SECTION 02 41 13 – SELECTIVE SITE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the requirements for:

1. Removal of existing debris
2. Removal of concrete and asphalt pavements
3. Removing above- and below-grade site improvements including pavement, structures, and vaults.
4. Disconnecting, capping or sealing, and removing site utilities.
5. Removal of utility appurtenances such as hydrants, valves (and boxes), meters, etc.
6. Abandonment of buried structures
7. Abandonment of site utilities
8. Salvage of existing site items / property to be reused or recycled.

B. Related Requirements:

1. Applicable Division 01 requirements
2. Section 31 10 00 - Site Clearing

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Protect / Protect in place: To take measures as necessary and reasonable to protect existing property or features from damage during removal and construction activities.

F. Contaminated Material: A material that is contaminated with one or more Chemicals of Concern (COCs) at concentrations that exceed applicable regulatory comparison standards.

G. Hazardous Waste: Hazardous waste as defined under federal Resource Conservation and Recovery Act (RCRA) 40 CFR 261 divided as listed and characteristic hazardous wastes. A waste that exhibits any of the characteristics as identified in NREPA 451 Part 111.

H. Non-Hazardous Waste: A waste that is not defined as a hazardous waste under federal and State regulations. Non-hazardous waste may include contaminated, but not hazardous waste; solid waste; infectious waste, and construction and demolition debris.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's and other tenants' on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Coordination of Owner's continuing occupancy of portions of existing lot and of Owner's partial occupancy of completed Work.

C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before Work begins.

D. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 FIELD CONDITIONS

A. Owner may occupy portions of lot immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Owner’s Representative of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Owner’s Representative. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1.8 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.9 STANDARDS

Except as modified herein, comply with the current edition of the following standards:

A. Federal, State, and Local Requirements that govern hazardous material management or transportation, and disposal of hazardous waste material.

B. Owner’s Safety and Environmental protection regulations and prceodures.

C. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) requirements.

1.10 QUALITY CONTROL

A. Maintain a safe worksite.

PART 2 - EXECUTION

2.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

2.2 UTILITY SERVICES

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.

2.3 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

2.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Owner’s Representative, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

2.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts. Saw cut to nearest joint outside indicated removal area unless otherwise indicated or directed by the Owner’s Representative.

2.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction and recycle or dispose of them.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn demolished materials.

2.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 13

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:
   1. Section 03 20 00 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
   2. Section 31 20 00 "Earth Moving" for drainage fill under slabs-on-ground.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .
   1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete Subcontractor.
      e. Special concrete finish Subcontractor.
   2. Review the following:
      a. Special inspection and testing and inspecting agency procedures for field quality control.
      b. Construction joints, control joints, isolation joints, and joint-filler strips.
      c. Semirigid joint fillers.
      d. Vapor-retarder installation.
      e. Anchor rod and anchorage device installation tolerances.
      f. Cold and hot weather concreting procedures.
      g. Concrete finishes and finishing.
      h. Curing procedures.
      i. Forms and form-removal limitations.
      j. Shoring and reshoring procedures.
      k. Methods for achieving specified floor and slab flatness and levelness.
      l. Floor and slab flatness and levelness measurements.
      m. Concrete repair procedures.
      n. Concrete protection.
      o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
      p. Protection of field cured field test cylinders.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Silica fume.
5. Aggregates.
6. Admixtures:
    a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
7. Curing materials.
    a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
8. Joint fillers.

B. Design Mixtures: For each concrete mixture, include the following:
1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Slump limit.
6. Air content.
7. Nominal maximum aggregate size.
8. Synthetic micro-fiber content.
9. Intended placement method.
10. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.8 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Cementitious Materials:
   1. Portland Cement: ASTM C150/C150M, Type I , gray .
   2. Fly Ash: ASTM C618, Class C or F.
   3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
   4. Blended Hydraulic Cement: ASTM C595/C595M, Type IS, portland blast-furnace slag Type IS or Type IL, portland blast-furnace slag cement.

B. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
   1. Alkali-Silica Reaction: Comply with one of the following:
      a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
      b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
      c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.
   2. Maximum Coarse-Aggregate Size: 1 inch nominal.
   3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Air-Entraining Admixture: ASTM C260/C260M.

D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.
   1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
   2. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.

E. Water and Water Used to Make Ice: ASTM C94/C94M, potable

2.3 CURING MATERIALS

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

B. Water: Potable or complying with ASTM C1602/C1602M.

C. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

2.4 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.

2.5 CONCRETE MIXTURES, GENERAL

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, in accordance with ACI 301.
   1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash or Other Pozzolans: 25 percent by mass.
   2. Slag Cement: 50 percent by mass.
   3. Silica Fume: 10 percent by mass.
   4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
   5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
   1. Use high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.

2.6 CONCRETE MIXTURES

A. Class A : Normal-weight concrete used for footings, grade beams, and tie beams.
   1. Exposure Class: ACI 318 F2 .
   2. Minimum Compressive Strength: 4500 psi at 28 days.
   3. Maximum w/cm: 0.45 .
   4. Slump Limit: 4 inches , plus or minus 1 inch .
   5. Air Content:
      a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size .
   6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

B. Class B : Normal-weight concrete used for foundation walls and exterior slabs on grade.
   1. Exposure Class: ACI 318 F3
   2. Minimum Compressive Strength: 5000 psi at 28 days.
   3. Maximum w/cm: 0.40 .
   4. Slump Limit: 4 inches , plus or minus 1 inch .
   5. Air Content:
      a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size .
   6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

C. Class C : Normal-weight concrete used for interior slabs-on-ground.

1. Exposure Class: ACI 318 F1 .
2. Minimum Compressive Strength: 3500 psi at 28 days.
3. Maximum w/cm: 0.50 .
4. Minimum Cementitious Materials Content: 520 lb/cu. yd. .
5. Slump Limit: 4 inches , plus or minus 1 inch .
6. Air Content:
   a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
7. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
   1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
   2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
   1. Daily access to the Work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.
   3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
   4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF 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.
   1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
   3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 JOINTS

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

B. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

C. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
   1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
   2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
   1. If a section cannot be placed continuously, provide construction joints as indicated.
   2. Deposit concrete to avoid segregation.
   3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
   4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
      a. Do not use vibrators to transport concrete inside forms.
      b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
      c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
      d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Do not place concrete floors and slabs in a checkerboard sequence.
   2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.6 FINISHING FLOORS AND SLABS

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

B. Trowel Finish:
1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system .
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
   a. Slabs on Ground:
      1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch .

3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:
1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.
   a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   b. Cast anchor-bolt insert into bases.

c. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.8 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
b. Continuous Sprinkling: Maintain concrete surface continuously wet.
c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
d. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
1) Recoat areas subject to heavy rainfall within three hours after initial application.
2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:
a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
a) Lap edges and ends of absorptive cover not less than 12 inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
a) Water.
b) Continuous water-fog spray.
b. Floors to Receive Curing Compound:
1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Maintain continuity of coating, and repair damage during curing period.
4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

3.9 TOLERANCES

A. Conform to ACI 117.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
   1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
   2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
   3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
      a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
         1) Project name.
         2) Name of testing agency.
         3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
         4) Name of concrete manufacturer.
         5) Date and time of inspection, sampling, and field testing.
         6) Date and time of concrete placement.
         7) Location in Work of concrete represented by samples.
         8) Date and time sample was obtained.
         9) Truck and batch ticket numbers.
         10) Design compressive strength at 28 days.
         11) Concrete mixture designation, proportions, and materials.
         12) Field test results.
         13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
         14) Type of fracture and compressive break strengths at seven days and 28 days.

B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

C. Inspections:
   1. Verification of use of required design mixture.
   2. Concrete placement, including conveying and depositing.
   3. Curing procedures and maintenance of curing temperature.
   4. Verification of concrete strength before removal of shores and forms from beams and slabs.
   5. Batch Plant Inspections: On a random basis, as determined by Architect.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
   1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:
   a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   b. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; .
   a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M:
   a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M:
   a. Cast and laboratory cure two sets of two 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
   b. Cast, initial cure, and field cure two sets of two standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M.
   a. Test one set of two laboratory-cured specimens at 7 days and 14 days, and one set of two specimens at 28 days.
   b. Test one set of two field-cured specimens at 7 days, 14 days, and one set of two specimens at 28 days.
   c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
9. Additional Tests:
   a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
   b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
      1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.
10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to Architect.

3.11 PROTECTION

A. Protect concrete surfaces as follows:
   1. Prohibit vehicles from interior concrete slabs.
   2. Prohibit use of pipe-cutting machinery over concrete surfaces.

3. Prohibit placement of steel items on concrete surfaces.
4. Prohibit use of acids or acidic detergents over concrete surfaces.
5. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 03 30 00

SECTION 04 43 13 – ADHERED STONE MASONRY VENEER

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. Cobblestone Veneer
   2. Cast Stone Masonry Cap
   3. Mortar materials.
   4. Mortar mixes.
   5. Miscellaneous masonry accessories.

B. Related Sections:
   1. Section 602 of the 2020 MDOT Standard Specifications for Construction

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site

B. Masonry Pre-Construction Conference Requirements:
   1. Schedule a Masonry Pre-Construction Conference at jobsite at approximately 3 weeks prior to start of masonry work at site.
   2. Submit required submittals to Engineer and verify acceptance prior to this conference.
   3. General Contractor will prepare and issue minutes of meeting to team members.
   4. Do not proceed with masonry work without Masonry Pre-Construction Conference.
   5. Required participants include representatives from:
      a. Owner.
      b. Engineer.
      c. General Contractor.
      d. Project Superintendent.
      e. Mason Contractor Foreman.
      f. Structural Masonry Special Inspector.
      g. Testing Agency.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. For cast stone cap units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For the following:
   1. Cast Stone Units: Show fabrication and installation. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.
      a. Include building elevations showing layout of units and locations of joints and anchors.

C. Samples for Initial Selection:
   1. Cobblestone veneer
   2. Cast Stone Units

3. Mortar.

D. Samples for Verification: For each type and color of the following:

1. Sample board of full-size cobblestone veneer to be used on the project.

2. Cast stone cap, 6 inch square in size.

1.5 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. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Engineer and approved in writing.

B. Material Certificates: For each type and size of the following:

1. Cementitious materials. Include name of manufacturer, brand name, and type.

2. Mortar admixtures.

3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.

C. Qualification Data: For manufacturer.

1. Include copies of material test reports, indicating compliance of cast stone with ASTM C1364.

D. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C1364.

1. Provide test reports based on testing within previous six months.

E. Qualification Statements: For testing agency.

F. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.

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

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Testing Agency: Qualified in accordance with ASTM C1093 for testing indicated.

B. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by CSI.

1. Submit a written list of projects similar in scape and at least three (3) years of age, along with owner, architect and contractor references.

C. Standards: Comply with the requirements of the Cast Stone Institute Technical Manual and the project specifications.

1.7 MOCKUPS

A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Sample Panels shall be of the materials specified to accurately represent each color and texture used on the project. Prepare sample panel using the same tools and techniques for actual project application.

1. Build sample panel for cobblestone veneer sized approximately 48 inches square.

2. Clean exposed faces of panels with masonry cleaner indicated.

3. Approval of sample panels is for color, texture, and blending of cobblestone units; relationship of mortar and sealant colors to cobblestone colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Engineer in writing.

    a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Engineer in writing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery of cast stone caps to avoid delaying the work and to minimize the need for on-site storage.

B. Pack, handle, and ship cast stone caps in suitable packs or pallets.

1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units if required, using dollies with wood supports.

2. Store cast stone caps on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

E. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

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

1.9 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover top of cobblestone, 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 face of cobblestone and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with masonry.

1. Protect base of cobblestone surfaces from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.

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 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.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain cobblestone veneer from single source under the same production batch to ensure material colors and textures are of the same appearance.

B. Obtain cast stone caps from single source from single manufacturer.

2.2 MATERIALS

A. Cobblestone Veneer

Basis of design: Natural thin cobblestone veneer to match pedestrian bridge adjacent to the project site.

a. Rounded cobblestone with natural finish
b. Color: Earthy Browns with gold and grey tones
c. Random, natural pattern

B. Grout

1. Masonry mortar conforming to ASTM C270 and intended for exterior brick veneer applications.
   a. Color: natural, unless otherwise selected by owner.

2.3 CAST STONE MATERIALS

A. General: Comply with current ASTM C1364.

B. Physical properties: Provide the following:

1. Compressive Strength - ASTM C1194: 6,500 psi minimum at 28 days.
2. Absorption - ASTM C1195: 6.0% maximum at 28 days.
3. Air Content - Provide sufficient air content to meet the freeze-thaw requirements for wet cast products, when the air content is tested in accordance with Test Method C173/C173M or Test Method C231/C231M. Air entrainment is not required for Vibrant Dry Tamp (VDT) Products.
4. Freeze-thaw - ASTM C666/C666M in accordance with ASTM C1364. The CPWL shall be less than 5.0% after 300 cycles of freezing and thawing.
5. Linear Drying Shrinkage - ASTM C426: Test and report in accordance with ASTM C1364.

C. Portland Cement: ASTM C150/C150M, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C114. Provide natural color or white cement as required to produce cast stone color indicated.

D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C33/C33M, gradation and colors as needed to produce required cast stone textures and colors.

E. Course aggregates - Granite, quartz or limestone, ASTM C33, except for gradation, and are optional for the Vibrant Dry Tamp (VDT) casting method.

F. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

G. Admixtures: Use only admixtures specified or approved in writing by Architect.

1. ASTM C260 for air-entraining admixtures.

2. ASTM C494/C495M Types A - G for water reducing, retarding, accelerating, and high range admixtures.

3. Other admixtures: Integral water repellents and other chemicals, for which no ASTM Standard exists, shall be previously established as suitable for us in concrete by proven field performance or through laboratory testing.

4. ASTM C618 mineral admixtures of dark and variable colors shall not be used in surfaces intended to be exposed to view.

5. ASTM C989 granulated blast furnace slag may be used to improve physical properties. Tests are required to verify these features.

H. Reinforcement:

1. ASTM A615/A615M: Grade 40 or 60 steel galvanized or epoxy coated when cover is less than 1-1/2 inch.

2. ASTM D7957/D7957M: Standard Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete Reinforcement.

3. Welded Wire Fabric: ASTM A1064/A1064M where applicable for wet cast units.

4. Fiber reinforcement (optional): ASTM C1116.

5. Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666, Type 304 .

2.4 CAST STONE UNITS

A. Cast Stone Units: Comply with ASTM C1364.
1. Units are manufactured as selected by the manufacturer to meet performance requirements and project conditions.

B. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
3. Provide drips on projecting elements unless otherwise indicated.

C. Fabrication Tolerances:
1. Minimum Thickness shall be 2 1/2 inches to facilitate testing for compressive strength and absorption as specified in ASTM C*1364 Standard Specification for Architectural Cast Stone.
2. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
3. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
4. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
5. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.

D. Cure Units as Follows:
1. Cure units in enclosed, moist curing room at 95 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
2. Keep units damp and continue curing to comply with one of the following:
   a. No fewer than five days at mean daily temperature of 70 deg F or above.
   b. No fewer than seven days at mean daily temperature of 50 deg F or above.

3. Formed cured units shall be protected from moisture evaporation with curing blankets or curing compounds after casting.

E. Colors and Textures: As selected by Engineer from manufacturer's full range.
   1. All surfaces intended to be exposed to view shall have a fine-grained texture similar to natural stone, with no air voids in excess of 1/32 inc. and the density of such voids shall be less than 3 occurrences per any 1 square inch and not obvious under direct daylight illumination at a 5 ft distance.
   2. Units shall exhibit a texture approximately equal to the approved sample when viewed under direct daylight illumination at a 10 ft. distance.
      a. ASTM D2244 permissible variation in color between units of comparable age subjected to weathering exposure.
         1) Total color difference - not greater than 6 units.
         2) Total hue difference - not greater than 2 units.

F. Reinforcing
   1. Reinforce the units as required by the drawings and for safe handling and structural stresses.
   2. Minimum reinforcing shall be 0.25 percent of the cross section area.
   3. Reinforcement shall be noncorrosive where faces exposed to weather are covered with less than 1-1/2 inches of concrete material. All reinforcement shall have a minimum coverage of twice the diameter of the bars

2.5 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 or grout.
   2. Use portland cement-lime 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.
   4. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches required consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.

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 C270, Property Specification. Use Type N unless another type is indicated.
   1. For masonry below grade or in contact with earth, use Type S.

D. Latex-Modified Portland Cement Setting Mortar: Proportion and mix portland cement, aggregate, and latex additive to comply with latex-additive manufacturer's written instructions.

E. Cement- Paste Bond Coat: Mix either neat cement and water or cement, sand, and water to a consistency similar to that of thick cream.
   1. For latex-modified portland cement, setting-bed mortar, substitute latex admixture for part or all of water, according to latex-additive manufacturer's written instructions.

F. Mortar for Scratch Coat over Metal Lath: 1 part portland cement, 1/2 part lime, 5 parts loose damp sand, and enough water to produce a workable consistency.

G. Mortar for Scratch Coat over Unit Masonry: 1 part portland cement, 1 part lime, 7 parts loose damp sand, and enough water to produce a workable consistency.

H. Pigmented Mortar: Use colored cement product.

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 Engineers sample.

I. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary.

1. Mix to match Engineers sample.

2.6 ACCESSORIES

A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666 .

