.
2.6 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
   1. Copper: ASTM B 370, Temper H00, cold-rolled copper sheet, 16-oz./sq. ft. weight or 0.0216 inch thick or ASTM B 370, Temper H01, high-yield copper sheet, 12-oz./sq. ft. weight or 0.0162 inch thick.
   2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
   3. Fabricate through-wall flashing with drip edge between brick and concrete foundation and limestone cap unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed. Retain first subparagraph below if either of last two subparagraphs above is used with ribbed metal flashing.

B. Solder and Sealants for Sheet Metal Flashings

C. Retain option in last paragraph above or one or more of three subparagraphs below.
   1. Solder for Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
   2. Elastomeric Sealant: ASTM C 920, chemically sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.7 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
   1. Do not use calcium chloride in mortar.
   2. Use portland cement-lime mortar cement mortar unless otherwise indicated.
   3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide Type N unless another type is indicated.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
   1. Pigments shall not exceed 10 percent of portland cement by weight.
   2. Pigments shall not exceed 5 percent of mortar cement by weight.
   3. Mix to match existing buildings in the project area.
   4. Application: Use pigmented mortar for exposed mortar joints with the following units:
      a. Face brick.
      b. Stone trim units.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
   1. Mix to match Architect's sample.
   2. Application: Use colored aggregate mortar for exposed mortar joints with the following units:
      a. Concrete facing brick.
      b. Face brick.
      c. Stone trim units.
d. Cast stone trim units.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
   1. Mix units from several pallets or cubes as they are placed.

D. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

E. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:
   1. For dimensions in elevation do not vary by more than plus 1/2 inch or minus 1/4 inch
   2. The cross section dimension of the brick walls must be completed such that the limestone cap fits on top of the wall as indicated on Drawings.
   3. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
   4. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
   4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
   6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch; do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
2. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.
3. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in Flemish bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow brick as follows:
1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With entire units, including areas under cells, fully bedded in mortar at starting course on footings.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set stone trim units in full bed of mortar with joints full, or cut to accept sealant as indicated on Drawings. Fill dowel, anchor, and similar holes.
1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.
3. Wet joint surfaces thoroughly before applying mortar.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated. Detail joints with incised line to match campus standards and building masonry in the project area.

3.6 ANCHORING MASONRY TO CONCRETE

A. Anchor masonry to concrete where masonry abuts or faces concrete to comply with the following:
1. Anchor masonry with anchors embedded in masonry joints and attached to structure.
2. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.
3.7 EXPANSION JOINTS

A. General: Install expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints in brick as follows:
   1. Build in compressible joint fillers where indicated.
   2. Form open joint full depth of brick wythe and of width indicated, but not less than 1/2 inch for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

C. Provide horizontal, pressure-relieving joints by inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 1/2 inch.
   1. Locate horizontal, pressure-relieving joints at joints in limestone cap.

3.8 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspections according to the "International Building Code."
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

C. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

3.9 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean brick by bucket-and-brush hand-cleaning method described in "BIA Technical Notes 20."
   6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
   7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
   8. Clean stone trim to comply with stone supplier's written instructions.
   9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."
3.10 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches in each dimension.
   2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
   3. Do not dispose of masonry waste as fill within 18 inches of finished grade, or in areas of proposed landscape beds.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION
SECTION 04 43 00 - LIMESTONE (FOR SITE WALLS)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Limestone caps and coping, and miscellaneous limestone construction as shown on drawings and specified herein.

1.2 REFERENCES

A. Installation, fabrication and performance requirements to meet specific reference standards as referred to hereinafter under individual items as follows:
   1. ILI - Indiana Limestone Institute of America

1.3 SUBMITTALS

A. Product Data: Submit specifications and other data for each type of stone, mortar material and accessories required (such as the stainless steel skate guard), including certification that each type complies with specified requirements.

B. Samples: Submit three sets of samples not less than 12 inches x 12 inches in size of each different color, grade and finish of limestone. Include in each set a full range of exposed color and texture to be expected in completed work.

C. Shop Drawings: Submit cutting and setting drawings showing sizes, dimensions, sections and profiles of limestone units; arrangement and provisions for jointing, anchoring and fastening; supports and other necessary details for lifting devices; and reception of other work. Indicate location of each stone unit on setting drawings with number designation corresponding to number marked on each unit.
   1. Show location of inserts (for stone anchors and supports) which are to be built into concrete or masonry.

1.4 QUALITY ASSURANCE

A. Obtain limestone from one quarry with consistent color range and texture throughout the work.

B. Quarrying, fabrication and installation of limestone shall be performed by a firm which has successfully performed stonework similar to the quality specified and quantity required for a period of not less than five years.

C. Coordination of Fabrication: Wherever possible, check dimensions of supporting structure at site by accurate field measurements before final submittal of shop drawings and fabrication of stone. However, coordinate fabrication schedule with construction progress to avoid delay of work. Where necessary, proceed without field measurements and coordinate installation tolerances to ensure proper fit of stonework.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect stone during storage and construction against moisture, soiling, staining and physical damage.

B. Handle stone to prevent chipping, breakage, soiling or other damage. Do not use pinch or wrecking bars without protecting edges of stone with wood or other rigid materials. Lift with wide-belt type slings wherever possible; do not use wire rope or ropes containing tar or other substances which might cause staining. If required, use wood rollers and provide cushion at end of wood slides.

LIMESTONE (FOR SITE WALLS)
C. Store stone on wood skids or pallets, covered with non-staining waterproof membrane. Place and stack skids and stones to distribute weight evenly and to prevent breakage or cracking of stones. Protect stored stone from weather with waterproof, non-staining covers or enclosures, but allow air to circulate around stones.

D. Protect mortar materials and stonework accessories from weather, moisture and contamination with earth and other foreign materials.

1.6 JOB CONDITIONS

A. Temperature conditions: Do not set stone units when air temperature is below 40 degrees Fahrenheit unless approved by the Architect.

PART 2 - PRODUCTS

2.1 LIMESTONE MATERIALS

A. Provide limestone complying with the requirements of ASTM C568, Category II (medium density), smooth finish on exposed surfaces.

B. Approved manufacturer:
   1. Bybee Stone Company. P.O. Box 968, Bloomington, IN 47402 Phone: 800-457-4530
   2. Stone Center, LLC 2970 Prow Road, Bloomington, IN 47402 Phone: (812) 330-9773.

C. Color to be selected by Owner. The intent is to match the limestone trim detailing of buildings and site masonry in the project area and vicinity.

D. Use only limestone whose exposed surfaces do not show any color, texture or other irregularities which would change its appearance and not be characteristic of the quarried stone represented by the approved samples. Do not use stone whose surfaces exhibit any cavities, holes, cracks, splinters or rust, or color faults. Apply indicated finish to all exposed surfaces, including edges.

E. 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.

F. Provide stone units accurately shaped, with exposed faces dressed true, and with beds and joints at right angles to faces.
   1. For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."

2.2 MORTAR MATERIALS

A. As specified in Section 04 21 13 Brick Masonry.

2.3 STONEWORK ACCESSORIES

A. Stone Anchors: Provide the type and size shown or, if not shown, as required to securely anchor and fasten stonework in place. Fabricate anchors and dowels from Type 302/304 stainless steel.

B. Setting Buttons: Lead or plastic buttons of the thickness required for the joint size shown or specified, and of the size required to maintain uniform joint width.
2.4 FABRICATION

A. General
   1. Fabricate as shown and as detailed on final shop drawings and in compliance with recommendations of ILI.
   2. Provide holes and sinkages cut or drilled for anchors, fasteners, supports and lifting devices, as shown and as necessary to secure stonework in place. Cut and back-check as required for proper fit and clearance. Shape beds to fit supports. Lifting holes and device locations shall be approved by the Architect.

B. Contiguous Work: Provide chases, reveals, openings and similar spaces and features as required for contiguous work. Coordinate with drawings and final shop drawings showing contiguous work.

C. Cut accurately to shape and dimensions shown on final shop drawings. Comply with fabrication tolerances of the ILI for specified finishes.
   1. Dress joints (bed and vertical straight and at 90-degree angle to face) unless otherwise indicated.
   2. Provide quirk-mitered corners, unless otherwise shown. Provide for cramp anchorage in top and bottom bed joints of corner units unless otherwise shown.
   3. Joint Width: Cut to provide joint widths as shown, or if not shown, cut to allow for uniform minimum 3/8 inch wide joints.

D. Thickness: Provide stone of thickness shown. Saw-cut or roughly dress back surfaces which will be concealed in finished work to approximately true planes. Maximum variations in thickness from that shown not to exceed 3/16 inch.

2.5 JOINT SEALANT AND EXPANSION JOINTS

A. Refer to Section 32 13 73, Site Joint Sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structure and the conditions under which the stone is to be installed, and notify the Architect in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation of stone until unsatisfactory conditions have been corrected in a manner acceptable to the installer and the Architect.

3.2 INSTALLATION, GENERAL

A. Do not use stone units with chips, cracks, voids, stains or other defects which might be visible in the finished work, unless otherwise acceptable to the Architect.

B. Clean stone before setting by scrubbing with fiber brushes followed by a thorough drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh fillers or abrasives. If not thoroughly wet at time of setting, drench or sponge stone.

C. Execute stonework by skilled mechanics, and employ skilled stone fitters at the site for necessary field cutting as stone is set.

D. Contiguous Work: Provide chases, reveals openings and other spaces as shown or required for contiguous work. Close up openings in stonework after other work is in place. Use materials and set to match surrounding stonework.
E. Ferrous Metal: Where stonework will contact ferrous metal surface which will be concealed in back-up construction (anchors, supports, structural framing and similar surfaces), apply a heavy coat of bituminous paint on metal surfaces prior to setting stone and do not extend coating onto portions of ferrous metal which will be exposed in the finished work, if any. Do not apply coating to stainless steel or non-ferrous metals.

F. Provide expansion joints where shown. Do not fill with mortar. Install continuous strips of preformed joint filler. Set joint filler to allow for installation of backer rod and sealant.

G. Set stone in accordance with drawings and final shop drawings for stonework. Provide anchors, supports, fasteners and other attachments shown, or necessary, to secure stonework in place. Shim and adjust accessories as required for proper setting on stone. Completely fill holes, slots and other sinkages for anchors, dowels, fasteners and supports with mortar during setting of stone.

H. Construction Tolerances for Stone
   1. Variation from Plumb: For lines and surfaces of columns, walls and areaways, do not exceed 1/4 inch in 10 feet. For external corners, expansion joints and other conspicuous lines, do not exceed 1/8 inch in 10 feet.
   2. Variation from Level: For grades shown for exposed sills, horizontal grooves and other conspicuous lines, do not exceed 1/8 inch in 10 feet.
   3. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions shown, do not exceed minus 1/4 inch, or plus 1/2 inch. Limestone caps must fit onto masonry walls as indicated in Drawings.

3.3 LIMESTONE COPINGS, PANELS AND CAPS

A. Erect units plumb and true with joints uniform in width and accurately aligned. Set in full bed or mortar, unless otherwise shown. Provide setting buttons, as required, to prevent extrusion of mortar. Do not set units above until mortar in courses below is set sufficiently to maintain alignment and prevent extrusion of mortar.

B. Joints: Butter vertical joints for full width before setting and set units in full bed of mortar, unless otherwise indicated.
   1. Rake out joints 3/4 inch deep before mortar sets to allow for mortar pointing. Clean face of stone after raking. After mortar is set, wet rake joints thoroughly and force pointing mortar into joints. Tool to profile shown; or if not shown, tool slightly concave.

C. Provide shims as required to maintain uniform joint width and alignment of stone units.

D. Sealed Expansion Joints: Refer to Section 32 13 73 - Site Joint Sealants.

3.4 INSCRIPTIONS

A. Inscribe recessed letters and graphics into limestone panels as indicated on drawings.

B. Provide full sized artwork for approval from reduced artwork provided by Architect.

3.5 REPAIR AND CLEANING

A. Remove and replace stone units which are broken, chipped, stained or otherwise damaged. Where directed, remove and replace units which do not match adjoining stone. Provide new matching units, install as specified and point up joints to eliminate evidence of replacement. Repoint defective and unsatisfactory joints to provide a neat, uniform appearance.
B. Clean stone not less than six days after completion of work, using clean water and stiff-bristle brushes. Do not use wire brushes, acid type cleansing agents, or other cleaning compounds with caustic or harsh fillers.

3.6 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to fabricator and installer, which ensures stone being without damage or deterioration at time of substantial completion.

B. Installer shall advise Contractor of proper procedures required to protect the stone from collapse, deterioration, discoloration or damage during construction and until acceptance of the work.

END OF SECTION
SECTION 129300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

A. All site furnishings shall be provided by Owner. Contractor shall unpack, assemble and install site furnishings in Owner approved locations.

B. Section Includes
   1. Tables and Seats.
   2. Benches and Chairs.
   3. Bike Racks
   4. Bollards

1.2 SUBMITTALS

A. Product Data
   1. Submit manufacturer's assembly and installation instructions for the following:
      a. Tables and Seats
      b. Benches and Chairs
      c. Bike Racks
      d. Bollards

B. Shop Drawings
   1. Submit site furnishings location plan and schedule for approval by Owner.

PART 2 - MATERIALS

2.1 PRODUCT MODELS AND MANUFACTURERS

A. All site furnishing product models and manufacturers shall be as noted on the Drawings. The Owner reserves the right to modify the specific site furnishings make and model without change to the contract amount, assuming that installation materials and practices are similar.
PART 3 - EXECUTION

3.1 GENERAL

A. Install site furnishings in Owner approved location and orientation as indicated on approved site furnishings location plan. Notify the Owner 48 hours prior to installation of site furnishings so that the Owner may coordinate with the installer and field adjust locations prior to actual installation.

B. The Drawings indicate mounting and anchoring details for each site furnishing product.

C. Anchoring and installation hardware is to be provided by Contractor. All anchoring and installation hardware shall be made of stainless steel.

D. All hardware to have vandal resistant, tamper proof screws and bolt heads to strongly discourage unauthorized removal.

3.2 TABLES AND SEATS

A. Install tables and seats in Owner approved location and orientation, level and plumb as required.

3.3 BENCHES AND CHAIRS

A. Install benches in Owner approved location and orientation, level with legs vertical.

3.4 BIKE RACKS

A. Install bike racks in brick paving areas, square to the edge of the bike pad paving, as required.

3.5 BOLLARDS

A. Install bollards in Owner approved location and orientation, level and plumb as required.

3.6 ADJUSTMENTS

A. It is understood and agreed that should minor changes and deviations from the locations established on the Drawings be required by the Owner, this shall be done by the Contractor at no additional cost thereto.

END OF SECTION
SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Carefully read the Project Manual and drawings for all parts of work so as to become familiar with the entire project.

B. Should any changes in the specifications and drawings be necessary to conform to the demands of any established local labor practices, or errors and omissions noted, notify A/E two weeks prior to bid opening the bid so that suitable adjustments can be made.

1.2 REGULATION AGENCIES

A. The Architect/Engineer shall obtain the Building Permit. Secure and pay for all permits and inspections required for execution of the electrical work. Comply with State of Ohio Building Code, National Electrical Code, NFPA, all other State, County and Local Laws or Ordinances, local Fire Codes and laws.

B. Give the proper authorities notice as required by law.

C. Arrange for all tests on any or all parts of the work required by authorities that have jurisdiction and pay all charges for same.

D. In no case shall the standard of work be inferior to the standard called for in the Code, but where the class of work called for by these specifications is superior to the Code requirements, the specifications shall govern the work and the work must conform to these requirements.

E. No extra compensation will be allowed for changes necessary for Code compliance regardless of the method of installation shown on the drawings or specified herein.

F. Certificates of inspection shall be delivered, without charge, to the Architect/Engineer before final payment showing that all work and materials under this Contract fully meet the requirements and approval of the City, County, and State Inspection Departments.

1.3 CODES AND STANDARDS

A. Refer to Division 1 for requirements for permitting and inspection. All required electrical permits shall be provided as a part of the complete package.

B. Completed electrical installations shall comply with applicable local, State of Ohio, and Federal laws, codes, and ordinances, including the following:

1. National Electrical Contractors Association (NECA):
   a. NECA “Standard of Installation”

2. National Fire Protection Association (NFPA):
a. 2011 NFPA 70.

3. Ohio Department of Industrial Compliance:
   a. 2009 Ohio Building Code

4. Underwriters’ Laboratories, Inc. (UL):
   a. Materials requiring UL examination service shall bear UL labels or be UL listed.
   b. Work under jurisdiction of Local Fire Marshal shall comply with requirements set forth by the Fire Marshal’s Office and the NFPA.
   c. Nothing contained in the drawings and specifications shall be construed to conflict with these laws, codes, and ordinances and they are hereby made a part of these specifications. Comply with drawing and specification requirements which are in excess of minimum code requirements.
   d. All motors used in Electrical Systems must comply with the requirements of the State of Ohio “Model code for Energy Conservation.”

1.4 COMPLETION DATE

   A. Coordinate, expedite and plan sequence of work for all phases of construction. The Electrical Contractor shall coordinate their work to keep up with the progress of the Lead Contractor.

1.5 SUBMITTALS

   A. See Division 1 for the requirements on submittals. Electrical components requiring submittal include:
      1. Cable.
      2. Raceways, fittings, boxes.
      3. Panelboards.
      5. Lighting Fixtures.

   B. Submit shop drawings, catalog sheets and wiring diagrams in six (6) copies.

   C. Shop drawings required for all custom built and/or special equipment.

   D. Standard catalog equipment.

   E. Working drawings.

   F. Manufacturers catalog cuts shall be securely fastened in folders with proper identification on the front cover.

   G. Furnish sets of approved shop drawings to all trades whose work pertain to this work and/or is affected thereby.

   H. The bid shall include the furnishing and installing of material and equipment, exactly as specified or shown as similar by the contract documents. Manufacturers of similar equipment must be submitted prior to bidding for approval and the contractor submitting on similar equipment will be responsible for all
costs associated with changes in architectural, structural, and/or electrical trades due to the similar equipment characteristics submitted. If manufacturers are listed, no other manufacturers except those listed within the sections of this Division, that are in turn able to comply with the contract document requirements and minimum standards of these specifications, will be acceptable.

I. MAINTENANCE MANUALS

1. Prepare three (3) complete operating and maintenance manuals in hardback binders describing operation of the systems and recommended maintenance schedule. The manual shall contain building floor plans reduced in scale to fit an 11 x 17 sheet showing the location of all equipment and with a short description of the function and maintenance requirements of each piece of equipment. Turn all equipment warranties over to Architect/Engineer.

2. Manual shall include:
   a. Identifications, name, mark, number, etc., as indicated on drawings.
   b. Step-by-step procedures for start-up and shut-down of each system and piece of equipment.
   c. Normal equipment operating characteristics.
   d. Performance data, curves, ratings.
   e. Wiring diagrams.
   f. Manufacturer's descriptive literature.
   g. Manufacturer's maintenance and service manuals.
   h. Spare parts and replacement parts list for each piece of equipment.
   i. Final approved shop drawings.

J. RECORD DRAWINGS

1. Assemble and submit to the Architect/Engineer one (1) complete "as-built" drawing set, one hard copy of mark-ups and one AutoCAD file (compatible with version 2000) for use in preparation of record drawings.

1.6 LOCAL CONDITIONS

A. It is strongly encouraged and recommended to visit the site, become familiar with conditions affecting this work.

B. Exercise extra care when working in areas where existing services may exist. Pay for any costs for repair of damage to such services.

1.7 PRODUCT HANDLING

A. Pay all costs for transportation of materials, equipment to job site.

B. Store materials, equipment, etc., in dry location until building is ready to receive them. Protect all openings, etc., from dirt and moisture.

1.8 WARRANTY

A. See Division 1 for warranty periods for standard electrical components.
B. Product guarantees greater than one (1) year shall be passed along to the University for full benefit of the manufacturer’s warranty.

C. All work shall be free from defect in material and workmanship for a period of one year following the date of final acceptance of the work. Guarantee that apparatus will develop capacities and characteristics required. Repair or replace at no additional cost to the University, any material or equipment developing defects and shall make good any damage caused by such defects or the correction of defects.

D. Submit equipment manufacturer's written certificates, warranting that each item of equipment furnished complies with all requirements of the drawings and specifications.

E. The guarantee shall run from date of final acceptance of the work, not from date of installation of a device or piece of equipment.

1.9 WORK STANDARDS AND SPECIFICATIONS

A. The bases for design standards are the 2011 National Electrical Code and the 2009 Ohio Building Code.

B. The electrical contractor shall organize his work so that these alterations and additions shall cause a minimum of interference and disturbance to the University. Arrangements shall be made with the University before interrupting service in any area; a minimum of two weeks notice shall be given before the interruption of any utilities. A written detailed method of interruption procedure indicating elapsed time required and time of interruption shall be prepared and submitted to the Architect/Engineer for approval prior to any interruption. Two weeks notice is required by the University for all Utilities interruptions.

1.10 SEQUENCING AND SCHEDULING

A. Coordinate installation with other building components and trades to avoid conflicts prior to installation of equipment, etc.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials used shall be new, free from defects, clean and shall be protected from dirt and damages before and after installation, shall be as specified under the base bid for each item.

B. See all other Sections relating to work, either affected or affected by.

PART 3 - EXECUTION

3.1 INSTALLATION – GENERAL

A. The Architectural drawings with field observations and field measurements shall be used for all building dimensions, structural materials, etc. and for all pertinent details. Should discrepancies exist or where any question arises in regard to the meaning of the drawings, the Architect/Engineer shall be consulted and his interpretation shall be followed.
B. Devices and equipment shown on the plans is diagrammatic and must be modified with prior approval of the Architect/Engineer as required to meet the conditions on the job. It is desired that the indicated positions be followed as closely as possible.

C. For salvage items and disposal of construction debris, refer to Division 1.

3.2 DAMAGE TO OTHER WORK

A. Maintain systems in proper working order, and be responsible for all damage to other work caused by his work or through the neglect of his workmen.

3.3 SCHEDULE AND COORDINATION OF WORK

A. Advise other trades as to location of equipment, conduit, panels, and as to schedule of work, delivery of equipment, and when services of other Contractors will be required

B. Coordinate each piece of equipment with all other trades prior to ordering equipment and again prior to installation. No extra compensation will be approved if coordination is not performed.

3.4 CLEANING UP

A. At all times keep the premises free from accumulation of waste material or rubbish and at the completion of the work, remove all his rubbish from and about the building including all tools, scaffolding and surplus materials and shall leave all areas "broom clean."

B. Provide daily housekeeping to provide a clean and safe work area for all personnel. Housekeeping that is not satisfactory will necessitate in charges for the cost of the work involved to clean up debris. If determination of responsibility for debris is not possible, the cost of clean-up will be shared equally.

3.5 TESTS AND INSPECTIONS

A. Coordinate all inspections required by all authorities having jurisdiction and obtain certificates of such inspections and submit same to the Architect/Engineer.

3.6 FINAL COMPLETION

A. All work shall be cleaned prior to issuance of Contract Completion.

B. Restore damaged materials, and leave the Work in acceptable condition.

C. Remove all site tools, equipment, surplus materials, and rubbish continuously at no additional cost to the Architect/Engineer.

END OF SECTION
SECTION 260519 LOW - VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY
   A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.
   B. Furnish and install necessary wire and cable for lighting systems and control systems as shown on the Drawings and specified herein.

1.2 SUBMITTALS
   A. Field quality-control test reports.

1.3 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
      1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
      2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 CONDUCTORS AND CABLES
   A. Manufacturers:
      1. Encore Wire.
      2. Southwire Company.
      3. General Cables.
      4. Okonite Company.
   B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.
C. Conductor Material: Copper stranded conductor. 98 percent conductivity shall be used unless use is restricted by Government Agencies. Aluminum wiring shall not be used. Use of aluminum plated bus and aluminum wound transformers are prohibited.

D. Conductor Insulation Types: Type THHN-THWN.

2.3 CONNECTORS AND SPLICES

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in conduit.

3.2 INSTALLATION

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to National Electrical Code.

F. Seal around cables penetrating fire-rated elements according to Section "Through-Penetration Firestop Systems."

G. Identify and color-code conductors and cables according to Division 26 Section 260553 "Identification for Electrical Systems."

H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
I. A dedicated neutral conductor shall be installed for each branch circuit.

J. Use of MC Cable is prohibited. All circuits and wiring shall be in conduit.

3.3 FIELD QUALITY CONTROL

A. Testing: Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

B. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION
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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.
B. Grounding system shall be in compliance with all requirements of the National Electrical Code.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, and marked for intended use.
B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor No. 8 AWG and smaller, and stranded conductors No. 6 AWG and larger, unless otherwise indicated.
3.2 **EQUIPMENT GROUNDING**

A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Lighting circuits see below.
      A wire equipment ground shall be installed within the branch circuit conduit and shall be grounded to the cabinet of the panelboard to an uninsulated ground bus. The neutral bar of the panel shall not be used for equipment grounds.
   2. Wiring devices.

3.3 **INSTALLATION**

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Grounding conductors shall be installed in rigid PVC or rigid galvanized conduit. No metal parts such as locknuts shall surround the ground conductor. If metal is used, protective conduits for ground conductors shall be bonded at both ends to reduce impedance in the ground path under fault current flow. All conduit connections shall be threaded and then welded.

3.4 **FIELD QUALITY CONTROL**

A. Report measured ground resistances that exceed the following values:
   1. Lighting Equipment or System with Capacity 500 kVA and Less: Less than 3 ohms.
   2. Power Equipment or System with Capacity 500 kVA and Less: Less than 3 ohms.

END OF SECTION
SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Seismic restraints for electrical equipment and systems.

1.2 SUBMITTALS

A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
   1. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of the ICC Evaluation Program or an agency acceptable to authorities having jurisdiction.
   2. Annotate to indicate application of each product submitted and compliance with requirements.

B. Shop Drawings for Seismic Restraints: For restraints and their attachments to structure not defined on Drawings, identify hardware, and indicate analysis, forces, strengths, materials, and dimensions, signed and sealed by a qualified professional engineer. Professional engineer qualification requirements are specified in Division 1 Section "Quality Requirements."

1.3 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the OBC/IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.

B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly, and provide finish suitable for the environment in which installed.

1. Manufacturers:
   a. Cooper B-Line; a division of Cooper Industries.
   b. ERICO International Corporation.
   c. Allied Support Systems; Power-Strut Unit.
   d. GS Metals Corp.
   e. Michigan Hanger Co., Inc.; O-Strut Div.
   f. National Pipe Hanger Corp.
   g. Thomas & Betts Corporation.
   h. Unistrut; Tyco International, Ltd.
   i. Wesanco, Inc.

