CLEVELAND HARBOR EASTERN EMBAYMENT RESILIENCE STRATEGY (CHEERS)

EARLY ACTION PROJECT, HABITAT LOOP - 90% Design

Project Manual

January 22, 2026

DOCUMENT 000101

PROJECT TITLE PAGE

PROJECT MANUAL

PROJECT:	CLEVELAND HARBOR EASTERN EMBAYMENT STRATEGY (CHEERS) Early Action Project, Habitat Loop E55th, Lakefront Cleveland, OH 44114
OWNER:	PORT OF CLEVELAND Port of Cleveland 1100 W 9th Street, Suite 300, Cleveland, OH 44113 CLEVELAND METROPARKS Cleveland Metroparks 4101 Fulton Parkway, Cleveland, OH 44144
ARCHITECT OF RECORD (ENGINEER):	ARUP, US INC 140 Broadway New York, NY 10005

END OF SECTION

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LIST OF CONSULTANTS

OWNERS CONSULTANTS:

ARCHITECT OF RECORD (ENGINEER):	ARUP, US INC 140 Broadway New York, NY 10005
COASTAL ENGINEERING CONSULTANT:	KS ASSOCIATES 260 Burns Road, Suite 100 Elyria, OH 44035
LANDSCAPE ARCHITECT:	WRT 1700 Market Street, Suite 2800 Philadelphia, PA 19103
ECOLOGIST:	DAVEY RESOURCE GROUP, INC. 1310 Sharon Copley Rd Sharon Center, OH 44274

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SITE PREPARATION

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, may apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected site elements.
2. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.
2. Section 312000 "Earth Moving" for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.

1.3 DEFINITIONS

A. Remove and Demolish: 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 / Reset / Reinstate: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

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

1.4 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.

1.5 PREINSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
4. Review areas where existing construction is to remain and requires protection.
    a. Review extents of existing Grove of Remembrance trees along Audrey Zapp Drive south of the Marina Green requiring protection.
    b. Review and protect extents of historic structures and the 9/11 Empty Sky Memorial around the Terminal Plaza requiring protection.

1.6 INFORMATIONAL SUBMITTALS

A. 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 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 building and of Owner's partial occupancy of completed Work.

B. Pre-construction and post-construction inspections include report preparation of all structures within 200 feet of the Project. Submit photos and note existing conditions of adjoining construction, including finish surfaces that might be misconstrued as damage caused by demolition operations. Submit before Work begins. Notable structures requiring reports include:

1. Existing all purpose trail at the southern limits of the project.

1.7 CLOSEOUT SUBMITTALS

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

1.8 FIELD CONDITIONS

A. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

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

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

1. Maintain lighting facilities along existing trail in service during selective demolition operations.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

1.10 BLASTING

A. Blasting is not permitted.

1.11 COORDINATION

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

B. Do not interfere with the use of adjacent buildings. Maintain free and safe ingress and egress from adjacent buildings during construction.

C. Take precautions to prevent damage to existing conditions including trees and vegetation to remain. Properly repair any damage identified by the Engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

2.2 SAFETY AND CONSTRUCTION FENCING

A. Safety and Construction Fencing: Where required, shall consist of six (6) foot height galvanized steel chain link fencing with 1 7/8” line posts, spaced 10 feet on center and 2 5/8” corner posts. Gates shall be twelve (12) feet wide and arranged for locking.

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION INSPECTIONS

A. Identify all structures/residences, and utilities, within 200 feet of aforementioned construction activities, and coordinate with owners to enter the structures for the purpose of taking photographs and performing visual inspection and measurements necessary to assess vibration susceptibility. Make a detailed pre-construction inspection of the inside and outside of these structures. The pre-construction inspection report shall include the following:

1. General description of structure, type of construction, materials used, and any vibration-sensitive equipment inside the structure.
2. Any pertinent information required to assess vibration susceptibility.
3. Complete interior and exterior photographs of the foundation and walls with close-ups of existing damage.
4. Detailed written notes indicating existing cracks, crack widths, crack lengths, displacements, and other evidence of existing damage or structural deficiencies.
5. Proposed changes to the vibration criteria based on the inspected condition of the structure or include a statement of no change.

B. The pre-construction inspection report shall be in 8.5-inch x 11-inch format including an index, names and responsibilities of the inspection party, notes, and 4-inch x 6-inch prints of photographs with date, location, and defect captions. Copies of the report shall be submitted to the Engineer for review in accordance with ODOT Specification at least 30 days prior to the commencement of proposed vibration-causing construction activities. Approval of proposed changes to the vibration criteria shall not relieve the Contractor from complete responsibility should damage occur to existing structures/residences or utilities.