B. Dowels: 1/2-inch- diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666 .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions of surfaces indicated to receive cobblestone, 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 PREPARATION

A. Protect surrounding material surfaces and areas during installation of cobblestone.

B. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

C. Prepare surfaces to receive the thin brick as recommended by the manufacturer for achieving the best results.

D. Install drainage mat/plane per manufacturers written instructions.

E. Install metal lath per manufacturers written instructions and in accordance with ASTM C1063.

3.3 SETTING COBBLESTONE VENEER

A. Spread only as much mortar as can be covered while the mortar surface is still wet and tacky.

B. Fit cobblestone units around corners, fitments, fixtures, and other built-in objects to maintain a uniform joint appearance.

C. Make cuts smooth, even, and free from chipping.

D. Use the appropriate trowel notch size to ensure proper bedding of the cobblestone, work the mortar into good contact with the substrate and comb with notched side of trowel. Completely cover back of cobblestone with mortar. Firmly press or tap brick into mortar or adhesive while maintaining joint width and coursing.

E. Expansion and Perimeter Joints: The cobblestones are installed up to the joint leaving a gap the width of the joint. Keep all control and expansion joints free of setting materials.

F. Install embedded weep and venting devices in masonry as necessary, or where indicated.

1. Space weep holes 24 inches o.c. unless otherwise indicated.
2. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
3. Trim wicking material flush with outside face of wall after mortar has set.

3.4 GROUTING

A. Verify grout joints are free of dirt, debris or tile spacers. Sponge or wipe dust/dirt off brick face and remove any water standing in joints. Surface and air temperature must be between 40-90°F (4-32°C).

B. Keep grout out of spaces to receive sealants.

C. Fill joints using a grout bag, mortar gun or other mortar delivery device. When thumbprint hard, rake out excess mortar, compact and seal edges around stones. Do not use a wet brush or sponge to treat the mortar joints in order to prevent staining.

D. Do not block weep or venting accessories.

3.5 SETTING CAST STONE IN MORTAR

A. Set cast stone as indicated in TMS 604.

B. Install cast stone units to comply with the manufacturer's requirements.

C. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
2. Coordinate installation of cast stone with installation of flashing indicated on the drawings.

D. Wet joint surfaces thoroughly before applying mortar or setting in mortar.

E. Set units in full bed of mortar with full head joints unless otherwise indicated.
1. Set units with joints 1/4 to 3/8 inch wide unless otherwise indicated.
2. Build anchors and ties into mortar joints as units are set.
3. Fill dowel holes and anchor slots with mortar.
4. Fill collar joints solid as units are set.
5. Build concealed flashing into mortar joints as units are set.
6. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.

F. Rake out joints for pointing with mortar to depths of not less than 3/4 inch. Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.

G. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.

H. Tool exposed joints slightly concave when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.

I. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.
1. Keep joints free of mortar and other rigid materials.

2. Build in compressible foam-plastic joint fillers where indicated.
3. Form joint of width indicated, but not less than 3/8 inch .
4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 07 92 00 "Joint Sealants."

3.6 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch in 40 feet or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.

B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.

C. Measure variation from level, plumb, and position shown in plan as a variation of the average plane of each brick face from level, plumb, or dimensioned plane.

D. Variation in Mortar-Joint Thickness: Do not vary from joint size range indicated.

3.7 ADJUSTING AND CLEANING

A. Remove and replace stone masonry of the following description:
1. Broken, chipped, stained, or otherwise damaged brick. Brick may be repaired if methods and results are approved by Engineer.
2. Defective Joints.
3. Brick not matching approved samples and mockups
4. Brick not complying with other requirements indicated.

B. Replace in a manner that results in thin brick matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

C. Remove and replace stained and otherwise damaged cast stone units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Engineer.

D. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.

E. In-Progress Cleaning: Clean brick and cast stone as work progresses.
1. Remove mortar fins and smears before tooling joints.
2. Remove excess sealant immediately, including spills, smears, and spatter.

F. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Engineer's approval of sample cleaning before cleaning think brick.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
4. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.
5. Clean thin brick by bucket and brush hand-cleaning method described in BIA Technical Note No. 20, Revised II, using job-mixed detergent solution.
6. Clean thin brick with proprietary acidic cleaner applied according to manufacturer's written instructions.

7. Clean cast stone by methods described in Cast Stone Institute Technical Bulletin #39.
8. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

3.8 EXCESS MATERIALS AND WASTE

A. Excess Stone: Stack excess stone where directed by Owner for Owner's use.

B. Disposal as Fill Material: Dispose of clean masonry waste, including mortar and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.
1. Crush masonry waste to less than 4 inches in greatest dimension.
2. Mix masonry waste with at least 2 parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 20 00 "Earth Moving”.
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

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

END OF SECTION 04 43 13

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Framing with dimension lumber.
   2. Wood blocking and nailers.

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. OSB: Oriented strand board.

E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

F. Lumber grading agencies, and abbreviations used to reference them, include the following:
   1. NeLMA: Northeastern Lumber Manufacturers' Association.
   2. NLGA: National Lumber Grades Authority.
   3. SPIB: The Southern Pine Inspection Bureau.
   4. WCLIB: West Coast Lumber Inspection Bureau.
   5. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
   3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber:
   1. Boards: 19 percent.
   2. Dimension Lumber: 19 percent unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
   1. Allowable design stresses, as published by manufacturer, are to meet or exceed those indicated. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

D. Treatment:
   1. Treat all lumber to UC4A ground contact.

2.2 DIMENSION LUMBER FRAMING

A. Load-Bearing Partitions by Grade: No. 1 grade.
   1. Application: Boardwalk headers .
   2. Species:
      a. Spruce-pine-fir; NLGA.

B. Joists, and Other Framing by Grade: No. 1 grade.
   1. Application: Stringers
   2. Species:
      a. Spruce-pine-fir; NLGA.

2.3 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of the following species:
   1. Spruce-pine-fir; NLGA.

C. Concealed Boards: 15 percent maximum moisture content and the following species and grades:
   1. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329.

B. Nails, Brads, and Staples: ASTM F1667.

C. Deck hangers and miscellaneous connection hardware are to be hot dipped galvanized manufactured by Simpson Strong-Tie or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Do not splice structural members between supports unless otherwise indicated.

D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

E. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

G. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

I. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

J. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
1. Comply with approved fastener patterns where applicable.
2. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

END OF SECTION 06 10 00

SECTION 06 73 00 - COMPOSITE DECKING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Composite Decking

1.2 RELATED SECTIONS

A. Section 13 34 23 - Wooden Pedestrian Bridge

B. ASTM International (ASTM):
1. ASTM D1037: Water Absorption of Plastics.
2. ASTM D1761: Mechanical Fasteners in Wood.
3. ASTM D1413: Test method for Wood Preservatives by Laboratory Soil-block Cultures.
4. ASTM D7031: Standard Guide for Evaluating Mechanical and Physical Properties of Wood-Plastic Composite Products, ASTM International.
5. ASTM D7032: Standard Specification for Establishing Performance Ratings for Wood-Plastic Composite Deck Boards and Guardrail Systems (Guards or Handrails).
6. ASTM E84: Test Method for Surface Burning Characteristics of Building Materials, ASTM International.

1.3 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

B. Shop Drawings:
1. Provide plans and details which include layout, spacing, and sizes of decking.

C. Selection Samples: For each finish product specified, one complete set of color chips representing manufacturer's full range of available colors and patterns.

D. Verification Samples: For each finish product specified, two samples, representing actual product color, size, and finish.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5 year experience manufacturing similar products.

B. Installer Qualifications: Minimum 2 year experience installing similar products.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship is approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.

1.5 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to starting work of this section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.

B. Store products on a flat and level surface. Adjust support blocks accordingly.

C. Support bundles on supplied dunnage.

D. When stacking bundles, supports should start approximately 8 inches from each end and be spaced approximately 2 feet on center. Supports shall line up vertically/perpendicular to the decking product.

E. Do not stack Transcend decking more than 12 bundles.

F. Keep material covered until time of installation.

G. Handle materials to avoid damage.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.9 WARRANTY

A. Provide manufactures warranty against rot, decay, splitting, checking, splintering, fungal damage, and termite damage for a period of 10 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Railing and Decking from Trex, Timber Tech, or an approved equal.

B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 Design/Performance Requirements:

A. Structural Performance:
1. Deck: Uniform Load - 100lbf/sq.ft.

B. Fire-Surface Burning Characteristics per ASTM E-84.

2.3 COMPOSITE DECKING

A. Wood-Plastic Composite Lumber:

1. Material Description: Composite Decking consisting of recycled Linear Low Density Polyethylene (LLDPE) and recycled wood. The product is extruded into shapes and sizes as follows:
    a. Width: 1 inch x 5.5 inches (25 mm x 140 mm).
    b. Lengths - 12 feet (3658 mm) 16 feet (4877 mm), and 20 feet (6096 mm).
    c. Color - To be specified by owner from manufacturer's standard list of colors.
2. Physical and Mechanical Properties as follows:
    a. Flame Spread, ASTM E 84: 70.
    b. Thermal Expansion, ASTM D 1037: 0.000019 inch/inch/degree F.
    c. Moisture Absorption, ASTM D 1037: Less than 1percent.
    d. Screw Withdrawal, ASTM D1761: 588 lbs/in.
    e. Fungus Resistance, ASTM D1413: Rating - no decay.
    f. Termite Resistance, AWPAE1-72: Rating: 9.6.
    g. Compression Parallel, ASTM D198: 1588 psi ultimate, 540 psi design.
    h. Compression Perpendicular, ASTM D143: 1437 psi ultimate, 540 psi design.
    i. Bending Strength, ASTM D198: 3280 psi ultimate, 500 psi design.
    j. Shear Strength, ASTM D143: 1761 psi ultimate, 360 psi design.
    k. Modulus of Elasticity, ASTM D4761: 412,000 psi ultimate, 200,000 psi design.
    l. Modulus of Rupture, ASTM D4761: 3280 psi ultimate, 500 psi design.
    m. Ultimate strength values are not meant for design analysis. Design values are for temperatures up to 125 degree F (52 degree C).

B. Accessory Hardware:
1. Fasteners:
    a. Composite Decking Screws:
        1) Manufacturers recommended composite screws.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.

B. Cut, drill, and rout using carbide tipped blades.

C. Do not use composite wood material for structural applications.

3.4 Cleaning

A. Cleaning as required by manufacturer for warranty compliance.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 06 73 00

SECTION 09 93 00 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wood stains.
   2. Transparent finishes.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. For each type of product.
   2. Include preparation requirements and application instructions.
   3. Indicate VOC content.

B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

C. Samples for Verification: Sample for each type of finish system and in each color and gloss of finish required on representative samples of actual wood substrates.
   1. Size: 8 inches long.
   2. Apply coats on Samples in steps to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.4 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply finishes when relative humidity exceeds 85 percent, at temperatures of less than 5 deg F above the dew point, or to damp or wet surfaces.

C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, undefined:
   1. Benjamin Moore & Co.
   2. Sherwin-Williams Company (The).

2.2 MATERIALS, GENERAL

A. Material Compatibility:
   1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

B. Stain Colors: As selected by Architect from manufacturer's full range .

2.3 WOOD STAINS

A. Stain, Exterior, Solvent Based, Semitransparent: Solvent-based, oil or oil/alkyd, semitransparent, pigmented stain for new wood surfaces.
   1. Manufacturers: Subject to compliance with requirements, undefined:
      a. Benjamin Moore & Co.
      b. Sherwin-Williams Company (The).

B. Stain, Exterior, for Wood Decks: Solvent- or water- based, modified-oil or alkyd-type, semitransparent, penetrating stain for exterior dimensional wood decking.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Benjamin Moore & Co.
      b. Sherwin-Williams Company (The).

2.4 TRANSPARENT FINISHES

A. Varnish with UV Inhibitor, Exterior, Semigloss: Solvent-based, alkyd-type, clear semigloss varnish stabilized against UV deterioration for exterior wood surfaces.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Sherwin-Williams Company (The).
   2. Gloss Level: Manufacturer's standard semigloss finish .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with finish application only after unsatisfactory conditions have been corrected.
   1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

B. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
   1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
   2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

C. Exterior Wood Substrates:
   1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
   2. Prime edges, ends, faces, undersides, and backsides of wood.
      a. For varnish-coated stained wood, stain edges and ends and prime with varnish. Prime undersides and backsides with varnish.
   3. Countersink steel nails, if used, and fill with putty or plastic wood filler tinted to final color. Sand smooth when dried.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions.
   1. Use applicators and techniques suited for finish and substrate indicated.
   2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
   3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 EXTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood Substrates, Glued-Laminated Construction, Exposed Framing:
   1. Varnish over Semitransparent Stain System :
      a. Stain Coat: Stain, exterior, solvent based, semitransparent.
      b. First Intermediate Coat: Varnish matching topcoat.
      c. Second Intermediate Coat: Varnish matching topcoat.
      d. Topcoat: Varnish, with UV inhibitor, exterior, semigloss .

END OF SECTION 09 93 00

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Sleeves and sleeve seals for cables.
4. Division 26 Section "Control Voltage Electrical Power Cables" for cabling used for control circuits.

1.03 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

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

1.05 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

2.01 CONDUCTORS AND CABLES

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

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.

3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.
6. Other acceptable manufacturers as approved by the Engineer.

2.02 Aluminum and Copper Conductors

A. Comply with NEMA WC 70/ICEA S-95-658.

B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN-2 or XHHW-2.

2.03 CONNECTORS AND SPLICES

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

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.
6. Other acceptable manufacturers as approved by the Engineer

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

C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
1. Material: Tin plated copper.
2. Type: One hole up through 4/0,Two hole for conductors larger, all with long barrels.
3. Termination: Compression

2.04 SLEEVES SEALS

A. See specification 26 05 44 – Sleeves and Sleeve Seals for Electrical raceways and cables.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; stranded.

B. Branch Circuits: Copper; stranded.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN-2 or XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN-2 or XHHW-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type XHHW-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type XHHW-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN or XHHW-2, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

I. Class 1 Control Circuits: Type THHN-THWN-2 or XHHW-2, in raceway.

J. Class 2 Control Circuits: Type THHN-THWN-2 or XHHW-2, in raceway or Power-limited tray cable, in raceway.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal conduits within the main building in finished walls, ceilings, and floors, unless otherwise indicated. Exterior conduits shall be buried except around areas of concrete tanks.

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 Division 26 Section "Hangers and Supports for Electrical Systems."

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

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.05 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

B. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

C. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches thickness shall be 0.052inch
2. For sleeve rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches thickness shall be 0.138inch

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both wall surfaces.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inchannular clear space between sleeve and cable unless sleeve seal is to be installed

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint.

J. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inchannular clear space between pipe and sleeve for installing mechanical sleeve seals.

K. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inchannular clear space between cable and sleeve for installing mechanical sleeve seals.

3.06 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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 grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

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

B. Bare Copper Conductors:

1. Stranded Conductors: ASTM B 8.

2. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
3. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.3 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

G. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

H. Conduit Hubs: Mechanical type, terminal with threaded hub.

I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

J. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

K. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.

L. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

M. Straps: Solid copper, copper lugs. Rated for 600 A.

N. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal two-piece clamp.

O. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

P. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.

a. Material: Die-cast zinc alloy.
b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 5/8 by 96 inches.

B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

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

B. Underground Grounding Conductors: Install barecopper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches below grade.

2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.

4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

E. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

F. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.5 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.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.

1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches from building's foundation.

F. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

G. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

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

1.05 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.

3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

1.06 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

1.07 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

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

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inchdiameter holes at a maximum of 8 incheso.c., in at least 1 surface.

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

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. Fabco Plastics Wholesale Limited.
d. Seasafe, Inc.

2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

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

E. 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.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; hot dip galvanized.

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

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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

        1) Hilti Inc.
        2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

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

        1) Cooper B-Line, Inc.; a division of Cooper Industries.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

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

PART 3 - EXECUTION

3.01 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4-inchin diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 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. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lbs

D. 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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inchesthick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.

6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 or Spring-tension clamps.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

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

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 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.

3.04 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 4000-psi 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils

B. Touchup: Touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

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

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For conduit, fittings, boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.
2. Process piping items and structural features in the paths of conduit groups with common supports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

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

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. Aluminum Rigid Conduit: ANSI C80.5.

D. IMC: ANSI C80.6.

E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040-inch minimum.

F. EMT: ANSI C80.3.

G. FMC: Zinc-coated steel, Aluminum, Zinc-coated steel or aluminum.

H. LFMC: Flexible steel conduit with PVC jacket.

I. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Steel, set-screw type.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040-inch with overlapping sleeves protecting threaded joints.

J. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

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

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.
6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 METAL WIREWAYS

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

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 3R, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: All wireways to include cover to maintain NEMA rating.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

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

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.

8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

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

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

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

E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

F. Hinged-Cover Enclosures: NEMA 250, Type 1 Gasketed, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.

G. Cabinets:

1. NEMA 250, Type 1 gasketed, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Gray.
2. Material of Construction: Polymer concrete unless noted otherwise.
3. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.

a. Handhole shall include 2 cable racks or struts for cable support.

4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC." as indicated for each service.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

8. Rated Tier 22 unless noted otherwise except rated H-20 if located within parking lot.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Use rigid galvanized steel conduit.
2. Concealed Conduit, Aboveground: Use rigid galvanized steel conduit where subject to damage, otherwise use EMT.
3. Underground Conduit: Use Type EPC- 40-PVC

4. Hazardous Locations: Use PVC coated rigid galvanized steel.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

6. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or 4.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, dry, Not Subject to Physical Damage: EMT.
2. Exposed and Subject to Physical Damage: Rigid steel conduit.
3. Concealed in Ceilings and Interior Walls and Partitions: Rigid steel conduit, IMC, or EMT.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: PVC coated rigid galvanized steel conduit.
6. Hazardous Locations: Use PVC coated rigid galvanized steel.
7. Corrosive environment: Use only non-metallic boxes, raceways and fittings EPC-40-PVC, with stainless fasteners.
8. Underground within buildings: Use only EPC-40-PVC.
9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

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

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Install conduit parallel or perpendicular to building structural members. Raceways above radius corridors shall follow the path of the corridor.