2. Channel Dimensions: Selected for structural loading and applicable seismic forces.

C. Materials for Straps and Hangers: Heavy-duty malleable iron or steel. For installation in locations above grade that are subject to moisture penetration, corrosion-resisting steel shall be installed. Perforated straps shall not be installed.

D. Raceway and Cable Supports: As described in NECA 1.

E. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

F. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

G. Independent Support Systems: Required for all installations, except that light weight incandescent light fixtures on, or recessed into, suspended ceilings may have adjustable bar strap supports carried on the ceiling suspension system.
   1. Surface outlet boxes to which fixtures are attached and pull boxes shall be fastened to the structure independent of the conduit system supports.
   2. Conduits above suspended ceiling shall be attached to the structure and shall not be supported by a ceiling suspension system.
   3. Surface mounted fluorescent lighting fixtures shall be supported from the structure above independent of any ceiling system by the use of 3/8 inch all thread rods.
   4. Flush or recessed lighting fixtures in ceilings of suspended lay-in type shall be installed so that the long dimension of the fixture is supported on the main support member of the ceiling system. Supply and install a minimum of two galvanized steel safety hanger wires or safety chains, attached from the fixture housing to the structure independent of the ceiling system. Wire or chain shall withstand a 3-foot, 50-pound drop test. In addition, the Luminaire Support Requirements of the NEC shall be strictly followed.
H. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

I. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Manufacturers:
      1) Cooper B-Line; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti, Inc.
      4) ITW Construction Products.
      5) MKT Fastening, LLC.
      6) Powers Fasteners.

2. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.


4. Toggle Bolts: All-steel springhead type.


2.3 SEISMIC-RESTRAINT COMPONENTS

A. Rated Strength, Features, and Application Requirements for Restraint Components: As defined in reports by an evaluation service member of the ICC Evaluation Program or an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Strength in tension, shear, and pullout force of components used shall be at least five times the maximum seismic forces to which they will be subjected.

B. Angle and Channel-Type Brace Assemblies: Steel angles or steel slotted-support-system components; with accessories for attachment to braced component at one end and to building structure at the other end.

C. Cable Restraints: ASTM A 603, zinc-coated, steel wire rope attached to steel or stainless-steel thimbles, brackets, swivels, and bolts designed for restraining cable service.

1. Manufacturers:
   a. Amber/Booth Company, Inc.
   b. Loos & Co., Inc.
   c. Mason Industries, Inc.

2. Seismic Mountings, Anchors, and Attachments: Devices as specified in Part 2 "Support, Anchorage, and Attachment Components" Article, selected to resist seismic forces.

3. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod, of design recognized by an evaluation service member of the ICC Evaluation Program or an agency acceptable to authorities having jurisdiction.
4. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to type and size of anchor bolts and studs used.

5. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to type and size of attachment devices used.

2.4 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 5 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 for application of hangers and supports for electrical equipment and systems, unless requirements in this Section or applicable Code are stricter.

B. Prior to all ceiling and/or fire alarm work, verify in presence of authorized University personnel that there are no existing issues with the systems.

3.2 SUPPORT AND SEISMIC-RESTRAINT INSTALLATION

A. Comply with NECA 1 for installation requirements, except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Install seismic-restraint components using methods approved by the evaluation service providing required submittals for component.

D. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

E. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods, unless otherwise indicated by Code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount on slotted-channel racks attached to substrate.

F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 5 Section "Metal Fabrications" for site-fabricated metal supports.
B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 INSTALLATION OF SEISMIC-RESTRAINT COMPONENTS

A. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
C. Restraint Cables: Provide slack within maximums recommended by manufacturer.
D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Make flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross expansion and seismic-control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to electrical equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

END OF SECTION
SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. See Section 26 05 29 "Hangers and Supports for Electrical Systems" for seismic restraints and bracing of raceways, boxes, enclosures, and cabinets.

C. See Section 26 27 26 "Wiring Devices" for devices installed in boxes.

1.2 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets indicated.

B. Shop Drawings: Show fabrication and installation details of components for raceways, fittings, boxes, enclosures, and cabinets.

1.3 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 METAL CONDUIT AND TUBING

A. Manufacturers:
1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. Electri-Flex Co.
5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
6. LTV Steel Tubular Products Company.
7. Manhattan/CDT/Cole-Flex.
8. O-Z Gedney; Unit of General Signal.
9. Wheatland Tube Co.

B. Rigid Steel Conduit: ANSI C80.1.

C. Aluminum Rigid Conduit: ANSI C80.5.

D. IMC: ANSI C80.6.

E. EMT and Fittings: ANSI C80.3.
   1. Fittings: Compression type. Setscrew fittings shall not be installed outdoors or indoors.

F. FMC: Aluminum.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers:
   1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
   2. Emerson/General Signal; Appleton Electric Company.
   3. Erickson Electrical Equipment Co.
   6. O-Z/Gedney; Unit of General Signal.
   7. RACO; Division of Hubbell, Inc.
  10. Spring City Electrical Manufacturing Co.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Surface Raceways’ acceptable manufacturers are limited to:
   1. Mono-Systems, Inc..
   2. The Wire Mold Co.
3. Square D. Co.

2.4 FACTORY FINISHES

A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

B. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Indoors:

1. Exposed: UL Listed and Labeled, Galvanized EMT.
2. Concealed: UL Listed and Labeled, Galvanized EMT may be installed in interior partitions, above ceilings and for surface application higher than 8-feet above floor except in corrosive and hazardous locations where fiberglass conduit is required to be used. << If corrosive environment, change out to “UL Listed and Labeled, Plastic Jacketed Rigid Steel Conduit.”

B. Outdoors:

1. Above Grade: Rigid Aluminum Conduit where corrosive atmosphere or conditions are not present.
2. Below Grade: PVC Schedule 40 under non-paved areas or areas not subject to vehicular traffic. PVC Schedule 80 under paved areas or areas subject to vehicular traffic.

C. Minimum Raceway Size: 3/4-inch trade size for power circuits. Minimum conduit size for control wiring shall be 1/2–inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

A. Use of MC Cable is prohibited. All circuits and wiring shall be in conduit.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Install set screw type fittings for conduits. Do not install compression type fittings.

E. Support raceways as specified in Division 26 Section ”Basic Electrical Materials and Methods Electrical Supports and Seismic Restraints.”
F. Install temporary closures to prevent foreign matter from entering raceways.

G. Make bends and offsets so ID is not reduced. Keep legs of bends in same plane and keep straight legs of offsets parallel, unless otherwise indicated.

H. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
   1. Install concealed raceways with a minimum of bends in shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
   1. Run parallel or banked raceways together on common supports.
   2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

J. Join raceways with fittings designed and approved for that purpose and make joints tight.
   1. Use insulating bushings to protect conductors.

K. 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.
   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.

L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

M. 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. Where otherwise required by NFPA 70.

N. Flexible Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

O. Prior to all ceiling and/or fire alarm work, verify in presence of authorized University personnel that there are no existing issues with the systems.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are 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.

END OF SECTION
SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Conduit.
   2. Handholes and pull boxes.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
   1. Duct entry provisions, including locations and duct sizes.
   2. Cover design.
   4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

C. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Comply with IEEE C2.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUIT


2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide by one of the following:
1. AFC Cable Systems.
2. ARNCO Corporation.
4. Cantex, Inc.
5. CertainTeed Corp.
7. DCX-CHOL Enterprises, Inc.; ELECSYS Division.
8. Electri-Flex Company.
9. IPEX Inc.
10. Lamson & Sessions; Carlon Electrical Products.
11. Manhattan Wire Products; a Belden company.

C. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type EB-20-PVC, ASTM F 512, UL 651A, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.

D. Duct Accessories:
   1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and retained to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
   2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."
   3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches (300 by 600 by 76 mm) in size, manufactured from 6000-psi (41-MPa) concrete.
      b. Mark each plank with "ELECTRIC" in 2-inch- (50-mm-) high, 3/8-inch- (10-mm-) deep letters.

2.3 HANDHOLES AND PULL BOXES

A. Description: Comply with SCTE 77.
   2. Configuration: Units shall be designed for flush burial.
   3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
   4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   5. Cover Legend: Molded lettering,
      a. "ELECTRIC."
      b. Tier level number, indicating that the unit complies with the structural load test for that tier according to SCTE 77.
   7. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.
PART 3 - EXECUTION

3.1 CORROSION PROTECTION

A. Aluminum shall not be installed in contact with earth or concrete.

3.2 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses" and "Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.3 INSTALLATION OF HANDHOLES AND PULL BOXES

A. Install handholes and pull boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use pull box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level 6-inch- thick bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: Set so cover surface will be flush with finished grade.

D. Install handholes and pull boxes with bottom below the frost line, 24” below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Retain arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi, 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
2. Dimensions: 10 inches wide by 12 inches deep.
3.4 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Prepare test and inspection reports.

3.6 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

END OF SECTION 260543
SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Identification for conductors and communication and control cable.
   2. Warning labels and signs.
   3. Equipment identification labels.

1.2 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

1.4 COORDINATION


PART 2 - PRODUCTS

2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Marker Tape: Vinyl or vinyl -cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 WARNING LABELS AND SIGNS


B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).
D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).

E. Fasteners for Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

F. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 mm)."
3. Workspace Warning: "WARNING – POTENTIAL ARC FLASH HAZARD – APPROPRIATE PPE AND TOOLS REQUIRED WHEN WORKING ON THIS EQUIPMENT."

2.3 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and ultraviolet-resistant seal for label.

B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

C. Updated panel legends must be submitted in MS Excel after project is completed.

PART 3 - EXECUTION

3.1 APPLICATION

A. Auxiliary Electrical Systems Conductor and Cable Identification: Use marker tape to identify field-installed alarm, control, signal, sound, intercommunications, voice, and data wiring connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and cable pull points. Identify by system and circuit designation.
2. Use system of designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

B. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
   a. Controls with external control power connections.

2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
C. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
   a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-(13-mm-) high letters on 1-1/2-inch-(38-mm-) high label; where 2 lines of text are required, use labels 2 inches (50 mm) high.
   b. Elevated Components: Increase sizes of labels and legend to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:
   a. Wiring Devices, panelboards, electrical cabinets, and enclosures. Provide updated panelboard schedule with new and existing circuits including detailed description including Room Number(s) for circuits, etc.
   b. Contactors.
   c. Other devices (label with circuit and panel board that feeds device – verify exact requirements with authorized University personnel).

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied.

2. Colors for 208/120-V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
   e. Equipment Ground: Green.

   Note: match existing color coding in building/area if different than above.
SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Duplex receptacles.

1.2 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. Samples: One for each type of device and wall plate specified, in each color specified.
D. Field quality-control test reports.

1.3 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Shall be hospital grade devices. Subject to compliance with requirements, provide products by one of the following:
   1. Wiring Devices:
      b. Cooper Products.
      c. Hubbell Incorporated; Wiring Device-Kellems.
      d. Leviton Mfg. Company Inc.
      e. Pass & Seymour/Legrand; Wiring Devices Div.

2.2 RECEPTACLES

A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.
2.3 FINISHES

A. Color:
   1. Wiring Devices Connected to Normal Power System: Ivory, unless otherwise indicated or required by NFPA 70.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies level, plumb, and square with building lines.

B. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Install all receptacles to match existing ground up/down configuration.

C. Remove wall plates and protect devices and assemblies during painting.

D. A dedicated neutral conductor shall be installed for each branch circuit.

3.2 IDENTIFICATION

A. Comply with Division 26 Section 26 05 53 “Identification for Electrical Systems.”

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

   1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION
SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior luminaires with lamps and ballasts.
2. Luminaire-mounted photoelectric relays.
3. Poles and accessories.

1.2 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4-M.

B. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-4-M.

C. Ice Load: Load of 3 lbf/sq. ft. (145 Pa), applied as stated in AASHTO LTS-4-M Ice Load Map.

D. Wind Load: Pressure of wind on pole and luminaire and banners and banner arms, calculated and applied as stated in AASHTO LTS-4-M.

1. Basic wind speed for calculating wind load for poles 50 feet (15 m) high or less is 90 mph (40 m/s).

a. Wind Importance Factor: 1.0.
c. Velocity Conversion Factors: 1.0.

1.3 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, and finishes.

B. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.


C. Comply with NFPA 70.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an
   NRTL acceptable to authorities having jurisdiction.

B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution
   patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support
   to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use.
   Provide filter/breather for enclosed luminaires.

F. 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. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect
   ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV
   radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to
   indicated portion of normally illuminated area or field.

J. 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.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses
   and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire
   before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for
   Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

   a. Color: Bronze.

N. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

   a. "USES ONLY" and include specific lamp type.
   b. Lamp tube configuration (twin, quad, triple), base type, and nominal wattage for compact fluorescent luminaires.
   c. Start type (preheat, rapid start, instant start) compact fluorescent luminaires.
   d. CCT and CRI for all luminaires.

2.3 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

A. Structural Characteristics: Comply with AASHTO LTS-4-M.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.

2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
3. Anchor-Bolt Template: Plywood or steel.

D. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws.

E. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

F. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.

G. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4-M.
2.4 STEEL POLES

A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig (317 MPa); one-piece construction up to 40 feet (12 m) in height with access handhole in pole wall.
   1. Shape: Square, straight.
   2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

B. Brackets for Luminaires: Detachable, cantilever, without underbrace.
   1. Adapter fitting welded to pole, allowing the bracket to be bolted to the pole mounted adapter, then bolted together with galvanized-steel bolts.
   2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.
   3. Match pole material and finish.

C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

D. Steps: Fixed steel, with nonslip treads, positioned for 15-inch (381-mm) vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet (3 m) above finished grade.

E. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

F. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.

G. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

H. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.

I. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."
   2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
   3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
      a. Color: Bronze.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.
B. Fasten luminaire to indicated structural supports.
   1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

3.2 POLE INSTALLATION
   A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
   B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:
      1. Fire Hydrants and Storm Drainage Piping: 60 inches (1520 mm).
      2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet (3 m).
      3. Trees: 15 feet (5 m) from tree trunk.
   C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."
   D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
      1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
      2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
      3. Install base covers unless otherwise indicated.
      4. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
   E. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch- (150-mm-) wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch (25 mm) below top of concrete slab.
   F. Raise and set poles using web fabric slings (not chain or cable).

3.3 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES
   A. Install on concrete base with top 4 inches (100 mm) above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.4 CORROSION PREVENTION
   A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

END OF SECTION 265600
SECTION 310000 - SITE EARTHWORK

PART 1- GENERAL

1.1 SUMMARY

A. Section Includes: Topsoil stripping, excavation, fill, geotextiles, grading and other site earthwork.

1.2 REFERENCES

A. ASTM International, as referenced herein as ASTM.

B. Ohio Department of Transportation, Standard Specifications for Construction, latest edition, as referenced herein as ODOT.

C. As it may apply to work in city owned right-or-ways, all relevant construction standards of the City of Oxford Ohio

1.3 SUBMITTALS

A. Product Data:
1. Submit manufacturers’ descriptive literature, detailed specifications, performance data, instructions and recommendations for installation of proposed geotextile fabrics.
2. Submit Certified Test Reports: Prior to construction, submit certified test reports for Contractor-supplied materials as listed in Part 1.04 A Laboratory Tests.
3. Field Test Reports: During construction, submit field test reports as listed in Part 1.04 B Field Control Tests.

1.4 QUALITY CONTROL

A. Testing Agency:
1. The Owner will engage a Testing Agency to perform sampling and testing of soil materials proposed for use in the work and field testing facilities for quality control during earthwork operations. Provide access to the areas to be tested at times necessary for the Testing Agency to perform its duties.

B. Laboratory Tests:
1. For each on-site type of soil to be used for fill, the Testing Agency will conduct soil classification tests in accordance with ASTM D2487, conduct moisture-density tests in accordance with ASTM D698 for silty or cohesive soils or ASTM D4253 and D4254 for clean granular soils.
2. For other material proposed for use as fill by the Contractor and accepted for testing by the Owner, the Testing Agency will conduct mechanical analysis and consistency tests and determine the amount of non-durable and organic material. Tests may include ASTM D422 (Particle Size), D4318 (Liquid Limit, Plastic Limit and Plasticity), D1140 (Fines), or D2974 (Loss on Ignition).
3. After testing, the Testing Agency will prepare written recommendations for use and compaction of the sampled soils and provide 1 copy of each report to both the Contractor and the Owner. The Contractor shall comply with such recommendations.

C. Field Control Tests:
1. Examine and document cut slopes, fill slopes and the presence of ground water within excavations.
2. Conduct field tests for density of sub-grade soils in compacted fill areas and examine proof-roll of sub-grade in cut areas.
3. Perform an in-place soil density test in accordance with ASTM D1556, sand cone method, or ASTM D2922 nuclear method, for each 5000 square feet of sub-grade and each compacted layer of backfill and fill.
5. Determine bearing capacity of the soil under foundations for site structures by use of appropriate testing means and methods.
6. When, in the judgment of the Owner, there is reasonable doubt about material characteristic of fill or backfill material used in field, a field-conducted 1 point proctor test will be conducted. If the moisture-density coordinates of the 1 point proctor test do not fall on the curve which has been established by laboratory tests, a sample of that material will be tested in the laboratory for conformance to the Specifications. One copy of each report, designating the location of the Work tested, will be submitted to the Contractor and the Owner.

1.5 DELIVERY AND STORAGE

A. Deliver and store materials in a manner to prevent contamination or segregation. Storage areas will be as designated by the Owner.

1.6 PROJECT CONDITIONS

A. Site Information:
   1. Examine the site to ascertain the state and conditions under which the Work is to be performed.
   2. If available, soil boring logs will be furnished on request; however, the data on indicated subsurface conditions are not intended as representations or warranties of the accuracy or continuity between soil borings. It is expressly understood that the Owner will not be responsible for interpretations of conclusions drawn by the Contractor.
   3. Additional test borings and other exploratory operations may be made by the Contractor at no cost to the Owner.
   4. Assume full responsibility for interpreting boring data and for the conclusions drawn from the information furnished, and from inspection of available information at the site.

B. Use of Explosives:
   1. The use of explosives is not permitted.

C. Protection of Persons and Property:
   1. Barricade open excavations occurring as part of the Work and post with warning lights. Operate warning lights as recommended by authorities having jurisdiction.
   2. Protect utilities, pavements and other facilities from damage caused by settlement, lateral movements, undermining, washout and other hazards created by excavation operations.

PART 2- PRODUCTS

2.1 SOIL MATERIALS

A. General:
   1. Provide soil materials which are free of debris, roots, wood, scrap material, vegetative matter, refuse, soft unsound particles, frozen, deleterious or objectionable materials and meet the following criteria.

B. General Site Fill/Engineered Fill:
   1. Unclassified, friable silty, clay or fine sand site soils, without clods of clay and a maximum particle size of 6 inches in longest dimension (4 inches within 2 feet below rough grade).
   2. Possesses the characteristics required for compaction to soil density specified for the location of intended use.
   3. Minimum dry maximum density: 105 pounds per cubic foot per ASTM D1557.
C. Granular Fill:
   1. Clean, free draining sand, or sand and gravel obtained from natural deposits meeting the general
      requirements of soil materials above, and classified as SW, SM or SP per ASTM D2487 and a
      maximum particle size of 3 inches in longest dimension.
   2. Particles of material free of any objectionable coating.
   3. Less than 10% passing a Standard No. 200 sieve when tested in accordance with ASTM D1140.
   4. Gradation: Meet the requirements of ODOT Class III granular material except as herein modified.

D. Impervious Fill:
   1. Clay, silty clay or clayey silt meeting soil classifications CL, CH or MH when tested in accordance with
      ASTM D2487.
   2. Maximum density not less than 110 pounds per cubic foot when tested in accordance with ASTM
      D1557.

2.2 GEOTEXTILE FABRICS

A. Filter Fabric:
   1. Synthetic, non-woven, needle-punched fabric that is resistant to chemicals and mildew, stable under
      freeze-thaw cycles, does not shrink or expand under wet conditions, does not unravel during use and
      meets the following criteria:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab Tensile Strength</td>
<td>ASTM D4632</td>
<td>100 lbs. min.</td>
</tr>
<tr>
<td>Mullen Burst</td>
<td>ASTM D3786</td>
<td>200 psi min.</td>
</tr>
<tr>
<td>Puncture Resistance</td>
<td>ASTM D4833</td>
<td>65 lbs. min.</td>
</tr>
<tr>
<td>Trapezoidal Tear</td>
<td>ASTM D4533</td>
<td>45 lbs. min.</td>
</tr>
<tr>
<td>Coeff. of Permeability</td>
<td>ASTM D4491</td>
<td>0.25 cm/sec. min.</td>
</tr>
</tbody>
</table>

B. Stabilization Fabric
   1. Synthetic, woven fabric that is resistant to chemicals and mildew, stable under freeze-thaw cycles, does
      not shrink or expand under wet conditions, does not unravel or become clogged during use, and meets
      the following criteria:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab Tensile Strength</td>
<td>ASTM D4632</td>
<td>180 lbs. min.</td>
</tr>
<tr>
<td>Grab Elongation</td>
<td>ASTM D4632</td>
<td>15% max.</td>
</tr>
<tr>
<td>Mullen Burst</td>
<td>ASTM D3786</td>
<td>350 psi min.</td>
</tr>
<tr>
<td>Puncture Resistance</td>
<td>ASTM D4833</td>
<td>110 lbs. min.</td>
</tr>
<tr>
<td>Trapezoidal Tear</td>
<td>ASTM D4533</td>
<td>75 lbs. min.</td>
</tr>
<tr>
<td>Coeff. of Permeability</td>
<td>ASTM D4491</td>
<td>0.25 cm/sec. min.</td>
</tr>
</tbody>
</table>

2.3 LEAN CONCRETE

A. A mixture of Portland cement, aggregate and water, having a minimum compressive strength of 1,500 psi at
   28 days.
PART 3- EXECUTION

3.1 STRIPPING AND CONSERVATION OF TOPSOIL

A. Stripping:
   1. Remove heavy growth of grass, sod, decayed vegetation and other unsuitable material from the areas to be stripped.

B. Conservation of Topsoil Suitable for Lawns:
   1. Remove acceptable topsoil within the areas to be stripped and stockpile in areas approved by the Owner. Topsoil suitable for lawns is defined as the material presently supporting vegetation and having not less than 10% organic content. Assure that topsoil stripped and stockpiled is without admixture of subsoil, free of plants and their roots, stones and other undesirable material. Store topsoil suitable for lawns separately from other excavated materials. Do not remove approved topsoil from the project site.

3.2 EXCAVATION

A. Stockpiling Excavated Material Suitable for Filling or Backfilling:
   1. Stockpile excavated materials where directed until required for backfill or fill.
   2. Locate and retain fill materials away from edges of excavations.
   3. Dispose of excess soil material and waste materials.

B. Drainage and Dewatering:
   1. Grade ground adjacent to excavations to prevent surface water from flowing into excavations. Cut ditches to cross sections and grades indicated.
   2. Remove water accumulating in excavations to prevent softening of foundation bottoms or soil changes detrimental to stability of the sub-grade.
   3. Provide and maintain sufficient dewatering devices, such as pumps, hoses, strainers and other appurtenances, required to convey the water away from excavations.
   4. Discharge water a sufficient distance from the excavations to prevent backflow. Maintain dewatering operations until backfill is placed, or as directed.

C. Unauthorized Excavations:
   1. Take care not to excavate below the depths indicated.
   2. Fill excessive or unauthorized excavation under site structures and footings with lean concrete.
   3. Fill excessive or unauthorized excavation in other locations with compacted fill material as directed.

D. Stability of Excavations:
   1. Slope the sides of excavations to comply with local codes and ordinances having jurisdiction. Sheet, shore and brace where sloping is not possible either because of space restrictions or stability of material excavated.
   2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

E. Shoring and Bracing:
   1. Provide sheeting, shoring and bracing as required to prevent cave-ins, and to comply with local codes and ordinances having jurisdiction.
   2. Provide shoring and protective measures as may be necessary to protect adjacent structures, facilities and utilities at all times. Assume the responsibility for the adequacy of the design, installation and effectiveness of all shoring and other protective methods utilized, and repair damage resulting from failure to take adequate measures for protection of persons and adjacent property.
   3. Construct shoring and bracing of sound material, accurately placed and securely braced. Maintain during period excavation is open. Remove when no longer required.

F. Frost Protection:
1. Protect trenches and bottoms of excavations against freezing by means of insulating materials or heat as approved.

G. Additional Excavation:
1. When excavation has reached required sub-grade elevations, notify the Testing Agency, who will make an inspection of conditions.
2. If unsuitable materials are encountered at the required sub-grade elevations, carry excavations deeper and replace the excavated material as directed.
3. Removal of unsuitable material and its replacement as directed will be paid on the basis of Contract conditions relative to changes in the work.

H. Excavation for Structures:
1. Excavate for site structures, such as, footings, walls and steps.
2. Trim excavation bottoms to required lines and grades, leaving a solid base to receive concrete.
3. Extend excavations a sufficient distance away from footings to permit placing and removal of forms, inspection of Work and installation of other Work.

3.3 FILL

A. Placing:
1. Do not place fill material upon a frozen surface.
2. Place fill materials in successive horizontal layers over the entire width and breadth of the section under construction. Each layer maximum thickness: 8 inches, loose measurement. After dumping, spread the fill material by approved means.
3. As soon as practicable after commencement of a fill section, raise or crown the central portion thereof with grades not to exceed 5% so that the surface will drain freely. Maintain drainage grades throughout construction until completed to indicated levels and grades.
4. Plow strip, or break-up sloped surfaces steeper than 1-foot vertical to 4 feet horizontal so that fill material will bond with existing surface.
5. During fill material placing operations, remove roots, trash, debris and all stones larger than 6 inches in maximum dimension, except 4 inches in longest dimension within 2 feet below rough grade.
6. Maintain the entire surface of a section under construction in such condition that construction equipment can travel on all parts of all sections. Fill ruts in surface before proceeding with compaction operations.

B. Compaction of Fill Layers:
1. Compact each layer of fill material at optimum moisture content to the density specified under Part 3.5 Compaction Requirements. Prior to compaction operations, require the layer of fill material to be scarified, disked, harrowed or pulverized sufficiently to break down oversized clods.