3.2 EXAMINATION

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

B. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs or video.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

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 electrical systems serving areas to be selectively demolished.

1. Contractor shall arrange and pay to shut off utilities with utility companies.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of the site.

3.4 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.

1. Provide protection to ensure safe passage of people around selective demolition area.

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.

D. The Contractor shall prevent damage to pipes, conduits, wires, cable or structures above or below ground, indicated on drawings to remain. No land monuments, property markers, or benchmarks shall be damaged or removed until an authorized agent has witnessed or otherwise referenced their location and approved their removal. The Contractor shall so control their operations as to prevent damage to trees and shrubs which are to be preserved. Protection may include fences and boards lashed to trees to prevent damage from blasting or machine operations. Fresh scars and wounds shall be painted with approved paint. Repair any damaged utilities as acceptable to the Engineer, at no additional cost to the Owner.

3.5 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. Proceed with selective demolition systematically.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
4. Maintain fire watch during and after flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.

6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
8. 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, parking lots, 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 Engineer, 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.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in a construction and demolition waste landfill acceptable to authorities having jurisdiction.

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.

3.7 POST-CONSTRUCTION INSPECTION

A. Take photographs and perform visual inspection and measurements to assess the post-construction condition of the structures/residences, and utilities. Coordinate with owners to enter the structures within the 200-foot zone for these purposes. Perform a detailed inspection of the inside and outside of structures/residences, private property, and utilities. The post-construction report shall be in the same format as the pre-construction report with the following inclusions:

1. Note any changes or damage or the absence of change or damage to the structures, and utilities.
2. Include photographs similar to those taken for the pre-construction report.
3. In the case of change or damage, note the cause and remedial action to be undertaken.

B. Submit for review 6 copies of the report no later than 60 calendar days after completion of the construction activities.

C. Damage to structures/residences, or utilities due to vibrations created by vibration-causing construction activities performed by the Contractor and its subcontractors is the sole responsibility of the Contractor. Damage caused by construction activity shall be repaired by the Contractor at no cost to the State.

3.8 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

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SELECTIVE DEMOLITION

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. Demolition and removal of selected site elements.
2. Salvage of existing items to be reused or recycled.
3. Demolition and relocation of stone from the former power plant breakwaters.
4. Excavation of sand and gravel that has accumulated within the footprint of stone to be demolished and relocated from the former power plant breakwaters. All sand and gravel shall be excavated and sidecast lakeward.

B. Related Requirements:

1. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.
2. Section 312000 "Earth Moving" for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.
3. Section 312500 “Erosion and Sedimentation Controls” for temporary erosion- and sedimentation-control measures.
4. Section 312319 "Dewatering" for lowering and disposing of ground water during construction.
5. Section 353119 “Armor Stone Breakwaters” for relocation and placement of stone generated from the partial demolition of the former power plant breakwaters.

1.3 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 / Reset / Reinstate / Relocate: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

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

1.4 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.

1.5 PREINSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site.

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

1.6 INFORMATIONAL SUBMITTALS

A. 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 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 building and of Owner's partial occupancy of completed Work.

B. Pre demolition 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.

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

D. Gauge Table Certifications: If marine equipment will be used for demolition and relocation of stone or for sidecasting of sand and gravel, the Contractor shall submit gauging table certifications to the Engineer for review and approval. Gauging table certifications shall include the approved methods of measurement and conversion from barge drafts to tonnages.

1.7 CLOSEOUT SUBMITTALS

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

1.8 FIELD CONDITIONS

A. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

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

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

1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

1.10 BLASTING

A. Blasting is not permitted.

1.11 COORDINATION

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs or video.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

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 electrical systems serving areas to be selectively demolished.

1. Arrange to shut off utilities with utility companies.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3.3 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.

1. Provide protection to ensure safe passage of people around selective demolition area.

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.

3.4 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. Proceed with selective demolition systematically.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
4. Maintain fire watch during and after flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
8. 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 Engineer, 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.

3.5 TEMPORARY REMOVAL, STOCKPILING, AND REUSE OF WOODY DEBRIS

A. The contractor shall remove and stockpile any woody debris found within the project area during construction.

B. All woody debris shall be removed, handled, and stockpiled in a manner to minimize and prevent damage or destruction of the material. This includes cracking of tree trunks, loss of branches, and separation of root wads or stumps.