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

D. Complete raceway installation before starting conductor installation.

E. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

F. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

G. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

H. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lbtensile strength. Leave at least 12 inchesof slack at each end of pull wire.

L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with 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.

M. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 degree F and that has straight-run length that exceeds 25 feet

    1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

        a. Outdoor Locations Not Exposed to Direct Sunlight: 125 degree Ftemperature change.
        b. Outdoor Locations Exposed to Direct Sunlight: 155 degree Ftemperature change.
        c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 degree Ftemperature change.
        d. Attics: 135 degree Ftemperature change.

    2. Install fitting(s) that provide expansion and contraction for at least 0.00041-inch per foot of length of straight run per degree Fof temperature change.
    3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

N. Flexible Conduit Connections: Use maximum of 72 inchesof flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

    1. Use LFMC in damp or wet locations subject to severe physical damage.
    2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

O. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

P. Set metal floor boxes level and flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section “Trenching and Backfilling” for pipe less than 6 inches in nominal diameter.
2. After installing conduit, backfill with Class 2 material and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Trenching and Backfilling”.
3. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.

4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor. Wrap all steel conduit underground with PVC pipe wrap adhesive tape.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

5. Warning Tape: Bury warning tape approximately 12 inches above direct-buried conduits, continuously along the length of the conduit.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level 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: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Field-cut openings for 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.

E. Support all splices on cable racks or struts within 8” of top of enclosure.

3.5 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 26 05 33

SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inchminimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches thickness shall be 0.052 inch
b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches thickness shall be 0.138 inch

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

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

a. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. Metraflex Company (The).
d. Pipeline Seal and Insulator, Inc.
e. Proco Products, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

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

a. Presealed Systems.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inchannular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inchannular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inchannular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.03 SUBMITTALS

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

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.04 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.05 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

PART 2 - PRODUCTS

2.01 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Metal Tags: Brass or aluminum, 2 by 2 by 0.05-inch with stamped legend, punched for use with self-locking cable tie fastener.

E. Write-On Tags: Polyester tag, 0.015-inchthick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.02 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.03 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

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

D. Write-On Tags: Polyester tag, 0.015-inchthick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.04 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: COMMUNICATIONS CABLE.

C. Tag: Type ID:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 5 mils
3. Foil Core Thickness: 0.35 mil
4. Weight: 28 lb/1000 sq. ft.3-InchTensile According to ASTM D 882: 70 lbf and 4600 psi

D. Tag: Type IID:

1. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 8 mils
3. Foil Core Thickness: 0.35 mil
4. Weight: 34 lb/1000 sq. ft.3-InchTensile According to ASTM D 882: 300 lbf and 12,500 psi

2.05 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

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:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inchgrommets in corners for mounting.

3. Nominal size, 7 by 10 inches

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inchgalvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inchgrommets in corners for mounting.

3. Nominal size, 10 by 14 inches

E. 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"

2.06 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16-inchthick for signs up to 20 sq. inchesand 1/8-inchthick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8-inch

C. 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 Overlay shall provide a weatherproof and UV-resistant seal for label.

2.07 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8-inch

B. 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 Overlay shall provide a weatherproof and UV-resistant seal for label.

C. 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

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be-3/8-inch

2.08 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16-inch
2. Tensile Strength at 73 degree F According to ASTM D 638: 12,000 psi
3. Temperature Range: Minus 40 to plus 185 degree F
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16-inch
2. Tensile Strength at 73 degree F According to ASTM D 638: 12,000 psi
3. Temperature Range: Minus 40 to plus 185 degree F
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16-inch
2. Tensile Strength at 73 degree F According to ASTM D 638: 7000 psi
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 degree F
5. Color: Black.

2.09 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

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

PART 3 - EXECUTION

3.01 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 signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-footmaximum intervals in straight runs, and at 25-footmaximum intervals in congested areas.

G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inchesbelow finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inchesoverall.

J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.02 IDENTIFICATION SCHEDULE

A. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 30-footmaximum intervals.

B. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot maximum intervals.

C. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.
3. UPS.

D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and hand holes, use color-coding conductor tape to identify the phase.

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

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

F. Conductors to Be Extended in the Future: Attach write-on tags or marker tape to conductors and list source.

G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

I. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.
b. Controls with external control power connections.

K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the 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: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inchhigh label; where two lines of text are required, use labels 2 inches high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
   b. Enclosures and electrical cabinets.
   c. Communication Racks, Frames and enclosures.
   d. Video Surveillance cabling at each termination point.
   e. Video Surveillance cameras
   f. Access doors and panels for concealed electrical items.
   g. Switchgear.
   h. Switchboards.
   i. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
   j. Substations.
   k. Emergency system boxes and enclosures.
   l. Motor-control centers.
   m. Enclosed switches.
   n. Enclosed circuit breakers.
   o. Enclosed controllers.
   p. Variable-speed controllers.
   q. Push-button stations.
   r. Power transfer equipment.
   s. Contactors.
   t. Power-generating units.
   u. Monitoring and control equipment.

END OF SECTION 26 05 53

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes Lighting and appliance branch-circuit panelboards.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.

6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 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.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

b. Damp or Wet Locations or Outdoor: NEMA 250, Type 4.

2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
3. Directory Card: Inside panelboard door, mounted in transparent card holder.

B. Incoming Mains Location: Bottom or Top, as required by project.

C. Phase, Neutral, and Ground Buses: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus Configured Terminators: Mechanical type.

E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Panelboards to be fully rated as indicated on plans. Utilizing series ratings to meet requirements is not allowable.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:

1. Square D; a brand of Schneider Electric.
2. Eaton/Cutler Hammer.
3. General Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: lugs only or Main circuit breaker as indicated on plans.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Contactors in Main Bus: NEMA ICS 2, Class A, electrically or mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. External Control-Power Source: 120-V branch circuit.
2. Doors: Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:

1. Square D; a brand of Schneider Electric.
2. Eaton/Cutler Hammer.
3. General Electric

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 150 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407 and/or NEMA PB 1.1.

B. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

C. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

D. Install filler plates in unused spaces.

E. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inchempty conduits into raised floor space or below slab not on grade.

F. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

G. Comply with NECA 1.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 26 05 53 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Test ground-fault protection of equipment for service equipment per NFPA 70.
   2. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

B. Panelboard will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. When main panelboard is energized verify phase rotation prior to installation of feeder circuits.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Weather-resistant receptacles.
3. Snap switches and wall-box dimmers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

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

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5351 (single), CR5362 (duplex).
b. Hubbell; HBL5351 (single), HBL5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5361 (single), 5362 (duplex).

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; VGF20.
b. Hubbell; GFR5352L.
c. Pass & Seymour; 2095.
d. Leviton; 7590.

2.5 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

1) Single Pole:
2) Cooper; AH1221.
3) Hubbell; HBL1221.
4) Leviton; 1221-2.
5) Pass & Seymour; CSB20AC1.
6) Two Pole:

7) Cooper; AH1222.
8) Hubbell; HBL1222.
9) Leviton; 1222-2.
10) Pass & Seymour; CSB20AC2.
11) Three Way:
12) Cooper; AH1223.
13) Hubbell; HBL1223.
14) Leviton; 1223-2.
15) Pass & Seymour; CSB20AC3.
16) Four Way:
17) Cooper; AH1224.
18) Hubbell; HBL1224.
19) Leviton; 1224-2.
20) Pass & Seymour; CSB20AC4.

2.6 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.05-inch-thick, anodized aluminum.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.7 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. TVSS Devices: Blue.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 56 19 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.

2. Luminaire supports.

3. Luminaire-mounted photoelectric relays.

B. Related Requirements:

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.

2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale and coordinated.

B. Product Certificates: For each type of the following:

1. Luminaire.

2. Photoelectric relay.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.

2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.6 FIELD CONDITIONS

A. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.7 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 LUMINAIRE REQUIREMENTS

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.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598 and listed for wet location.

E. Lamp base complying with ANSI C81.61.

F. CRI of minimum 70. CCT as indicated by model on plans.

G. L70 lamp life of 80,000 hours.

H. Nominal Operating Voltage: As indicated on the plans.

I. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.

J. Source Limitations: Obtain luminaires from single source from a single manufacturer.

K. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 LUMINAIRE TYPES

A. As scheduled on drawings.

2.4 MATERIALS

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

B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.

C. 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.

D. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2. Glass: Annealed crystal glass unless otherwise indicated.

3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.

2. Specular Surfaces: 83 percent.

3. Diffusing Specular Surfaces: 75 percent.

G. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.

2. Provide filter/breather for enclosed luminaires.

2.5 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. 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.

C. 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.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.

3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

a. Color: As indicated on drawings.

D. Factory-Applied Finish for Steel Luminaires: 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, 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 or SSPC-SP 8.

2. 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: As selected from manufacturer's standard catalog of colors.
b. Color: Match Architect's sample of manufacturer's standard color.
c. Color: As selected by Architect from manufacturer's full range.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Provide mounting accessories appropriate for mounting to proposed poles.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Fasten luminaire to structural support.

D. Supports:

1. Sized and rated for luminaire weight.

2. Able to maintain luminaire position after cleaning and relamping.

3. Support luminaires without causing deflection of finished surface.

4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Wiring Method: Install cables in raceways. Conceal raceways and cables.

F. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.

G. Coordinate layout and installation of luminaires with other construction.

H. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.2 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 Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Verify photocell operation for each light. The latest starting light should come on within 15 minutes of the first light. Replace/revise photocells to achieve this timeframe.

C. Luminaire will be considered defective if it does not pass tests and inspections.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires.

END OF SECTION 26 56 19

SECTION 31 10 00 - SITE CLEARING

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. Protecting existing vegetation to remain.
   2. Removing existing vegetation.
   3. Clearing and grubbing.
   4. Stripping and stockpiling topsoil.
   5. Removing above- and below-grade site improvements including pavement, structures, and vaults.
   6. Disconnecting, capping or sealing, and removing site utilities.
   7. Abandonment of buried structures

B. Related Sections:
   1. Division 01 Section "Temporary Facilities and Controls"
   2. Division 01 Section "Execution" for field engineering and surveying.

1.3 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil and spoils materials indicated to be stockpiled on-site, transported off-site to designated location or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
   1. Use sufficiently detailed photographs or videotape.
   2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Shop Drawings:
   1. Plan for removing trees and other large vegetation not explicitly shown or indicated for removal in the Contract Documents.
   2. Plan showing proposed limits of clearing and grubbing, if different from clearing and grubbing limits shown or indicated in the Contract Documents.

C. Record Drawings: Identifying and accurately showing locations and elevations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference in accordance with Division 01.
   1. Review methods and procedures to maintain sensitive natural features, as identified by the Owner’s Representative.

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service: Notify MISS for area where Project is located before site clearing. Provide a minimum of three full working days advance notification.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

E. The following practices are prohibited within protection zones, the 100-year floodplain, and surrounding wetlands:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.

3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

F. Do not direct vehicle or equipment exhaust towards protection zones, the 100-year floodplain, and surrounding wetlands.

G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones, the 100-year floodplain, and surrounding wetlands.

H. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist, as determined by the Engineer or Owner's Representative.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 23 33 "TRENCHING AND BACKFILL" as "Job Excavated Fill"
1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide staking or flagging to delineate limits of areas to be cleared or grubbed as depicted on plans or directed by Owner's Representative. Review at site with Owner's Representative before commencing removal of trees, vegetation, and other materials to be removed.

B. Replace staking or flagging that is lost, removed, or destroyed, until clearing and grubbing work is complete and Owner's Representative allows removal of flagging.

C. Protect and maintain benchmarks and survey control points to remain from disturbance during construction. Contractor shall be responsible for re-establishing benchmarks and control points that have been disturbed or damaged by the work. Benchmarks and control points in demolition areas shall be re-established in non-demolition areas by the Contractor's surveyor, prior to disturbance.

D. Protect existing site improvements to remain from damage during construction. Existing site improvements include, but are not limited to, streets, parking lots, sidewalks, curb and gutter. driveways, structures, underground facilities to remain, adjacent property, and structures.
1. Restore damaged improvements to their original condition, as acceptable to Owner, at Contractor's expense.

E. Place removed materials in salvage area as indicated by Owner's Representative.

3.2 TEMPORARY EROSION SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures in accordance with Part 91, Act 451, PA 1994, the Soil Erosion and Sedimentation Control Act, Michigan Department of Natural Resources Environmental Act guidelines and all pertinent local enforcing agency rules and regulations having jurisdictions prior to beginning site clearing.

3.3 TREE PLANT PROTECTION

A. General: Protect trees and plants remaining on-site according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Owner's Representative. Trees and shrubs intended to remain, that are damaged beyond repair or that are removed, shall be replaced by Contractor at no additional cost to Owner.

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
   1. Coordinate with utility owners as required for shutting off service.

B. Interrupting 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 not less than five days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner's written permission.

C. Excavate for and remove underground utilities indicated to be removed after Owner's permission has been obtained. Notify property owners and residents of proposed interruption schedule two days in advance of interruption.

3.5 CLEARING GRUBBING

A. Prior to the start of construction, the Contractor shall verify the limits of trees and other items that are to be saved. The Contractor shall then clear the site or trench excavation area of all remaining trees, brush, and other miscellaneous items that are not to be saved.

B. Remove obstructions, trees (including stump and main roots), shrubs, and other vegetation to permit installation of new construction.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
   2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
   3. Use only hand methods for grubbing within protection zones.
   4. Chip removed tree branches.
   5. Dispose of all trees, shrubs, stumps, root, and all associated foliage and debris offsite.
   6. Trees less than six (6) inch diameter shall be removed where required by the work as incidental to the Contract.
   7. The Contractor shall abide by any easement agreements regarding the tree removal work and wood ownership.
   8. Clear undergrowth and deadwood without disturbing subsoil.

9. Do not use cleared or grubbed materials as fill, backfill, or in embankments.

C. Fill depressions caused by clearing and grubbing operations in accordance with the materials and procedures as specified in Section 31 23 00 “Excavation and Fill”, unless the depressions are in an area requiring excavation per plan.

D. Stump Removal: Where called for on the plans, the Contractor shall remove existing stumps, including main roots (two (2) inch diameter and larger), dispose of all associated debris offsite, and backfill the void as above.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth indicated on drawing in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials. Topsoil stockpiles that have been contaminated by subsoil or nonsoil materials, as determined by the Owner’s Representative, shall be removed from the site at the Contractor’s expense. The contractor shall replace, at his expense, any topsoil needed to replace the contaminated topsoil removed due to contamination.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
   1. Limit height of topsoil stockpiles to 72 inches.
   2. Do not stockpile topsoil within protection zones, the 100-year floodplain, and surrounding wetlands.
   3. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 IMPROVEMENT REMOVAL

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
   2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

C. Remove fencing where removal is designated on the drawings.

3.8 STRUCTURE ABANDONMENT

A. Underground utility structures indicated for abandonment shall be abandoned as follows:
   1. Salvage and stockpile, without damaging, castings, grates, and covers or dispose at the direction of the Owner.
   2. Remove and dispose of the cone, masonry, and riser sections such that the remaining structure is no higher than 3 feet below the proposed finish grade.

3.9 DISPOSAL OF SURPLUS WASTE MATERIALS

A. Stockpile all surplus soil material in the area designated on the construction drawings.

B. Remove, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

C. Do not burn clearing debris at the site, unless approved by Owner and authorities having jurisdiction. If burning is permitted, comply with requirements of authorities having jurisdiction and Owner’s requirements.

END OF SECTION 31 10 00

SECTION 31 23 00 - EXCAVATION AND FILL

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.

B. ASTM D 2487 “Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

C. ASTM D 6938 “Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods”

D. ASTM D 1557 “Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort”

E. Michigan Department of Transportation Density Testing and Inspection Manual (rev 2014)

1.2 SUMMARY

A. Work shall include furnishing of labor, materials, tools, equipment, accessories, and services necessary for completing the excavation and backfilling for the items as shown on the contract drawings and/or as herein required. This also includes excavation, dewatering, earth moving, placement, grading and compaction of earth, and the disposal of excess materials.

B. Section Includes:
1. Excavation
2. Fill / Embankment
3. Preparing subgrades for slabs-on-grade, sidewalks, pavements, turf, grasses and plants.
4. Cutting, grading, filling, compacting and rough contouring the site for structures, walks, pavements, and drainage.
5. Placing Topsoil for Site Restoration
6. Surplus Material Hauling

C. Related Sections:
1. Division 01 Section “Temporary Facilities and Controls”.
2. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
3. Division 31 Section “Trenching and Backfilling” for excavation, bedding, and backfill of underground utilities.
4. Division 33 Sections for installing underground utilities and buried structures.

1.3 DEFINITIONS

A. Base Course: Aggregate layer placed between the subbase course or subgrade and paving.

B. Backfill: material places in an excavated area

C. Borrow Soil: Soil imported from off-site for use as fill or backfill, as approved by the Engineer

D. Embankment: Fill soils placed and compacted such that future site improvements will be constructed above or near the placed soils

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Owner's Representative. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
   2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owner's Representative. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

F. Fill: material placed above the original or natural ground line.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, utility appurtenances, or other man-made stationary features constructed above or below the ground surface.

H. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

I. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

J. Suitable Earth Material: job excavated fill or borrow material that meets the requirements of this section for Fill.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
   1. None.