C. Temporary Suspension of Work:
1. If work is suspended more than 24 hours on a section receiving fill, the Owner may, as a protective measure, direct that the area be graded and compacted to prevent loss of moisture and to facilitate drainage. Before work is resumed in the area, require the surface to be scarified, watered or allowed to dry as required, and re-compacted.
2. If compaction occurs in the fall or early winter and operations have ceased during the winter, require the surface to be rolled with a flatwheel roller, re-compacted and sloped to allow runoff of surface water. Do not place equipment on the surface after the completion of the above operations until it is dry enough that rutting and remolding of the surface will not occur.

3.4 GENERAL GRADING

A. Grade excavated and filled sections, including transition areas, to provide positive drainage. Reshape graded areas over underground mechanical and electrical utilities provided under mechanical work and electrical
work, and areas rutted or otherwise disturbed during construction operations to obtain uniform transition to adjacent areas or finish grades as indicated.

B. Grades not otherwise indicated: uniform levels or slopes between points where elevations are given, or between such points and existing grades.

C. Condition of finish surface: reasonably smooth, compacted and free from irregular surface changes.

D. Degree of finish to be ordinarily obtainable from either blade-grader or scraper operations, except as otherwise specified. Tolerance of finished surface: not more than 0.1 foot above or below the established grade or cross section. Hand-grade areas immediately adjacent to building walls and other structures to slope down away from building or structure for proper drainage.

E. Finish ditches so as to permit adequate drainage. Finish lawn areas to a smoothness suitable for the application of topsoil. Grade areas for paving and walks for proper drainage.

F. Protect newly graded areas from traffic and erosion. Before final acceptance of the work, repair and reestablish grades in settled, washed away or rutted areas.

3.5 GRADING LAWN AND LANDSCAPED AREAS

A. General: In areas of the Project Site that are compacted during construction, as determined by Owner, and after completion of construction operations where vehicles/equipment would be required to travel across the soil around the constructed site improvement, the existing subsoil, as well as the top 12 inches of newly placed fill soil, shall be loosened using the procedures outlined below, prior to placement of topsoil.

1. Prior to beginning this work, notify Project Representative at least 1 business day in advance. Also, re-stake existing and new utilities that may be disturbed by these earthwork operations.

2. The moisture content of existing and new soil shall be optimum for this earthwork operation.

B. For areas where the existing subsoil grade is to remain and for areas which will receive additional soil:

1. STEP 1 – Loosening Existing Subsoil and Debris Removal: Existing subsoil shall be brought to a friable condition 12-inches deep, prior to placing additional subsoil fill. Possible equipment to use to loosen the soil include, but are not limited to, chisel plow, backhoe bucket, disc or harrow; followed by discing, (if a disc is not initially used), to reduce the soil clump to the desired size. Contractor will submit a proposed method of loosening the subsoil to the Owner for approval at least 14 days prior to commencement of the work. The soil shall be broken up sufficiently so that the resulting soil fragments are less than 6 inches in the longest dimension. Legally dispose of construction debris and rocks larger than 27 cubic inches exposed during this process.

2. STEP 2 – Placing of Additional New Subsoil - Transitional Layer Blending: Where additional subsoil is required, place the initial “transitional” layer and blend with the existing subsoil utilizing methods mentioned in Step 1.

3. STEP 3 – New Subsoil - Top Layer Loosening: Loosen top layer to a friable condition, even if less than 12 inches is added. If no additional subsoil is required, omit Steps 2 and 3.

4. STEP 4 – Final Grading and Protection: Grade the disturbed area to the elevations as specified, in preparation for topsoil placement. Do not otherwise re-compact the subsoil. Once the subgrade is approved, construction equipment and vehicles unrelated to topsoiling and planting operations shall be prohibited. Do not permit re-compaction of soils.

C. For areas where existing subgrade is to be lowered:

1. STEP 1 – Existing Subsoil Excavation and Debris Removal: Excavate the subsoil, removing all excess material from the site to the proposed subgrade. Remove and legally dispose of construction debris exposed during this process.

2. STEP 2 – Subsoil Loosening: Existing subsoil shall be brought to a friable condition 12-inches deep. Possible equipment to use to loosen the soil include, but are not limited to, chisel plow, backhoe bucket, disc or harrow; followed by discing, (if a disc is not initially used,) to reduce the soil clump to the
desired size. The resulting soil shall be broken up sufficiently so that the resulting soil fragments are small.

3. **STEP 3 – Final Grading and Protection:** Grade the disturbed area, as specified, in preparation for topsoil placement. Do not otherwise recompact the subsoil. Once the subgrade is approved, construction equipment and vehicles, unrelated to topsoiling and planting operations, shall be prohibited.

### 3.6 COMPACCIÓN REQUIREMENTS

**A.** Structures and pavement sub-grade and all engineered fill are defined as all areas below or within 5 feet of any proposed structure, pavement or walk.

**B.** For silty or clay soils Moisture-Density:

1. Compacted density at optimum moisture content as determined by moisture-density test in accordance with ASTM D698:
   a. 98% of maximum dry density for structures, pavement sub-grade and all engineered fill areas (and all engineered fill).
   b. 95% of maximum dry density for general site.

2. Maximum variation in moisture content in the compacted material, at the time of compaction, from the optimum moisture content for the material:
   a. 1.5% over optimum when atmospheric conditions would tend to decrease the moisture content.
   b. 1.5% under optimum when atmospheric conditions would tend to increase the moisture content.

**C.** Moisture-Density:

1. For clean sands, compacted relative density in accordance with ASTM D4254:
   a. 80% of maximum relative density for structures, pavement sub-grade and engineered fill areas.

**D.** **Moisture Control:**

1. Prior to compaction operations, provide the necessary equipment for adding moisture to the sub-grade material and to each layer of backfill and fill material.

2. If moisture is required to be added to the surface of the sub-grade or layer of backfill or fill material, uniformly apply and accurately measure water, and control application of water so that free water will not appear on the surface during or subsequent to compaction operations.

3. Allow material to dry that is too wet for compaction. Assist by discing, harrowing or pulverizing, until the moisture content is reduced to within the maximum variation from optimum.

### 3.7 SPECIAL EARTHWORK REQUIREMENTS

**A.** **Sub-grade Preparation:**

1. **Proof roll for pavement area:** Proof roll sub-grade with a 10-ton roller. If the imprint made by a 10-ton roller on the sub-grade is more than 1 inch deep, compact or remove and replace the sub-grade if found unsuitable to a depth as determined by the Testing Agency.

2. **Sub-grade Compaction:** Thoroughly loosen the top 8 inches of sub-grade to be compacted by scarifying or plowing. Remove roots and other debris turned up by such loosening. Compact the loosened sub-grade at optimum moisture content to the density specified for each class of area under Part 3.06 Compaction Requirements, using approved equipment.

3. **Unsuitable Material:** Remove material found unsuitable for compaction to a depth as determined by the Testing Agency and replace with suitable material. Removal and replacement of material will be paid for in accordance with the contract conditions relative to changes in the work.

**B.** **Backfilling for Structures:**

1. **Backfill Materials:**
   a. Material for backfilling excavations and depressions below or within 1.0 foot of site structures and paving shall be granular fill in accordance with Part 2.01 C.

2. **Placing Backfill:**
   a. Before backfilling is placed against structures, remove forms, trash and debris.
b. Place backfill material in uniform layers and symmetrically on all sides of structures. Maximum thickness each layer: 8 inches for granular fill and 6 inches for general site fill.

c. Moisture-condition and compact each layer with mechanical or hand tampers to density specified under Part 3.5 Compaction Requirements. Carry the backfill up to the surface of the adjacent ground and neatly grade its top to slope away from building or structure for proper drainage.

d. Do not operate power-operated earth moving equipment closer to foundation walls or other structures than a distance equal to the height of backfill above the top of footing to the ground surface.

C. Abandoned Underground Services:
   1. Remove abandoned underground pipe, conduit, and other services to accommodate new Work. Do not remove such abandoned services until disconnected from remaining active services. Seal open ends of abandoned pipe left in place with concrete.

3.8 SEDIMENTATION AND SOIL EROSION CONTROL

A. Conduct earth changes in a manner which will effectively reduce accelerated soil erosion and resulting sedimentation.

B. Provide temporary soil erosion control to eliminate sedimentation from entering sewers and open ditches.

C. Remove sediment caused by accelerated soil erosion from runoff water before it leaves the site.

D. Maintain temporary soil erosion control measures until permanent soil erosion control measures are implemented.

E. Promptly remove soil, debris or other material spilled, dumped or otherwise deposited on public streets, highways or other public thoroughfares during transit.

3.9 FINISH OPERATIONS

A. Topsoil Placement: Topsoil shall be placed to the depths noted on the drawings, spread and smoothed to minimize compaction and insure a smooth surface that drains.

B. Grading:
   1. Tolerance: Final grades shall be within 0.10 foot of finished grades indicated. Grade areas to drain water away from structures. Grade as directed existing grades which are to remain, but are disturbed by Contractor's operations.

C. Protection of Surfaces:
   1. Protect newly graded areas from traffic, erosion and settlements that may occur. Repair or reestablish damaged grades, elevations or slopes.

3.10 DISPOSAL OF SURPLUS OR UNSUITABLE MATERIAL

A. Unsuitable Material, Debris and Refuse:
   1. Dispose of excess excavated material or material unsuitable for filling or grading operations, trees not indicated to remain on site, stumps, debris from previously demolished structures, parking lot bumpers, miscellaneous refuse and other items indicated to be removed, off the Owner's property in compliance with local codes and ordinances.

B. Fill:
   1. Remove and legally dispose of surplus excavated fill not required for backfilling or filling, off the Owner's property.
END OF SECTION
SECTION 311000 - SITE PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Clearing and grubbing; pavement and structure demolition; miscellaneous site removals; utility adjustments; salvage items; and, debris removal and disposal.

1.2 REFERENCES

A. ASTM International, as referenced herein as ASTM.

B. Ohio Department of Transportation, Standard Specifications for Construction, latest edition, as referred herein as ODOT.

C. As it may apply to work in city owned right-or-ways, all relevant construction standards of the City of Oxford Ohio

1.3 QUALITY CONTROL

A. Codes, Standards, Permits and Regulations:
   1. All work shall be in accordance with the standard City of Kent construction specifications except as modified herein.
   2. Demolition and site clearance is subject to all provisions of applicable local ordinances and regulations.
   3. Observe all local codes, rules and regulations governing the respective utilities in executing the Work under this Section.

B. Contractor's Qualifications:
   1. Require demolition work which is governed by a local ordinance for building wrecking operations to be performed by a duly licensed wrecking contractor. Obtain separate permit for each building which is to be demolished.

1.4 PROJECT CONDITIONS

A. General Site Protection:
   1. Protect from damage existing items indicated to remain by the erection of barriers or by other appropriate means to ensure protection.
   2. Barricade all open depressions, excavations, pits and the like. Provide adequate barricades at all times. Construct barricades of fencing materials and/or salvaged lumber from the structures to be removed, conforming to local safety regulations. Remove barriers and fences when no longer required.
   3. Maintain and keep public sidewalks, highways and streets in a condition satisfactory to local and/or state officials, and provide necessary watchmen if, and as required, in the use of public thoroughfares. Keep public sidewalks, highways and roads clean of spillage at all times.

B. Utility Protection:
   1. Verify location of and protect all existing utilities from damage resulting from operations under the Contract.
   2. Tree Protection:
      a. Protect all trees to remain within the Contract limit lines from damage or injury by any construction operation or equipment, from abuse by workers or any other danger that might arise as a result of this Work.
b. Where existing trees are vulnerable to damage by construction operations, erect suitable barriers around trees to be protected.

c. Require any damage to trees resulting from insufficient protection to be repaired by a competent tree surgeon to the satisfaction of the Engineer.

d. Remove barriers when protection is no longer required.

e. The Owner shall be compensated for the full value of trees damaged beyond repair. Value shall be determined by guidelines proposed by the Council of Tree and Landscape Appraisers as interpreted by a member of the American Society of Consulting Arborists.

C. Shoring and Bracing:
   1. Provide sheeting, shoring and bracing as required to prevent cave-ins, and to comply with local codes and ordinances having jurisdiction.
   2. Provide shoring and protective measures as may be necessary to protect adjacent structures, facilities and utilities at all times. Assume the responsibility for the adequacy of the design, installation and effectiveness of all shoring and other protective methods utilized, and repair damage resulting from failure to take adequate measures for protection of persons and adjacent property.
   3. Construct shoring and bracing of sound material, accurately placed and securely braced. Maintain during period excavation is open. Remove when no longer required.

D. Environmental Protection:
   1. Wet down materials or use other suitable methods to limit the amount of airborne dust and dirt from the site to the lowest practical level.

E. Site Maintenance:
   1. Maintain the site in a condition such that mobile construction equipment can move with its own power.

PART 2 - PRODUCTS

2.1 BLOCKING UTILITIES
   A. Materials required for blocking and discontinuance of utilities shall be in accordance with local codes, rules and regulations governing the respective utilities.

2.2 FILL
   A. Fill material shall be granular fill in accordance with Section 31 00 00 Site Earthwork.

PART 3 - EXECUTION

3.1 CLEARING AND GRUBBING
   A. Clearing: Remove trees not indicated to remain, shrubs, plants, crops and other above-ground vegetation.

   B. Grubbing: Excavate stumps, roots, and other on-ground and below-ground vegetation or organic debris and remove to a minimum depth below existing grade of 36 inches for stumps and 8 inches for roots, and other vegetative or organic debris.

3.2 PAVEMENT AND STRUCTURE DEMOLITION
   A. Pavement and Other Site Work:
      1. Break up and remove existing hard surface pavements including concrete walks, curbs, slabs and bituminous pavements. Remove all base material within 12 inches of finish grade in areas outside of areas to receive new paving.
2. Perform pavement demolition by air hammer or other approved means. The use of drop hammers or ball, or explosives will not be permitted.

3. Saw cut the limits of all concrete paving and curbs to be removed when the pavement or curb does not terminate at an existing expansion joint. Saw cut limits of existing bituminous pavements where adjoining pavement is to remain.

4. Remove existing fences, posts, poles and other foundations embedded in the ground.

B. Remove structures down to and include basement floor slabs and wall footings. Completely remove all building debris from the site.

3.3 UTILITY ADJUSTMENTS OR ABANDONMENT

A. General:
   1. Perform cutting, blocking and discontinuance of utilities in accordance with local codes, rules and regulations governing respective utilities.
   2. Immediately notify utility companies involved so that demolition operations may proceed without danger to, or interruption of, said services for other property owners or liability to the Owner.

B. Abandonment of Manholes or Inlets:
   1. Remove the casting from existing manholes and inlets to be abandoned, and either reuse it on this Project, if approved by the Engineer, or turn it over to the Owner for salvage.
   2. Demolish and remove the cone, break and remove the walls to a depth necessary to accommodate new construction. Break up bottom to allow for drainage.
   3. Plug all inlets and outlets with a minimum of a 12-inch brick and mortar or concrete plug. Place correcting pipe between inlet and outlet, properly connected, of any sewers that are to remain in use.
   4. Fill the manhole or inlet with granular fill and provide compaction per Section 31 00 00 Site Earthwork.

C. Adjustment of Existing Utility Covers:
   1. Adjust tops of existing utility structures, covers, frames and grates to meet future finished grade elevations.
   2. Adjust tops of all existing water valves and gas valves in the project area as necessary to meet future finished grades.

D. Cathodic Protection:
   1. Do not remove cathodic protection system, including rectifiers, conduits, anode beds and test stations, without first notifying the Engineer and utility companies.

3.4 SALVAGE, CLEAN UP AND DISPOSAL

A. Salvage Items:
   1. Items to be salvaged shall be surrendered to the Owner in the manner indicated on the drawings.

B. Debris:
   1. Remove all debris found on the site or accumulated during performance of the Work.
   2. Items to be removed that are not indicated as salvage items shall become the property of the Contractor and shall be legally disposed of off the site.
   3. Do not offer debris or other materials for sale on the Project site.
   4. Burning of debris will not be permitted on the site.

END OF SECTION
SECTION 311400 - SITE RESTORATION OF LANDSCAPING

PART 1 - GENERAL

1.1 SCOPE

A. General: Spread and condition existing stockpiled topsoil; provide new, if required; lime, till, distribute and grade topsoil; clean up and do related work necessary to complete the work shown and specified.
   1. Submittals: Submit copies to the Owner, in triplicate, for review.
   2. Soils Laboratory: Laboratory shall be an organization regularly engaged in the analysis of soils and shall be subject to the Owner’s approval.

1.2 SUBMITTALS.

A. Seed Mix: Submit copies attesting to the seed mix composition to the Owner, in triplicate, for review.

B. Sod: Submit copies from the sod source attesting to the seed mix composition to the Owner, in triplicate, for review.

1.3 SITE PROTECTION

A. Protect existing grounds, plants, lawns and vegetation to remain.
   1. Protect existing trees to remain in place against unnecessary cutting, breaking, skinning, or bruising of roots and bark, smothering of trees by compaction or stockpiling construction materials or excavated materials within five feet of outer edge of drip line.
      a. Erect minimum of four (4) foot high fence five (5) feet outside drip line of trees to remain.
      b. Erect tree protection before starting site work of any kind. Maintain fencing during construction period.
      c. Interfering branches may only be removed with prior consent from Owner.
      d. Identify any trees Owner would like vertically mulched, trimmed or repaired as result of construction impact at end of project. All work to be done by a certified arborist to be approved by Owner.
   2. Water trees and vegetation to remain with one inch of rain (rain gauge or NOAH local weather verified) per week for duration of construction project.
   3. Contractor is responsible for all damage to plants to remain. Cost for tree replacement shall be determined in accordance with the “Guide for Plant Appraisal” by the Council of Tree and Landscape Appraisers (International Society of Agriculture, Publication #P1209).

B. Temporary Construction Access: Project site access and equipment access routes within the project site must be approved by the Owner prior to commencement of work. Any temporary gravel path or access way must include a geofabric liner to ensure full removal of gravel/stone from project site at project completion.

1.4 STRIPPING AND STORAGE OF EXISTING TOPSOIL

A. Strip topsoil to its full depth at areas impacted and at all areas to be re-graded or resurfaced.

B. Stop topsoil stripping outside drip line of trees to remain / do not strip as to impact root line of trees to remain.

C. Dispose of roots, stone and other debris; store topsoil in piles within the work limits.
   1. Obtain approval of Owner prior to establishing topsoil storage areas.
   2. Grade and slope stockpiles for proper drainage and to prevent erosion.
D. The reuse of stockpiled topsoil within the project site must be approved for placement by the Owner.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. All Topsoil shall meet the requirements of specifications Section 32 05 13 Topsoil.

2.2 GRASS SEED

A. Grass seed shall be a turf-type tall fescue blend such as Trophy XRE Turf-Type Tall Fescue Blend or approved equal blend with fresh, clean, new crop seed mixtures.

B. Seed mixture shall be POA-Free meeting Oregon State Standards for noxious weed exams.

C. Seed shall be applied at a rate of no less than 10 pounds per 1,000 square feet.

2.3 SOD

A. Sod shall be certified 80% Fescue / 20% Blue-Grass sod as approved by the Owner for use in establishing grass on lawn areas. Sod shall be Ohio No. 1 and have not more than 5% of other permanent undesirable lawn grasses. Work shall meet ODOT Item 660. Sod areas so noted on the Drawings. Sod thickness (exclusive of leaf blade and thatch) shall be 5/8” plus or minus 1/4” and shall be machine cut. Sod shall maintain size and shape when strip is firmly suspended and held at top 10% of strip. Sod shall be recently mowed to 1-1/2” to 2-1/2” height, and shall be moist. Sod not planted within 36 hours of harvesting shall be rejected.

B. Provide well-rooted, healthy sod, free of diseases, nematodes, and soil borne insects. Provide sod in uniform color, leaf, texture, density, and free of weeds, undesirable grasses, capable of growth and development when planted. Sod is considered free of weeds if less than 5 weeds are found per 100 sq. ft.

C. Furnish sod machine stripped and of supplier’s standard width and length; uniformly 1” to 1-1/2” thick with clean cut edges. Sod shall be relatively free of thatch, up to ½” permissible. Sod shall be mowed uniformly before harvesting.

D. Delivery, Storage, and Handling: Sod shall be harvested, delivered, and transported within a period of twenty-four (24) hours.
   1. Do not harvest or transport sod when moisture content may adversely affect sod survival.
   2. Protect sod from sun, wind, and dehydration prior to installation.
   3. Do not tear, stretch, or drop sod during handling and installation.

2.4 FERTILIZER

A. Granular, non-burning produce composed of not less than 50% organic slow acting, guaranteed analysis professional fertilizer conforming to the following:
   1. Type A: Starter Fertilizer containing 20% nitrogen, 26% phosphoric acid, and 6% potash by weight, or similar approved composition.
   2. Type B: Secondary fertilizer containing 31% nitrogen, 3% phosphoric acid, and 10% potash by weight, or similar approved composition.

2.5 GRASS SEED MULCH

A. Green dyed cellulose or wood fiber mulch such as Conwed Hydromulch, Weyerhauser Silva-Fiber or clean fresh straw.
2.6 WATER

A. Clean, potable and free of substance harmful to lawn growth. Lawn watering equipment, hoses or other methods of water transportation furnished by Contractor.

PART 3 - EXECUTION

3.1 PREPARATION OF SEED BED/ SODDED AREAS

A. De-compaction: De-compact areas trafficked by construction activities as specified in Section 31 00 00 Site Earthwork.

B. Rough Grading: Grade surfaces to assure drainage away from structures and to prevent ponding and pockets of surface drainage. Provide subgrade free from irregular surface changes and as follows:

1. Rough grade shall equal plus/ minus 0.20 ft., sub grade tolerance shall be free of exposed boulders or stones exceeding 1” in greatest dimension.
2. Fill in all areas of settlement to proper grade before subsequent placement of topsoil.

C. Topsoil Depths:

1. Lawn: Areas to receive sod or seed must have minimum six (6) inches depth of topsoil placed. The recreation Field east of Maple Street Station shall have minimum of eight (8) inches depth of topsoil, as indicated on the Drawings.
2. Planted Beds: Areas identified as planting beds shall have minimum twelve (12) inches depth of topsoil placed.

D. Topsoil Spreading and Fine Grading: Grade area to a smooth, free draining even surface with a loose, moderately course texture. Roll, scarify, rake and level as necessary to obtain a true, even lawn surface and fill depressions as required to drain. Seed bed to be approximately ½” – 1” below all sidewalks and curbs. Do not move heavy objects except necessary lawn making equipment over the lawn areas after the soil is prepared unless it is loosened and re-graded. Restore prepared areas to specified condition if eroded, settled, or otherwise disturbed after fine grading.

E. Fertilizing: Apply Type A / starter fertilizer to indicated turf areas at a rate equal to 1.0 lb. of actual nitrogen per 1,000 s.f. or as directed by Owner.

1. Apply fertilizers by mechanical drop or rotary distributor, thoroughly and evenly incorporated with soil to a depth of 3” by dicing or other approved method. Fertilize areas inaccessible to power equipment with hand tools and incorporate into soil.

3.2 INSTALLATION OF GRASS SEED

A. Grass seed shall only be sown at times approved by the Owner.

B. Perform seeding work only after planting and other work affecting the ground surface have been completed. Limit preparation of seed areas to those ready for immediate seeding.

C. Seed immediately after preparation of bed.

D. Perform seeding operations when soil is dry and when winds do not exceed five miles per hour velocity.

E. Seed to be applied at approved manufactured rates in cross directions with approved seed drilling or slice seeding equipment. Apply 50% of the seed in each direction. Seed application by hydro-seeding methods is not acceptable.
F. Apply hydro-mulch with approved hydro-mulch equipment immediately after seeding. Slurry to be composed of clean water and mulch. Apply mulch slurry at minimum rate of 1,500 pounds to 2,000 pounds per acre on slopes steeper than 4:1. Direct slurry to evenly cover designated seed areas. Repair ruts, depressions and all damage caused by hydro-mulching equipment.

G. Immediately reseed and reapply hydro-mulch to areas that show poor germination.

3.3 INSTALLATION OF SOD

A. Perform sodding work only after planting and other work affecting the ground surface have been completed. Limit preparation of sodded areas to those ready for immediate sodding.

B. Sod immediately after preparation of bed.

C. Install initial row of sod in a straight line, beginning at bottom of slopes, perpendicular to direction of the sloped area. Place subsequent rows parallel to and tightly against previously installed row.

D. Lay sod to form a solid mass with tightly fitted joints. Sod strips shall butt close together with no voids between the pieces. Care shall be exercised to ensure that the sod is not stretched or overlapped. Lateral joints shall be staggered. Remove excess sod to avoid smothering of adjacent grass. Provide sod pad top flush with adjacent curbs, sidewalks, drains, and seeded areas.

E. To enhance rooting, moisten the soil to a depth of four (4) to six (6) inches twenty-four (24) hours before laying sod. Do not lay sod on a hot dry soil surface.

F. Do not lay, place or install dormant sod pads on saturated or frozen soil.

G. Peg sod on slopes greater than 3:1 to prevent slippage at a rate of two stakes per yd. of sod.

H. Water sod thoroughly with a fine spray immediately after laying/installation.

I. Roll with light lawn roller to ensure contact with sub-grade.

3.4 MAINTENANCE

A. Watering and maintenance activities must be reviewed and approved with the Owner. Unless otherwise approved, the following requirements are to be completed at a minimum:

1. Maintain new installed seeded/ sodded lawn areas in an acceptable manner until final acceptance of project, including watering, spot weeding, mowing, trimming, removal of clippings, leaf removal, application of herbicides, fungicides, insecticides, and re-seeding until a full, uniform stand of grass free of weed, undesirable grass species, disease, and insects is achieved and accepted by the Owner.

2. Water daily to maintain adequate surface soil moisture for proper seed germination. Continue daily watering for not less than thirty (30) days. Thereafter apply one-half (1/2) inch water every two or three days until accepted.

3. Repair, re-work, re-seed, and or sod all respective areas that have washed out, are eroded, or did not catch.

4. Set mower blades at a minimum height of two and one-half (2-1/2) inches. Not more than thirty (30) percent of the grass leaf/blade shall be removed at the initial or subsequent mowing. Mow all lawns before turf reaches a height of four (4) inches.

5. If infestation of weeds or crabgrass develops, treat infestation by hand weeding or herbicidal control. Furnish and install weed chemical control as recommended by manufacturer. Herbicidal controls, including renovation before seeding operations, shall be acceptable to the Owner.
6. Apply Type B fertilizer to lawns approximately thirty (30) days after installation at a rate equal to 1.0 lb. of actual nitrogen per 1,000 sq. ft. Apply with mechanical drop or rotary type distributor. Water the fertilizer thoroughly into the soil.