C. The contractor shall maintain a stockpile of all woody debris found within the project area during construction and maintain a stockpile of any woody debris delivered to the site by the owner or owner’s assigns.

D. The contractor shall make all woody debris stockpiles available for the examination by the engineer, owner, or owner’s representative. The engineer, owner, or owner's representative will select all woody debris to be utilized within the project area as material for the habitat features shown in the project plans.

E. The contractor shall utilize all stockpiled woody debris as directed by the engineer, owner, or owner’s representative.

F. All stockpiled woody debris rejected by the engineer, owner, or owner’s representative, and all woody debris not utilized in project construction shall be disposed of by the contractor in an approved manner.

3.6 DEMOLITION AND RELOCATION OF STONE FROM FORMER POWER PLANT BREAKWATERS

A. The eastern breakwater from the former power plant cooling water inlet shall be demolished to the lines and grades shown on the Contract Drawings. All demolished stone shall be relocated and placed to construct the core layers of the new breakwaters per Section 35 31 19.

B. All material excavated, including sand and gravel, to access and remove the stone from the existing structures shall be sidecast outside of the project area.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in a construction and demolition waste landfill acceptable to authorities having jurisdiction.

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.

3.8 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

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

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

1. ACI 301/301M
2. ACI 117/117M
3. ACI 315
4. ACI 347
5. ACI 318/318 M
6. ACI 305.1/ACI 305.1M
7. ACI 306.1/306.1M
8. ACI 308.1/308.1M

C. ASTM Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ASTM C172/C172M
2. ASTM C143/C143M
3. ASTM C231/C231M
4. ASTM C138/C138M
5. ASTM C173/C173M
6. ASTM C1064/C1064M
7. ASTM C31/C31M
8. ASTM C39/C39M
9. ASTM C94/C94M
10. ASTM A615/A615M

D. AWS (American Welding Society) code: Comply with the following unless modified by requirements in the Contract Documents:

1. AWS D1.4/D 1.4M

E. State of Ohio Department of Transportation (ODOT) Construction and Material Specifications.

1.2 SUMMARY

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

B. Related Requirements:

1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.

1.3 DEFINITIONS

A. Special Inspection Agency: A testing agency that is entirely independent of the contractor and commissioned directly by the Owner. The Special Inspection Agency shall be properly certified for their scope of work as required in the jurisdiction of the project.

B. Engineer: As used in this Section, the term Engineer signifies the Structural Engineer of Record for the work in question, or that individual’s designated representative.

C. Cementitious Materials: Materials that have cementing value if used in grout, mortar, or concrete, including Portland cement, blended hydraulic cements, expansive cement, fly ash, raw or calcined natural pozzolan, ground glass pozzolan, slag cement, and silica fume.

D. W/C Ratio: The ratio by weight of water to cementitious materials, excluding water absorbed by aggregate.

E. Environmental Product Declaration: An Environmental Product Declaration (EPD) estimates environmental information on the life cycle of a product to inform comparisons between products fulfilling the same function. EPDs are developed in accordance with a Product Category Rule for the specific product being evaluated.

F. Exposure Class as defined in ACI 318.

1.4 ACTION SUBMITTALS

A. General:

1. Action Submittals listed below are submittals that will be reviewed and returned to Contractor.
2. Review of submittals is of a general nature only, and the responsibility for conformance with intent of drawings shall remain with the Contractor. Review does not imply or state that the fabricator has correctly interpreted the construction documents.
3. All submissions shall be in accordance with the submission schedule developed and agreed between the Engineer and Contractor at the commencement of the project. Submission shall include dates of order and delivery of materials to the shop and the site.
4. Shop drawing schedule shall allow adequate time for reviews. Reinforcing steel shall not be fabricated or placed before the shop drawings have been reviewed by the Engineer and returned.

B. Product Data: For each type of product.

C. Design Mixtures: For each concrete mixture, submit mixture information as required by ACI 301 and as specified herein. Mixture submittals shall be reviewed by the Testing Agency and Engineer. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. In addition to the ACI 301 submittal requirements, each design mixture submittal shall include the following information: mixture proportions per cubic yard of concrete, measured fresh properties (air content, slump, fresh temperature and density) during trial batching, measured compressive strength on at least three cylinders at 7 days and at the specified age for acceptance, W/C ratio, aggregate grading and aggregate reactivity test results, aggregate petrographic report, aggregate test results that demonstrate compliance with relevant ASTM, water-soluble chloride content of the concrete mixture, evidence of compliance of cementitious materials with exposure class (as applicable) and intended method of placement during construction.
2. Design mixture submittals shall indicate for which structural elements each mix is to be used.
3. If historical data is used to justify compressive strength, test results shall date from within the past two years.
4. Each mixture design shall have a unique identifying number, and that number shall be the same as shown on all related test data.
5. Provide shrinkage test results for mixes with shrinkage criteria showing that mix meets performance criteria.
6. Indicate amounts of mixing water to be withheld for later addition at Project site.
7. Each mix shall be stamped and signed by a Professional Engineer licensed in the State where the Project is located.