B. Samples for Verification: For the following products, in sizes indicated below:
   1. None.

C. Material Test Reports: For each borrow soil material proposed for fill and backfill as follows:
   1. Classification according to D 2487 (USCS).
   2. Laboratory compaction curve according to ASTM D 1557 (Modified Proctor)

D. Pre-excavation Photographs or Video Recording: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.5 QUALITY ASSURANCE

A. Pre-excavation Conference: Conduct conference in accordance with Section 01 31 00 “Project Management and Coordination”

B. References to Michigan Department of Transportation (MDOT) Specifications shall pertain to the current edition of the Standard Specifications for Construction.

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify MISS for area where Project is located before beginning excavation. Provide a minimum of three full working days advance notification.

C. Do not commence earth-moving operations until temporary erosion- and sedimentation-control measures are in place.

D. Do not commence earth-moving operations until plant-protection measures are in place, if applicable.

E. The following practices are prohibited within protection zones, 100-year floodplain and wetlands:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

F. Do not direct vehicle or equipment exhaust towards protection zones, 100-year floodplain and wetlands.

G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones, 100-year floodplain and wetlands.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS - GENERAL

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

2.2 FILL / EMBANKMENT

A. Fill and Embankment have the same requirements under this contract. References in the plans to embankment and fill shall be considered references to the same material requirements.

B. Suitable Earth Material shall be either of the following, with approval of the Owner's Representative:
   1. Job Excavated Fill shall be defined as material excavated from the site that can be classified as GW, GP, GM, SW, SP, and SM according to ASTM D 2487 or a combination of these groups and is free from frozen earth, boulders, rocks, stones larger than 3 inch in size, debris, vegetation, blue and gray clay, and organic material.
   2. Granular Fill:
      a. Granular fill shall be defined as sharp sand, gravel, or crushed stone that is free from lumps of clay and soft or flaky material and shall conform to requirements of MDOT Specification Section 902.07 and the gradation of MDOT Specification Table 902-3 for MDOT Class I
      b. Granular material shall be used for fill work located under or within the influence of roadway surfaces, structures, or other constructed site improvements. Project plan details or the Engineer shall dictate which Class of granular material is required for the project.
      c. Material excavated from the trench may be used as granular fill when, in the opinion of the Owner's Representative, it meets the granular backfill grading requirements.

C. Topsoil
   1. Stripped and re-used material or local borrow material.
   2. Graded.
   3. Free of roots, rocks larger than ½ inch, subsoil, debris, weeds, and foreign matter.
   4. Contains no greater than 20 percent nor less than 5 percent organic matter.

D. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that survey benchmark and intended elevations for the Work are as indicated on the plans.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Protect benchmarks, fences, structures, utilities, sidewalks, pavements, protection zones, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

C. Protect plant life, lawns, trees and shrubs, and other features to remain as a portion of final landscaping.

D. Protect and maintain erosion and sedimentation controls during earth moving operations.

E. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.3 CLASSIFICATION OF EXCAVATION

A. Earth, as a name for excavated material, shall include all glacial deposits whether cemented or not, except solid boulders one-half cubic yard or more in volume. It shall also include all alluvial deposits and material of every kind that can be excavated with equal facility by the equipment and means typically used for earth excavation.

B. Peat, as a name for excavated material, shall include all unstable organic soils such as peat, muck, marl, and underlying very soft clay.

C. Rock, as a name for excavated material, shall include pre-glacial solid ledge rock that can be removed most practically by blasting, barring or wedging, or by some other standard method of quarrying solid rock. It shall also include solid boulders of one-half cubic yard or more in volume as well as existing concrete, masonry with mortar joints, or other existing structural work that can be excavated practically only by methods of quarrying solid rock. It shall not include fragile, friable, or disintegrated materials of any kind that can be excavated by equipment and means used for earth excavation.

3.4 SUBGRADE ELEVATION

A. Contractor, or his surveyor, shall calculate the subgrade elevation required for excavation and fill work by referencing the proposed final grade and back-calculating the subgrade elevation based on the project plans, details, specifications, and/or direction of the Owner's Representative regarding the finish surface or pavement cross section.

3.5 EXCAVATION, GENERAL

A. Remove topsoil in accordance with Section 31 10 00 "SITE CLEARNING" from area of construction, areas to be filled and graded, and other areas designated.

B. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
   2. Remove rock to lines and grades indicated to permit installation of permanent construction.

3.6 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
   2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
   3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

3.7 METHODS OF EXCAVATION IN EARTH

A. All excavation shall be by open cut from the surface using appropriate and efficient equipment to handle the materials.

B. Stockpile excavated topsoil and subsoil material classified by Owner's Representative as suitable for further used and remove material classified as unsuitable and material in excess of project requirements.

3.8 EXCAVATION FOR WALKS, PAVEMENTS ROADWAYS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

B. Roadway earthwork shall be performed in accordance with the construction methods that are described in MDOT Section 205 Roadway Earthwork unless otherwise called for in the plan notes, details, or supplemental specifications.

3.9 EXCAVATION FOR UTILITY TRENCHES

A. Trench excavation and backfill shall be in accordance with Section 31 23 33 "Trenching and Backfill"

3.10 EXCAVATION FOR SITE GRADING

A. Excavate areas identified on the plans where final or proposed grades are lower than existing or interim grades in areas for proposed pavement, walks, utility construction, open space, or other proposed feature.

B. Contractor shall maintain the overall storm water flow direction of the site until measures and utilities are in place to manage the modified or final flow condition.

C. Contractor shall prepare subgrade in excavation areas by smoothly grading and compacting the surface with equipment necessary to achieve the specified density.

D. Contractor shall be responsible for staking excavation areas to prevent unauthorized excavation and to ensure that the subgrade elevations are achieved.

3.11 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Owner's Representative.
   1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Owner's Representative.

3.12 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and job excavated soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile materials on-site at approved locations and so as not to impede the natural drainage in the area.
   2. Stockpile in sufficient quantities to meet project requirements.
   3. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
   4. Do not store in protection zones, 100-year floodplain, or wetlands, as identified on the plans.

3.13 STOCKPILE CLEANUP

A. Remove stockpile; leave area in a clean and neat condition. Grade site surface to prevent free standing surface water. If approval given by Owner, leave unused materials in a neat, compact stockpile.

B. If a borrow area is indicated, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.

3.14 TRANSPORT OF NATIVE MATERIALS OFFSITE

A. If the Contractor encounters suitable materials (sand, gravel, topsoil, etc.) during the course of construction, he shall not be allowed to transport these materials offsite. Wherever possible, suitable native sands and gravels shall be used as backfill rather than transporting them to the spoils berm and replacing them with non-native materials of a lesser quality.

3.15 EMBANKEMENT

A. Construction requirements for Fill and Embankment are the same under this contract. References on the plans and in the specifications to “Embankment” shall be placed, compacted, and tested according to the provisions of this section for “Fill”

3.16 FILL

A. Construction requirements for Fill and Embankment are the same under this contract. References on the plans and in the specifications to “Fill” or “Embankment” shall be placed, compacted, and tested according to the provisions of this section.

B. Contractor shall fill with suitable earth material (see “PART 2 – PRODUCTS”) the areas identified on the plans where final or proposed grades are higher than existing or interim grades in areas for proposed pavement, walks, structures, utility construction, open space, or other proposed feature.

C. Contractor shall place fill on soils free of mud, frost, snow, or ice.

D. Contractor shall maintain the overall storm water flow direction of the site until measures and utilities are in place to manage the modified or final flow condition.

E. Contractor shall prepare subgrade in fill areas by smoothly grading and compacting the surface with equipment necessary to achieve the specified density.

F. Fill material shall consist of granular fill for areas within the influence of proposed pavements or structures. Job excavated fill may be used elsewhere, except when compaction cannot be achieved.

G. Contractor shall place fill material in 12 inch lifts unless the Contractor can demonstrate to the satisfaction of the Owner's Representative that he can consistently attain the specified density on thicker lifts. Compact the entire lift in accordance with "COMPACTION" to the specified density before placing an additional lift. This procedure shall be repeated until all areas have reached indicated subgrade elevation.

H. Contractor shall be permitted to place excavated material that does not meet the product requirements of Suitable Earth Material only as directed and approved by the Owner's Representative.

3.17 COMPACTION OF FILL / SUBGRADE

A. Where plans, details, or specifications call for subgrade or other soil to be compacted, such material shall be compacted according to this section for "Fill."

B. If the moisture content of cohesive fill material exceeds the optimum moisture content for maximum density by more than three percent (3%), the Contractor shall dry the material to meet the foregoing moisture content limitation or provide, at his own expense, Granular Fill. No sloppy or wet backfill will be allowed, as determined by the Owner's Representative.

C. Specified compaction shall be obtained with the use of a bulldozer, sheepsfoot roller, vibratory roller, mechanical tamper, or other similar and effective equipment. Specified compaction for areas under structures, building slabs, pavements and sidewalks means not less than 95 percent (not average 95 percent) of all tests of maximum unit weight when tested in accordance with ASTM D 6938 (nuclear gauge). Specified compaction for areas under lawn or unpaved areas means not less than 90 percent (not average 90 percent) of all tests of maximum unit weight when tested in accordance with ASTM D 6938 (nuclear gauge).

D. Compaction equipment or methodology shall be altered by the Contractor if the Owner's Representative determines that the methodology is not capable of consistently compacting suitable material to the specified density. Additional equipment, labor, or time as required by this procedural change shall be at the expense of the Contractor.

E. Maximum unit weight will be determined by ASTM D 1557 (modified proctor), current methods of Test for Compaction and Density of Soil, AASHTO Designation T-180 or by the Cone Density Method developed by MDOT, as directed by the Owner or Owner's Representative.

F. If job excavated material is not suitable to obtain 95 percent minimum compaction, the Contractor shall, at his expense, remove unsuitable materials and replace with granular fill materials, to obtain ninety-five percent (95%) minimum compaction as specified.

G. Compaction tests will be made by a representative of the Owner and paid for by the Owner, unless otherwise specified in the Contract Documents.

H. Any depression resulting from settlement of any material prior to the date of final payment for all work under this contract shall be brought to the proper grade and surface and made to match the adjacent surface. Any damage to pavement, landscaping, or structures resulting from settlement

in areas compacted by the Contractor shall be repaired or replaced at the direction and to the approval of the Owner's Representative at no additional cost to the Owner.

I. Compaction Under structures
   1. Compact structure embankment to 100 percent of the maximum unit weight within the limits of 1:1 slopes, extending outward and downward from the bottom edges of the structure footings.

3.18 SUBGRADE INSPECTION

A. Notify Owner's Representative when excavations and fills have reached required subgrade elevation/

B. If Owner's Representative determines that unsatisfactory soil is present in an excavation area, continue excavation and replace with compacted backfill or fill material as directed.

C. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Owner's Representative, without additional compensation.

E. Areas to receive slab on grade concrete or pavement shall be proof rolled by the Contractor and accepted by the Owner's Representative prior to installation of further work.

3.19 SURPLUS MATERIAL HAULING

A. Excavated fill which is not required for site grading, construction of embankments, backfill, or other earthwork requirement at the project site as shown or described in the Contract Documents shall be hauled off-site unless otherwise directed by the owner.

B. Excess excavated soil material shall be hauled off-site, unless directed by the owner to place on site at a designated location, prior to beginning any fill or embankment operations.

C. Placement, compaction, and testing of materials , if requested to remain on site by the Owner, shall be in accordance with the compaction listed above for lawn and unpaved areas or as specified per the direction of the Owner's Representative.

D. Contractor shall transport surplus material in vehicles designed for transporting earth on public roads.

E. Contractor shall comply with any and all procedure as directed and decided by the Owner's Representative or Owner to measure the weight, mass, or volume of materials which are requested to remain on site.

3.20 DISPOSAL OF EXCAVATED MATERIAL

A. After all suitable excavated material shall be utilized as fill on site or as fill at an off-site location as directed by the Owner or Owner's Representative. Placement of excavated material at off-site location(s) shall be in accordance with the direction of the off-site owner or separate contract documents.

B. Excess excavated material shall be hauled off site unless directed by the Owner's Representative to be placed on site.

C. The Contractor shall also be responsible for disposing of all excavated soil materials that are unsuitable for use as fill or backfill at an off-site location unless otherwise directed by the Owner. All other unsuitable materials may include, but are not limited to, broken concrete, asphalt, rock, and other non-soil debris. The Contractor shall be required to obtain his own disposal areas and permits and shall receive no additional compensation for this disposal work.

D. Surplus or unsuitable material shall not be disposed of either temporarily or permanently beyond the plan grading limit line or across any wetland or flood plain unless the plans provide for such placement.

3.21 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades and between utility structure rims and adjacent earthwork
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
   3. Slope grade away from building at a minimum of 2 inches in 10 feet, unless noted otherwise.

B. Site Rough Grading: Slope grades to direct water away from buildings and structures to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Unpaved Areas: Plus or minus 1 inch.
   2. Walks: Plus or minus 1 inch.
   3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

D. Final Cleanup and Grading: Upon completion of the construction, and before final payment is made, the Contractor shall restore his working area to as clean a condition as existed before his operations were started. He shall go over the entire line and refill any place that may have settled. He shall then re-grade and put in shape all backfilled trenches, all fills he may have made from excess excavated materials, and all other areas that may have been disturbed through all operations.

3.22 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: As specified on drawings and in accordance with Section 33 42 00 "Storm Conveyance"

3.23 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified geotechnical engineering testing agency to perform the following tests and inspections.
   1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
   2. Determine that fill material and maximum lift thickness comply with requirements.

3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Contractor shall engage a qualified land surveyor to perform all staking and layouts. Surveyor shall utilize the design datum and pre-construction benchmarks to ensure accurate excavation and fill according to the project plans.

D. When testing agency reports that subgrades, fills, or backfills have not achieved the degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.24 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
1. Scarify or remove and replace soil material to depth as directed by Owner's Representative; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.25 CONTACTOR SAFETY REQUIREMENTS

A. The excavation and fill operations shall be conducted by the Contractor in a manner that will provide safe working conditions for all persons on the site who may be affected by the Work. The Contractor shall also conduct his operations in a manner that will protect adjacent property from damage.

B. Trench sides shall be either cut back to the slope as necessitated by soil and ground water conditions which will provide stable sides, or supporting systems shall be installed that are capable of restraining the earth sides from movement. A qualified employee of the Contractor shall design the trench supporting systems.

C. The Contractor shall employ, at all times at the site of the work, a qualified person who will be responsible for the safety of both the work and workmen, and who will make all the decisions relevant to the stability of trenches, the adequacy of any and all protective devices, proper operation of equipment, and all other matters related to safety.

D. The Contractor shall not store, along and adjacent to the trench, excavated material, heavy equipment, backfill materials, sewer pipe, or other construction materials which may impose too great a load on the earth and cause displacement or caving of the earth. The Contractor shall, at all times, provide a safe means of emergency exit from all trench excavations.

END OF SECTION 312300

SECTION 31 23 33 - TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Retain or delete this Article in all sections of the Project Manual.

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

C. ASTM D 6938 “Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods”

D. ASTM D 1557 “Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort”

E. Michigan Department of Transportation Density Testing and Inspection Manual (rev 2024)

1.2 SUMMARY

A. Work shall include furnishing of labor, materials, tools, equipment, accessories, and services necessary for completing the excavation and backfilling for the items as shown on the contract drawings and/or as herein required. This also includes trenching, trench or undercutting, complete and continual drainage of excavation, sheeting, bracing, and shoring of sides of the excavation, backfilling around structures and over pipelines, and the disposal of excess excavated material.

B. Section includes:
1. Excavating and backfilling for structures.
2. Subsurface drainage backfill for walls and trenches.
3. Excavating and backfilling trenches for utilities, piping, and pits for buried utility structures.
4. Trench Backfill Compacted-in-Place (CIP).
5. Trench Undercut and Refill.
6. Dewatering.

C. Related Section:
1. Division 01 Section “Temporary Facilities and Controls”.
2. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.

1.3 DEFINITIONS

A. Backfill: Soil material or flowable fill used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

C. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated or to elevation necessary for buried pipe or structure installation or construction.
   1. Authorized Additional Excavation: Excavation below trench bottom or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
   2. Unauthorized Excavation: Excavation below trench bottom elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

D. Fill: Soil materials used to raise existing grades.

E. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, utility appurtenances and structures, or other man-made stationary features constructed above or below the ground surface.

F. Subbase Course: Aggregate layer placed between the subgrade and base course for asphalt or concrete pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a paved walk.

G. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

H. Trenching: Excavation for installation of pipe or conduit utilities.

I. Utilities: Underground pipes, drains, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Samples for Verification: For the following products, in sizes indicated below:
   1. Warning tape: 12 inches long; of each color.

B. Material Test Reports: For each borrow soil material proposed for fill and backfill as follows:
   1. Classification according to ASTM D 2487.
   2. Laboratory compaction curve according to ASTM D 1557.

C. Pre-excavation Photographs or Video Recording: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.5 QUALITY ASSURANCE

A. Pre-excavation Conference: Conduct conference at Project site as directed by the Owner’s Representative.

B. References to Michigan Department of Transportation (MDOT) Specifications shall pertain to the current edition of the Standard Specifications for Construction.

1.6 PROJECONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during trenching operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify MISS DIG for area where Project is located before beginning earth moving operations or excavation. Provide a minimum of three full working days advance notification. Do not commence excavation until marking, flagging, and/or clearing by local facility and utility owners has been completed.

C. Do not commence earth-moving or excavation operations until temporary erosion- and sedimentation-control measures are in place.

D. Do not commence trenching operations until plant-protection measures are in place, if applicable.

E. The following practices are prohibited within protection zones, 100-year floodplain and wetlands:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

F. Do not direct vehicle or equipment exhaust towards protection zones, 100-year floodplain and wetlands.

G. Contractor shall prohibit heat sources, flames, ignition sources, and smoking within or near protection zones, 100-year floodplain and wetlands.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS – GENERAL

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations for use as fill or backfill.