3.5 ACCEPTANCE

A. Inspection to determine acceptance of installed lawns will be made by the Owner, upon Contractor’s request. Provide notification at least three (3) working days before requested inspection date.

1. New lawn areas will be acceptable provided all requirements, including maintenance, have been complied with, and a healthy uniform, close stand of grass is established free of weeds, undesirable grass species, disease and insects.

2. No individual lawn areas shall have bare spots or unacceptable cover totaling more than two (2) percent of the individual areas, in those areas requested for inspection.

3. Upon acceptance, the Owner will assume lawn maintenance.

END OF SECTION
SECTION 311416.10 - BRICK PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Brick pavers laid with over a sand setting bed on a concrete base slab.

B. Related work specified elsewhere includes but is not limited to:
   1. 32 11 23 – Aggregate Base Course
   2. 32 13 00 – Concrete Pavement and Curbs

1.2 REFERENCES

A. ASTM International, as referenced herein as ASTM.

1.3 SUBMITTALS

A. Samples
   1. Submit one sample of each shape and color of paver for approval. Where necessary submit additional pavers showing extreme range of color and texture for specified items.

B. Test Reports
   1. Submit required laboratory test reports for each type of brick paving unit.
   2. Test ten samples of brick pavers, randomly selected from the job stock in accordance with ASTM C67 for:
      a. Compressive Strength - 69 MPa (10,000 psi) minimum.
      b. Flexural Strength - 7.6 MPa (1,100 psi) minimum.
      c. Absorption - 5 percent maximum.
      d. Freeze/Thaw Resistance - 0.5 percent dry weight loss maximum and no breakage after 100 cycles.

C. Maintenance Materials - Extra Stock
   1. Provide and deliver to the Owner's designated place of storage an amount equal to 10% of the total quantity of each paver used for this Project. Neatly stack this extra stock on pallets, secured to the pallet if necessary, and place in a location as directed by the Owner.

1.4 QUALITY ASSURANCE

A. Employ one installing entity to be responsible for the finished pavement surface, including installation of the paver containment, setting bed, joint filler and setting of unit pavers, who has, in the past three years, installed at least three projects of this size or larger.

B. Job Mock-Up
   1. Construct a mock-up sample, 10 feet square minimum, of the paving system indicating the pattern and joints required in actual construction. Make all mock-up samples as required until accepted by the Owner. Consider the selected mock-up a minimum standard of workmanship when accepted, to be matched or bettered throughout the Project. The mock-up may be constructed as part of the Project and, if approved, will be accepted as part of the Work. However, should the Mock-up fail to meet the Owner’s approval, remove and reconstruct it until approved.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials
1. Deliver materials to the job site in a timely manner so as not to delay progress of the Work.
2. Deliver materials to the job site in their original unopened containers bearing labels clearly identifying
   the manufacturer's name.

B. Storage of Materials
   1. Suitably store materials, if necessary, in a location agreeable to the Owner and Contractor.
   2. Store the materials under cover, clear of the ground, and protected from the weather and damage during
      storage.

1.6 JOB CONDITIONS

A. Protection
   1. Protect this Work, adjacent work and materials against damage during progress of the Work until
      complete.

PART 2 - MATERIALS

2.1 CONCRETE BASE SLAB

A. Comply with Section 32 13 00, Concrete Pavement and Curbs.

2.2 SAND SETTING BED

A. Sand shall be well graded, washed sharp sand conforming to ASTM C33, and meeting the following sieve
   analysis gradations:

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<thead>
<tr>
<th>Sieve</th>
<th>Percent Passing</th>
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<tr>
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<td>20-30</td>
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<tr>
<td>No. 200</td>
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</table>

B. Use of masonry sand will not be permitted.

2.3 BRICK PAVERS

A. Solid, wire cut or non-slip surface, extruded from fine clay or shale specifically for exterior applications,
   ASTM C902.,Class PX, having a 6900 kPa (10,000 psi) minimum compressive strength, an average
   absorption of less than 6 percent in a 24-hour cold water absorption test, and capable of withstanding at least
   the equivalent of 50 cycles of freeze-thaw conditions.
   1. Maximum tolerance in paver size: 0.6 mm (1/16 inch) in depth, width or length.

B. Require the manufacturer to furnish independent laboratory test reports and certify that its material meets the
   above specifications.

C. Paving Brick
   1. Paver Type 1 ‘English Edge Autumn’, 4”x8”x2 ¼” brick paver with lugs as manufactured by Pine Hall
      Brick.
   2. No substitutions will be accepted for paving brick.
2.4 JOINTING SAND

A. Clean, fine, sharp sand, in compliance with ASTM C144 (gradation for 1/8 inch joints). The jointing sand shall be free of organics and soluble salts or other contaminants likely to cause efflorescence. The jointing sand mixture will include an elastomeric compound. The jointing sand shall be in compliance with the following grading limits:

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<thead>
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<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
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<td>40-75</td>
</tr>
<tr>
<td>No. 50</td>
<td>10-35</td>
</tr>
</tbody>
</table>

2.5 GEOTEXTILE FABRIC

A. Filter Fabric

1. Filter fabric shall be synthetic, non-woven, needle-punched fabric that is resistant to chemicals and mildew, stable under freeze-thaw cycles, shall not shrink or expand under wet conditions, shall not unravel during use and shall meet the following criteria:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>ASTM D3776</td>
<td>4.5 oz./sq. yd. min.</td>
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<tr>
<td>Grab Tensile Strength</td>
<td>ASTM D4632</td>
<td>100 lbs. min.</td>
</tr>
<tr>
<td>Mullen Burst</td>
<td>ASTM D3786</td>
<td>210 psi min.</td>
</tr>
<tr>
<td>Puncture Resistance</td>
<td>ASTM D4833</td>
<td>65 lbs. min.</td>
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<tr>
<td>Trapezoidal Tear</td>
<td>ASTM D4533</td>
<td>40 lbs. min.</td>
</tr>
<tr>
<td>Coefficient of Permeability</td>
<td>ASTM D4491</td>
<td>0.01 cm/sec.</td>
</tr>
</tbody>
</table>

2.6 DRAINAGE AGGREGATE

A. Clean natural gravel or crushed stone meeting the following grading requirements:

B. Sieve Analysis (ASTM C136)

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2”</td>
<td>100</td>
</tr>
<tr>
<td>3/4”</td>
<td>52-100</td>
</tr>
<tr>
<td>3/8”</td>
<td>36-65</td>
</tr>
<tr>
<td>No. 4</td>
<td>8-40</td>
</tr>
<tr>
<td>No. 16</td>
<td>0-12</td>
</tr>
<tr>
<td>No. 30</td>
<td>0-8</td>
</tr>
</tbody>
</table>

PART 3 - EXECUTION

3.1 INSTALLATION

1. Sand Setting Bed
2. The sand shall be of uniform moisture content when screeded and shall be protected against rain when stockpiled on site prior to screeding. For installation, the moisture content shall be in the range of 4 to 8 percent.
3. **Spreading:** The bedding sand shall be spread loose in a uniform layer to give a depth after compaction of the paving units of a maximum 1/2 inch thickness and as required to achieve designed grades.

4. **Screeding**
   a. The spread sand shall be carefully maintained in a loose condition and protected against pre-compaction by traffic or rain both prior to and following screeding. Sand shall be lightly screeded in a loose condition to predetermined depth. Under no circumstances shall the sand be screeded in advance of the laying face to an extent to which paving will not be completed on that day. Any screeded sand which is pre- compacted prior to laying of paving unit shall be brought back to profile in a loose condition. Neither pedestrian nor vehicular traffic shall be permitted on the screeded sand.
   b. The Contractor shall screed the bedding sand using either an approved mechanical spreader or by the use of screed guides and boards.

B. **Placing Brick Pavers**
1. Pavers chips, cracks, voids, discolorations or other defects shall not be installed.
2. **Pattern:** The pavers shall be laid in the pattern as shown on drawings.
3. **Color Blending:** Paving units shall be installed from a minimum of three bundles simultaneously drawing the paver vertically rather than horizontally.
4. **Joints:** Joint spacing shall be consistent and of approximately 1/8 inch, or as recommended by the manufacturer, unless noted otherwise. If the pavers have a spacing lug, the bricks shall be placed butt tight. This spacing must also be provided for the first row abutting the edge restraint.
5. **Alignment:** String lines or chalk lines on bedding sand should be used to hold all pattern lines true.
6. **Cutting of Brick Pavers**
   a. Contractor shall make all efforts to use full bricks to the maximum extent possible. Where cutting of brick is required to achieve the desired pattern, brick shall be cut to leave a clean edge to the traffic surface using a mechanical hydraulic, or guillotine cutter or masonry saw.
   b. Discontinuities in patterns will not be permitted. Lay out pavers in all areas so as to eliminate slivers at edges. Minimum length of cut 4” x 8” paver shall be four (4) inches. Minimum length of 8” x 8” paver shall be four (4) inches. Minimum width of cut 4” x 8” paver shall be 2 ¾ inches.
7. Carefully place the pavers by hand in straight courses with hand-tight joints and uniform top surface. Maintain good alignment and provide the pattern indicated.
8. Protect newly laid pavers at all times by panels of plywood, on which the installer stands, which can be advanced as work progresses. However, keep the plywood protection in areas which will be subjected to continued movement of materials and equipment. Take these precautions to avoid depressions and protect paver alignment.
9. If additional leveling of the pavers is required, and before sweeping in joint filler, roll with a power roller after sufficient heat has built up in the surface from several days of hot weather.
10. **Inspection of Installed Pavers:** After sweeping and prior to compaction, the paved area shall be inspected by the Owner and the A/E to ensure satisfactory color blending. Areas deemed poorly blended shall be removed and re-installed in order to achieve satisfactory color distribution.

C. **Compaction**
1. After inspection of the pavers, they shall be compacted to achieve consolidation of the sand bedding and brought to design levels and profiles by not less than three passes of a suitable plate compactor.
2. Compaction shall be accomplished by the use of a plate compactor capable of a minimum of 5,000 pound compaction force.
3. Initial compaction should proceed as closely as possible following installation of the paving units and prior to acceptance of any traffic or application of jointing sand.
4. Care shall be taken not to damage pavers or surface finish during compaction.

D. **Joint Treatment**
1. Jointing sand shall be spread over the pavement after initial compaction has been completed. The jointing sand shall be spread as soon as is practical after initial compaction and prior to the termination of work on that day. The Contractor shall not use wet sand.
2. The jointing sand shall be broomed to fill the joints. Excess sand shall then be removed from the pavement surface and the pavers shall be compacted again to settle the jointing sand.
3. Repeat this operation a minimum of two times.

E. Final Compaction
   1. After jointing sand has been installed and the pavement surface swept clean, final compaction shall be
      accomplished by not less than two passes of the plate compactor.
   2. Final compaction should proceed as closely as possible following installation of jointing sand and prior
      to the acceptance of any traffic.

F. Proof Rolling
   1. Proof roll the completed installation with pneumatic tire equipment which replicates anticipated service
      traffic. Subject each individual paver to at least one passage of load.
   2. Proof roll paver areas with the equivalent of a 907-kg (2,000-pound) wheel load with a tire pressure of
      345 kPa (50 psi).
   3. Equipment and procedures are subject to approval by the Owner and A/E and proof rolling will be
      observed and recorded by the A/E.
   4. Remove and replace units cracked or otherwise damaged by proof rolling, including inspection and
      repair of setting bed.

G. Allowable Tolerance
   1. Finished surface: smooth, even, and true to the lines, grades and cross section indicated. Maximum
      deviation when tested with a 3-meter (10-foot) straight-edge parallel to the centerline of the surfaced
      area: 6 mm in 3 meters (1/4 inch in 10 feet).
   2. Maximum offset from flush from paver surface to paver surface or from paver surface to a fixed flush
      edge: 0.6 mm (1/16 inch).
   3. Slope finished walk for drainage without any ponded water on the finished surface.

3.2 REPAIR, CLEANING AND PROTECTION

A. Clean paver surface of all debris, dirt, and sand.

B. Remove and replace pavers which are 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 the same
   manner as original units, with same joint treatment to eliminate evidence of replacement.

C. Provide final protection of paver areas in a manner acceptable to the installer, which ensures paver work
   being without damage or deterioration at the time of substantial completion.

3.3 GUARANTEE

A. Finished area shall be free of bumps or depressions, evenly graded to levels shown, and shall be guaranteed
   against defects of materials and workmanship for a period of two years after substantial completion.

END OF SECTION
SECTION 312333 - EARTHWORK FOR UTILITIES

PART 1 -  GENERAL

1.1 SUMMARY

A. Section Includes: Excavation, bedding and backfill for all buried utilities; installation of casing pipes; and, removal and replacement of sidewalk, pavement or other surface materials.

1.2 REFERENCES

A. ASTM International, as referenced herein as ASTM.

B. Ohio Department of Transportation, Standard Specifications for Construction, latest edition, as referenced herein as ODOT.

C. As it may apply to work in city owned right-of-ways, all relevant construction standards of the City of Oxford Ohio

1.3 SUBMITTALS

A. Product Data:
   1. Submit manufacturers' descriptive literature, detailed specifications, performance test data, instructions and recommendations for installation of geotextile fabrics.

B. Laboratory Test Reports:
   1. Submit laboratory test reports per Part 1.04 Quality Control.

1.4 QUALITY CONTROL

A. Testing Agency:
   1. The Owner will engage a Testing Agency to perform sampling and testing of soil materials proposed for use in the work and field testing facilities for quality control during earthwork operations. Provide access to the areas to be tested at times necessary for the Testing Agency to perform its duties.

B. Laboratory Tests:
   1. Prior to use, test each granular bedding and backfill material source for gradation in accordance with ASTM C136 and compacted density and optimum moisture content in accordance with ASTM D698.
   2. After testing, make recommendations for compaction of the soil samples submitted for testing with 1 copy of each report sent to the Contractor and Owner. The Contractor shall comply with such recommendations.

C. Field Control Tests:
   1. Perform one in-place density test for each 400 linear feet of line for each layer of Granular Bedding/Backfill, Granular Fill and General Site Fill in accordance with ASTM D1556 (sand cone method), or ASTM D2922 (nuclear methods) as follows:
   2. Perform compressive strength tests of lean concrete in accordance with ASTM C31 and C39.

1.5 DELIVERY AND STORAGE

A. Deliver and store materials in a manner to prevent contamination or segregation. Storage areas will be as designated by the Owner.
1.6 PROJECT CONDITIONS

A. Site Information:
   1. Examine the site to ascertain the state and conditions under which the work is to be done.
   2. If available, soil boring logs will be furnished upon request; however, the data on indicated subsurface conditions are not intended as representations or warranties of the accuracy or continuity between soil borings. The Owner will not be responsible for interpretations of conclusions drawn therefrom by the Contractor.
   3. Additional test borings and other exploratory operations may be made by the Contractor at no cost to the Owner.
   4. Be responsible for interpreting boring data and for the conclusions drawn from the information furnished and from inspection of available information at the site.

B. Use of Explosives:
   1. The use of explosives is not permitted.

C. Protection of Persons and Property:
   1. Barricade open excavations occurring as part of the Work and post with warning lights. Operate warning lights as recommended by authorities having jurisdiction.
   2. Protect utilities, pavements and other facilities from damages caused by settlement, lateral movements, undermining, wash-out and other hazards created by excavation operations.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General:
   1. Provide soil materials that are free of debris, roots, wood, scrap material, vegetative matter, refuse, soft and/or unsound particles, frozen, deleterious or objectionable materials.
   2. Material supplied by the Contractor; clean natural sand, gravel or crushed stone meeting the grading requirements of ASTM D448 Size Number 7.

B. Granular Fill (Refer to Section 31 00 00 Site Earthwork).

C. General Site Fill (Refer to Section 31 00 00 Site Earthwork).

D. Drainage Aggregate:
   1. Clean gravel or crushed stone, passing a 1.5 inch sieve and be retained on a .5 inch sieve.

2.2 GEOTEXTILE FABRICS

A. Filter Fabric:
   1. Synthetic, non-woven, needle-punched fabric that is resistant to chemicals and mildew, stable under freeze-thaw cycles, does not shrink or expand under wet conditions, does not unravel during use and meets the following criteria:
### EARTHWORK FOR UTILITIES

#### PART 3 - EXECUTION

##### 3.1 SHORING AND SHEETING

A. Provide temporary shoring, bracing, cribbing or sheeting as required to prevent undermining of structures, utilities, pavements and slabs, and to provide a safe work area in accordance with OSHA safety regulations. Be responsible for the design of all shoring and sheeting including utility supports.

##### 3.2 DEWATERING

A. Include in dewatering the collection and disposal of all forms of surface and subsurface water that are encountered in the course of construction. Operate the dewatering system continuously, 24 hours per day, 7 days per week, until such a time as construction work below existing water levels is complete, unless otherwise directed. After placement of backfill, the water level may rise, but at no time higher than 1 foot below the prevailing level of backfill. Slope tops of excavations to drain rain water runoff away from excavation.

##### 3.3 EXCAVATION

A. Excavate to the elevations and dimensions indicated or otherwise specified. Keep excavations free from water while construction is in progress. Notify the Owner immediately if it becomes necessary to remove hard, soft, weak or wet material to a depth greater than indicated.

#### Property | Test Method | Results
---|---|---
Grab Tensile Strength | ASTM D4632 | 100 lbs. min.
Mullen Burst | ASTM D3786 | 200 psi min.
Puncture Resistance | ASTM D4833 | 65 lbs. min.
Trapezoidal Tear | ASTM D4533 | 40 lbs. min.
Coefficient of Permeability | ASTM D4491 | 0.25 cm/sec. min.

#### B. Stabilization Fabric:

1. Synthetic, woven fabric that is resistant to chemicals and mildew, stable under freeze-thaw cycles, does not shrink or expand under wet conditions, does not unravel or become clogged during use, and meets the following criteria:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab Tensile Strength</td>
<td>ASTM D4632</td>
<td>180 lbs. min.</td>
</tr>
<tr>
<td>Grab Elongation</td>
<td>ASTM D4632</td>
<td>50% max.</td>
</tr>
<tr>
<td>Mullen Burst</td>
<td>ASTM D3786</td>
<td>350 psi min.</td>
</tr>
<tr>
<td>Puncture Resistance</td>
<td>ASTM D4833</td>
<td>110 lbs. min.</td>
</tr>
<tr>
<td>Trapezoidal Tear</td>
<td>ASTM D4533</td>
<td>75 lbs. min.</td>
</tr>
<tr>
<td>Coefficient of Permeability</td>
<td>ASTM D4491</td>
<td>0.25 cm/sec.</td>
</tr>
</tbody>
</table>

#### 2.3 LEAN CONCRETE

A. A mixture of Portland cement, aggregate and water, having a minimum compressive strength of 1,500 psi at 28 days.
B. Make trench sides as nearly vertical as practicable except where sloping of sides is allowed. Do not slope sides of trenches from the bottom of the trench up to the elevation of top of the pipe, conduit or duct.

C. Excavate large rock, boulders and hard material to an overdepth at least 4 inches below the bottom of the pipe, conduit, duct and appurtenances, unless otherwise indicated or specified.

D. Use bedding material to refill overdepths to the proper grade and place in 6 inch maximum layers. At the option of the Contractor, the excavations may be cut to an overdepth of not less than 4 inches and refilled to required grade as specified.

E. Grade bottom of trenches accurately to provide uniform bearing and support for each section of pipe, conduit, duct or structure on undisturbed soil or bedding material as indicated or specified at every point along its entire length, except for portions where it is necessary to excavate for bell holes and for making proper joints. Dig bell holes and depressions for joints after trench has been graded and to dimensions as indicated and required for properly making the particular type of joint to ensure that the bell does not bear on the bottom of the excavation.

3.4 BEDDING

A. Provide bedding for utility lines and utility line structures of the materials specified and to depths indicated.

B. Place bedding in 6 inch maximum loose lifts. Provide uniform and continuous support for each section of structure except at bell holes or depressions necessary for making proper joints. Do not use frozen bedding material.

3.5 BACKFILLING

A. Surround pipes, conduits and ducts with bedding or granular fill as indicated. Ensure that granular fill is placed completely under pipe haunches. Do not use frozen fill on the drawings. Ensure that no damage is done to structures or protective coatings thereon.

B. Place granular fill in 6-inch maximum loose lifts to 1 foot above pipe or other utility, unless otherwise specified. Bring up evenly on each side and for the full length of the structure.

C. Place general site backfill in 8 inch maximum loose lifts, unless otherwise specified.

D. Compact each loose lift as specified in Part 3.06 Compaction, before placing the next lift.

E. Do not backfill in freezing weather where the material in the trench is already frozen or is muddy.

F. Where unacceptable settlements occur in trenches and pits due to improper compaction, excavate to the depth indicated by the Testing Agency, then backfill and compact the excavation as specified herein and restore the surface to the required elevation.

G. Coordinate backfilling with testing of utilities. Assure that testing for water distribution, storm drainage and sanitary sewer systems is complete before final backfilling.

3.6 COMPACTION

A. Use hand-operated plate-type vibratory or other suitable hand tampers in areas inaccessible to larger rollers or compactors. Be careful to avoid damaging utilities and protective coatings. Comply with the following, unless otherwise specified:

1. Bedding: Compact to 98% of ASTM D698 maximum density.
2. Granular Backfill Surrounding Pipes, Cables, Conduits or Ducts: compact to 98% of ASTM D698 maximum density.

3. General Site Backfill: Compact to 95% of ASTM D698 maximum density, except as modified below.

3.7 SPECIAL EARTHWORK REQUIREMENTS

A. Piping or Utilities Under Embankment: Construct the embankment to 6 inches above the elevation of the top of the pipe. Excavate the trench through the constructed embankment as specified in Part 3.03 Excavation.

B. Manholes and Other Appurtenances: Provide at least 12 inches clear from outer surfaces to the embankment or shoring. Remove unstable soil that is incapable of supporting the structure to an overdepth of 1 foot and refill with compacted bedding material to the proper elevation.

C. Roads, Streets, Walkways and Other Areas to be Paved: Place backfill in 6 inch maximum loose lifts. Compact bedding and granular fill surrounding pipes, ducts, conduits and other structures as specified above. Use granular fill for the entire excavation up to the sub-bases (no general site fill unless site material meets granular fill requirements). Backfill in a manner to permit the rolling and compacting of the completed excavation with the adjoining material to provide the specified density so that paving of the area can proceed immediately after backfilling has been completed.

D. Boring and Jacking: Casing pipes or conduits may be bored and jacked under existing roadways. Submit materials and procedures for review and approval, and comply with rules and regulations of the utility company and road owner.

3.8 PAVEMENT AND WALK REMOVAL OR REPLACEMENT

A. Where construction requires cutting and replacing of pavement or walks, perform cutting so that the remaining exposed edges conform vertically and horizontally to a straight line. Remove the full depth of surface and binder course to a minimum width of 10 feet with a saw cut on the edges. Remove base course to a point 1 foot back from each side of the trench. After backfill and compaction, replace all removed pavement with concrete pavement of the same total thickness of the removed section, but not less than 6 inches. Provide concrete work in accordance with Section 32 13 00 Concrete Pavement and Curbs. Dispose of waste materials off the site.

3.9 FINISH OPERATIONS

A. Tolerance: Grade to finished grades indicated within 0.10 foot. Grade areas to drain water away from structures. Grade as directed existing grades which are to remain, but are disturbed by the Contractor’s operations.

B. Disposition of Surplus Material: Remove from the Project site surplus and other soil material not required or suitable for filling, backfilling or grading.

C. Protection of Surfaces: Protect newly graded areas from traffic, erosion and settlements that may occur. Repair or reestablish damaged grades, elevations or slopes.

END OF SECTION
SECTION 312500 - EROSION AND SEDIMENT CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The requirements of each Contract Document apply to the Work of this Section.

B. Refer to Division 1 for further technical requirements.

1.2 WORK OF THIS SECTION

A. Furnishing and maintaining erosion and sediment control procedures as regulated by the proper Governmental Authority.

1.3 RELATED WORK

A. Site Earthwork 31 00 00

B. Site Preparation 31 10 00

C. Site Restoration 31 14 00

D. Earthwork for Utilities 31 23 33

1.4 STANDARDS

A. Ohio EPA - Environmental Protection Agency ODNA - Ohio Department of Natural Resources, Division of Soil and Water Conservation


B. ODOT Specifications

C. Item 207 Temporary Soil Erosion and Sediment Control

1. Methods of measurement and bases of payment clauses are excluded from this Specification reference.


1.5 CODES and PERMITS

A. Conform to all codes and requirements of governing authority.

B. Obtain and pay for all permits and file with governing agencies all required forms including but not limited to:

1. Ohio EPA Storm Water General Permit.


1.6 QUALITY ASSURANCE

A. Testing and Inspection

1. Regular inspections and maintenance shall be provided for all erosion control practices.
a. Inspect all erosion and sediment controls at least once every seven (7) calendar days and within twenty-four (24) hours after each storm event greater than 0.5 inch of rain per twenty-four (24) hour period and evaluate whether measures are adequate.
b. Provide name of inspector, major observations, date of inspection, certification of compliance and corrective measures taken.
c. Copies of the inspections shall be maintained at the construction site with copies forwarded to the Owner and the Architect.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lime - Apply agricultural ground limestone at 46 lbs. per 1000 square feet to correct any excess acidity determined by a soil test.

B. Fertilizer - Commercial fertilizer shall be 12-12-12 at 20 lbs. per 1000 square feet.

C. Seed - Annual ryegrass (Lolium multifolium) at 2 lbs. per 1000 square feet.

D. Straw or hay bales.

E. Filter fabric (silt, sediment fences) ODOT Item 712.09, Type C.

F. Mulch, straw or hay conforming to ODOT 659.06 at the rate of 2 tons per acre kept in place with an approved non-asphalt tackifier.

PART 3 - EXECUTION

3.1 RULES AND REGULATIONS

A. Excerpts of the National Pollutant Discharge Elimination System Permit (NPDES) follows however the Contractor shall secure copies of all rules, regulations and requirements which shall govern execution.

3.2 NOTIFICATION

B. The Contractor shall inform all subcontractors involved in the storm water pollution control plan of its requirements.

3.3 INSTALLATION

A. The Contractor shall initiate appropriate vegetative or non-vegetative practices on all disturbed areas within seven (7) days if they are to remain dormant (undisturbed) for more than forty-five (45) days.

B. Temporary soil stabilization (seeding) shall be applied to disturbed areas within seven (7) days after final grade is reached. Comply with Sections 312219 Finished Grading and 329200 Turf & Grasses with respect to preparation, sowing and reseeding, etc.