2.2 BEDDING AND BACKFILL MATERIALS

A. Granular bedding and backfill shall be defined as sand, gravel, crushed stone, slag or a blend of aggregates that is free from lumps of clay and soft or flaky material meet the requirements of Section 902.07 and Table 902-3 of the MDOT Standard Specifications for Construction.
   1. Job excavated material may be used as granular backfill when, in the opinion of the Engineer or Owner’s Representative, it meets the granular backfill grading requirements and is approved by them for use as granular backfill.

B. Bedding material shall be provided from offsite unless the trench passes through a well-defined strata of sand or gravel as determined by the Engineer or Owner's Representative. Bedding material shall be subject to the approval of the Engineer or Owner's Representative.

C. Stone bedding and backfill natural gravel, slag, or crushed gravel and shall meet the requirements of Section 902.03, Table 902-1 and Table 902-2 of the MDOT Standard Specifications for Construction.

D. Excavated Backfill: Job excavated backfill shall be defined as material excavated from the trench or elsewhere on-site that is free from the following: frozen earth, boulders, rocks, stones larger than 3 inch in size, debris, blue and gray clay, and organic material.

E. Crushed portland cement concrete may be used by as granular and stone bedding and/or backfill only if approved by the Owner's Representative.

2.3 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:
   1. Red: Electric.
   2. Yellow: Gas, oil, steam, and dangerous materials.
   3. Orange: Telephone and other communications.
   4. Blue: Water systems.
   5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Protect benchmarks, fences, structures, utilities, sidewalks, pavements, curbs, protection zones, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by trenching and backfill activities.

C. Protect plant life, lawns, and other features remaining as part of final landscaping. Protect existing trees and shrubs.

D. Protect and maintain erosion and sedimentation controls during earth moving operations.

E. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

F. In lawn areas and in farm fields, as determined by Engineer, remove and stockpile topsoil for replacement during backfilling.

G. Prior to open trenches entering paved limits of a street, alley, driveway, or parking area, nearly cut the pavement for its full depth, then remove, land dispose of off-site.

3.2 PAVEMENT CUTS

A. Where a trench must be cut through pavement, driveway, or sidewalk, particular care shall be taken to avoid unnecessary damage to adjoining areas of the pavement, driveway or sidewalk to remain. All cuts through existing surfaces shall be made full-depth with a concrete saw. Cuts in concrete pavement shall be made parallel with longitudinal and transverse construction or contraction joints.

B. Saw cuts in concrete pavement shall not be nearer than five feet (5'-0") to a transverse joint, to the centerline of pavement, or to the edge of pavement or curb, i.e., no existing or replacement pavement shall be less than five feet (5'-0") in width. If the damaged pavement or surfacing is nearer than five feet (5'-0") to a joint or centerline of pavement , or to edge of pavement, surfacing or curb, removal and replacement shall be extended to said joint, centerline, edge of pavement, surfacing, or curb. These same requirements shall apply to the saw cutting and replacement of concrete driveways.

C. If a square, block, or flag of sidewalk is cut, broken, or cracked, the entire square or block shall be removed and replaced.

3.3 EXCAVATION AND TRENCH DEWATERING

A. The Contactor shall maintain any excavation or trench free of water during construction of any structures and/or utilities. Any and all dewatering methods are considered to be incidental to the contract unless noted as otherwise elsewhere in the Contract Documents.

B. The Contractor shall take adequate precautions to control the discharge of dewatering pumps so as to prevent soil erosion or sedimentation of drainage ditches, structures, storm sewers, culverts, natural drainage courses, ponds, lakes or wetlands.

C. The Contractor shall insure that discharge from any dewatering operations has a suitable outlet and that it will not cause any damage to adjacent dwellings or property. Water and discharge hoses shall be placed and/or controlled so as to prevent a hazard to pedestrians or motor vehicles passing in the vicinity of the construction site.

D. The Contractor shall not directly discharge water to a storm sewer prior to treatment by one of the following methods, demonstrated to and approved by the Owner's Representative. The approved methodology shall be considered incidental to the contract.
   1. Sediment filter bag or silt sack.
   2. Turf or grass filtering (erosion control must be maintained).
   3. Sedimentation pond.

E. Electric pumps shall have suitable power supply and appurtenances meeting NEC requirements and properly fused and grounded to prevent electrical shock hazards to on-site personnel.

F. Internal combustion engine driven pumps, if operated 24 hours per day, shall have adequate exhaust silencers in good repair to muffle engine noise to an acceptable level for the area where located.

3.4 CLASSIFICATION OF EXCAVATION

A. Earth, as a name for excavated material, shall include all glacial deposits whether cemented or not, except solid boulders one-half cubic yard or more in volume. It shall also include all alluvial

deposits and material of every kind that can be excavated with equal facility by the equipment and means typically used for earth excavation.

B. Peat, as a name for excavated material, shall include all unstable organic soils such as peat, muck, marl, and underlying very soft clay.

C. Rock, as a name for excavated material, shall include pre-glacial solid ledge rock that can be removed most practically by blasting, barring or wedging, or by some other standard method of quarrying solid rock. It shall also include solid boulders of one-half cubic yard or more in volume as well as existing concrete, masonry with mortar joints, or other existing structural work that can be excavated practically only by methods of quarrying solid rock. It shall not include fragile, friable, or disintegrated materials of any kind that can be excavated by equipment and means used for earth excavation.

3.5 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, as determined by the Engineer, replace with satisfactory soil materials.
   2. Remove rock to lines and grades indicated to permit installation of permanent construction.

3.6 METHODS OF EXCAVATION IN EARTH

A. All excavation shall be by open cut from the surface, except in special cases where trenchless utility installation is required on the plans and approved by the Owner. All excavation shall be made in such a manner and to such depth, length, and width as will give ample room for building the structures, bracing, sheeting, and supporting the sides of the excavation, pumping and drainage of ground water and sewage which may be encountered, and removal of all materials excavated. Special care shall be taken so that the soil below the bottom of structures and utilities to be built shall be left undisturbed so that a firm bed will be provided for construction. Any voids shall be backfilled with suitable granular material and shall be compacted in accordance with this section.

3.7 EXCAVATIN FOR STRUCTURES

A. Excavation for Underground Tanks, Basins, and Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:
   1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.8 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. General.
   1. Excavation shall be of sufficient width and depth to provide adequate room for construction and installation of the work to the lines, grades and dimensions called for on the plans. Unless otherwise called for in the Contract Documents, the width of a trench from the pipe invert to a height twelve (12) inches above the top of the pipe barrel shall be indicated as follows:
      a. Pipe diameter 4” through 12”: Maximum trench width = 30”.
      b. Pipe diameter 4” through 12”: Maximum trench width = 30”.
   2. If the maximum trench width as specified above is exceeded, unless otherwise shown on the drawings, the Contractor shall install, at his own expense, such concrete cradling or other bedding as is approved by the Owner’s Representative or Engineer, to support the added load of the backfill.
   3. 2.Where trench excavation is in granular material, the last six (6) inches of trench depth shall be carefully excavated and trimmed by hand to the exact elevation and contour of pipe. Where trench excavation is in rock or clay soil, the trench bottom shall be undercut a minimum of four (4) inches below the final bottom elevation of pipe. The bedding material as hereinafter specified shall be placed and compacted to the underside of the pipe.
   4. Excavation for structures shall be made to the outside lines and surfaces of such structures wherever it is practicable to build directly against the sides and bottoms of excavations. In such cases, care shall be taken not to disturb the original foundation or backing. Final trimming shall be done by hand just before construction of the structure. If excess excavation is made, or the material becomes disturbed so as to require removal beyond the prescribed limits, the resulting space shall be refilled with bedding, as specified hereinafter, and solidly machine tamped into place to 95 percent of maximum unit weight before the construction work proceeds.
   5. Excavation for structures shall be extended sufficiently beyond the limits of the structure to provide ample room for form construction and other construction methods to be followed, wherever necessary.

C. Bedding:
   1. Where the subgrade below the bottom of the pipe is disturbed during the construction, the space shall be refilled with granular or stone bedding solidly tamped to form a firm foundation for the pipe.

D. Amount of Trench Opening:
   1. Not more than 50 lineal feet of trench shall be open at one time in advance of the pipe unless permitted by the Owner’s Representative. The length of street that may be occupied by the construction work at any one time shall be subject to the direction of the Owner and will be based on requirements of the use of the street by the public or Owner. No more than 600 consecutive feet of street length shall be occupied at one time, and vehicle traffic through the street shall not be entirely stopped without permission of the Engineer. After placement of the utility line, the Contractor shall backfill the trench promptly in order to minimize the length of open trench and avoid any unsafe conditions.

E. Trenches in Tree-and-Plant-Protection Zones:
   1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
   2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3.9 Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection." TRENCH INSPECTION

A. Notify Owner’s Representative when excavations have reached required elevation for bedding or structure foundation.

B. Trench undercut: If the Owner’s Representative determines that unsatisfactory soil is present or that the soil at the bottom of the trench is instable, the contractor shall continue trenching below the elevations needed for pipe bedding and replace with compacted stone refill or granular backfill as directed by the Owner’s Representative. Trench undercut up to 18 inches below the bottom of the typical or per plan detail trench shall be performed at no additional cost to the Owner.

C. Contractor shall reconstruct trench soils damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.10 SUBGRADE INSPECTION

A. Notify Engineer when excavations have reached required subgrade.

B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.11 REMOVAL OF EXISTING FACILITIES

A. Remove such existing facilities as noted to be removed, and as required to complete abandonment of existing facilities.

B. Owner reserves the right to salvage existing facilities and portions thereof removed. Dispose of all existing facilities and portion thereof removed and not salvaged by Owner.

C. For existing structures not required to be completely removed for proper completion of other work, remove castings, if any, and remove the walls to a point at least 3’-0” below grade. Provide a minimum 6 inch diameter hole in the bottom of the structure. Removed materials may be used to fill the remaining portion of the structure; limit size of materials and place so as not to prohibit complete and proper filling as approved by Engineer.

D. Plug existing sewers entering and leaving existing structures to be removed as noted on Drawings and as specified below.

3.12 PROTECTION FO EXISTING UTILITIES

A. Uncover and determine the elevation, size and materials of existing underground utilities along the route of construction, as shown on Drawings or marked at the time of construction by the Utility Owner, at least 200 feet in advance of pipe installation.

B. Adequately support, shore up, or otherwise protect underground utilities whenever exposed in the trench. Extend supports a minimum of 12 inches into undisturbed earth each side of trench. Band or tie utility to bridging for its full length. Where bridging cannot be supported by a firm foundation, provide vertical support, including any lateral bracing necessary to provide firm support.

C. Above ground (aerial) utilities, including power, telephone and cable television, shall remain in service at all times. Any anticipated disruption of service shall be with the full knowledge of the Utility Company and required advance notice to affected users. Removal of guy wires and holding of poles shall be done as required to complete the Work, shall be as agreed upon by the Utility Company and Contractor, and shall be at the expense of the Contractor.

D. Arbitrary disruption of underground and aerial utility services will not be permitted.

3.13 PROTECTION, REMOVAL, AND REPAIR OF TREES AND SHRUBS

A. Consult with Engineer and obtain permission prior to removal of any tree, shrub, or limb not noted on Drawings to be removed well in advance of such removals. Such removals outside right-of-way or easement limits shall not be performed without written permission of property owner.

B. Fell trees to be removed so as not to injure trees to remain.

C. Remove stumps and roots to a minimum of 12 inches below grade.

D. Take every precaution to prevent damage to trees and shrubs not noted to be removed.

E. Carefully trim and shape trees, tree limbs and bushes located such that Contractor's equipment will damage same during construction. Squarely cut all limbs and branches. Replace trees and bushes other than those whose removal is approved by Engineer, which are destroyed or damaged to the extent that their continued life is impaired.

E. Prior to Final Payment, employ a competent arborist to inspect all trees and shrubs along the Work line and to properly trim, prune, repair and protect any that have been damaged, and to designate those which have been so damaged as to require replacement.

3.14 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by the Engineer.
   1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer or Owner's Representative.

3.15 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
   2. Do not store in protection zones, 100-year floodplain, or wetlands, as identified on the plans.

3.16 TRANSPORT OF NATIVE MATERIALS OFFSITE

A. If the Contractor encounters suitable materials (sand, gravel, topsoil, etc.) during the course of construction, he shall not be allowed to transport these materials offsite. Wherever possible, suitable native sands and gravels shall be used as backfill rather than transporting them to the on-site spoils berms and replacing them with non-native materials of a lesser quality.

3.17 STONE REFILL FOR TRENCH UNDERCUT

A. In locations where soil at the bottom trench is unstable, the Contractor shall excavate (undercut) below the trench bottom and place stone refill.

3.18 DIVERTING EXISTING SEWERS

A. Where existing sewers or drains are encountered in the work, adequate provision shall be made for diverting flow in the existing sewers so that the excavation will be kept dry during the progress of the construction work. Upon completion of the construction work, the existing sewers shall be restored or otherwise provided with an adequate outlet as directed by the Owner's Representative. Sewer diversion shall be considered incidental to the project.

3.19 SHEETING, BRACING, SHORING

A. Where required to properly support the surfaces of excavations to protect the construction work, adjacent work or workers, sheeting, bracing and shoring shall be provided by the contractor. If the Owner's Representative determines that at any point sufficient or proper supports have not been provided, he may order such additional supports at the expense of the Contractor, but neither the placing of such additional supports by the order of the Owner's Representative nor failure of the Owner's Representative to order such additional supports placed shall release the Contractor from his responsibility for the sufficiency of such supports and the integrity of the work. In removing the sheeting and bracing after the construction has been completed, special care shall be taken to prevent any caving of the sides of the excavation and injury to the completed work or to the adjacent property.

3.20 SHEETING LEFT IN PLACE

A. Sheeting, bracing and shoring shall not be left in place after completion of the work except as required by the Engineer or Owner's Representative. Where sheeting, bracing, and shoring must be left in place in order to protect the work, adjacent structures, or property, it shall be cut off or left not less than two (2) feet below the finish surface grade. If sheeting, shoring or bracing must be left in place, then it shall be paid for at the contract unit bid price that is shown on the Bid Form. If a pay item was not included on the Bid Form, then a work order shall be negotiated.

3.21 CROSSING EXISTING STRUCTURES AND PIPES

A. During construction, it may be necessary to cross under certain sewers, drains, culverts, water lines, gas lines, electric conduits and other underground structures. Every effort shall be made to prevent damage to such structures. Wherever such structures or utilities are disturbed or broken, they shall be restored to good working condition. Compacted granular backfill shall be placed around, above, and below such utilities as described in the section pertaining to backfilling. MDOT Grade S3 concrete shall be utilized where directed by the Engineer or Owner's Representative at

no additional cost to the project. Either granular backfill or concrete shall be brought to, at minimum, the spring line of the higher utility.

3.22 TUNNELING TREES

A. Trees eight (8) inches in diameter or less will require a minimum tunnel length of eight (8) feet. Trees over eight (8) inches in diameter, measured four (4) feet above the ground surface, will require a minimum tunnel length equal to one foot for each inch of tree diameter.

B. Trees shall be tunneled whenever any portion of an excavation approaches within a distance equal to one-half the required tunnel length except as otherwise noted on the plans.

C. Tunneling under trees may be accomplished by one of the following:
   1. Boring and jacking casing pipe along with placement of a carrier pipe.
   2. Boring and jacking of sewer pipe or water main without a casing pipe.
   3. Jacking sewer or water main without boring and without a casing pipe.

D. Plan notes or existing field conditions shall indicate which method may be used for the tree tunneling work.

3.23 BEDDING

A. Bedding shall be worked under the haunches of the pipe to provide firm, continuous support.

B. Material shall be placed and compacted on the sides and above the pipe in accordance with the “Initial Backfill” paragraph below.

3.24 BACKFILL

A. Place and compact backfill in excavations promply, but not before completing the following:
   1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for Record Documents.
   3. Testing and inspecting underground utilities.
   4. Removing concrete formwork.
   5. Removing trash and debris.
   6. Removing temporary shoring and bracing, and sheeting.

B. Place backfill on subgrades free of mud, frost, snow, or ice. No sloppy or wet material shall be used as backfill.

C. Contractor shall backfill trenches and other excavations with suitable excavated material or granular material as specified in this section.

D. Initial Backfill (up to 12” over pipe) shall be compacted granular backfill for pipes less than 36 inches in diameter. Bedding and backfill of pipes 36 inches in diameter or greater shall be pea gravel up to the spring line of the pipe and compacted granular backfill from the spring line up to 12 inches above the pipe.

E. Final backfill (greater than 12” above pipe):
   1. Final backfill shall be compacted granular backfill unless otherwise noted in the project plans and details. Final backfill material shall be placed in layers not to exceed 12 inches

thick unless the Contractor can demonstrate to the satisfaction of the Owner's Representative that he can consistently attain the specified density at all depths on thicker lifts.

2. If the moisture content of job excavated cohesive backfill material exceeds the optimum moisture content for maximum density by more than three percent (3%), the Contractor shall dry the material to meet the foregoing moisture content limitation or provide, at his own expense, approved granular backfill.
3. Each lift of final backfill, granular material and job excavated backfill, shall be compacted by the contractor to 95% of maximum unit weight, as verified in accordance with the "Density Testing of Backfill" paragraph below. Additional lifts of backfill shall not be placed until acceptable compaction has been achieved and verified on the underlying lift.
4. Wherever gas mains, water mains, sewers, or other utilities are located in the trench area, granular backfill shall be used for backfill from bottom of the trench up to the spring line of the highest pipe. Granular backfill shall be placed across the full trench width and extend far enough either side of the existing pipe to allow specified compaction so as to thoroughly support the pipe within the trench area.

F. Maximum unit weight will be determined by ASTM D 1557, current methods of Test for Compaction and Density of Soil, AASHTO Designation T-180 or by the Cone Density Method developed by MDOT, as directed by the Owner or Owner's Representative.

G. When job excavated backfill and/or compaction methods are not suitable to obtain the specified compaction, the Contractor shall, at his expense, remove unsuitable materials or add granular materials, or both, to obtain compaction as specified.

H. Any depression resulting from settlement of any backfill prior to the date of final payment for all work under this contract shall be brought to the proper grade and surface and made to match the adjacent surface. Any additional surface restoration, re-pavement, utility repair, and/or landscaping repairs required as a result of settlement shall be performed in accordance with the relevant Section at the Contractor's expense.

I. Compaction:
1. Initial backfill of pipes (up to 12" over pipe) shall be compacted with a hand tamper, walk-behind vibratory compactor or equivalent equipment.
2. Compaction of Final backfill shall be obtained with the use of a bulldozer, sheepsfoot roller, mechanical tamper, excavator mounted compactor, or other similar and effective equipment. Compaction shall be performed by the contractor at his expense, in order to satisfy the density requirements of this contract.
3. Materials identified on the plans as "CIP" or "Compacted" shall be compacted in this manner and to the requirements of this section.

J. Density Testing of Backfill
1. Density of compacted final backfill shall be verified in-place by the Owner's Representative in accordance with ASTM D 6938 (nuclear gauge).
2. The Contractor shall be informed of all density test results as they are recorded.
3. Contractor is responsible for providing and maintaining safe and reasonable access for a field engineer or technician to verify the compaction of each lift in the trench.

K. Trenches in Pavement Areas
1. Final backfill shall be granular backfill for all trenches under proposed or existing paved streets, shoulders, traveled roadways, parking areas and driveways as shown on the plans up to the required surface subgrade elevation which will allow for placement of the required gravel base and/or pavement surface. With the approval of the Owner's Representative, water jetting may be accepted in lieu of tamping for granular backfill only.
2. Final backfill shall be compacted granular backfill for the entire trench when either edge of trench is within three (3) feet of proposed or existing edge of pavement. On road crossings,

specified compaction shall extend ten (10) feet beyond the edge of pavement for paved roadways with gravel shoulders or shall extend three (3) feet beyond the back of curb for roadways with curb.

3. Trenches under proposed or existing concrete sidewalks and bike paths shall be backfilled from one foot above top of pipe to a level four (4) inches below finished grade of the sidewalk with approved suitable excavated backfill or granular backfill and compacted to ninety-five percent (95%) maximum density.

L. Backfilling Around Structures

1. As soon as practicable after concrete structures have set, forms and debris shall be removed and the surface of the concrete pointed. After the structure has been checked and approved, the excavated area around the structure shall be backfilled up to specified subgrade with granular material or suitable excavated material as called for on the drawings for the adjacent trench. The fill shall be thoroughly compacted by machine tamping. No large boulders or ma-sonry shall be placed in backfill. No backfill will be placed against manhole walls within 48 hours after the plaster coat has been applied to the outside of the walls nor shall backfill be placed about concrete structures until concrete has attained at least 75 percent of its design strength and approval of the Engineer has been obtained.

3.25 PLACING AND COMPACTING EMBANKMENT

A. Embankment material for fill work shall be in accordance with Section 2.05. 03 of the MDOT Standard Specifications for Construction.

3.26 WARNING TAPE INSTALLATION

A. Contractor shall place warning tape directly over all lengths of pipe, between lifts of final backfill a minimum of 12 inches above the top of the pipe and no less than 12 inches from the finish grade of the trench, as directed by the Owner’s Representative or the plans.

3.27 REMOVAL AND TRANSPORT OF EXCAVATED MATERIAL

A. Excess suitable material and unsuitable material that remains after trenching and backfill activities shall be handled and disposed of in accordance with the Division 31 Section regarding “EARTH MOVING”

3.28 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide: a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

D. Final Cleanup and Grading: Upon completion of the construction, and before final payment is made, the Contractor shall restore his working area to as clean a condition as existed before his operations were started. He shall go over the entire line and refill any place that may have settled. He shall then re-grade and put in shape all backfilled trenches, all fills he may have made from excess excavated materials, and all other areas that may have been disturbed through all operations.

3.29 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.30 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified geotechnical testing agency to perform the following special inspections:
   1. Determine that backfill material and maximum lift thickness comply with requirements.
   2. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Contractor shall allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent trenching and backfilling only after test results for previously completed work comply with requirements.

C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained. Material shall be replaced at the cost of the contractor if repeated tests of backfill are not verified as acceptable to the testing agency.

3.31 CONTRACTOR SAFETY REQUIREMENTS

A. The excavation and trenching operations shall be conducted by the Contractor in a manner that will provide safe working conditions for all persons on the site who may be affected by the Work. The Contractor shall also conduct his operations in a manner that will protect adjacent property from damage.

B. Trench sides shall be either cut back to the slope as necessitated by soil and ground water conditions to provide stable sides, or supporting systems shall be installed that are capable of restraining the earth sides from movement. A qualified employee of the Contractor shall design the trench supporting systems.

C. The Contractor shall employ, at all times at the site of the work, a qualified person who will be responsible for the safety of both the work and workmen, and who will make all the decisions relevant to the stability of trenches, the adequacy of any and all protective devices, proper operation of equipment, and all other matters related to safety.

D. The Contractor shall not store, along and adjacent to the trench, excavated material, heavy equipment, backfill materials, sewer pipe, or other construction materials which may impose too great a load on the earth and cause displacement or caving of the earth. The Contractor shall, at all times, provide a safe means of emergency exit from all trench excavations.

END OF SECTION 31 23 33

SECTION 31 25 00 – SOIL EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes conducting earthwork and earth change activity operations in a manner to protect Waters of the State (of Michigan), storm drains, and adjacent properties from soil erosion and sedimentation transport.

B. Work shall include furnishing of labor, materials, tools, equipment, accessories, and services necessary for installing the control measures as shown on the contract drawings and/or as herein required. This also includes maintenance, cleaning, and removal of temporary control measures, as required.

C. Section Includes:

1. Temporary control measures
    a. Diversion Channels
    b. Stone Check Dams (as indicated)
    c. Straw Wattles
    d. Silt Fence
    e. Construction entrances
2. Permanent control measures
    a. Stone Check dams (as indicated)
    b. Turf reinforcement mats / mulch blankets
    c. Slope Stabilization (Mulch Blankets)
    d. Vegetated Tied Concrete Block Mat
    e. Riprap

D. Related Sections:

1. Section 31 10 00 - Site Clearing.
2. Section 32 90 00 – Planting

1.2 RELATED DOCUMENTS

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

B. ASTM D 4632 “Standard Test Method for Grab Breaking Load and Elongation of Geotextiles”

C. ASTM D 3786 “Standard Test Method for Bursting Strength of Textile Fabrics – Diaphragm Bursting Strength Tester Method”

D. ASTM D 4833 “Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products”

E. ASTM D 4533 “Standard Test Method for Trapezoid Tearing Strength of Geotextiles”

F. ASTM D 4355 “Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc Type A Apparatus”

G. ASTM D 4751 “Standard Test Method for Determining Apparent Opening Size of a Geotextile”

H. ASTM D 4491 “Standard Test Methods for Water Permeability of Geotextiles by Permittivity”

I. Michigan Department of Transportation Density Testing and Inspection Manual (rev 2024)

J. Michigan Department of Transportation (MDOT) Standard Specifications for Construction (rev 2020).

1. All reference to MDOT specifications apply to methodology, materials, and quality control only. Measurement and payment shall be in accordance with these Contract Documents; MDOT payment provisions do not apply.

1.3 DEFINITIONS

A. "Waters of the State" includes the Great Lakes and their connecting waters, lakes, ponds and streams which may or may not be serving as a County drain as defined by the drain code; or any other body of water that has definite banks, a bed and visible evidence of a continued flow or continued occurrence of water or wetlands regulated under Part 303.

B. Temporary control measures shall be defined as protective measures installed by the contractor to control erosion of earth and to maintain quality of discharged runoff during the activities described in this contract and shown on the contract plans. Temporary measures shall be removed after the conclusion of associated work when permanent control measures and restoration are functioning fully and only under the direction of the Owner's Representative.

C. Permanent control measures shall be defined as protective measures installed by the contractor to control erosion of earth and maintain quality of discharged runoff during and after execution of the contract.

D. Local Regulator or Local Authorized Agency: Department of Environment, Health and Safety (EHS) or their designee.

1.4 SUBMITTALS

A. Submit product information for each material proposed for use including but not limited to:

1. Aggregate / riprap (include gradation analysis)
2. Geosynthetics
3. Mulch blankets
4. Turf reinforcement mats
5. Silt fence

1.5 QUALITY CONTROL

A. Requirements of Regulatory Agencies: For earth changes, comply with the following:

1. Part 91, Soil Erosion and Sedimentation Control (SESC) of the Natural Resource & Environmental Protection Act, 1994 PA 451, as amended (Part 91).
2. The Genesee County Drain Commission SESC Standard Specifications and Details.

1.6 INSPECTIONS

A. The Contractor or their designee, who have received a Michigan Department of Environment, Great Lakes, & Energy (EGLE) SESC certificate of training, will inspect sites weekly during construction activities and within 24 hours of a significant rain event (for sites 1 acre or more in size or within 500 feet of a lake,river, or stream) to ensure compliance with Part 91 SESC Regulations. These inspections will continue from the beginning of earthwork until the site is stabilized.

1.7 PERFORMANCE REQUIREMENTS

A. Implement the soil erosion and sedimentation control plan including required maintenance during construction and final removal as directed in the plans, and as needed per site conditions and as required by site inspections.

B. Control runoff, soil erosion, and sedimentation. No sediment shall leave the site.

C. Prevent wind erosion. No visible emissions (dust) shall leave the site.

1.8 REFERENCES

A. Genesee County Drain Commissioner's Standard Specifications & Details for Soil erosion & Sedimentation Control.

PART 2 - MATERIALS

2.1 GENERAL

A. Do not used crushed concrete, crushed HMA, or brick for any erosion control materials, except as noted.

2.2 ANTI-TRACKING PAD / CONSTRUCTION ENTRANCE

A. Woven geotextile shall meet the requirements of MDOT specification 910.03 and Table 910-1 for "Woven Geotextile Separator" as follows:

1. Grab Tensile Strength (ASTM D 4632): 270 pounds minimum
2. Trapezoid Tear Strength (ASTM D 4533): 100 pounds minimum
3. Puncture Strength (ASTM D 4833): 100 pounds minimum
4. Mullen Burst Strength (ASTM D 3786): 400 psi minimum
5. Permittivity per second (ASTM D 4491): 0.05
6. Apparent Opening Size (ASTM D 4751): 0.425 mm maximum

B. Aggregate shall be 2-inch diameter coarse stone or meet the requirements of MDOT Specification 916.01.B for Coarse Aggregate: commercially graded material with particle sizes from 3/4-inch to 3 inches. Aggregate must be free of debris and protruding reinforcement.

C. Crushed concrete may only be used if approved by the Owner's Representative in advance of the project's commencement.

2.3 CHECKDAMS

A. Check dams shall be straw wattles (see below).

2.4 PLANTING MATERIALS

A. Seed and mulch for general site restoration shall be in accordance with Section 32 90 00 "Planting."

2.5 RIPRAP

A. Riprap and geotextile liner for riprap shall be in accordance with Genesee County Drain Commissioners Standard Specifications and Details.

2.6 VEGETATED CHANNEL - TURF REINFORCEMENT MAT

A. Turf Reinforcement Mat shall be North American Green ERONET P300, VMAX SC250, or approved equal.

2.7 SILT FENCE

A. Filter Fabric: geotextile filter fabric meeting the following requirements:

1. Fabric width: 36 inches
2. Grab Tensile Strength (ASTM D 4632): 100 pounds minimum
3. Trapezoid Tear Strength (ASTM D 4533): 45 pounds minimum
4. Permittivity per second (ASTM D 4491): 0.10

5. Apparent Opening Size (ASTM D 4751): 0.60 mm maximum

B. Wood stakes shall be 48 inches long and 1.5-inch by 1.5-inch

2.8 SLOPE STABILIZATION

A. General

1. Install mulch blankets in accordance with the standard details to prevent erosion of soils along all slopes equal to or greater than 6H:1V.

B. Mulch Blankets

1. Mulch blankets shall be in accordance with Section 32 39 00 “Planting.”

2.9 STRAW WATTLES

A. Straw wattles shall have a minimum diameter of 8 inches.

B. Wood stakes shall be 1-inch by 1-inch by 18 to 24 inches long.

PART 3 - EXECUTION

3.1 GENERAL

A. Where the following events result in the need for additional or modified soil erosion and sedimentation control installations to meet the objective of the referenced procedures, provide remedial installations on a timely basis.

1. Unanticipated alterations to the construction schedule.
2. Unanticipated site conditions except Acts of God such as a tornado or fire.

B. Install temporary erosion and sedimentation control measures prior to or upon commencement to earthwork activities.

1. Install an entrance anti-tracking pad with a minimum of 50 feet in length. A geotextile filter fabric should be placed under 6 inches of limestone aggregate.
2. Install silt fence with stakes on the side down gradient from the disturbed area. Toe in six inches of the fencing material.
3. Place stockpiles and other spoil piles away from the drainage system to minimize sediment transport. Keep as few stockpiles as possible during the course of the project. If the stockpile and/or spoil pile must remain on-site overnight, or if the weather conditions indicate the chance for precipitation,
   a. cover the pile with water repellent material to prevent erosion or
   b. install silt fencing or appropriate sedimentation barrier around the base of the pile to prevent transport of sediment to the storm water system and wet the pile as needed to prevent wind erosion, or
   c. apply other control methods as appropriate to the site.

C. Utilize a water truck as needed for dust control.

D. Utilize a sweeping machine to remove sediment tracked onto the pavement on a daily basis at minimum. Use sweeper more frequently as dictated by site conditions and/or as recommended by site inspections.

E. Maintain erosion and sedimentation controls on a daily basis until the contract has been completed and accepted. Maintenance shall include:

1. Repair of damaged installations.
2. Replacement of lost soil erosion & sedimentation control measures.
3. Periodic removal of collected silt and sedimentation as required or directed to maintain effectiveness of the silt traps, filters and basins.

F. Correct non-conforming soil erosion and sedimentation control measures on a timely basis, within 24 hours if Waters of the State are being impacted or could be impacted, or within 5 days if not impacting Waters of the State.

G. When measures not described in this section are required by ordinance or directed by the Owner's Representative or local regulator, the Contractor shall furnish and install such measures in full accordance with MDOT Erosion Control Specification section 208 and related sections. Such additional measures shall be incidental to the contract.

H. Complete permanent soil erosion control measures for all slopes, channels, ditches, or any disturbed land area within 5 calendar days after final grading or the final earth change has been completed. Maintain temporary control measures until permanent soil erosion control measures are in place and the area is stabilized.

3.2 CHECK DAMS

A. Install and maintain check dams across ditches and swales as shown in the plan details and as directed by the Owner's Representative or the regulator.

3.3 SWALE AND CHANNEL PREPARATION

A. Excavate to subgrade and/or place and compact embankment for the installation of the swales and channels as indicated in the drawings.

B. Compact subgrade to 95% of modified proctor value prior to installation

C. Remove and replace soft or yield material with compacted embankment.

3.4 MULCH BLANKETS AND TURF REINFORCEMENT MATS

A. Install all slope and channel erosion control and stabilization items in accordance with the manufacturer's instructions and recommended procedures.

B. All mats, geosynthetics, and blankets shall be anchored in backfilled trenches and/or stapled as necessary to prevent damage and to prevent erosion beneath and around installed materials.

C. All materials shall overlap at least 12 inches or as recommended by the manufacturer, whichever is greater.

3.5 RIPRAP

A. Place riprap in accordance with Genesee County Drain Commissioners Standard Specifications and Details.

3.6 SILT FENCE INSTALLATION

A. Silt fence shall be installed, trenched, overlapped, and attached in accordance with the contract plan detail(s).

B. Extents of silt fence shall be in accordance with the contract plans or as directed by the Owner's Representative or local regulator.

3.7 CLEAN UP

A. Remove temporary erosion control measures after permanent soil erosion measures are in place and the area is stabilized, unless recommended by the Inspector to remain in place. Care shall be taken during removal to prevent soil erosion and sedimentation.

END OF SECTION 31 25 00

SECTION 32 11 00 - SECTION 32 11 00 – BASE COURSES

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.

B. ASTM D 6938 “Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods”

C. ASTM D 1557 “Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort”

D. Michigan Department of Transportation Density Testing and Inspection Manual (rev 2024)

1.2 SUMMARY

A. Work shall include furnishing of labor, materials, tools, equipment, accessories, and services necessary for completing the placement and inspection of the items as shown on the contract drawings and/or as herein required. This also includes proof rolling, preparing subgrade, placing and compacting base courses, and required remedial action, and the disposal of unsuitable material.

B. Section Includes:
1. Subgrade Preparation and Inspection
2. Subgrade Undercut
3. Base aggregate course placement and compaction.

C. Related Sections:
1. Division 01 Section “Temporary Facilities and Controls”.
2. Division 31 Section "Excavation and Fill”
3. Division 32 Sections for “Asphalt Paving” and “Concrete Paving”.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

B. Base Course: Aggregate soil layer placed above subgrade and below pavement, above subbase and below pavement, or above subgrade and below sidewalk.