C. When seasonal conditions prohibit temporary seeding, non-vegetative soil stabilization practices such as mulching and approved matting shall be used.

D. Permanent soil stabilization (seeding and planting) shall comply with Sections 312219 Finished Grading and 329200 Turf & Grasses.
E.  Erosion and sediment control practices as shown on the Drawings shall be installed as indicated. Contractor shall provide interim erosion and sediment control as required in all phases of the construction to provide protection to completed and active walkways, roads and all pavements as directed.

3.4 MAINTENANCE

A.  All control practices shall be maintained and repaired as needed to assure continued performance for the duration of the Contract.

3.5 COMPLETION

A.  Once the construction activity is completed, provide the Owner with all pertinent data for submission, within forty-five (45) days after site stabilization has been achieved, a Notice Of Termination (NOT) to the appropriate governing agencies.

END OF SECTION
SECTION 320513 - TOPSOIL

PART 1 - GENERAL

1.1 SUMMARY

A. Section specifies soil material designated as “topsoil” on the Drawings or in the specifications.

1.2 REFERENCE

A. United States Department of Agriculture (USDA)
   1. Ag. Handbook 60 - Diagnosis and Improvement of Saline and Alkali Soils.

B. ASTM International, as referenced herein as ASTM.

1.3 SUBMITTALS

A. Samples
   1. Provide 1-quart Samples for each soil unit composing the topsoil source, each sample representing a composite of five to seven subsamples taken the full depth of proposed source. On stockpiles, discard upper 6 inches of soil before sampling.
   2. Place samples in plastic bags, seal and place in second paper bag, and label.
   3. Submit samples to an agronomic soil testing laboratory for testing.

B. Test Reports
   1. Prior to starting work, submit two certified copies of soil test reports performed by an agronomic testing laboratory. Contractor will be responsible for all costs related to topsoil testing.
   2. Fertilizer: Submit copies attesting to the fertilizer composition, in duplicate, for review.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. Furnish all topsoil for landscape and site restoration work from off-site sources. Topsoil must meet the following requirements, regardless of the source:
   1. A fertile, friable, sandy, loamy surface soil without admixture of subsoil and free of stones, stumps, root, trash, debris, and other materials deleterious to plant growth.
   2. pH range: 6.5 to 8.4. Topsoil that does not meet this range shall not be approved by the Owner’s Representative.
   3. Nutrient data in parts per million (ppm) dry soil.
   4. Organic content: not less than 3 percent and not greater than 10 percent determined by loss through ignition.
   5. Clay content shall not exceed 15%.
   6. Gradation:

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 inch screen</td>
<td>100</td>
</tr>
<tr>
<td>1/4 inch screen</td>
<td>97 - 100</td>
</tr>
<tr>
<td>No. 10 U.S.S. mesh sieve</td>
<td>95 - 100</td>
</tr>
<tr>
<td>No. 140 U.S.S.</td>
<td>15 – 35</td>
</tr>
</tbody>
</table>

   a. Base percentages on dry weight of the sample.
2.2 SOURCE QUALITY CONTROL

A. Laboratory Test Reports:
   1. Conduct topsoil testing for each soil test unit as follows:
      a. Existing off-site location(s): 1 sample per acre of site to be excavated.
      b. Exiting site soils after excavation: 3 samples from locations to be identified by the Design Professional.
      c. Existing stockpile: 1 sample per 1,000 cubic yards of stockpiled soil.
   2. Submit all test reports for Design Professional approval. Topsoil units that do not meet the soil requirements specified under this section will not be permitted for use as Topsoil.
   4. Physical Properties: Determine percent sand, silt and clay and textural classification. Identify all foreign materials such as rock, roots, and vegetation.
   5. Recommendations: Based on the test results, the independent testing laboratory shall state recommendations for soil treatments and soil amendments to be incorporated. List recommendations in weight per 1000 square feet for turf area and volume per cubic yard of planting mix. Recommendations shall include; nitrogen, phosphorus, and potash nutrients and all soil amendments to be added to produce the specified topsoil material satisfactory for the long-term growth of the specified plants and turf.
   6. The Contractor will be responsible for amending the all topsoil to be installed pursuant to the recommendations of the testing laboratory, including the cost of any additional materials and supplies.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

1. Sampling: Each sample shall be a composite of five to seven subsamples taken the full depth of proposed source for each acre of surface area. For on-site stockpiles, discard upper 6 inches of soil before sampling. For large stockpiles, partial excavation will be required for collection of representative samples. Include site plan verifying the locations of all topsoil sampling. Topsoil test reports shall be accompanied with each sample unit for review and approval by the Design Professional.

2. Testing methods and written recommendations when not references elsewhere, shall comply with USDA's Handbook No. 60. Nutrient data to be given in parts per million (ppm) dry soil.

3. Textural classification shall be determined in accordance with ASTM D2487.

4. Topsoil shall be as defined in ASTM D5268.

5. Soil pH shall be tested in accordance with ASTM D4972.

6. Test for organic material by using ASTM D2974.

END OF SECTION
SECTION 321123 - AGGREGATE BASE COURSE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Aggregate Base Course on a prepared sub-grade.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials, as referenced herein as AASHTO.
B. ASTM International, as referenced herein as ASTM.
C. Ohio Department of Transportation, as referenced herein as ODOT.
D. As it may apply to work in city owned right-of-ways, all relevant construction standards of the City of Oxford Ohio

1.3 SUBMITTALS

A. Certification of aggregate conformance to specification.
B. Field Test Reports: During Construction, submit field test reports in accordance with the testing schedule specified herein.

1.4 QUALITY CONTROL

A. Testing Agency:
   1. The Owner will engage a Testing Agency to perform sampling and testing of aggregate materials proposed for use in the work and field testing facilities for quality control during construction operations. Provide access to the areas to be tested at times necessary for the Testing Agency to perform its duties.

B. Laboratory Tests:
   1. The Testing Agency will conduct sieve analysis of base course aggregate in accordance with ASTM C136 for each source.

C. Field Control Tests:
   1. Perform Field Density-in-Place Tests for each 5000 square feet and each compacted layer of base course aggregate. Tests shall be in accordance with ASTM D1556, ASTM D2922 or other ASTM Test as determined by the Testing Agency.
   2. When, in the judgment of the Owner, there is reasonable doubt about material characteristic of base course aggregate used in field, a field-conducted 1 point proctor test will be conducted. If the moisture-density coordinates of the 1 point proctor test do not fall on the curve which has been established by laboratory tests, a sample of that material will be tested in the laboratory for conformance to the specifications.
   3. One copy of each report will be submitted to the Contractor. Reports will designate the location of the Work tested and document conformance or non-conformance to specification requirements. The report shall state recommendations for remediation of non-conformances. The Contractor shall comply with such recommendations.
   4. Tolerances:
      a. Flatness: maximum variation of 1/4 inch measured with 10 foot straight edge.
b. Compacted thickness: within 1/4 inch.
c. Variation from true elevation: within 1/2 inch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate:
   1. Crushed gravel, crushed stone, complying with the grading and physical requirements of the ODOT specification 304 Crushed Limestone.

PART 3 - EXECUTION

3.1 CONSTRUCTION OF AGGREGATE BASE COURSE

A. Examination:
   1. Before placing base course, examine subgrade surfaces and verify that subgrade has been inspected, gradients and elevations are correct and subgrade surface is dry.
   2. Smooth and trim unsuitable sub-grade to required line, grade and cross section to receive the base course.

B. Aggregate Placement:
   1. Spread base course aggregate over prepared base. Do not place aggregate over frozen sub-grade or if there is indication that aggregate may become frozen before compaction is completed.
   2. Place aggregate in layers not more than 6 inches and compact as specified. Provide total thickness after compaction as indicated.
   3. Level and contour surfaces to elevation and gradients indicated.
   4. Compact placed aggregate materials by appropriate equipment to achieve compaction of 95% of its maximum density as determined by ASTM D1557. Use mechanical vibrating tamping in areas inaccessible to compaction equipment.
   5. Add water to assist compaction only when necessary to increase the performance of moisture or, if excess water is apparent, remove aggregate and aerate to reduce moisture content for proper compaction.

C. Maintenance:
   1. Maintain the aggregate base course in a smooth, compacted condition, true to line, grade and cross section, until paving placement.

END OF SECTION
SECTION 321200 - HMA PAVEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: HMA (Hot Mix Asphalt) Pavement.

1.2 REFERENCES

A. ASTM International, as referenced herein as ASTM.
B. Ohio Department of Transportation, Construction and Material Specification, latest edition, as referenced herein as ODOT

1.3 SUBMITTALS

A. Test Reports:
   1. Submit certified test reports for Contractor-supplied HMA mix design and materials.
   2. Submit field test reports in accordance with the testing schedule.

1.4 QUALITY CONTROL

A. Testing Agency:
   1. The Owner will engage a Testing Agency to prepare and submit a HMA mix design for HMA mixtures types specified herein; perform sampling and testing of HMA paving materials proposed for use in the work; and, perform field testing for quality control during HMA paving operations. Testing shall be in accordance with ODOT requirements. The requirements listed in this specification are to supplement or clarify the ODOT specifications. Provide access to the areas to be tested at times necessary for the Testing Agency to perform its duties.

   B. Field Testing: Take representative samples for the determination of thickness and density of the completed pavements. The diameter of the specimens shall be as determined by the Testing Agency. At least one sample shall be removed for each 10,000 square feet, and no less than 4 samples shall be removed for the project. Record the location of each sample removed in the field report. Replace the pavement at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 HMA PAVING MATERIALS

A. HMA Paving Courses:
   1. Hot mix HMA concrete base, leveling and top courses: ODOT, Sections 448.
   2. HMA Leveling Course: ODOT, mixture type 2, medium.
   3. HMA Top Course: ODOT mixture type 1, medium.

B. Bond Coat or Tack Coat:
   1. Rapid setting asphalt emulsion: ODOT, Section 702.01.
PART 3 - EXECUTION

3.1 CONSTRUCTION OF HMA PAVING

A. General:
   1. Apply HMA paving in one or more layers as indicated, consisting of a leveling course and a wearing course. Minimum thickness after compaction of each HMA paving course: as indicated on construction drawings.

B. Hot Mix Plant:
   1. HMA mixing plant and preparation, and mixing of HMA mixtures: ODOT, Section 402.

C. Equipment:
   1. Placing equipment: self-propelled paver capable of spreading the HMA mixture true to line and grade, and in uniform thickness, maintained in good mechanical condition.

D. Weather Limitations:
   1. Perform mixing and placing of hot HMA mixture in accordance with ODOT, Section 401.06.

END OF SECTION
SECTION 321300 - CONCRETE PAVEMENT AND CURBS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Both reinforced and non-reinforced, Portland cement concrete pavement and curbs on a prepared surface for streets, roads, walks and other pedestrian areas.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials, as referenced herein as AASHTO.

B. American Concrete Institute, as referenced herein as ACI.

C. ASTM International, as referenced herein as ASTM.

D. Ohio Department of Transportation, Construction and Material Specification, latest edition as referenced herein as ODOT.

E. As it may apply to work in city owned right-of-ways, all relevant construction standards of the City of Oxford Ohio

1.3 SUBMITTALS

A. Concrete Mix Design

B. Test Reports for mix proportion

C. Product Data for joint filler

1.4 QUALITY CONTROL

A. Workmanship:
   1. The Contractor is responsible for correction of concrete work which does not conform to the specified requirements, including strength, tolerances and finishes. Correct deficient concrete as directed by the Owner.

B. Testing Agency:
   1. The Owner will engage a Testing Agency to perform sampling and testing of concrete materials proposed for use in the work and field testing facilities for quality control during earthwork operations. Provide access to the areas to be tested at times necessary for the Testing Agency to perform its duties.

C. Field Quality Control Testing:
   1. Perform slump measurement according to ASTM C143.
   2. Perform air content according to ASTM C231.
   3. Perform compressive strength tests according to ASTM C31 and C39.
   4. Concrete temperature: Test hourly when air temperature is 80 degrees F. and above, and each time a set of compression test specimens is made.
   5. Submit written reports to the Owner for each material sampled and tested. Provide the project identification name and number, date of report, name of contractor, name of concrete Testing Agency, material manufacturer and brand name for manufactured materials, values specified in the referenced
specification for each material and test results. Indicate whether or not material is acceptable for intended use.

6. Make additional tests of in-place concrete when test results indicate the specified concrete strengths and other characteristics have not been attained in the structure as directed by the Engineer. Conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed.

D. Job Mock-Up:
1. Construct a mock-up sample, 50 square foot minimum, of the concrete walk surface, indicate all the typical jointing, score lines, texture or finishes, and color required in actual construction. Make mock-up samples as required until acceptance by the Owner. Consider the selected mock-up as a standard of workmanship to be matched throughout the Project. The sample may be constructed as part of the Project and, if approved, will be accepted as part of the Work. Remove samples which fail to meet the Owner's approval.

1.5 PROJECT CONDITIONS
A. Cold Weather Concreting:
1. Do not place concrete when the temperature of the surrounding air is expected to be below 40 degrees F during placing or within 24 hours thereafter. Do not allow the temperature of plastic concrete to drop below 55 degrees F.

B. Hot Weather Protection:
1. When the mean daily temperature of the atmosphere is 80 degrees F and above, or during hot and dry weather, do not place the concrete with a placing temperature which causes difficulty from loss of slump, flash set or cold joints 75 degrees F where possible and not more than 90 degrees F in any event. Where climatic conditions cause too rapid drying, make arrangements prior to placing concrete for installation of wind breaks, shading, fog spraying, water sprinkling, ponding or wet covering of a light color. Take such protective measures as quickly as concrete hardening and finishing operation allow, and maintain throughout the entire curing period.

PART 2 - PRODUCTS
2.1 MATERIALS
A. Concrete Materials:
1. Portland cement: ASTM C150, Type I.
4. Water-reducing admixture: ASTM C494, Type F or G.

B. Reinforcement:
1. Reinforcing Bars: ASTM A615, Grade 60.
2. Joint dowel bars: Plain steel bars, ASTM A615, Grade 60. Cut bars true to length with ends square and free of burrs.
3. Polypropylene fibrillated fibers: 1.5 pounds per cubic yard.

C. Forms:
1. Steel, wood or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use forms free of distortion and defects.
2. Use flexible spring steel forms or laminated boards to form radius bends.
3. Coat forms with a non-staining form release agent that will not discolor or deface surface of concrete.

D. Curing Materials:
2. Membrane curing compound: ASTM C 309, Type II, Class B vehicle.

E. Joint Material:
   2. Joint Sealer: Refer to Section 321373 Site Joint Sealants

2.2 CONCRETE MIX

A. ODOT Class C mix to produce normal-weight concrete consisting of Portland cement, aggregate (1 inch maximum size), water-reducing or high-range water reducing admixture, air-entraining admixture and water to produce the following properties:
   1. Compressive strength: 4000 psi (minimum) at 28 days.
   2. Water-cement ratio: use water-cement ratio of 0.50.
   3. Minimum cement content: 600 pounds per cubic yard.
   4. Air content: 6.0% plus-or-minus 2.0% per ASTM C173 or ASTM C231.
   5. Slump: 1 to 3 inches nominal; 4 inches maximum. Can be increased to 6 inches and 7 inches maximum provided the increase is achieved by adding a chemical admixture.

B. The project schedule outlined in the Drawings includes a provision which may require the Contractor to utilize a high early strength concrete mix. If this is required, a concrete mix design must be submitted to the Owner for approval prior to installation of this concrete.

2.3 CONCRETE PRODUCTION

A. Conform to ACI 301 for production of ready-mixed concrete and concrete produced by on-site volumetric batching and continuous mixing.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examination:
   1. Examine the compacted aggregate base (or sub-grade) for conformity with indicated cross-section, gradients and elevations. If necessary, trim high areas to proper elevation and fill low areas and compact to specified compaction requirements for base course.
   2. Remove any loose material from base course before placing concrete.

3.2 FORM CONSTRUCTION

A. Compact the foundation under the forms and cut to grade such that forms are uniformly supported for their entire length and are at the proper elevation.

B. Assemble form work to permit easy stripping and dismantling without any damage to concrete.

C. Set forms at least 1 construction day ahead of concrete placement. Provide supply of forms sufficient to permit forms being kept in place for at least 12 hours after placing concrete. Clean form after each use and coat with form release agent.

D. Place joint filler vertical in position, in straight lines, and secure to form work.

E. Check form work for grade and alignment to following tolerances:
   1. Top of the form: not more than 1/8 inch in 10 feet.
   2. Vertical face on longitudinal axis: not more than 1/4 inch in 10 feet.
3. Exception: In areas of barrier-free parking and ramps, the maximum allowable slope per ADA requirements shall not be exceeded. Pavement exceeding the allowable slopes will be removed and replaced at Contractor’s expense.

3.3 REINFORCEMENT

A. Clean all reinforcement so that it is free of mud, oil, or other materials that adversely affect or reduce the bond.

B. Support and fasten all reinforcement by suitable chairs or other devices to insure accurate spacing, both horizontally and vertically, and sufficient rigidity to secure against displacement during concrete placing.

C. Unless otherwise indicated, lap reinforcing bar with 30-bar-diameter and not less than 16 inch splices. Splice length for welded wire fabric: in accordance with ACI 318, Section 12.19.

D. Locate reinforcement not less than 2 inches nor more than 4 inches from the edges.

E. Tolerance in concrete cover for formed surfaces: plus-or-minus .25 inch.

3.4 CONCRETE PLACEMENT

A. Comply with the requirements of ACI 301 for placing concrete and as herein specified.

B. Do not place concrete until aggregate base (or sub-grade) and forms have been checked for line and grade. Moisten aggregate base if required to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

C. Place concrete by methods that prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, and side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.

D. Deposit and spread concrete in a continuous operation between transverse joints as far as possible. If the placement of concrete is interrupted for more than 1/2 hour, provide a construction joint.

E. When adjacent pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained sufficient strength to carry loads without injury.

F. Form grooves in paving in which snow melting pipes or cables are being embedded by inserting a pre-molded or metal strip finishing flush with surface when concrete is placed. Do not saw grooves.

3.5 JOINTS

A. General:
   1. Construct expansion, contraction (weakened-plane), and construction joints true to line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated.
   2. When joining existing structures, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Contraction Joints (Weakened-Plane):
   1. Provide contraction joint (weakened-plane), sectioning concrete into area as shown on Drawings. Construct weakened-plane joints for a depth equal to at least 1/4 concrete thickness and as follows:
a. Tooled Joints: Form joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer. Install joints with a smooth trowelled border as indicated on Drawings.

C. Construction Joints:
1. Place construction joints at end of placement and at location where the placement operations are stopped for more than 1/2 hour, except where such placements terminate at expansion joints.
2. Construct joints as shown, or if not shown, use standard keyway section.
3. Install load transfer-slip dowels, as directed by the engineer, so that one end of each dowel bar is free to move.
4. Construction joints shall receive the smooth troweled border as indicated in the Drawings.

D. Heavy Duty Concrete Pavement Expansion Joints:
1. Provide 0.5 inch thick pre-molded joint filler (ASTM D1751) for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks, and other fixed objects.
2. Extend joint fillers full width and depth of joint, not less than 0.5 inch nor more than 1 inch below finished surface, where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.
3. Furnish joint filler in one piece length for full width being placed where possible. Where more than one length is required, lace or clip joint filler together.
4. Protect top edge of joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joints.
5. Install load transfer-slip dowels, where indicated, so that one end of each, dowel bar is free to move.
6. Expansion joints shall receive the smooth troweled border as indicated in the Drawings.

E. Sidewalk Expansion Joints:
1. For unsealed joints, install the expansion joint filler strip 0.125 inch below the finish surface of the walk.
2. For sealed joints, install expansion joint filler strips in a manner to provide a void having depth equal to width of joint plus 0.125 inch for sealing compound.
3. Provide 0.5 inch thick expansion joints at points of contact with fixed objects such as building, curbs, pavement, poles, signs and hydrants, at intervals not exceeding 30 feet, or as indicated.
4. With handicapped ramps to front doors, check to ensure door threshold will not be resting on walk pavement. If this occurs, provide detail for extra expansion joint under threshold.
5. Expansion joints shall receive the smooth troweled border as indicated in the Drawings.

F. Curb Joints:
1. Provide control joints in curbs in such a manner as to align with control joints in adjacent Work. Form control joints by 0.25 inch thick steel template of a width equal to that of curb and depth at least 2 inches greater than required curb depth, set vertically within the curb forms and at right angles to curb face.
2. Provide 0.5 inch thick expansion joint opposite expansion joint in adjacent walk at the tangent points of curb returns, at intersections, between the walk and curb where the walk is parallel and adjacent to the curb, and elsewhere at intervals not exceeding 30 feet. Establish expansion joints by placing prepared strips of 0.5 inch thick fiber matrix, cut to conform to the shape of the curb and gutter and extending the full depth of the concrete, flush with the finish surface.

3.6 CONCRETE FINISH

A. Striking and Floating:
1. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use suitably stiffened float of at least 12 feet in length and not less than 10 inches in width. Use hand methods only where mechanical floating is not possible. Waste excess water or soupy material over side form on each pass.
2. Check and level surface plane to a tolerance not exceeding 0.25 inch in 10 feet when tested with a 10 foot straight-edge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, re-float surface to a uniform, smooth, granular texture.

3. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to 1/2 inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface.

4. After completion of floating and when excess moisture or surface sheen has disappeared, complete troweling and finish surface as follows and as approved by the Engineer.

B. Finishing:
1. Coarse Broom Finish: After surface of concrete has been brought true to grade and cross section by floating, finish surface of concrete with a coarse hair push broom drawn over the surface transverse to the line of traffic. Take care that concrete surface does not ravel or ball during brooming. Broom out smooth margin of edging tool at joints and slab edges. After brooming, re-tool edges and joints with an edging tool having a radius of 0.25 inch and a flat trowel border surface, leaving a smooth margin, as indicated on the Drawings.

2. Light Broom Finish: After surface of concrete has been brought true to grade and cross section by floating, trowel the surface smooth and round edges with an edging tool having a radius of 0.25 inch. Then finish with a fine hair push broom drawn over the surface transverse to the line of traffic. After brooming, re-tool edges and joints with an edging tool having a radius of 0.25 inch and a flat trowel border surface, leaving a smooth margin, as indicated on the Drawings.


4. On inclined slope surfaces, provide a coarse non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to line of traffic.

5. Finish the formed surfaces and face of curbs exposed to view to provide a wood float finish.

6. Curb Finish: Finish surfaces exposed to view smooth and even by means of a moistened wood float followed by a light brushing, using either a broom brush or burlap. Edge and trowel corners, edges and joints with 0.125 inch radius, except as indicated. Maximum top of curb variation: 0.1875 inch in 10 feet when checked with a 10 foot straight-edge. After the forms have been removed and prior to final finishing, repair all honeycomb and minor defects with mortar composed of 1 part Portland cement and 2 parts sand.

3.7 CURING

A. General:
1. Protect and cure finished concrete surfaces in accordance with ACI 301.
2. Use membrane-forming curing compound, ASTM C309 Type II, or another method as approved by Owner.

B. Liquid Membrane:
1. Apply liquid membrane curing compound to cover surface completely and uniformly at a rate which will achieve the performance requirement specified in AASHTO Specification M148. Apply membrane curing compound immediately behind final finishing operation. Failure to provide complete and uniform coverage at required rate will be cause for rejection of all concrete so affected. Take special care to apply curing compound to pavement and walk edges immediately after forms have been removed.

C. Moisture Curing, (use only as approved by Owner):
1. Execute moisture curing by covering surface with blankets of wetted burlap. Keep material saturated and in place for at least 7 days. Apply water in form of spray to avoid damage to fresh concrete. Prevent blankets from being displaced.

D. Continue curing until the cumulative number of hours or fractions thereof during which temperature of the air in contact with the concrete is above 50 degrees F has totaled at least 168 hours. Prevent rapid drying at the end of the curing period.
E. After completion of curing, sweep concrete surfaces clean.

3.8 JOINT SEALER

A. Refer to Section 32 13 73 Site Joint Sealants.

3.9 PROTECTION

A. During the curing period, protect the concrete from damaging mechanical disturbances; particularly load stresses, heavy shock, and excess vibration. Protect finished concrete surfaces from damage caused by construction equipment, materials or methods, and by rain or running water.

B. Exclude traffic from newly constructed pavement until pavement has attained a strength sufficient to carry traffic without being damaged. Seal the joints before any traffic is permitted.

C. Provide security as required to monitor concrete paving and to prevent damage (such as, but not limited to, vandals scratching figures or notations into concrete).

3.10 CLEANING

A. Remove concrete spilled on the pavement or structures and thoroughly clean the pavement or structures before the concrete sets. Do not wash spilled concrete into sewers or drains. Restore the site of the Work to a neat and sightly appearance, including removal of excess materials, forms and equipment.

END OF SECTION
SECTION 321373 - SITE JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Joint sealants for site pavement.

1.2 REFERENCES

A. ASTM International, as referenced herein as ASTM.

1.3 DESCRIPTION

A. Perform sealant work as indicated on the Drawings and as specified herein.

B. Required applications of sealants include, but are not necessarily limited to, the following general locations:
   1. Paving and sidewalk joints.
   2. Site wall joints.
   3. Limestone wall cap joints

C. Related work specified elsewhere includes, but is not limited to:
   1. 03 30 00 Cast in Place Concrete
   2. 04 21 13 Brick Masonry
   3. 04 43 00 Limestone
   4. 32 13 00 Concrete Pavement and Curbs
   5. 32 32 00 Concrete Walls, Steps and Structures

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's specifications, recommendations and installation and instructions for each type of sealant and associated miscellaneous material required.

B. Samples: Submit 12 inch-long sample of each color required for each type of sealant exposed to view. The intent of this work is to match the color of the adjacent surfaces.

C. Quality Control: Submit statement written on sealant manufacturer's official letter head and signed by the responsible representative, indicating that sealants proposed for use have been tested and conform to the requirements of the Contract Documents and the following:
   1. The sealant meets applicable referenced specification requirements.
   2. The sealant is compatible with specified sealant backing materials as determined by ASTM C1087.
   3. The sealant is compatible with and does not adhere to specified bond breaker as determined by ASTM C1087.
   4. The sealant is compatible with and has been tested for adequate adhesion to each respective substrate. Include identification of any primer(s) required to obtain adequate adhesion.