C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

E. Fill: Soil materials used to raise existing grades.

F. Pavement: Portland Cement Concrete or Hot-Mix Asphalt (HMA) installed over an aggregate base course for supporting vehicular traffic and/or parking.

G. Sidewalk: Portland Cement Concrete installed over a granular base course for supporting pedestrian traffic.

H. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

I. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

J. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Material Test Reports: For each borrow soil material proposed as follows:
   1. Classification according to D 2487.
   2. Laboratory compaction curve according to ASTM D 1557.

1.5 QUALITY ASSURANCE

A. References to Michigan Department of Transportation (MDOT) Specifications shall pertain to the current edition of the Standard Specifications for Construction.

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during PAVING operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Maintain erosion control measures during base and paving work.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS - GENERAL

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

2.2 BASE AGGREGATES

A. Granular Material: shall meet the requirements of Section 902.07 of the MDOT Standard Specifications for Construction for Granular Material for Fill and Subbase.

B. Stone Aggregate shall meet the requirements of Section 902.05 of the MDOT Standard Specifications for Construction for Coarse Aggregate or approved salvaged on-site material.

PART 3 - EXECUTION

3.1 PREPARATION

A. Excavation and filling operations shall be complete prior to placing base courses.

B. Trenching and backfilling operations shall be complete prior to placing base courses over trenches.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

D. Subgrade shall be graded and compacted prior to placing subbase or base course(s).

3.2 SUBGRADE INSPECTION

A. Contractor shall proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. If Engineer or Owner's Representative determines that unsatisfactory soil is present – perform "SUBRADE UNDERCUT". Subgrade undercut performed by the Contractor in areas designated for Fill or Embankment under this contract shall be performed at the expense of the Contractor.

C. Contractor shall reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.3 SUBGRADE UNDERCUT

A. Undercut and remove unsatisfactory soils to depth and horizontal extents as directed by the Engineer or Owner's Representative.

B. Replace the removed material with fill, grade and compact to the plan-indicated subgrade elevations in accordance with the FILL materials and procedures as specified in Section 31 23 00 "Excavation and Fill."

C. Contractor shall underlay fill material with a Stabilization Geotextile as specified in MDOT Specification Table 910-1 placed atop soft soil and fill with compacted granular material, as directed by the Owner's Representative.

3.4 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

2. Do not store in protection zones, 100-year floodplain, or wetlands, as identified on the plans.

3.5 SUBBASE

A. Where identified on the plans and in the applicable details, Contractor shall place and compact a subbase course of GRANULAR MATERIAL atop the subgrade, prior to placing base aggregate course.

B. Compact subbase according to “COMPACTION.”

3.6 AGGREGATE BASE COURSE FOR PAVING

A. In areas to receive concrete pad or HMA pavement, Contractor shall place a base course of STONE AGGREGATE, as identified on the plan, on subgrades or subbase free of mud, frost, snow, organics, or ice as specified in the project plans and details. Thickness and top of base course grades shall match project plans and details.

B. Compact base course according to “COMPACTION.”

3.7 GRANULAR BASE COURSE FOR SIDEWALK

A. Contractor shall place a base course of GRANULAR MATERIAL, as identified on the plan, on prepared subgrades free of mud, frost, snow, or ice as specified in the project plans and details. Thickness and top of base course grades shall match project plans and details.

B. Compact granular base course according to “COMPACTION.”

3.8 COMPACTION

A. Base courses shall be placed in lift thickness as needed to achieve density.

B. Each lift shall be compacted by the contractor to 95% of maximum unit weight, as verified in accordance with the “Density Testing of Base Courses” paragraph below. Additional lifts of subbase, base course and/or pavement shall not be placed until acceptable compaction has been achieved and verified on the underlying lift.

C. Maximum unit weight will be determined by ASTM D 1557, current methods of Test for Compaction and Density of Soil, AASHTO Designation T-180 or by the Cone Density Method developed by MDOT, as directed by the Owner or Owner’s Representative.

D. When compaction methods are not suitable to obtain the specified compaction, the Contractor shall, at his expense, remove unsuitable materials and replace with specified material.

E. Compaction of material shall be obtained with the use of a vibratory roller, mechanical tamper, excavator mounted compactor, or other similar and effective equipment. Compaction shall be performed by the contractor at his expense, in order to satisfy the density requirements of this contract.

F. Density Testing

1. Density of compacted material shall be verified in-place by the Owner's Representative in accordance with ASTM D 6938 (nuclear gauge).
2. The Contractor shall be informed of all density test results as they are recorded.
3. Contractor is responsible for providing and maintaining safe and reasonable access for a field engineer or technician to verify the compaction of each lift of base course.

3.9 REMOVAL AND TRANSPORT OF EXCAVATED MATERIAL

A. Unsuitable material that remains after base course activities shall be hauled off-site.

3.10 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified testing agency to perform the following special inspections:
   1. Determine that fill material and maximum lift thickness comply with requirements and are appropriate to achieve density.
   2. Determine, at the required test frequency, that in-place density of compacted fill complies with requirements.

B. Contractor shall allow testing agency to inspect and test subgrades and each layer of base course. Proceed with subsequent work only after test results for previously completed work comply with requirements.

C. When testing agency reports that base courses have not achieved the degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained. Material shall be replaced at the expense of the contractor if repeated tests are not verified as acceptable to the testing agency.

3.11 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 32 11 00

SECTION 32 13 13 - CONCRETE PAVING

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.

B. ASTM C 94 “Standard Specification for Ready-Mixed Concrete”

C. ASTM C 150 “Standard Specification for Portland Cement

D. MDOT Special Provision for Quality Control and Acceptance of Portland Cement Concrete (12SP-604B-06)

E. American Concrete Institute (ACI) Standard 301 “Specifications for Structural Concrete”

1.2 SUMMARY

A. Work shall include furnishing of labor, materials, tools, equipment, accessories, and services necessary for completing the items as shown on the contract drawings and/or as herein required.

B. Section Includes Concrete Paving Including the Following:
   1. Walks (Sidewalks)

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of product, ingredient, or admixture requiring color selection.

C. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.4 QUALITY ASSURANCE

A. Ready-Mix-Concrete 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" (Quality Control Manual - Section 3, "Plant Certification Checklist").

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Contractor shall engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

B. All reinforcement, aggregates, admixtures, curing compounds, cementitious materials and any other materials required to batch concrete materials and maintain specified criteria shall be considered incidental to the contract.

2.2 STEEL REINFORCEMENT

A. Contractor shall supply in accordance with MDOT Specification 905 and as noted on the plans.

2.3 CONCRETE MATERIALS

A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
   1. Portland Cement, Fly Ash, Slag Cement, and Blended Cement shall be supplied in accordance with MDOT Section 901 “CEMENT AND LIME”

B. Fine Aggregate shall be 2NS Sand in accordance with MDOT Section 902.

C. Course Aggregate shall be 6AA limestone in accordance with MDOT Section 902.

D. Concrete Admixtures shall be supplied in accordance with MDOT Section 903.

E. Water: supplied in accordance with MDOT Section 911.

2.4 CURING MATERIALS

A. Curing materials shall be supplied in accordance with MDOT Section 903.

2.5 RELATED MATERIALS

A. Jointing and waterproofing materials shall be supplied in accordance with MDOT Section 914.

2.6 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to MDOT Section 601 and/or Section 701, for each type and strength of concrete, and as determined by either laboratory trial mixtures or field experience.

B. Mix design identification and/or requirements shall be per the project plans. When the plans do not specify, the following mix designs shall be use:
   1. Driveways: MDOT Concrete Grade P1, P-NC, or S2 or approved equivalent
   2. Roadways: MDOT Concrete Grade P1, 4,000 psi 28-day strength or approved equivalent
   3. Parking lots: MDOT Concrete Grade P1 or approved equivalent
   4. Curbs and gutters:
      a. MDOT Concrete Grade P1 or S2 or approved equivalent
      b. Approved equivalent shall achieve 3,500 psi compressive strength at 28-days
   5. Walks: MDOT Concrete Grade P2, P1, S3, or S2 or approved equivalent

C. Cementitious Materials: Contractor shall select, for approval of the engineer, a mixture with ONE of the following cementitious proportions
   1. 100% Portland cement with an alkali level of less than 0.60% per ASTM C 150 expressed as equivalent Sodium Oxide. The total alkali content from the cement shall not exceed 3.0 pounds per cubic yard.
   2. 35% GGBFS (slag cement) Grade 100 or 120 per ASTM C 989, 65% Portland cement
   3. Other proportion approved by the Engineer

D. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
   1. Air Content: 5.5 percent to 8.0 percent.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

F. Synthetic Fiber: If fiber is included in approved mix design, uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd.

G. Concrete Mixtures.
   1. Compressive Strength (28 Days): per mix design.
   2. Maximum W/C Ratio at Point of Placement: 0.45.
   3. Slump Limit: 3 inches, plus or minus 1 inch unless modified by approved admixture and approved by the Owner’s Representative.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

A. Place steel reinforcement in accordance with MDOT Section 802.03.C

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated on the plans or as directed by the Owner's Representative.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated or in accordance with ACI procedures. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Moisten subbase 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.

B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

D. Screed paving surface with a straightedge and strike off.

E. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
   1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions.
   1. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
   2. After curing, lightly work surface with a steel-wire brush or abrasive stone and water to expose nonslip aggregate.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to 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.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete in accordance with MDOT Section 602.03.M.

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:
   1. Elevation: 3/4 inch.
   2. Thickness: Plus 3/8 inch, minus 1/4 inch.
   3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/2 inch.
   4. Joint Spacing: 3 inches.
   5. Contraction Joint Depth: Plus 1/4 inch, no minus.
   6. Joint Width: Plus 1/8 inch, no minus.

3.10 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by the Owner’s Representative.

B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

D. When pouring against exciting pavement, prevent damage to the adjoining work. Any damage to adjacent work during concrete placement shall be repaired at the expense of the Contractor and to the Owner's acceptance.

3.11 WASHOUT

A. Contractor shall excavate and protect a concrete washout pit as directed by the Owner or Owner's Representative. Contractor shall be fully responsible for compliant clean-up and removal of the wash-out pit at the conclusion of the concrete work. Wash out pit excavation, clean-up, protection, backfill and compaction shall be compliant with Division 31 Section "Excavation and Fill" and shall be performed at no additional cost to the owner.

B. No concrete shall be poured or washed out into storm or sanitary sewers, whether publicly or privately owned.

3.12 BACKFILL

A. After concrete gains the required strength, backfill, compact, and grade the remaining excavated areas.

3.13 QUALITY CONTROL

A. The Contractor shall supply and install concrete which meets or exceeds the requirements as described in this section.

B. The Owner's Representative may sample and test concrete during placement for conformance to the Contract Documents. The Contractor shall provide access to the work area and shall ensure that concrete sampling is facilitated as directed by the Owner's Representative.

C. Sampling and Testing Frequency shall be at the discretion of the Owner or Owner's Representative.

D. In the event that the Owner's Representative determines that the concrete does not meet any one specification, the concrete may be rejected by the Owner's Representative at no cost to the Owner. The Contractor shall be provided with all test results by the Owner's Representative.

E. Rejected loads shall not be placed on site; rejected concrete shall be removed from the site and disposed of at the Contractor's expense.

END OF SECTION 32 13 13

SECTION 32 33 00 - SITE FURNISHINGS

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:

A. Aluminum Fencing.

B. Walkway Handrail.

C. Bench.

D. Trash Receptacle.

B. Related Requirements:

A. Section 31 20 00 "Earth Moving" for excavation for installing concrete footings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

C. Samples for Initial Selection: For units with factory-applied finishes.

D. Product Schedule: For site furnishings.

E. Shop Drawings:
A. Handrails
B. Fencing
C. Bench & trash receptacle

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 DECORATIVE FENCING

A. Basis of Design: Provide 3-Rail aluminum fence with flat top rail and circular accents as depicted in the plans with the following characteristics or an approved equal:
   A. Fence design shall match existing fencing adjacent to the park on the Leroy Street bridge.
   B. Black powder coated finish.
   C. Fence height: 4 feet, grade to top rail.
   D. Component sizing:
      a. Pickets: ¾” square x 0.055 wall thickness
      b. Rails:
         1) Top rail: 1-3/8” x 0.065 wall thickness
         2) Side rail: 1-1/4” x 0.088 wall thickness
      c. Posts:
         1) Standard line posts: Minimum 2” square x 0.080 minimum wall thickness
         2) Gate posts: Minimum 3” square x 0.125 minimum wall thickness
   E. Picket spacing: 3-5/8” maximum.
   F. Post spacing: 72-1/2” maximum.

B. All hardware shall be noncorrosive and tamper proof. Utilize manufacturer recommended hardware where possible.

C. Concrete footing shall be per manufacturers recommended specifications.

2.2 HANDRAIL

A. Handrail basis of design: Provide handrail as depicted on the plans and details, or an approved equal, for the locations shown on the plans.
   A. Handrail Materials: Commercial grade, tubular aluminum, powdercoated black.
      a. ADA compliant.
      b. ASTIM B429, ASTM 247 compliant.
      c. Free of burs or other imperfections.
      d. See plans and details for size.
   B. Mounted as indicated on the plans and details.
      a. Anchorages shall comply with local codes and standards.
      b. Grout (where applicable): Non-shrink Portland cement-based hydraulic grout, mixed and applied in accordance with manufacturer’s instructions; gypsum based materials are not acceptable. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and recommended by manufacturer for exterior use.
   C. Pipe cuts shall be square and accurate for minimum joint gap. Cuts shall be clean and free of chamfer, deburring, nicks and burrs.
   D. No field welding is permitted.
   E. All hardware shall be noncorrosive and tamper proof. Utilize manufacturer recommended hardware where possible.

2.3 BENCH

A. Basis of Design: Provide Waldorf bench manufactured by THOMAS STEELE (www.thomas-steele.com) as depicted in the plans with the following:
   A. Power-coated e-Steele finish
   B. Length: 6 feet.

C. Color: black
D. Surface mounted.
    a. Anchoring accessories shall be per manufacturers recommended specifications.

B. All hardware shall be noncorrosive and tamper proof. Utilize manufacturer recommended hardware where possible.

2.4 TRASH RECEPTACLE

A. Basis of Design: Provide Langdon Receptacle manufactured by THOMAS STEELE (www.thomas-steele.com) as depicted in the plans with the following:
    A. Vertical Strap
    B. Lid Option: crowne lid.
    C. Finish: powder coated e-steele.
    D. Color: black
    E. Capacity: 32 gallon.
    F. Surface mounted.
        a. Anchoring accessories shall be per manufacturers recommended specifications.

B. All hardware shall be noncorrosive and tamper proof. Utilize manufacturer recommended hardware where possible.

2.5 MATERIALS

A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes and complying with the following:
    A. Structural Pipe and Tube: ASTM B 429/B 429M.
    B. Sheet and Plate: ASTM B 209.
    C. Castings: ASTM B 26/B 26M.

B. Steel and Iron: Free of surface blemishes and complying with the following:

    A. Plates, Shapes, and Bars: ASTM A 36/A 36M.
    B. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53/A 53M, or electric-resistance-welded pipe complying with ASTM A 135/A 135M.
    C. Tubing: Cold-formed steel tubing complying with ASTM A 500/A 500M.
    D. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513/A 513M, or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500/A 500M; zinc coated internally and externally.
    E. Sheet: Commercial steel sheet complying with ASTM A 1011/A 1011M.

    F. Perforated Metal: From steel sheet not less than 10 GA; manufacturer's standard perforation pattern.

    G. Expanded Metal: Carbon-steel sheets, deburred after expansion, and complying with ASTM F 1267.
    H. Malleable-Iron Castings: ASTM A 47/A 47M, grade as recommended by fabricator for type of use intended.
    I. Gray-Iron Castings: ASTM A 48/A 48M, Class 200.

C. Stainless Steel: Free of surface blemishes and complying with the following:

A. Sheet, Strip, Plate, and Flat Bars: ASTM A 666.
B. Pipe: Schedule 40 steel pipe complying with ASTM A 312/A 312M.
C. Tubing: ASTM A 554.

D. Plastic: Color impregnated, color and UV-light stabilized, and mold resistant.

A. Polyethylene: Fabricated from virgin plastic HDPE resin.

E. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard

F. Galvanizing: Where indicated for steel and iron components, provide the following protective zinc coating applied to components after fabrication:

A. Zinc-Coated Tubing: External, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, polymer film. Internal, same as external or consisting of 81 percent zinc pigmented coating, not less than 0.3 mil thick.
B. Hot-Dip Galvanizing: According to ASTM A 123/A 123M, ASTM A 153/A 153M, or ASTM A 924/A 924M.

2.6 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended, so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

E. Factory Assembly: Factory assemble components to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.7 GENERAL FINISH REQUIREMENTS

A. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.9 STEEL AND GALVANIZED-STEEL FINISHES

A. Powder-Coat Finish: Manufacturer's standard polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

B. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

2.10 IRON FINISHES

A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.11 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

   A. Run directional finishes with long dimension of each piece.
   B. Directional Satin Finish: No 4.
   C. Dull Satin Finish: No. 6.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Notify Landscape Architect of conditions that would adversely affect installation or subsequent use.

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

3.2 INSTALLATION

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Confirm final location and orientation of Site Furnishings with Landscape Architect prior to installation.

C. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

D. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

E. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

F. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

G. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

3.3 ADJUSTING

A. Finish Damage: Repair minor damages to finish in accordance with manufacturer’s instructions and as approved by Landscape Architect.

B. Component Damage: Remove and replace damaged components that cannot be successfully repaired as determined by Landscape Architect.

3.4 CLEANING

A. Clean site furnishings promptly after installation in accordance with manufacturer’s instructions.

B. Do not use harsh cleaning materials or methods that could damage finish.

3.5 PROTECTION

A. Protect installed site furnishings to ensure that, except for normal weathering, site furnishings will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 32 33 00

SECTION 32 90 00 - PLANTING

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 the following:
   1. Trees.
   2. Shrubs.
   3. Perennials & Annuals.
   4. Lawns.
   5. Plant Mix, topsoil, and soil amendments
   6. Edging
   7. Fertilizers and mulches
   8. Stakes and Guys
   9. Irrigation

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
   2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:
   1. Plant Mix: 1-quart volume of plant mix required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of materials. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
   2. Topsoil: 1-quart volume of topsoil required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of materials. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
   3. Mulch: 1-quart volume of mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Provide an accurate representation of color, texture, and composition.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

B. Soil Analysis: Furnish soil test analysis and a written report by a qualified soil-testing laboratory for the planting mix and topsoil. Soil analysis shall state percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.
   1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
   2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Landscape Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
   3. Report suitability of tested soil for plant growth.
      a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
      b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

D. Sample Warranty: For special warranty, see section 1.9, B. below.

E. Shop Drawings
   1. Irrigation plan: Irrigation systems, drawn to scale, on which components are shown and coordinated with each other, using input from Installers of the items involved. Also include adjustments necessary to avoid plantings and obstructions such as signs and light standards.
      a. Zoning Chart: Show each irrigation zone and its control valve.
      b. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance and warranty periods.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
   1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that landscaping is in progress.

B. Provide quality, size, genus, species, and variety of trees, shrubs, and perennials indicated, complying with applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock."
   1. Contractor shall submit sources for all plant materials for the job at the award of contract and in no case less than three months from start of construction.
   2. Plant schedules shown on the drawings outline proposed sizes for plants. The sizes listed shall be considered as the minimum that will be accepted under the contract.
   3. Contractor should notify the Landscape Architect if plants are unavailable in size specified. No substitutions shall be permitted without Landscape Architect approval.

C. Measurements: Measure trees and shrubs according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size, and 12 inches above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

D. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Bulk and Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.

B. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

C. Trees and Shrubs: Deliver freshly dug trees and shrubs. Do not prune before delivery, except as approved by the Landscape Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape. Provide protective covering during delivery. Do not drop trees and shrubs during delivery.

D. Handle balled and burlapped stock by the root ball.

E. Deliver trees, shrubs, ground covers, perennials, and plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist.
   1. Set balled stock on ground and cover ball with soil, mulch, peat moss, sawdust, or other acceptable material.
   2. Do not remove container-grown stock from containers before time of planting.
   3. Water root systems of trees and shrubs stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.8 COORDINATION AND SCHEDULING

A. Coordinate installation of planting materials during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
   1. Spring Planting: March 15 to June 1.
   2. Fall Planting: September 1 to November 30

1.9 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. B. Special Warranty: Warrant the following living planting materials for a period of one year after date of Substantial Completion, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, abnormal weather conditions unusual for warranty period, or incidents that are beyond Contractor's control.
   1. Trees.
   2. Shrubs.
   3. Perennials & Ornamental Grasses
   4. Lawn Seed Mixes

C. Remove and replace dead planting materials immediately within the following period. Wait until the next planting period if outside of these periods.

D. Replace planting materials that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
   1. Spring Planting: March 15 to June 1.
   2. Fall Planting: September 1 to November 30.

E. A limit of one replacement of each plant material will be required, except for losses or replacements due to failure to comply with requirements.

1.10 TREE AND SHRUB MAINTENANCE

A. Maintain trees and shrubs by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings. Maintain trees and shrubs for the following period:
   1. Maintenance Period: One (1) year from date of Substantial Completion.

B. Contractor shall remove all tree staking and guying no later than after the first growing season.

1.11 PERENNIAL MAINTENANCE

A. Maintain ground cover and shrubs by watering, weeding, fertilizing, and other operations as required to establish healthy, viable plantings for the following period:
   1. Maintenance Period: One (1) year from date of Substantial Completion.

1.12 LAWN MAINTENANCE

A. Begin maintenance of lawns immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
   1. Seeded Lawns: One (1) year from date of Substantial Completion.
      a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established at that time, continue maintenance during next planting season.

B. Maintain and establish lawns by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.

C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawns uniformly moist to a depth.
   1. Water lawn at the minimum rate of 1 inch per week.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

A. General: Furnish nursery-grown trees and shrubs conforming to ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide vigorous plant stock that is healthy, well-shaped and fully-branched with intact, strong, straight leaders, free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Grade: Provide trees and shrubs of sizes and grades conforming to ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

2.2 FLOWERING TREES

A. Small Trees: Small upright or spreading type, branched or pruned naturally according to species and type, and with relationship of caliper, height, and branching recommended by ANSI Z60.1, and stem form as follows:
   1. Form: Single stem.
   2. Form: Multistem, clump, with 2 or more main stems.

B. Provide balled and burlapped trees.

2.3 DECIDUOUS SHRUBS

A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.

2.4 BROADLEAF EVERGREENS

A. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, conforming to ANSI Z60.1.

2.5 PERENNIALS

A. Provide perennials and ornamental grasses established and well rooted in removable containers and with not less than the minimum number and length of runners required by ANSI Z60.1 for the pot size indicated.

2.6 GRASS MATERIALS

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with the Association of Official Seed Analysts' "Rules for Testing Seeds" for purity and germination tolerances.
   1. Seed Mixture: Subject to compliance with requirements, available products that may be

Kind of Seed	% by Weight	% Purity	% Germination	% Pure Life Seed
Perennial Ryegrass	10	98	85	82
	Perennial Ryegrass: To be either Caddieshack II of Top Gun II			
Kentucky Bluegrass	10	38	85	82
	Kentucky Bluegrass: To be either Chip or Nu Blue			
Tall Fescue	80	98	85	82

Tall Fescue: To be a blend of two (2) cultivars of equal percentage of Arid 3, Inferno or Quest by Jacklin seed by Simplot

incorporated into the Work include, but are not limited to, the following:

2.7 PLANT MIX

A. All materials must be as specified and detailed in the Landscape Plans, except that the planting mix must consist of three parts well-drained, screened organic topsoil, to one part imported clean sand meeting 2NS gradation, to one-part natural compost (weed-free) or peat moss.
   1. Topsoil: ASTM D 5268, pH range of 5.5 to 7, with a minimum of 5 percent organic material, free of stones 1 inch or larger in any dimension, and other extraneous materials harmful to plant growth.
      a. Topsoil Source: Amend existing surface soil to produce topsoil. Supplement with imported topsoil when required.

B. Provide compost, peat moss and topsoil in accordance with section 917 of the MDOT Standard Specifications for Construction. Sand must be clean and free of rocks, clods, sticks, and other such debris.

2.8 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, with a minimum of 5 percent organic material, free of stones 1 inch or larger in any dimension, and other extraneous materials harmful to plant growth.
   1. Topsoil Source: Amend existing surface soil to produce topsoil. Supplement with imported topsoil when required.

2.9 SOIL AMENDMENTS

A. Lime: ASTM C 602, Class T, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, with a minimum 99 percent passing a No. 8 sieve and a minimum 75 percent passing a No. 60 sieve.
   1. Provide lime in the form of dolomitic limestone.

B. Sand: Clean, washed, natural or manufactured sand, free of toxic materials.

C. Perlite: Horticultural perlite, soil amendment grade.

D. Peat Humus: Finely divided or granular texture, with a pH range of 6 to 7.5, composed of partially decomposed moss peat (other than sphagnum), peat humus, or reed-sedge peat.

E. Peat Humus: For acid-tolerant trees and shrubs, provide moss peat, with a pH range of 3.2 to 4.5, coarse fibrous texture, medium-divided sphagnum moss peat or reed-sedge peat.

F. Sawdust or Ground-Bark Humus: Decomposed, nitrogen-treated, of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
   1. When site treated, mix with at least 0.15 lb of ammonium nitrate or 0.25 lb of ammonium sulfate per cu. ft. of loose sawdust or ground bark.

G. Manure: Well-rotted, unbleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

H. Herbicides: EPA registered and approved, of type recommended by manufacturer.

I. Water: Potable.

2.10 FERTILIZER

A. Bonemeal: Commercial, raw, finely ground; minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea-form, phosphorous, and potassium in the following composition:
   1. Composition: 1 lb per 1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
   2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

D. Slow-Release Fertilizer: Granular fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
   1. Composition: 5 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight.
   2. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
   3. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.11 MULCHES

A. Organic Mulch: Organic mulch, free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
   1. Type: Triple processed shredded hardwood.

2. Size Range: 2 inches maximum, ½ inch minimum.

2.12 MISCELLANEOUS MATERIALS

B. Stakes and Guys: Provide stakes of sound new hardwood, treated softwood, or redwood, free of knot holes and other defects. Provide wire ties and guys of 2-strand, twisted, pliable galvanized iron wire, not lighter than 12 ga. with zinc-coated turnbuckles. Provide not less than ½ inch diameter rubber or plastic hose, cut to required lengths and of uniform color, material and size to protect tree trunks from damage by wires.

C. Steel Edging: Standard-profile extruded-aluminum edging, ASTM A1011, fabricated in standard lengths with interlocking sections with loops stamped from face of sections to receive stakes.
1. Thickness: 3/16 inch
2. Height: 4 inches
3. Stakes: Aluminum, ASTM A1011, 3/16 inch by 16 inches long
4. Finish: Manufacturer's standard paint, unless otherwise noted.
   a. Color: Black

D. Irrigation: Automatic Underground Irrigation System to provide head to head coverage to all proposed plantings. Expand the existing irrigation system(s) where possible.
1. Contractor shall design the irrigation system to provide head to head coverage to all proposed lawn and planting areas as indicated on the plans and submit shop drawings to the Landscape Architect for approval prior to installation. Refer to plans for additional irrigation information.
2. Where an existing system is expanded, all new materials (heads, nozzles, valves, etc.) shall be of the same manufacturer as the existing system.
3. Provide at least 18 inches of cover over piping. Cap or plug pipe ends when pipe installation is not completed at the end of each day.
4. Backfill. Backfill and compact all trenching required for complete installation of the system. Compaction must be such that the original density of the material is obtained. Backfill material must be free from rock, large stones or other unsuitable substances that may damage the piping. Backfilling of trenches containing plastic pipe must be conducted when the pipe is cool to avoid excessive contraction.
5. Testing and Flushing. Test all main lines and lines that will have continuously applied pressure at 160 psi or at the rated pressure of the pipe, whichever is lower. Repair any leaks discovered during testing. Retest the line following the repairs and repeat the pressure testing and subsequent repairs until repairs are satisfactory to the Landscape Architect.
6. Test each individual zone line at the operating pressure of the zone and repair any leak that is found. Retest any zone with leaks and repairs. Thoroughly flush the entire system after testing. Following the testing and flushing of the system, demonstrate the full operation of the irrigation system, in the presence of the Landscape Architect and/or owner, with particular attention to the operation of the irrigation controller.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, and secure Landscape Architect's acceptance before the start of planting work. Make minor adjustments as may be required.

3.3 PLANTING SOIL PREPARATION

A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.

B. Mix soil amendments and fertilizers with topsoil at rates indicated in the planting details. Delay mixing fertilizer if planting does not follow placing of planting soil within a few days.

C. For tree pit or trench backfill, mix planting soil before backfilling and stockpile at site.

D. For planting beds and lawns, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.
   1. Mix lime with dry soil prior to mixing fertilizer. Prevent lime from contacting roots of acid-tolerant plants.
   2. Apply phosphoric acid fertilizer, other than that constituting a portion of complete fertilizers, directly to subgrade before applying planting soil and tilling.

3.4 LAWN PLANTING PREPARATION

A. Limit subgrade preparation to areas that will be planted in the immediate future.

B. Excavate existing soils as required to meet specified grade requirements. Contractor shall properly remove and dispose of unwanted spoils from site at no additional cost to the owner.

C. Loosen subgrade to a minimum depth of 4 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous materials.

D. Spread topsoil to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen.
   1. Place approximately 1/2 the thickness of topsoil mixture required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.

E. Preparation of Unchanged Grades: Where lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare soil as follows:
   1. Remove and dispose of existing grass, vegetation, and turf. Do not turn over into soil being prepared for lawns.
   2. Till surface soil to a depth of at least 6 inches. Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches of soil. Trim high areas and fill in depressions. Till soil to a homogenous mixture of fine texture.
   3. Clean surface soil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
   4. Remove waste material, including grass, vegetation, and turf, and legally dispose of it off the Owner's property.

F. Grade lawn and grass areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1 inch in any dimension, and other objects that may interfere with planting or maintenance operations.

G. Moisten prepared lawn areas before planting when soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

H. Restore prepared areas if eroded or otherwise disturbed after fine grading and before planting.

3.5 PERENNIAL AND ANNUAL BED PREPARATION

A. Excavate planting bed areas to a minimum depth of 12 inches, or as specified on the plans. Contractor shall properly remove and dispose of unwanted spoils from site at no additional cost to the owner.

B. Loosen subgrade of planting bed areas to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension, sticks, roots, rubbish, and other extraneous materials.

C. Spread planting soil mixture to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Place approximately 1/2 the thickness of planting soil mixture required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.

D. Till soil in beds to a minimum depth of 6 inches and mix with specified soil amendments and fertilizers.
   1. Refer to plans for bed depths.
   2. Take cautions and preventative measures in accordance with Division 31 Section "Site Clearing" for protection of existing plant material to remain.

E. Finished grade of planting beds, including mulch, must be level with the grade of the adjacent ground (existing planting areas, lawn areas, walkways, curb grades, etc.).

3.6 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.
   1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
   2. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
   3. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
   4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
   5. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.

6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
7. Maintain supervision of excavations during working hours.
8. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
9. If drain tile is indicated on drawings or required under planting areas, excavate to top of porous backfill over tile.
10. Contractor shall properly remove and dispose of unwanted spoils from site at no additional cost to the owner.

B. Backfill Soil: Subsoil and topsoil removed from excavations may not be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

D. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.

E. Fill excavations with water and allow to percolate out, before placing setting layer and positioning trees and shrubs. If pit doesn't drain within a 24-hour period, notify Landscape Architect before planting and implement means to provide adequate drainage.

F. Finished grade of planting beds, including mulch, must be level with the grade of the adjacent ground (existing planting areas, lawn areas, walkways, curb grades, etc.).

3.7 PLANTING TREES AND SHRUBS

A. Set balled and burlapped stock plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated.
1. Place stock on setting layer of compacted planting soil.
2. Remove burlap and wire baskets from tops of balls and partially from sides, but do not remove from under balls. Remove pallets, if any, before setting. Do not use planting stock if ball is cracked or broken before or during planting operation.
3. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately 1/2 backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.
4. Verify root flare is visible and no more than 1" above adjacent grades.

B. Set container-grown stock plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated.
1. Carefully remove containers so as not to damage root balls.
2. Place stock on setting layer of compacted planting soil.
3. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately 1/2 backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.

C. Dish and tamp top of backfill to form a 4-6 inch high mound around the rim of the pit. Do not cover top of root ball with backfill.

3.8 TREE AND SHRUB PRUNING

A. Prune, thin, and shape trees and shrubs as directed by Landscape Architect.

B. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by Landscape Architect, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character. Shrub sizes indicated are size after pruning.

3.9 PLANTING PERENNIALS AND ANNUALS

A. Space ground cover and plants as indicated.

B. Dig holes large enough to allow spreading of roots and backfill with planting soil. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

3.10 STEEL EDGING

A. Install steel edging where indicated on the plans according to manufacturer's written instructions and the contract documents. Anchor with stakes as shown on the contract documents. Top of stakes are to be below top elevation of edging.

3.11 MULCHING

A. Mulch backfilled surfaces of pits, trenches, planted areas, and other areas indicated.

B. Organic Mulch: Apply the following average thickness of organic mulch and finish level with adjacent finish grades. Do not place mulch against trunks or stems.
   1. Thickness: 3 inches.

3.12 SEEDING NEW LAWNS

A. Sow seed with a spreader or a seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in 2 directions at right angles to each other. Alternatively, lawn areas may be hydroseeded.
   1. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.

B. Sow seed at the following rates:
   1. Seeding Rate: Per manufacturers recommendations

C. Rake seed lightly into top 1/8 inch of topsoil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acreto form a continuous blanket 1-1/2 inchesin loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

3.13 RECONDITIONING LAWNS

A. Recondition existing lawn areas damaged by Contractor's operations, including storage of materials or equipment and movement of vehicles. Also recondition lawn areas where settlement or washouts occur or where minor regrading is required.

B. Remove sod and vegetation from diseased or unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.

C. Where substantial lawn remains, mow, dethatch, core aerate, and rake. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

D. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of it off the Owner's property.

E. Till stripped, bare, and compacted areas thoroughly to a depth of 6 inches.

F. Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches of soil. Provide new planting soil as required to fill low spots and meet new finish grades.

G. Apply seed and protect with straw mulch as required for new lawns.

H. Apply sod as required for new lawns.

I. Water newly planted areas and keep moist until new grass is established.

3.14 CLEANUP AND PROTECTION

A. During landscaping, keep pavements clean and work area in an orderly condition.

B. Protect landscaping 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.

3.15 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner's property

3.16 FINAL INSPECTION

A. Final walk through:
   1. Landscape Architect shall perform a walk-through inspection at Substantial Completion for review of all planting and landscape operations and compliance with Construction Documents.
   2. Landscape Architect shall identify any deficiencies in the form of a punch list.

3. Contractor shall correct deficiencies within ten days of receiving the punch list.
4. Final acceptance shall not be given until all deficiencies are corrected and approved by the Owner.
5. Contractor shall maintain site until final acceptance.

END OF SECTION 32 90 00