1.5 QUALITY ASSURANCE

A. Manufacturers: Firms with not less than 5 years of successful experience in production of types of sealants required for this project.
   1. Obtain elastomeric sealants from a manufacturer which will, upon request, send a qualified technical representative to the project site for purpose of advising installer on proper procedures for use of products.
B. Installer: A firm with a minimum of 5 years of successful experience in application of types of materials required.

1.6 PROJECT CONDITIONS

A. Weather Conditions: Do not proceed with installation of sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended temperature range for installation. Proceed with the work only when the weather conditions are favorable for proper cure and development of high early bond strength. Where joint width is affected by ambient temperature variations, install elastomeric sealants only when temperatures are in lower third of the manufacturer's recommended installation temperature range so that sealant will not be subjected to excessive elongations and bond stress at subsequent low temperatures. Coordinate time schedule with Contractor to avoid delay of project.

1.7 SPECIAL PROJECT WARRANTY

A. Sealant Warranty: Provide written warranty, signed by manufacturer and installer agreeing to, within warranty period of 5 years after date of substantial completion, replace/repair defective materials and workmanship defined to include: instances of leakage of water or air; failures in joint adhesion, material cohesion, abrasion resistance, strain resistance, or general durability; failure to perform as required; and the general appearance of deterioration in any other manner not clearly specified in manufacturer's published product literature as an inherent characteristic of the sealant material.

PART 2 - PRODUCTS

2.1 SEALANT MATERIALS FOR VERTICAL SURFACES

A. Single-component, elastomeric sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT, a silicone material.

2.2 SEALANT MATERIALS FOR HORIZONTAL SURFACES

A. Multi-component, elastomeric, sealant complying with ASTM C920, Type M, Class 50, Use T, a urethane material. Provide primer recommended by sealant manufacturer.
   1. Grade P (self-leveling), one of the following or as approved:
      a. LymTal International, Inc. "Iso-Flex 880GB".
      b. Pecora Corp. "NR-200 Urexpan".
   2. Grade NS (non-sag) for use where Grade P can't be used, such as at sloping surfaces, one of the following or as approved:
      a. LymTal International, Inc. "Iso-Flex 881".
      b. Pecora Corp. "Dynatred".

2.3 MISCELLANEOUS MATERIALS

A. Joint Cleaner: Provide type of substrate cleaning compound recommended by sealant manufacturer for substrate surfaces to be cleaned.

B. Joint Primer/Sealer: Provide a non-staining type of joint primer/sealer recommended by sealant manufacturer for joint substrates to be primed or sealed.

C. Bond Breaker Tape: Polyethylene or teflon, self-adhesive tape, 11-mil minimum thickness, colored, as recommended by sealant manufacturer to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant.
D. Sealant Backer Rod: Expanded closed cell polyethylene shape compressed no more than 25 to 33% of its dimension at the time of installation in the joint opening. Furnish Industrial Thermo Polymers Limited "ITP Standard Backer Rod"; Nomaco, Inc. "Green Rod"; W.R. Meadows, Inc. "Sealtight Backer Rod" or as approved.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection:
   1. Protect the Work and adjacent construction against damage. Clean Work adjacent to joints free of smears of sealant as Work progresses. Protect surfaces difficult to clean with masking tape or other suitable means not injurious to surfaces being protected.

3.2 JOINT OPENING PREPARATION

A. Substrates:
   1. General:
      a. Prepare joint openings in conformance with manufacturer's written instructions and ASTM C1193, and as specified.
      b. Dry, sound and thoroughly clean sealant substrates are required when primer (where required by manufacturer for optimum adhesion) and sealant are installed. Allow concrete, masonry or other porous substrates wetted by rain or other sources of moisture to dry for at least 24 hours under good drying conditions before application of primer or sealant. Protect surfaces that have been cleaned from contamination by deleterious materials such as oil, dust and rain, until primer (where required) and sealant are applied.
      c. Use cleaning solvents as recommended by the sealant manufacturer. Furnish containers for cleaning solvent storage that are clean, oil-free and suitable for use with the solvent.
   2. Masonry, concrete or other porous substrates:
      a. Remove loose particles, dirt, paint, foreign matter, and concrete curing compound by sandblasting, nylon bristle brush or other sealant manufacturer approved method not injurious to the substrate material and that will not change the appearance of the exposed surfaces adjacent to the sealant joint opening. Expose fine aggregate of concrete substrates to be sealed. Remove dust created by cleaning by repeated brushing with a soft bristle brush or by blowing dust from the substrate with oil-free compressed air.
      b. Clean sealant joint opening of mortar droppings and any other materials that affect finished sealant joint performance prior to installation of sealant backing material.
   3. Metal substrates: Remove oils, residues from forming processes, corrosion and oxide build-up by nylon bristle brush, chemical cleaners or other sealant manufacturer approved method. Following removal, clean the substrate surface using the two-cloth system with a clean, lint free, white cloth soaked in solvent which is poured, not dipped, onto the cloth, followed by wiping the substrate surface dry, with the second clean, lint free, dry, white cloth before the solvent evaporates. Change to clean rags frequently. Brush application of solvents is not permitted.
   4. Coated metal or other non-porous substrates:
      a. Clean the substrate surface using the two-cloth system with a clean, lint free, white cloth soaked in solvent which is poured, not dipped, onto the cloth, followed by wiping the substrate surface dry with the second clean, lint free, white cloth before the solvent evaporates. Change to clean rags frequently. Brush application of solvents is not permitted.
      b. Clean organically coated (PVF, silicone-polyester, etc.) panels or other similar factory applied finishes with sealant and finish manufacturer approved solvent that is compatible with organic coating system.
   5. Elastomeric rubber and other organic substrates:
      a. Submit organic materials to sealant manufacturer for compatibility testing by ASTM C1087 and adhesion testing by ASTM C794.
b. Remove lubricants, release agents, dusting agents, and other materials from the substrate surface, using cleaning procedures based on the successful completion of the above testing, as provided in writing by the sealant manufacturer.

6. Mortar joints: Where indicated or specified, rake out mortar joints to width and depth indicated to receive sealant. Bring joints having excessive depth to proper depth with sealant backing specified. Rake out to proper depth joints that are too shallow.

B. Primer:
1. Apply primer, as recommended by the sealant manufacturer, only to previously cleaned substrate surfaces to which sealants will be applied. The preferred method for application is with a clean, lint-free cloth for non-porous substrates and a clean natural bristle brush for porous substrates. Apply primer to the cloth or brush by pouring; dipping is not permitted. Take adequate measures, such as masking joint opening edges, to prevent primer from being applied to the face of adjacent surfaces. Allow primer to cure as recommended by the sealant manufacturer before installation of sealant.
2. Prime only those substrate surfaces that can be sealed immediately after the recommended primer curing period to preclude dust, oil, rain, condensation or other deleterious conditions to contaminate primer.

C. Sealant Backing Material:
1. Install sealant backing, of proper type and size, at proper depth in joint to provide specified joint dimensions. Place sealant backing into the joint to avoid lengthwise stretching, twisting, braiding or lapping. Provide continuity with tight butt joints. Install dry sealant backing immediately prior to installing sealant. Apply sealant with sealant backing in place unless otherwise indicated.
2. Install closed cell sealant backing using good practices to avoid compression in excess of that specified or puncturing of the sealant backing material.
3. If the sealant backing is to function as a temporary joint seal for weather protection or other reasons, for a period of time before sealant installation, remove the backing and replace it immediately prior to sealant installation with new sealant backing.

D. Bond Breaker:
1. Install properly sized bond breaker tape so that the entire surface is covered. One tape may be lapped over another to achieve total coverage. Do not extend bond breaker tape onto the substrate surfaces to interrupt or prevent adhesion of the sealant to the substrate.

E. Joint Dimensions:
1. Create joint opening depth (as measured at the sealant and substrate interface) for sealant contacting and bonded to substrate surfaces no less than 0.25 inch in depth. Minimum sealant depth at the mid-point of the joint width: 0.125 inch.
2. Unless indicated otherwise on the Drawings, for joint opening widths from 0.25 inch up to 0.5 inch wide, provide joint opening depth of .25 inch.
3. Refer to Drawings for joint opening requirements.

3.3 SEALANT INSTALLATION

A. General:
1. Provide sealant in conformance with manufacturer’s written instructions and ASTM C1193, and as specified.
2. Inspect joint opening prior to sealant installation for proper installation of sealant backing or bond breaker, proper opening depth and proper substrate preparation, cleaning and (where required) priming.
3. Do not apply sealant to damp, wet or frost covered substrates, sealant backing or bond breaker.
4. Dry-tool exposed sealant surface immediately using no lubricant such as soap and water. A lubricant is allowed, if permitted by the sealant manufacturer and is a solvent or similar type product as recommended in writing by the sealant manufacturer.
5. Where required or specified, to avoid smearing sealant on surfaces adjacent to joint opening, use masking tape or other suitable means and remove after tooling sealant surface and before sealant begins to cure.
6. Use drop cloths to cover horizontal or other surfaces likely to receive sealant droppings during installation.

B. Non-Sag or Gunnable Sealant:
1. Non-sag sealant into joint opening with hand- or air-powered sealant gun so as to fill void completely. Use gun nozzle of proper size to fit joint opening.
2. Apply Take care not to smear adjoining surfaces with sealant. Force sealant, by tooling, fully into joint opening and intimate contact with substrate surface. Tool exposed joint surface so that a slight concave surface is formed. Use of the sealant gun for tooling is not allowed.

C. Pourable or Self-Leveling Sealant:
1. Apply self-leveling sealant to finish close to the joint opening surface without overflowing and to form a slightly concave joint surface. Where required due to slope or other conditions, install a non-sag formulation of the same sealant in accordance with the procedures specified for that sealant type.

3.4 SEALANT USAGE

A. Sealant Joints in Vertical Surfaces:
1. Install sealant for vertical surfaces in the following joint openings:
   a. Control joints in masonry.
   b. Horizontal (for non-traffic areas) and vertical expansion joints in brick masonry.
   c. Joints in stone or cast stone copings.
   d. Joints in cast stone masonry.
   e. Other joints as indicated.

B. Sealant Joints in Horizontal Surfaces:
1. Install sealant for horizontal surfaces, Grade NS (where required due to slope) and P, in the following joint openings: Expansion joints in curbs and walks and in paving, other than concrete road paving, subject to pedestrian and vehicular traffic.

END OF SECTION
SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Pavement markings as shown on the drawings and specified herein.

1.2 QUALITY CONTROL

A. Qualifications of Applicator: The applicator shall be experienced in this type of work. The applicator shall submit evidence of such experience, including a list of projects in which the work was similar in scope and quality to that specified.

1.3 PROJECT CONDITIONS

A. Existing Conditions: Examine work in place on which this work is dependent. Defects which may influence satisfactory completion and performance of this work shall be corrected in accordance with the requirements of the applicable section of work prior to commencement of the work. Commencement shall be construed as work in place being acceptable for satisfying the requirement so this section.

B. Protection: Protect the work and adjacent work against damage during progress of the work. Construction equipment which will damage existing or new pavement shall not be used.

PART 2 - PRODUCTS

2.1 PAVEMENT MARKING PAINT

A. Traffic paint shall be one of the following, having alkyo resin vehicle, non-bleeding over asphalt, non-reflectorized, complying the qualitative requirements of FS TT-P-115E:

1. Pratt & Lambert P & G Traffic Paint
2. PPG Traffic and Zone Marking Paint
3. Glidden Romark Traffic Paint
4. Devoe Bitubar Sealer-Marker
5. Sherwin-Williams Traffic Marking Paint Series B46
6. Dirako K-831 Hi-Flash Aisle Marking Enamel
7. Standard TP Traffic Marking Paint
8. TNEMEC Traffic Paint

B. Color for all continuous lane striping shall be yellow. Color for all broken (dashed) line striping shall be white.

C. Color for all directional striping shall be white.

D. Color for all parking stall striping shall be white.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surfaces to be painted shall be clean and dry. Remove dirt, oil, grease, stains and other foreign substances. Protect surfaces from dampness before application of paint.
3.2 APPLICATION

A. Lines shall be mechanically painted on bituminous paving with one coat of traffic paint in the locations shown on the drawing.

B. Apply traffic paint to a minimum net film thickness of 15 mils in lines 4 inches wide.

C. Apply two coats of traffic paint for all pavement markings. Second coat of traffic paint shall be applied after a period of 90 days from the initial painting.

D. Wavy or lines with ragged edges will not be accepted.

END OF SECTION
SECTION 323200 - CONCRETE WALLS, STEPS AND STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Concrete steps, walls, planter curbs, and structures as indicated on Drawings and specified herein.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials, as referenced herein as AASHTO.
B. American Concrete Institute, as referenced herein as ACI.
C. ASTM International, as referenced herein as ASTM.
D. Ohio Department of Transportation, Standard Specifications for Construction, latest edition, as referred herein as ODOT.

1.3 SUBMITTALS

A. Submit Shop Drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI 315, showing bar schedules, stirrup spacing, diagrams of bent bars and arrangement of concrete reinforcements. Include special reinforcement required and openings through concrete structures.
B. Submit two copies of laboratory test reports for concrete materials and mix design test as specified.
C. Provide material certificates in lieu of material laboratory test reports only when permitted by the Landscape Architect. Material certificates shall be signed by the manufacturer and the Contractor certifying that each material item complies with, or exceeds, the specified requirements.

1.4 QUALITY CONTROL

A. Workmanship
   1. The Contractor is responsible for correction of concrete work which does not conform to the specified requirements, including strength, tolerances and finishes. Correct deficient concrete as directed by the Architect.

B. Testing
   1. The Owner may employ a testing laboratory to perform tests specified in Section 01450 / 01 45 23.
   2. Materials and installed Work may require testing and retesting, as directed by the Landscape Architect, at any time during the progress of the Work. Allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be done at the Owner's expense, including the retesting of rejected materials and installed work, shall be done at the Contractor's expense.
   3. Certificates of material properties and compliance with specified requirements may be submitted in lieu of testing when acceptable to the Landscape Architect. Certificates of compliance must be signed by the material's producer and the Contractor.

C. Additional Tests
   1. The testing laboratory will make additional tests of in-place concrete when test results indicate the specified concrete strengths and other characteristics have not been attained in the structure as directed by the Architect. The testing laboratory may conduct tests to determine adequacy of concrete by cored
CONCRETE WALLS, STEPS AND STRUCTURES

D. Job Mock-Up
1. Construct a mock-up sample, 5 lineal feet minimum, of the concrete wall and planter curb indicating all the typical jointing, texture or finishes, and color required in actual construction. Make all mock-up samples as required until acceptance by the Owner. The selected mock-up shall become a standard of workmanship and shall be matched throughout the Project. The sample may be constructed as part of the Project and, if approved, will be accepted as part of the Work. However, should the sample fail to meet the Owner’s approval, remove and reconstruct the sample until approved.

1.5 JOB CONDITIONS

A. Protection
1. Protect the Work and adjacent work against damage during progress of the Work.

PART 2 - MATERIALS

2.1 GENERAL

A. Comply with applicable portions of ACI 301.

B. Do not use standard and high early strength portland cement interchangeably in the same element or portion of Work. Only use one brand of cement throughout the Work.

C. Proportion ingredients to produce homogeneous concrete which will attain the required strength, durability, resistance to deterioration and abrasion, water tightness, appearance, and other specified properties.

D. Minimum compressive strength: 4,000 psi.

2.2 PROPORTIONING AND DESIGN OF MIXES

A. 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 is 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 used for field quality control testing, unless otherwise acceptable to the Architect.

B. Submit written reports to the Architect of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by the Architect.

C. ODOT Class C mix to provide normal weight concrete with the following properties:
1. 4,000 psi 28-day compressive strength; W/C ratio, 0.50.

D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results or other circumstances warrant; at no additional cost to Owner and as accepted by the Architect. Submit laboratory test data for revised mix design and strength results to and obtain acceptance from the Architect before using in Work.

E. Admixtures
1. Use water-reducing admixture or high-range, water-reducing admixture (super plasticizer) in concrete as required for placement and workability.
2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees F.
3. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus-or-minus 2.0 percent.

F. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement of 1 to 3 inches nominal; 4 inches maximum. This can be increased to 6 inches nominal and 7 inches maximum provided the increase is achieved by adding a chemical admixture.

G. Ready-Mix Concrete: Comply with requirements of ASTM C94.

2.3 FORMWORK
A. Comply with the applicable portion of ACI 301.

2.4 REINFORCEMENT
A. Reinforcing Bars: ASTM A615, Grade 60.
B. Joint Dowel Bars: ASTM A615, Grade 60. Cut bars true to length, with ends square and free of buns.
C. Polypropylene Fibrillated Fibers: 1.5 pounds per cubic yard.

2.5 EXPANSION JOINT MATERIAL
A. Joint Filler: AASHTO M153 or AASHTO M213.

2.6 CURING MATERIALS
A. Burlap: AASHTO M182, Class 2.
B. Membrane Curing Compound: ASTM C309, Type II, Class B Vehicle.

2.7 ABRASIVE AGGREGATE FOR STEPS
A. Mineral emery, fine size, and manufactured by one of the following, or as approved:
   B. Sonneborn - Contech "Frictex 176"
   C. Norton Company "Alundum CF".

2.8 JOINT SEALING
A. Comply with Section 02760 / 32 13 73, Site Joint Sealants.

PART 3 - EXECUTION

3.1 INSPECTION
A. Examine subgrade upon which concrete work is to be placed for improper grade, poor compaction, or other conditions which will adversely affect execution or quality of the work.
B. Do not place concrete until conditions are satisfactory.
3.2 PREPARATION

A. Forms
   1. Use forms which are free from warp and substantial enough to maintain their shape and position without springing or settlement when the concrete is placed and mechanically vibrated. Stake, brace and/or securely tie forms. Use new forms or used forms which are clean and approved by the Architect. Construct formwork so that concrete structures are of correct size, shape, alignment, elevation and position.
   2. Tightly and evenly butt forms or liner joints. Rework the damaged edges of reused high-density overlay plywood form liners as required to maintain tight joints. Severely damaged liners will be rejected.
   3. Tape joints in form liners at concrete surfaces to prevent leakage.
   4. Horizontal joints in liners of formwork for concrete are not permitted above finish grade.
   5. To avoid marking or staining of concrete, or uneven curing effect, entirely remove the forms in rapid sequence between expansion joints or other natural termination points.
   6. Thoroughly clean and wet forms prior to placing concrete. Install forms complete for each pour, in correct alignment, shape and elevation, and ready for inspection and approval by the Architect prior to placing concrete.
   7. Chamfer exposed corners and edges as shown, using wood, metal, pvc or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
   8. Form ties: factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete surfaces upon removal.
   9. Provisions for other trades: Provide openings in concrete 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.

B. Placing Reinforcement
   1. Comply with the specified codes and standards and Concrete Reinforcing Steel Institute’s recommended practice for ”Placing Reinforcing Bars,” for details and methods of reinforcement placement and supports, and as herein specified.
   2. Clean reinforcement of loose rust and mill scale, earth, ice and other materials which reduce or destroy bond with concrete.
   3. 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.
   4. Place reinforcement to at least obtain the minimum coverage 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.

C. Joints
   1. Construction joints: Locate and install construction joints which are not shown on the Drawings so as not to impair the strength and appearance of the structure as acceptable to the Architect.
      a. Provide keyways at least 1-1/2 inches deep in all construction joints in walls, slabs, and between walls and footings. Accepted bulkheads designed for this purpose may be used for slabs.
      b. Place construction joints perpendicular to the main reinforcement. Continue all reinforcement across construction joints.
   c. Expansion joints
      d. Construct expansion joints as indicated on the Drawings. Install premolded joint filler strips full thickness, accurately positioned and supported against displacement.
      e. Construct expansion joints as indicated on the Drawings. Install premolded joint filler strips so as to leave a void having a depth equal to the width of the joint plus 1/8 inch for sealing compound. Accurately position and support filler strips against displacement.
      f. Cover expansion joints in retaining walls on the earth fill side with a waterproof fabric membrane such as ”All Seal Fabric” by Wasco Products or ”Sprandel Cloth” by Sandell Manufacturing Company, or as approved. Extend fabric a minimum of 6 inches either side of joint. Apply fabric or
coating of approved asphalt waterproofing mastic and top coat with a full application of the same asphaltic material.

g. Install steel dowels, rigidly bonded half their length into one side, piercing the premolded joint filler, and wrapped with tar paper for slippage in the other side to ensure continuous vertical alignment.

2. Install control joints as indicated on the Drawings.

D. Embedded Items
   1. Set and build into the Work anchorage devices and other embedded items required for the Project.

3.3 CONCRETE PLACEMENT

A. General
   1. Place concrete in compliance with practices and recommendations of ACI 304 and as specified herein.

B. Placing Concrete in Forms
   1. 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 within the section.
   2. If a section cannot be placed continuously, provide construction joints as herein specified.
   3. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing.

C. Consolidation and Vibration
   1. 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 the recommended practices of ACI 309 to suit the type of concrete and Project conditions.
   2. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine.
   3. Place vibrators to rapidly penetrate the placed layer of concrete and at least 6 inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set.
   4. At each insertion limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement, and other embedded items without causing segregation of the mix.

3.4 FINISH OF FORMED SURFACES

A. Rough Form Finish
   1. This treatment is for formed concrete surfaces not exposed to view in the finished Work or by other construction unless otherwise indicated.
   2. This is the concrete surface having the 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 inch in height rubbed down or chipped off.

B. Smooth Form Rubbed Finish
   1. This treatment is for formed concrete surfaces exposed to view or those to be covered with a material bonded to the concrete such as waterproofing, damp proofing, painted or other similar system.
   2. This is the as-cast concrete surface as obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams.
   3. Repair and patch defective areas with all fins or other projections completely removed and smoothed.
   4. Provide smooth rubbed finish to scheduled concrete surfaces which have received smooth form finish treatment no later than the day after form removal. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.

C. Related Unformed Surfaces
1. This treatment is for tops of walls, horizontal offsets and other similar unformed surfaces occurring adjacent to formed surfaces.
2. 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 shown.

3.5 CONCRETE CURING

A. General
1. Protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at a relatively constant temperature for a period of time necessary for hydration of cement and proper hardening.

B. Duration of Curing
1. Continue curing until the cumulative number of hours or fractions thereof during which temperature of the air in contact with the concrete is above 50 degrees F has totaled at least 168 hours.
2. Prevent rapid drying at the end of the curing period.

C. Curing Methods
1. Moisture curing: Execute moisture by covering surface with blankets of wetted burlap. Keep material saturated and in place for at least 168 hours. Apply water in form of spray to avoid damage to fresh concrete. Take precaution to prevent blankets from being displaced.
2. Liquid membrane curing: Apply liquid membrane curing compound to cover surface completely and uniformly per manufacturer's instructions and at a rate which will achieve the performance requirement specified in AASHTO Specification M148, but at a rate not less than 1 gallon per 200 square feet. Apply membrane curing compound immediately behind final finishing operation. Failure to provide complete and uniform coverage at required rate will be cause for discontinuation of this method of curing and the substitution of moisture curing. Take special care to apply curing compound immediately after forms have been removed.
3. Curing formed surfaces: Cure formed concrete surfaces by moisture curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

3.6 CONCRETE REPAIRS

A. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of the Architect. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning.

B. Repair and patch defective areas with cement mortar immediately after removal of forms, but only when acceptable to the Architect.
1. Cut out honeycomb, rock pockets, voids over 1/4 inch 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 inch. Make edges of cuts perpendicular to the concrete surface. Before placing cement mortar or proprietary patching compound, thoroughly clean, dampen with water, and brush-coat the area to be patched with neat cement grout, or proprietary bonding agent.

C. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

END OF SECTION
SECTION 324020 - PIPE AND TUBE RAILINGS (FOR SITE)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Fabrication and installation of all site steel handrails and railings as indicated on plans and as specified herein.

1.2 REFERENCES

A. ASTM International, as referenced herein as ASTM.

B. United States defense standard, as referenced herein as MIL.

C. American Welding Society, as referenced herein as AWS.

1.3 SUBMITTALS

A. Product Data:
   1. Submit manufacturer's product specifications and installation instructions for products and processes used in handrails and railings, including finishes and grout.

B. Source Quality Control:
   1. Submit shop drawings for fabrication and erection of handrails and railings. Include plans, elevations and details of fittings, connections and anchorages to other work. Provide templates for anchor and bolt installation by others.
   2. Where materials or fabrications are indicated to comply with certain requirements for design loadings, include structural details, material properties and other information needed for review.

1.4 QUALITY ASSURANCE

A. Shop Assembly:
   1. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel:
   1. Steel Pipe: Schedule 40 steel pipe conforming to ASTM A53 type S grade A.
   3. Anchor Bolts: Anchor Bolts shall be hot dipped galvanized threaded rod or bolts with nuts and washers meeting ASTM A325.

B. Non-Shrink Non-Metallic Grout:
   1. Premixed, factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with CE 1107. Provide grout specifically recommended by manufacturer for wet exterior applications of type specified in this section.

C. Welding Electrodes and Filler Metal:
1. Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, and as required for color match, strength and compatibility in fabricated items.

D. Anchors and Inserts:
   1. Provide anchor as shown of proper type, size and material as shown unless otherwise indicated. Use non-ferrous metal of hot-dipped galvanized anchors for exterior locations and elsewhere as required for corrosion resistance.

2.2 FABRICATION

A. Fabricate handrails and railings to design, dimensions and details shown. Provide handrail and railing members in sizes and profiles indicated, with supporting posts and brackets of size and spacing shown.

B. Welded Connections:
   1. Fabricate handrails and railings of materials for interconnections of members by welding. Preassemble railing units in shop to maximum extent practicable and consistent with shipping and handling limitations. Perform welding to comply with applicable AWS specifications, using method appropriate for metal and finish indicated. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

C. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain profile of member throughout entire bend without buckling, twisting or otherwise deforming exposed surfaces of handrail and railing components.

D. For exterior handrails and railings, and those exposed to moisture from condensation or other sources, provide weep holes or other means for evacuation of entrapped water in hollow sections of railing members.

E. Brackets, Flanges, Fittings and Anchors: Provide manufacturer's standard wall brackets, flanges, miscellaneous fittings and anchors for interconnection of handrail and railing members to other work, unless otherwise indicated. Furnish inserts and other anchorage devices for connecting handrails and railing to concrete or masonry work. Fabricate and space anchorage devices as indicated and as required to provide adequate support. Coordinate anchorage devices with supporting structure.

2.3 METAL FINISHES

A. All metal components of the rail system are to be galvanized steel; shop galvanized.

B. All decorative metal railings, fences, gates and appurtenances shall be finished as follows
   1. Primer Paint for Ferrous Metals - Primer paint shall be metal primer specifically made to coat galvanized metals: Tnemec Series 66, Color Hi-Build Epoxoline, Sherwin-Williams DTM Wash Primer B71Y1, or approved equal. Select color to work with a black finish coat
   2. Finish Paint – Finish paint shall be black alkyd gloss enamel: Tnemec Series 2H Hi-Build Tneme-Gloss, Sherwin-Williams Industrial Enamel HS B54, or approved equal.
   3. Surface Preparation - All metalwork shall be galvanized prior to finishing. No powder coating will be allowed. Prepare all surfaces by removing all loose mill scale, loose rust, dirt, grease or other foreign matter by sandblasting to a commercial grade according to SSPC-SP6, or as recommended by the manufacturer of the paint system
   4. Shop Applied Prime Coat - Apply two prime coats of paint to a dry thickness of a minimum of 5 mils on all surfaces. The Owner will inspect the prime coats after they are applied, and the finish coat shall not be applied without approval of the prime coat by the Owner. Testing to verify mils between primer and finish coats to be provided by Owner. Coordination of this testing by Contractor.
   5. Shop Applied Finish Coat - Apply a finish coat of paint to a dry film thickness of a minimum of 3 mils. Apply extra paint if color is not uniform. Testing after finish coat applied to verify mils to be provided by Owner. Coordination of this testing by Contractor
6. Bolts, anchors, flanges and appurtenances shall be painted identical to posts prior to assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Installer must examine the areas and conditions under which handrails and railings are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions and directions for installation of anchorages such as sleeves, concrete inserts, anchor bolts and miscellaneous items having integral anchors which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

B. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible.

3.3 INSTALLATION

A. General:
1. Fit exposed connections accurately together to form tight, hairline joints.
2. Perform cutting, drilling and fitting required for installation of handrails and railings. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Do not weld, cut or abrade surfaces of handrails and railing components which have been coated or finished after fabrication, and are intended for field connection by mechanical means without further cutting or fitting.
3. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal-arc welding, for appearance and quality of welds made, and for methods used in correcting welding work. Weld connections which are not to be left as exposed joints, but could not be shop welded because of shipping size limitations. Grind exposed joints smooth and touch-up shop paint coat.
4. Adjust handrails and railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated or, if not indicated, as required by design loadings.

3.4 ADJUSTING

A. Protect finishes of railings and handrails from damage during construction period by use of temporary protective coverings approved by railing manufacturer. Remove protective covering at project completion or when directed by Owner's representative. Restore finishes damaged during installation and construction period so that no evidence remains of correction work. Return items which cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units as required.

3.5 TOUCH UP

A. Touch-up painting will be permitted in the field after installation. Touch-up imperfections in the paint surface according to manufacturer’s recommendations.

3.6 CLEANING

A. Remove and replace handrails that have been damaged or where coating finish has been compromised.
SECTION 328400 - PLANTING IRRIGATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Piping.
   2. All pipe, sleeving, and fittings
   3. Two-wire cable.
   4. Decoders, surge arrestors and sensor decoders
   5. Wire splice kits
   6. Backflow preventer
   7. Backflow preventer enclosure
   8. Flow meter
   9. Isolation, master and and zone valves
   10. Sprinkler Heads
   11. Quick-Coupling Valves
   12. Valve Boxes
   13. Controller.

1.3 DEFINITIONS

A. Lateral Piping: Downstream from control valves to sprinklers. Piping is under pressure during flow.

B. Mainline Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 PERFORMANCE REQUIREMENTS

A. Irrigation zone control shall be automatic operation with controller and automatic control valves.

B. Irrigation system shall operate from the Miami campus wide Rainbird IQ central control system.

C. Location of Sprinklers: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.

D. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
   1. Irrigation Mainline Piping: 200 psig.
   2. Lateral Piping: 200 psig.
1.5 ACTION SUBMITTALS

A. Product Data: Submit product data for each of the following equipment. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   1. All pipe, sleeving, and fittings
   2. Two-wire cable.
   3. Decoders, surge arrestors and sensor decoders
   4. Wire splice kits
   5. Backflow preventer
   6. Backflow preventer enclosure
   7. Flow meter
   8. Isolation, master and zone valves
   9. Sprinkler Heads
   10. Quick-Coupling Valves
   11. Valve Boxes
   12. Controller
   13. Pipe primer and glue.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For all irrigation components to include in operation and maintenance manuals.

B. Zoning Chart: Show each irrigation zone and its control valve.

C. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.

D. As-built drawings indicating all valve, mainline, two-wire cable, and wire splice locations. All locations shall be shown with dimensions from two fixed points. Mainline and two-wire cable dimensions shall be shown from two fixed points at 50’ intervals and at all elbow and tee locations.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
   1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of water service.
   2. Do not proceed with interruption of water service without Construction Manager’s and Owner’s written permission.
1.10 GUARANTEE AND SERVICE

A. The entire installation shall fully comply with all local and state laws and ordinances and with all established
codes applicable thereto.

B. Any permits for the installation of construction of the work included under this contract which are required
by any of the legally constituted authorities having jurisdiction, shall be obtained and paid for by the
Contractor, each at the proper time. He shall also arrange for and pay all costs in connection with any
inspections and examinations required by these authorities.

C. In all cases where inspection of the sprinkler system work is required and/or where portions of the work are
specified to be performed under the direction and/or inspection of the Owner's authorized representative, the
Contractor shall notify the Owner's authorized representative at least 24 hours in advance of the time and
such inspection and/or direction is required.

D. Any necessary re-excavation or alterations to the system needed because of failure of the Contractor to have
the required inspections shall be performed at the Contractor's own expense.

E. The Contractor shall service the system at the request during the guarantee period and shall be paid for work
performed which is not covered by the guarantee. Contractor shall winterize the system the first year as part
of this contract, and will provide written instructions to the Owner for future service and maintenance.

F. Return to the site during the subsequent spring season and demonstrate to the Owner the proper procedures
for the system start-up, operation and maintenance.

G. Final payment will not be made without the receipt of an accurate as-built drawing by the Architect.

H. It shall be the Contractor's responsibility to ensure and guarantee satisfactory operation of the entire system
and the workmanship and restoration of the area. The entire system shall be guaranteed to be complete and
perfect in every detail for a period of one year from the date of its acceptance and he hereby agrees to repair
or replace any such defects occurring within that year, free of expense to the Owner. Minor maintenance
and adjustment shall be by Owner.

I. Contractor to guarantee that all trenches and other disturbed areas to be free from heaving or settling more
than one-quarter (1/4") . Should it become necessary to adjust the grade, re-grade the trench and re-sod.
This no-settlement clause shall extend over the entire period of guarantee of the job.

J. One month prior to the conclusion of the warranty period, the Contractor and Owner’s representative shall
meet at the site and adjust the zone watering times on the controller to reflect run times for established plant
material.

1.11 ACCEPTANCE

A. Installation will be accepted only when the entire contract is completed to the satisfaction of the Owner's
authorized representative.

B. Prior to requesting inspections, adjust sprinkler heads and automatic equipment to provide optimum
performance, and submit accurate record drawings and operating instructions by the Owner as a condition of
final payment.

C. After completion, testing and Provisional Acceptance of the system, instruct the Owner's personnel in the
operation and maintenance of the system.

D. Inspections for Acceptance of Work
1. Provisional Acceptance Inspection: Notify the Owner’s representative in writing of the completion of work. Within 10 days after notification, the Owner’s representative shall inspect the work and prepare a Notice of Provisional Acceptance, along with a list of items which require completion or correction. Issuance of the Notice of Provisional Acceptance shall constitute the start of the warranty period for portion accepted.

2. Final Acceptance Inspection: The final inspection of all work under the contract will be made by the Owner, Contractor, and Landscape Architect/Engineer.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Comply with requirements in the piping schedule for applications of pipe and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

B. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
   3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

   1. PVC Socket Fittings: ASTM D 2466, Schedule 40.
   2. PVC Threaded Fittings: ASTM D 2464, Schedule 80.
   3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.

2.2 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 SLEEVING FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: Class 200 PVC.

2.4 MANUAL VALVES

A. Brass Ball Valves (located on irrigation mainline pipe):
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hammond Valve.
      b. NIBCO INC.
      c. Red-White Valve Corporation.
   2. Description:
      b. SWP Rating: 150 psig (1035 kPa).
      c. CWP Rating: 600 psig (4140 kPa).
      d. Body Design: Two piece.
      e. Body Material: Forged brass.
f. Ends: Threaded or solder joint if indicated.
g. Seats: PTFE or TFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.

B. Plastic Ball Valves (immediately upstream of automatic valves and installed in same valve box):
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. NIBCO INC.
      b. Spears Manufacturing Company.
      c. Lasco Valves Inc.
   2. Description:
      b. Pressure Rating: 150 psig (1035 kPa).
      c. Body Material: PVC.
      d. Type: Union.
      e. End Connections: Socket or threaded.
      f. Port: Full.

2.5 AUTOMATIC CONTROL VALVES AND FLOW METER

A. Plastic, Automatic Control Valves:
   1. Manufacturers: Rainbird PESB series.
   2. Description: Molded-plastic body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

B. Flow meter: Rainbird FS-150P, as noted on plans.

2.6 TRANSITION FITTINGS

A. General Requirements: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings:
   1. Manufacturers: Shall be same as pipe manufacturer.
   2. PVC one-piece fitting with manufacturer’s Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-socket[ or threaded] end.
   3. Plastic to metal: Description: MSS SP-107, PVC four-part union. Include one brass[ or stainless-steel] threaded end, one solvent-cement-joint[ or threaded] plastic end, rubber O-ring, and union nut.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      b. Zurn Plumbing Products Group; Wilkins Water Control Products.
      c. Or equal.
   2. Description: Factory-fabricated union, NPS 2 (DN 50) and smaller.
      a. Pressure Rating: 250 psig (1725 kPa) at 180 deg F (82 deg C).
      b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.
2.8 SPRINKLERS

A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.

B. Plastic, Pop-up, Gear-Drive Rotary Sprinklers:
   1. Manufacturers: Rainbird 5000-plus-PRS and Rainbird 8000 as noted on the plans.
   2. Description:
      a. Body Material: ABS.
      b. Nozzle: ABS.
      c. Retraction Spring: Stainless steel.
      d. Internal Parts: Corrosion resistant.

C. Plastic, Pop-up Spray Sprinklers:
   1. Manufacturers: Rainbird 1800 series as noted on the plans.
   2. Description:
      a. Body Material and Flange: ABS.
      b. Pattern: Fixed, with flow adjustment.

2.9 QUICK COUPLERS

A. Manufacturers: Rainbird, 1” size, as noted on the plans.

B. Description: Factory-fabricated, bronze or brass, one-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key.

2.10 VALVE BOXES

A. Plastic Boxes:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Pentek Products Company.
      b. Carson Industries LLC.
      c. Dura.
   2. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
      a. Size: As required for valves and service.
      b. Shape: As noted in the detail for specific equipment.
      c. Sidewall and cover material: ABS.

B. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch minimum to 1 inch maximum.

2.11 CONTROLLER, TWO-WIRE CABLE, DECODERS, AND WIRE CONNECTORS

A. Controller shall be Rainbird ESP-LXD, two-wire controller with IQ-NCC Cartridge.

B. Control wire and two-wire cable shall be Type UL approved, for direct burial and shall be Size 14 or larger, as recommended by the manufacturer for the conditions of the project. Conductor to be single strand soft annealed copper.

C. Two-wire cable shall be Rainbird Maxi cable, 14 AWG.

D. Decoders, sensors and surge arrestors shall be per Rainbird specifications.
E. Low voltage wire connectors to be made using 3M DBY connectors.

F. 110 volt or heavier splices made underground to be made using 3M DBY connectors.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

B. Provide minimum cover over top of underground piping according to the following:
   1. Irrigation Mainline Piping: Minimum depth of 24 inches below finished grade.
   2. Lateral Piping: 12 inches.

3.2 PREPARATION

A. Set stakes to identify locations of proposed irrigation system. Obtain Architect's approval before excavation.

3.3 PIPING INSTALLATION

A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.

B. Install piping outside of existing tree driplines wherever possible. If piping cannot be positioned outside of existing tree driplines, contact Owner and Construction Manager to determine the preferred pipe routing.

C. Install piping free of sags and bends.

D. Install groups of pipes parallel to each other, spaced to permit valve servicing.

E. Install fittings for changes in direction and branch connections.

F. Install unions adjacent to valves and to final connections to other components with NPS 2 (DN 50) or smaller pipe connection.

G. Install underground thermoplastic piping according to ASTM D 2774.

H. Lay piping on solid subbase, uniformly sloped without humps or depressions.

I. Install PVC piping in dry weather when temperature is above 40 deg F (5 deg C). Allow joints to cure at least 24 hours at temperatures above 40 deg F (5 deg C) before testing.

J. Install piping in sleeves under parking lots, roadways, and sidewalks.

K. Install sleeves made of Class 200 PVC pipe and socket fittings, and solvent-cemented joints.

L. Install transition fittings for plastic-to-metal pipe connections according to the following:
   1. Underground Piping:
      a. NPS 1-1/2 (DN 40) and Smaller: Plastic-to-metal transition fittings.
      b. NPS 2 (DN 50) and Larger: AWWA transition couplings.
   2. Aboveground Piping:
      a. NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings.
      b. NPS 2 (DN 50) and Larger: Use dielectric flange kits with one plastic flange.
M. Install dielectric fittings for dissimilar-metal pipe connections according to the following:
   1. Underground Piping:
      a. NPS 2 (DN 50) and Smaller: Dielectric coupling or dielectric nipple.
      b. NPS 2-1/2 (DN 65) and Larger: Prohibited except in control-valve box.
   2. Aboveground Piping:
      a. NPS 2 (DN 50) and Smaller: Dielectric union.
      b. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Dielectric flange.
      c. NPS 5 (DN 125) and Larger: Dielectric flange kit.
   3. Piping in Control-Valve Boxes:
      a. NPS 2 (DN 50) and Smaller: Dielectric union.
      b. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Dielectric flange.
      c. NPS 5 (DN 125) and Larger: Dielectric flange kit.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Copper-Tubing Soldered Joints: Apply ASTM B 813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.

E. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   3. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.5 VALVE INSTALLATION

A. As detailed on the drawings.

3.6 SPRINKLER INSTALLATION

A. As detailed on the drawings.

B. Install sprinklers at 12" off edges of pavement to prevent damage from snow removal operations.

C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches (100 mm) from walls and 2 inches (50 mm) from other boundaries unless otherwise indicated.
3.7 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

A. Install all two-wire cable in same trench as irrigation piping and at least 2 inches (51 mm) beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install wire inside sleeve under paved areas.

B. Install valve decoders and sensor decoders per Rainbird specifications.

C. Ground controller per manufacturer’s recommendations.

D. Ground two-wire cable every 500’ using Rainbird lightning arrester.

3.8 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "Facility Water Distribution Piping" for water supply from exterior water service piping, water meters, protective enclosures, and backflow preventers. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.

C. Connect wiring between controllers and automatic control valves.

3.9 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Any irrigation product will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Verify that electrical wiring installation complies with manufacturer's submittal.

3.11 ADJUSTING

A. Adjust settings of controller.

B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/4 “ above, finish grade.

3.12 CLEANING

A. Flush dirt and debris from piping before installing sprinklers and other devices.

3.13 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain all irrigation components.

END OF SECTION
SECTION 329301 - LANDSCAPE PLANTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Plant materials, installation, soil treatments, installation warranty and plant maintenance of landscape as indicated on Drawings and specified herein.

B. Topsoil will be supplied from off-site sources.

1.2 SUBMITTALS

A. Samples: Provide representative samples of the following materials to the Owner’s Representative from the supply source being used:
   1. Plant material: Sources and nursery purchase order agreements for each specified plant. Plant samples or digital photographs may be requested in lieu of inspection. Photographs must clearly depict the entire size and condition of the plant and include a yardstick or other measuring device to show scale.

B. Test Reports: Submit to the Owner's Representative two copies each of certified test reports for:
   1. Topsoil – See Section 32 05 13

C. Certification
   1. Phytosanitary certification: All plant material inspection certificates required by federal, state or other governing authorities will accompany each shipment and be turned over to the Owner’s Representative upon delivery.
   2. Invoice: Vendor or grower's invoice for each shipment of plants shall show sizes, quantities, and root treatment of plants, i.e., containerized, balled and burlapped, or bare root.

D. Construction Schedule: Upon authorization to proceed with the work, submit three copies of Construction Schedule indicating dates for the items of work, shown in Paragraph 1.5 F.

E. Maintenance Instructions: Prior to the issuance of Substantial Completion, submit detailed typewritten methodology and schedules for warranty maintenance of all landscape activities outlined in Part 3.2D of this Section. Coordinate landscape maintenance with other applicable Sections (Irrigation). The schedule shall be comprehensive and shall be the basis for monthly payment during the maintenance period.

1.3 QUALITY CONTROL

A. Qualifications
   1. Employ a company specializing in landscape plant installation.

B. All materials and work shall comply with applicable sections of the following references:
   2. Hortus Third, Cornell University, 1976

C. Regulatory Requirements
   1. All work shall be in accordance with all local, state and federal environmental regulations.

D. Source Quality Control
1. Certification: All landscape materials shall be from stock inspected and certified by authorized governmental agencies. The stock shall comply with governmental regulations prevailing at the supply source and the job site.

2. Plant material selection: Prior to digging and shipment by the nursery, plant materials shall be tagged for inspection and approval by the Owner. Notify the Owner of tagged material locations at least four weeks prior to digging.

E. Substitutions
1. Substitutions will be made only in exceptional cases when the Contractor submits satisfactory evidence that, through no fault of his own, specified or otherwise approved items cannot be obtained in time to avoid delay of the work. In any case, substitutions are subject to acceptance by the Owner.

2. Plants shall be supplied at the sizes specified. Plants of larger size may be used if acceptable to Owner and if sizes of roots or balls are increased proportionately and they occur at no extra cost to the Owner.

3. Container plants may be substituted for those designated "B & B" if approved by the Owner.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General
1. Notify Owner of all delivery times.

2. Store materials only in locations approved by the Owner.

B. Plant Materials
1. Shipping shall be scheduled to minimize on site storage of plants. Stock shall not be shipped until the planting preparations have been completed.

2. Labels: Shipment of plants shall be clearly identified with legible labels stating correct name and size of plant securely attached to individual plants or to bundles of like variety and size.

3. Shipping of aquatic plants shall be scheduled to avoid on-site storage of plants. Stock shall not be shipped until the planting preparations have been completed.

4. During shipment, landscape plants shall not be bent, stacked, or bound in a manner that damages bark, breaks branches, deforms root balls, or destroys natural shape.

5. Transport plant material in closed vehicles or in open vehicles with the entire load properly covered for protection from drying winds, heat, freezing, or other exposure that may be harmful.

6. If delays beyond the Contractor's control occur after delivery, plants shall be kept watered and protected from sun, wind, and mechanical damage; root balls shall be covered with topsoil or mulch. Do not remove container-grown stock from containers until planting time.

7. Handle plants at all times in accordance with the best horticultural practices. Lift B&B materials from the bottom of the ball only. Plants handled otherwise will be subject to rejection. Balled and burlapped plants which have cracked or broken balls are not acceptable and shall not be planted.

1.5 SITE CONDITIONS

A. General
1. Prior to beginning work, the Contractor shall examine and verify the acceptability of the job site and notify the Owner of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected or resolved in writing by the Owner.

2. Where planting occurs in close proximity to other site improvements, adequate protection shall be given to all features prior to commencing work. Any items damaged during planting operations shall be promptly repaired to their original condition at no cost to the Owner.

3. If adjacent campus areas are disturbed during planting operations, they shall be promptly restored to their original condition at no additional cost to the Owner.

B. Utilities: Have all underground utilities located by servicing agencies. In the vicinity of utilities, hand excavate to minimize possibility of damage to underground utilities.

C. On-site sources of water will be available from proposed the irrigation system.
D. Excavation: When conditions detrimental to plant growth are encountered such as rubble fill, adverse drainage conditions, or obstructions, notify Owner before planting.

E. Planting Season
   1. Materials shall be installed during planting seasons normally recognized in the job locality for the species being utilized.
   2. If special conditions exist which warrant installation outside the normal planting season, submit a written request to the Owner describing conditions and stating the proposed variance. Permission for the variance will be given only if, in the opinion of the Owner, the variance is warranted.

F. Work Schedule
   1. Upon authorization to proceed with the work, submit a project work schedule indicating the dates of each of the following items.
      a. Tagging of plants in nurseries
      b. Delivery of topsoil to the site.
      c. Delivery of other materials to the site
      d. Staking of plant locations on the site
      e. Digging and preparation of plant pits
      f. Delivery of plant material to the site
      g. Planting
      h. Substantial completion of the work
   2. Notify Owner in advance of any deviations from schedule.

G. Coordination with Other Work
   1. Proceed with and complete landscape work as rapidly as portions of the site become available, working within the seasonal limitations for each kind of work required.

H. Barricades
   1. Provide barricading and related protective safety measures around excavated areas.

1.6 WARRANTY

A. General
   1. Warrant all plant material to be true to botanical name, specified size.
   2. After receiving a Notice of Substantial Completion, warrant and maintain all plant materials in a vigorous condition and warrant against defects including death, improper maintenance, and unsatisfactory growth for one year.
   3. The Contractor will not be responsible for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents beyond Landscape Installer's control which result from natural causes such as floods, lightning, storms, freezing rains, or winds over 60 miles per hour, fires, or vandalism.

B. Replacements
   1. During the warranty period, replace, at no additional expense to the Owner, plant materials that are dead or that are, in the opinion of the Owner, in an unhealthy or unsightly condition, or that have lost their natural shape due to dead branches, excessive pruning, or inadequate or improper maintenance. Rejected plant materials shall be removed from the site and legally disposed of at no additional expense to the Owner.
   2. Only one replacement of any plant is required after Substantial Completion, except for losses or replacements due to failure to comply with specified requirements.
   3. Replacement plants and planting operations shall be in accordance with the original specifications. Replacements shall be made immediately but no later than the next succeeding planting season. Fully restore areas damaged by replacement operations to their original and specified condition.
4. If, in the opinion of the Owner and Landscape Architect, it is advisable to extend guarantee for a second growing season, an inspection at the end of extended guarantee period will be made to determine acceptability of the items involved.

PART 2 - MATERIALS

2.1 MATERIALS

A. Plant Materials
   1. Plant materials shall be true to name and variety described in "Hortus Third," Cornell University, 1976, or by cultivars generally accepted in the trade.
   2. All planting stock shall be nursery-grown in accordance with good horticultural practice. Plants shall be free of disease, insects, eggs, larvae, and defects such as knots, sunscald, injuries, abrasions, or disfigurement. They shall be sound, healthy and vigorous, of uniform growth, typical of the species and variety, well-formed, free from irregularities, with the minimum quality conforming to American Standard for Nursery Stock.
   3. Unless otherwise designated on the plant list, all plant dimensions shall conform to those listed in ANSI A60.1, American Standard for Nursery Stock. No plant shall be pruned before arriving onsite.
   4. Root Treatment: Root treatments on all plants shall conform to the requirements of ANSI Z60.1. Plants shall be dug and prepared for shipment in a manner that will not cause damage to branches, shape, and future development after planting.
      a. Balled and burlapped ("B&B") plants shall have a firm, natural ball of earth of sufficient diameter and depth to encompass the fibrous and feeding root systems necessary for full recovery of the plant. Balls shall be securely wrapped with burlap and bound with cord. Ball sizes shall meet the requirements of the ANSI Z60.1.
      b. Plants furnished in containers shall have the roots well established in the soil mass and shall have grown in the container for at least one growing season. Containers shall be large enough to provide earth-root mass of adequate size to support the plant tops being grown. Plants, other than ground covers, over-established in the container, as evidenced by pot-bound root ends, will not be accepted.
   5. Plant materials shall be subject to final approval by the Owner at the site before installation.

B. Topsoil – See Section 32 05 13.

C. Mulch shall be well-composted, finely shredded processed hardwood bark, free from foreign material, resin, tannin, wood fiber, salts, or other compounds detrimental to plant life, with no fragments in excess of 2 inches in any dimension.

PART 3 - EXECUTION

3.1 PREPARATION

A. Layout
   1. Individual plant locations shall be staked on the project site by the Contractor and approved by the Owner’s Representative before any planting pits are dug. The Owner reserves the right to adjust plant material locations to meet field conditions, without additional cost to the Owner.
   2. Accurately stake plant material according to the Drawings. Stakes shall be above grade and painted a bright color to be clearly visible for inspection.
   3. If obstructions are encountered that are not indicated, do not proceed with planting operations until alternative plant locations have been selected and approved in writing by the Owner. Where location or spacing dimensions are not clearly shown, request clarification by the Owner’s Representative.

3.2 PLANTING

A. Excavation
1. Remove rocks and other underground obstructions to a depth necessary to permit proper planting according to plans and specifications. If underground utilities or other structural obstructions are encountered, alternate planting locations will be determined by the Owner.

2. Size and configure planting pits in accordance with planting details. If rotating augers or other mechanical diggers are used to excavate holes, scarify, fracture, or otherwise break down the vertical sides of the pits to eliminate impervious surfaces. Loosen or scarify in the bottom of all plant pits to a depth of 4 inches.

3. Excavate planting pits to a depth shown on the Drawings and be replace with planting soil mixture. When backfilling, bring plant beds to a smooth and even surface conforming to established grades.

4. Do not use excavated material that is not the specified planting soil for backfill in any planting pit and remove such material to an area designated by the Owner.

B. Planting

1. Planting, unless otherwise directed, shall be performed as specified in planting details. Do not plant when the ground is frozen or saturated, except in areas where aquatic plants will be installed.

2. Balled and burlapped plants: Place a minimum of 4 inches of compacted planting mixture in the bottom of the pit or to depth necessary to set the plant to required grade. Set the plant in the pit to the proper grade and position, faced to give the best appearance or relationship to one another and adjacent structures. Cut away burlap, rope, wire, or other wrapping materials from the top of the ball and remove from pit. Do not remove burlap or ties from sides or bottom of ball. If plastic wrap or other non-degradable materials are used in lieu of burlap, completely remove them before placing of backfill. Cleanly cut off broken or frayed roots. Place planting mixture around the ball and carefully compact to avoid injury to the roots and to fill the voids. After backfilling planting pit approximately two-thirds full, add water and allow planting mixture to settle. After the water has been absorbed, fill the planting pit with planting mixture and tamp light to grade and form a watering basin of the size indicated.

3. Plant container-grown stock as specified above for balled and burlapped plants and as modified herein. Remove containers before planting and sever the sides of root ball in several places, loosening the roots on the outside of the ball sufficiently to encourage rapid root extension into the surrounding soil and to prevent girding of root mass.

C. Pruning

1. Shrub and Trees
   a. The only pruning allowed is removal of dead wood and broken branches. Pruning shall result in a loose outline conforming to the natural shape of the plant type. Do not use hedge shears.

D. Maintenance

1. Planting maintenance shall begin immediately after each plant is installed and shall continue as required until Final Acceptance at the end of the one year warranty period.

2. Plants shall be inspected at least once per week by the Contractor during the installation period and needed maintenance performed promptly.

3. The Contractor shall irrigate all plants adequately to maintain optimum supply of moisture within the root zone; reoccurring overly dry or wet conditions shall be grounds for rejection of plant material. Hand watering shall be accomplished from a source approved by the Owner. Water shall not be applied with a force that will cause soil erosion and shall not be applied so quickly that it cannot be absorbed by the soil and plants.

4. Maintain all shrub and perennials beds weed-free. Refresh mulch as necessary, maintaining no more and no less than 2” depth at all times.

5. Keep plants free of insects and disease. Apply late spring general insecticide; additional applications as required to control specific pests. Apply when areas are clear of pedestrians and automobiles. Notify Owner at least 24 hours prior to application and post all applications as completed. No mixing or disposal of pesticides on site.

6. Remove, at no cost to Owner, dead and unacceptable plants as their condition becomes apparent.
3.3 ACCEPTANCE

A. Inspections for Acceptance of Work
   1. Substantial Completion
      a. Notify the Owner and Owner’s Representative in writing when planting is complete. Within 10 days after notification, the Owner’s Representative will inspect the work and prepare a Notice of Substantial Completion, along with a punchlist of items that require completion or correction before Substantial Completion can be granted. Issuance of the Notice of Substantial Completion shall constitute the start of the warranty.

   2. Final Acceptance Inspection
      a. The final inspection of all planting under the contract will be made by the Owner’s Representative.
      b. Before Final Acceptance will be granted, the terms of the warranty shall be met and the site shall be in the condition stipulated under "Clean Up."
      c. Final acceptance inspection of plantings or material planted during recognized planting seasons will be made during the following September for fall planting and by the following June for spring planting.

3.4 CLEAN UP AND PROTECTION

A. Clean Up
   1. Excess and waste material shall be removed daily.
   2. When planting in an area has been completed, the area shall be cleared of all debris, soil piles, and containers.

B. Repairs
   1. Any damage to existing landscape, paving, or other such features as a result of work related to this contract shall be repaired by the responsible Contractor to its original condition.

C. Protection
   1. Protect landscape work and materials from damage due to landscape operations, operations by other Contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.
SECTION 334000 - STORM DRAINAGE PIPING AND STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Site drainage system from a point 5 feet outside of the building to the limits of the project.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials, as referenced herein as AASHTO.
B. American Concrete Pipe Association, as referenced herein as ACPA.
C. ASTM International, as referenced herein as ASTM.
D. American Water Works Association, as referenced herein as AWWA.
E. Uni-Bell PVC Pipe Association, as referenced herein UNI.
F. As it may apply to work in city owned right-or-ways, all relevant construction standards of the City of Oxford Ohio

1.3 SUBMITTALS

A. Shop Drawings:
   1. Submit Shop Drawings on all catch basins and manholes, including frames and covers.

B. Test Reports:
   1. Submit laboratory test reports for tests specified under this Section.
   2. Submit test reports demonstrating conformance to applicable pipe specifications before pipe is installed.
   3. Submit laboratory report on a representative sample of sewer bedding material. Do not commence Work until approval has been obtained.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 QUALITY CONTROL

A. Manufacturer Quality Control:
   1. Precast concrete pipe and related precast concrete products will be accepted for use in the work from recognized Association member manufacturers on the basis of certification under the Concrete Pipe Association.

B. Field Quality Control:
   1. Owner will engage an independent Testing Agency for testing of sewer systems.
   2. Complete finish Work on structures and sewer line prior to any testing of the line.
   3. Prior to testing for leakage, backfill the trench sufficiently to prevent pipe movement during testing, leaving joints uncovered to permit inspection.
   4. Secure plugs or caps on branch connection against blow-off during leakage testing.

C. Field Control Tests:
   1. Perform test in accordance with applicable local codes. Where local codes do not require testing, provide testing as specified herein.
D. Deflection Testing and Correction:
   1. Perform random deflection tests on installed pipe. Use electronic deflectometers, calibrated television
      or video camera, or properly sized "go / no go" mandrel or sewer ball for deflection testing.
   2. Maximum deflection of installed plastic pipes (ABS, PSM and PVC) measured not less than 30 days
      following completion of installation is 7-1/2% of base inside diameter.
   3. Correct visible leaks regardless of test results.
   4. Should the sewer systems fail to meet the test requirements, make the necessary repairs to the systems
      and re-test. Submit all test results and calculations to the Engineer for final approval.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Distribute pipe at the job site in a manner so as not to damage the pipe, using approved unloading
   implements and methods.

B. Inspect pipe prior to use and, if damaged, reject and immediately remove it from the site.

C. Do not store plastic structures, pipe, and fittings in direct sunlight.

D. Protect pipe, pipe fittings, and seals from dirt and damage.

E. Handle precast concrete manholes and other structures according to manufacturer's written rigging
   instructions.

1.6 PROJECT CONDITIONS

A. Site Information: Perform site survey and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted
   under the following conditions and then only after arranging to provide temporary utility services according
   to requirements indicated:
   1. Notify Owner and Utility Authority not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner’s and Utility Authority’s written permission.

D. Utility Compliance:
   1. Comply with local utility regulations and standards pertaining to storm drainage.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Provide compatible pipe and pipe fitting materials as indicated in drawings. Where no pipe material
   designation is provided, the contractor may select from the material types indicated herein. Within this
   specification, concrete pipe is considered to be rigid pipe and plastic (PE, PVC) pipes are considered to be
   flexible piping systems.

B. Reinforced Concrete Pipe:
   1. Reinforced concrete pipe conforming to ASTM C76, Class IV, Wall B. Joints to be modified tongue
      and groove with rubber gasket conforming to ASTM C443

   1. NPS 15 and Smaller: ASTM D3034, SDR 35 with solvent cemented or gasketed joints with ASTM
      F477 elastomeric seals.
D. Wyes:
   1. Provide wye branches, slants, or stubs fitted with suitable stoppers as shown and required. For concrete pipe, use "Kor-N-Tee", as manufactured by NPC, Inc.

E. Smooth Lined Corrugated Polyethylene Pipe:
   1. Corrugated polyethylene pipe and fittings conforming to ASTM F2648 and AASHTO M252, Type S for 8 inch and 10 inch diameter. Fittings and couplings for joints shall be a non-corrugated, solid sleeve fabricated from polyethylene (PE) with a gasket on both sides of the joint to ensure a watertight joint. Each sleeve shall have an indentation in the center to ensure proper positioning of the pipe sections in the field. Sleeves shall be factory installed on one end of the pipe sections and a removable protective material placed over the exposed gaskets. Gaskets and sleeves shall be lubricated prior to insertion as required by the manufacturer.

F. Smooth Lined Corrugated Polypropylene Pipe:
   1. Corrugated polyethylene pipe and fittings conforming to AASHTO MP21-11 and ASTM F2738, for 12 inch to 24 inch diameter; and corrugated polyethylene pipe and fittings conforming to ASTM D3212. Fittings and couplings for joints shall be a non-corrugated, solid sleeve with a gasket on both sides of the joint to ensure a watertight joint. Each sleeve shall have an indentation in the center to ensure proper positioning of the pipe sections in the field. Sleeves shall be factory installed on one end of the pipe sections and a removable protective material placed over the exposed gaskets. Gaskets and sleeves shall be lubricated prior to insertion as required by the manufacturers.

2.2 JOINT MATERIALS

A. General:
   1. Provide joint materials which have been approved prior to use. Use only one type or brand throughout the Work for similar conditions unless the change is specifically noted, authorized or directed by the Engineer.

B. Joints for Plastic (ABS, PSM, PVC) Pipe:

C. Joints for Concrete Pipe:
   1. Form joints entirely of concrete surfaces employing an O-ring rubber gasket in accordance with ASTM C443.

2.3 MANHOLE MATERIALS

A. Precast Concrete Manholes:
   1. ASTM C478
   2. Top section: Eccentric cone type, unless concentric cone or flat-slab-top is indicated.
   3. Joints: Storm Sewer manhole joints shall be plain tongue and groove with cold mastic sealer. Joints shall be pointed inside and out.
   4. Pipe connector: ASTM C923, or per pipe manufacturer's recommendations.

B. Manhole Steps:
   1. Cast iron complying with ASTM A48, Class 35B, approximately 10 x 10 x 2 inch; East Jordon Iron Works No. 8500 for precast manhole sections, No. 8503 for brick and block construction, or as approved. Steps in precast manhole sections shall be cast in place at the manufacturing facility.
   2. Steel-reinforced plastic consisting of 0.75 inch-diameter, grade 60 reinforcing, encapsulated in copolymer polypropylene plastic as manufactured by M.A. Industries of Peach City, GA, step PS-1-PF for precast manhole sections and step PS-1-8 for block/brick manhole construction. Install steps in precast units at precaster's plant.

C. Manhole Frames and Covers:
2.4 CATCH BASIN MATERIALS

A. Precast Concrete Catch Basins:
   1. ASTM C478 with provision for rubber gasket joints.

B. Catch Basin Frames and Cover:
   1. ASTM A536, Grade 65-45-R heavy duty ductile iron, or ASTM A48, Class 35B cast gray iron, type as indicated.

2.5 CONCRETE

A. Minimum cement content: 423 lb/cu. yd.

B. Maximum water-cement ratio: 0.50

C. Slump: 3 inches

D. Compressive strength: 3000 psi

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification:
   1. Before any work is done on the Project, uncover the existing utility at each point of connection and determine the actual location and elevation of the utility.
   2. If the actual location and elevation of the utility is not as shown, notify the Engineer by letter prior to beginning any utility work on the Project.
   3. Verify that trench bottom is smooth, firm, stable and free of rocks throughout the length of the pipe. Shape bottom of trench to fit bottom of pipe.

B. Correct site work in compliance with instructions by the Engineer, when the installed Work is in error due to deviations between the Drawings and actual utility location and elevation and the Contractor has not acted in compliance with the specified verification procedure.

3.2 SITE PREPARATION AND EXCAVATION

A. Protect and maintain in good condition those trees which are not on the area assigned for the Work or which need not be damaged during construction.

B. Excavation: Comply with Section 31 23 33 Earthwork for Utilities, as modified below.
   1. Trench excavation depth and width shall be as detailed on drawings.
   2. If the widths referenced above are exceeded, install Class A concrete bedding as required by the Engineer to support the load of the backfill.
   3. Excavate for structures such as manholes, catch basins and inlets to the depth required for pouring or placing the base slab. Whenever possible, excavate so that the base will rest on undisturbed soil with a minimum amount of compacted sand-cement mixture to be used for leveling. Depth of sand-cement mixture shall be no more than 3 inches under a base slab. If ground conditions or excess excavation causes need for more than 3 inches of fill or leveling course, provide an approved aggregate fill, compacted in place.
4. Finish excavations to the required grade for an adequate distance in advance of the completed sewer line, but do not open more than 100 feet of trench at one time ahead of the pipe laying operation.

3.3 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.

C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

3.4 LAYING AND BEDDING

A. General Laying and Bedding:
   1. Perform laying and bedding, and jointing of pipe in accordance with the standard workmanship and methods as outlined in:

      Concrete pipe: ACPA Concrete Pipe Handbook
      ABS, PSM, PVC pipe: ASTM D2321

B. Pipe Alignment:
   1. Begin construction at the outlet end and proceed upgrade with the spigot ends pointing in the direction of flow. Lay pipe to the line and grade indicated.
   2. Use laser aligning equipment for the laying of sewers to the specified lines and grades. Furnish all necessary equipment and personnel required to operate the laser equipment.
   3. Rigidly mount the laser beam projector to its support platforms in an approved manner and to ensure that ground equipment vibrations will be kept to a minimum and will permit the laser beam to be projected coaxially through the center of the pipe. Furnish units with equipment to control atmospheric conditions in the pipe which could affect the acceptable standard of construction.
   4. Submit evidence that the laser alignment method selected has performed satisfactorily on at least three previous projects of a similar nature. Require the equipment to be operated by competent, trained operators.

C. Pipe Laying Construction Procedures:
   1. Lay pipe in clean and dry trenches. Do not lay pipe when trench condition or weather is unsuitable for Work.
   2. Provide, if necessary, diversion of drainage or dewatering of trenches during construction.
   3. Examine the sub-grade to assure that it is suitable to support the construction. Inform the Engineer in writing of any unsatisfactory conditions.
   4. Provide bedding of class or type for the type of pipe as specified under bedding requirements.
   5. Lay pipe to the grade and alignment as indicated.
6. Inspect each pipe for defects prior to being lowered into trench. Clean inside of pipe and outside of spigot of dirt and foreign matter. Lower the pipe into the trench in a manner which will avoid injury to the workmen and damage to the pipe.

7. Lay concrete and PVC pipe upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

8. Prepare and seat in the manner recommended by the manufacturer and approved by the Engineer. When pipe is laid in trenches, provide suitable mechanical means for seating the joint and holding it in position. Use mechanical means for seating rubber gasket joints when manual means will not result in pushing and holding the pipe in position.

9. Completely fill remaining annular space in the joints of pipes 30 inches in diameter or larger on the insides with mortar.

10. Whenever the pipe is found to be off line or grade by sighting through the completed portion, re-lay the pipe properly at no extra cost to the Owner.

D. Bedding and Backfill Requirements:
1. Comply with Section 31 23 33 Earthwork for Utilities, as modified below.
2. Do no backfilling prior to inspection of the pipe, and after the inspection, place the granular backfill required to a point 1 foot above the pipe. Proceed with the entire backfilling operation along with the laying of the pipe.
3. Fill and reshape settlement of trench backfill during the warranty period.
4. After the structure and mortar coating has set sufficiently to avoid damage, backfill in a manner that will not cause unequal pressure on the structure. Do not place backfill material other than sand within 12 inches of the structure.

3.5 TAP CONNECTIONS

A. Make connections to existing piping and underground structures so finished Work complies as nearly as practical with requirements specified for new Work.

B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6 inch overlap, with not less than 6 inches of concrete with 28 day compressive strength of 3000 psi.

C. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches of concrete with 28 day compressive strength of 3000 psi.

D. Make branch connections from side into existing piping, NPS 21 or larger, or to underground structures by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
1. Use concrete that will attain minimum 28 day compressive strength of 3000 psi, unless otherwise indicated.
2. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

E. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.6 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
1. Close open ends of piping with at least 8 inch thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Structures: Excavate around structure as required and use one procedure below:
1. Remove structure and close open ends of remaining piping.
2. Remove top of structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
3. Backfill to grade according to Section 31 23 33 Earthwork for Utilities.

3.7 MANHOLES AND CATCH BASINS

A. General:
1. Construct manholes and catch basins of the type and in compliance with the details and at the locations shown. Provide necessary steps, frames, and covers. Set covers at the required final elevation so subsequent adjustment will not be necessary.
2. Provide manholes of the offset type to provide a straight ladder wall for the full depth of the manhole.
3. Perform backfilling in a manner that will not cause unequal pressure on the structure. Do not place backfill material other than sand within 1 foot of the structure.
4. When completed, clear structures of scaffolds and clean off surplus foreign material.
5. Pipe connections to manholes and catch basins: in accordance with ASTM C923 or as per pipe manufacturer's recommendation. Connection to be water tight. Make connection to insure that the rigid pipes are properly bedded and flexible pipes are properly supported by concrete encasement.
6. Set manhole frames and covers flush with sidewalk, ground or pavement elevation in full bed of mortar.

B. PVC Surface Drainage Inlets:
1. PVC surface drainage inlets shall be installed using conventional flexible pipe backfill materials and procedures. The backfill material shall be crushed stone or other granular material meeting the requirements of class 2 material as defined in ASTM D2321. Bedding and backfill for surface drainage inlets shall be placed and compacted uniformly in accordance with ASTM D2321. The drain basin body will be cut at the time of the final grade. No brick, stone or concrete block will be required to set the grate to the final grade height. For H-20 load rated installations, a concrete ring will be poured under and around the grate and frame. The concrete slab must be designed taking into consideration local soil conditions, traffic loading, and other applicable design factors. For other installation considerations, such as migration of fines, ground water, and soft foundations, refer to ASTM D2321 guidelines.

C. Precast Concrete Manholes and Catch Basins:
1. For storm sewer structures provide plain tongue-and-groove joints with cold mastic sealer.
2. Plug and mortar lifting holes to a smooth surface finish.

D. Base Slab for Structures:
1. Base slabs shall be precast reinforced concrete placed on 6 inches of granular backfill. Concrete to be used shall be Type "I". Catch basin base slabs shall be at least 6 inches thick and of the diameter required. Manhole base slabs shall be at least 8 inches thick and of the diameter required.
2. Precast base riser sections may have an integral base slab.

3.8 MISCELLANEOUS ITEMS OF WORK

A. Provide stubs, connections, bulkheads, end section, and miscellaneous items of Work as shown.

B. Connect existing sewers to the sewer under construction as indicated. Fernco Inc. "Fernco" flexible couplings may be used.

C. Construct drop connections where shown.
D. Construct bulkheads, temporary or permanent, to a thickness of 8 inches or 12 inches as shown. Make brick and mortar watertight.

E. Provide stubs consisting of one complete length of sewer pipe of the size and type indicated. Terminate stubs with appropriate cap, plug or stopper.

F. Install check valve on discharge end of leader from sub-drainage system at manhole, with clamps.

3.9 CLEANING

A. Prior to final acceptance of the Contract, make necessary corrections and adjustments and finish cleanup operations. Clean sewer pipes, manholes, catch basins and other related drainage structures and flush them out with water, after paving and lawn work has been completed and accepted. Leave drainage systems clean, clear of debris and other materials.

END OF SECTION
SECTION 334600 - SUB-DRAINAGE SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Sub-drainage systems.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials, as referenced herein as AASHTO.
B. American National Standards Institute, Inc., as referenced herein as ANSI.
C. ASTM International, as referenced herein as ASTM.
D. Ohio Department of Transportation, Standard Specifications for Construction, latest edition, as referred herein as ODOT.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical literature and installation instructions for drainage piping and filter fabric.

1.4 QUALITY CONTROL

A. Testing Agency:
   1. The Owner will engage a Testing Agency to perform sampling and field testing facilities for quality control during earthwork operations, as specified in Section 31 23 33 Earthwork for Utilities. Provide access to the areas to be tested at times necessary for the Testing Agency to perform its duties.
   2. Inform the Owner in writing of its recommendations for compaction of the soil samples submitted for testing. One copy of each report will be sent to the Contractor and Owner. The Contractor shall comply with such recommendations.
   3. After installation of piping and placement of initial backfill, test piping for crushing and obstructions.
   4. Pull a mandrel with diameter of 90% of the pipe diameter through the pipe.
   5. Locate and replace damaged pipe or remove obstructions and re-test until mandrel passes entire length of pipe.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver and store materials in a manner to prevent contamination or segregation.
B. Do not store plastic materials in direct sunlight.

1.6 PROJECT CONDITIONS

A. Protection of Persons and Property:
   1. Barricade open excavations occurring as part of this Work and post with warning lights. Operate warning lights as recommended by authorities having jurisdiction.
   2. Protect utilities, pavements and other facilities from damages caused by settlement, lateral movements, undermining, wash-out and other hazards created by excavation operations.
PART 2 - PRODUCTS

2.1 PIPE FOR UNDERDRAINS

A. Smooth Plastic Pipe:
   1. Perforated Polyvinyl Chloride (PVC) pipe and fittings meeting the requirements of AASHTO M278 (ASTM F758).
   2. Solid Polyvinyl Chloride (PVC) pipe and fittings meeting the requirements of AASHTO M278 (ASTM D3034).

B. Corrugated Plastic Tubing:
   1. Perforated and non-perforated corrugated Polyethylene (PE) pipe meeting the requirements of AASHTO M252.

C. Provide fittings and accessories of same material as pipe or compatible material for intersections, bends, transitions, and the like.

D. Cleanouts:
   1. Riser piping for outside the building: PVC soil pipe complying with ASTM D2665.
   2. Cleanout plug: Threaded cast plug to fit bell end of riser pipe.
   3. Housing: Cast iron, round, flanged, with extra-heavy cast iron locking cover.

2.2 GEOTEXTILE FABRIC FOR PIPE WRAP AND TRENCH LININGS

A. Synthetic, non-woven, needle-punched fabric that is resistant to soil, chemicals and mildew, is stable under freeze-thaw cycles, does not shrink or expand under wet conditions, does not unravel during use, and meets the following:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>ASTM D3776</td>
<td>4.5 oz./sq. yard min.</td>
</tr>
<tr>
<td>Grab Tensile Strength</td>
<td>ASTM D4632</td>
<td>120 pounds min.</td>
</tr>
<tr>
<td>Mullen Burst</td>
<td>ASTM D3786</td>
<td>210 psi min.</td>
</tr>
<tr>
<td>Puncture Resistance</td>
<td>ASTM D4833</td>
<td>70 pounds min.</td>
</tr>
<tr>
<td>Trapezoidal Tear</td>
<td>ASTM D4533</td>
<td>50 pounds min.</td>
</tr>
<tr>
<td>Coefficient of Permeability</td>
<td>ASTM D4491</td>
<td>0.35 cm/sec. min.</td>
</tr>
</tbody>
</table>

2.3 SOIL MATERIALS

A. General: free of debris; roots; wood; scrap material; vegetable matter; refuse; soft, unsound particles; frozen, deleterious or objectionable materials.

B. Drain Aggregate: Material supplied by the Contractor, clean natural gravel or crushed stone meeting the following grading requirements:

<table>
<thead>
<tr>
<th>Sieve Analysis (ASTM C136)</th>
<th>Total Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1-1/2&quot;)</td>
<td>100</td>
</tr>
<tr>
<td>(3/4&quot;)</td>
<td>52-100</td>
</tr>
<tr>
<td>(3/8&quot;)</td>
<td>36-65</td>
</tr>
<tr>
<td>(No. 4)</td>
<td>8-40</td>
</tr>
<tr>
<td>(No. 16)</td>
<td>0-12</td>
</tr>
<tr>
<td>(No. 30)</td>
<td>0-8</td>
</tr>
</tbody>
</table>
Percent Loss by Washing (ASTM C117): 0-3

C. Granular Backfill: Clean, natural sand, gravel or crushed stone meeting the following grading requirements:

   Sieve Analysis (ASTM C136)

<p>| Total Percent Passing |</p>
<table>
<thead>
<tr>
<th>(3&quot;)</th>
<th>(2&quot;)</th>
<th>(1&quot;)</th>
<th>(No. 4)</th>
<th>(No. 30)</th>
<th>(No. 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>95-100</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0-30</td>
</tr>
</tbody>
</table>

D. General Site Backfill: Material excavated on the site of this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and areas for suitable conditions where sub-drainage systems are to be installed.

B. If sub-drainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Layout:
   1. Establish lines, grades, and locations of piping and accessories.
   2. Maintain grade stakes, batter boards, and the like, to permit rapid checking of grades and lines as work progresses.

3.3 INSTALLATION - GENERAL

A. Trench Excavation:
   1. Excavate trenches so the underdrains may be placed correctly on line and grade. Completely remove large rocks, stumps, masses of concrete and other materials encountered in the trench from the trench, and do not use for backfill. Protect utilities and surface structures to assure their safety from damage. Keep trenches free from water while construction is in progress.
   2. Grade bottom of trenches accurately to provide uniform bearing and support for each section of pipe.
   3. Place filter fabric in the trench and cover with drainage aggregate to the depth shown on the Drawings.

B. Pipe Laying:
   1. Lay pipe in close conformity with the lines and grades shown on the Drawings. Provide tight joints between sections of pipe and each section with a firm bearing aggregate bedding throughout its length. Make junctions, turns and connections with fittings applicable for the type of pipe being laid. Take up and relay pipe which is not laid in or becomes displaced from close conformity with the lines and grades required. Close the upgrade ends of all drains with suitable plugs to prevent entry of solid or other foreign material. Lay perforated pipe with the perforations down.

C. Connection to Drainage Structures:
   1. Provide under-drainage piping entering drainage structures with flexible water-tight seals at structure walls.

D. Drain Aggregate and Backfill:
1. Do not backfilling prior to inspection of the underdrain system.
2. Begin backfilling of drain aggregate at the bedding of the pipe, continue vertically to a minimum of 6 inches above the pipe, unless otherwise indicated, and install in 12 inch maximum loose lifts. Ensure that drain aggregate is placed completely under pipe haunches. Do not use frozen backfill. Ensure that no damage is done to structures.
3. Cover trench with filter fabric as indicated on Drawings.
4. Fill remainder of trench with granular backfill in pavement areas or general site backfill and topsoil in non-pavement areas.
5. Place granular backfill in 6 inch maximum loose lifts.
6. Place general site backfill in 8 inch maximum loose lifts.
7. Compact each loose lift as specified in Part 3.03 E. Compaction, before placing the next lift.
8. Do not backfill in freezing weather where the material in the trench is already frozen or is muddy.
9. Where unacceptable settlements occur in trenches and pits due to improper compaction, excavate to the depth necessary to rectify the problem, then backfill and compact the excavation as specified herein and restore the surface to the required elevation.

E. Compaction:
   1. Use hand-operated plate-type vibratory or other suitable hand tampers in areas inaccessible to larger rollers or compactors. Be careful to avoid damaging underdrain system or adjacent utilities and structures. Compact as follows:
      a. Compaction of underdrain aggregate bedding and backfill: Hand tamp to ensure complete distribution and interlocking of material.
      b. Compaction of granular backfill: To 95% of ASTM D1557 maximum density.
      c. Compaction of general site backfill: To 90% of ASTM D1557 maximum density.

F. Cleanouts:
   1. Install solid risers at locations indicated. Provide watertight connection at drainage piping and at joints in riser.
   2. Bring plug end of cleanout riser to within 4 to 6 inches of finish grade and install housing so that no surface loads will be transmitted to riser pipe.
   3. Set housing and cover flush with finish grade in a 5 inch thick square concrete pad with each side at least 12 inches greater than the housing diameter.

END OF SECTION