D. Steel Reinforcement Shop Drawings: Placing Drawings in accordance with ACI 315 that detail fabrication, bending, and placement. Direct copies of the Contract Documents are not acceptable as a submission from the Contractor.

1. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Include any welding to be done.
2. Shop drawings shall make it clear where each bar is located. Beams, grade beams and walls shall be shown in elevation. On elevations show locations of sleeves and penetrations.
3. Check architectural, structural, mechanical, and electrical and other contract documents for anchor bolt schedules and locations, anchors, inserts, conduits, sleeves, and any other items which are required to be cast in concrete, and make necessary provisions as required so that reinforcing steel will not interfere with the placement of such embedded items.
4. Show all areas of congestion. Identify where reinforcing steel will interfere with the placement of embedded items such as anchor bolts, anchors, inserts, conduits, sleeves and any other items which are required to be cast in concrete.

E. Concrete Environmental Product Declarations: Provide EPDs covering concrete mixtures which account for a minimum of 90% of concrete by volume, subject to the following requirements:

1. EPDs shall be product-specific Type III EPD conforming to ISO 14025 and having at least a cradle-to-gate scope.
2. If an EPD for a given product is not currently available, contractor may submit a letter of commitment to furnish an EPD within 18 months of bid award.
3. If an EPD for a given product cannot be obtained within 18 months of bid award, contractor shall provide written notification to the Engineer that compliance is not feasible and shall demonstrate a written request was made to at least two suppliers requesting EPDs.

F. Construction, Contraction and Expansion Joint Layout: Indicate locations of proposed joints.

1. Location of joints is subject to approval of the Engineer.

G. Penetration, Blockout and Slab Edge Layout: Provide the following:

1. Composite layout plans for all mechanical, electrical and plumbing penetrations, sleeves and blockouts, where permitted. As a minimum, these plans shall show the locations and sizes of all penetrations, sleeves and blockouts that pass through the element depth.
2. Plans showing locations of slab edges, depressions, curbs and equipment pads.

H. Embedment Layout: Provide composite layout plans for all embedded mechanical, electrical and plumbing items, where permitted. As a minimum, these plans shall show the following:

1. Plan locations and outer diameter of all embedded conduit.
2. Locations and sizes of all embedded electrical junction boxes and recessed lighting.

1.5 INFORMATIONAL SUBMITTALS

A. Informational submittals listed below shall be submitted for project record only, and will not be formally returned to contractor.

B. Qualification Data: For Installers, manufacturers, testing agency and other entities for which qualifications are specified in this Section.

C. Welding Procedures for all reinforcement welding. Welding procedures shall be reviewed and approved by the Testing Agency, but are retained by the Engineer for information only.

D. Welding certificates.

E. Material and Product Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Welding Electrodes
6. Fiber reinforcement.
7. Waterstops.
8. Curing compounds.
9. Floor and slab treatments.
10. Non-shrink grout, per ASTM C1107.
11. Bonding agents.
12. Adhesives.
13. Vapor retarders.
14. Semirigid joint filler.
15. Joint-filler strips.
16. Post-installed concrete anchors.
17. Repair materials.

F. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal. Provide calculations by a Professional Engineer licensed in the project jurisdiction, demonstrating transfer of forces to reshores without causing damage to the structure nor resulting in additional permanent deflections.

2. Design of concrete formwork, shoring, reshoring and bracing shall be the sole responsibility of the Contractor and shall conform to Code requirements and shall be in accordance with the recommendations of ACI 347.
3. Shop Drawing Requirements:

    a. Shop Drawings shall show location and layout of construction joints, reveals, slab edges, form joints, sleeves, openings, textures, locations of tie holes or plugs, location of embedded items and blockouts, and all related details affecting Architectural quality.
    b. Shop Drawings shall show dimensioned location to the face of formwork for walls, beams, columns, slab edges, slab depressions, etc.
    c. Formwork details affecting Architectural finish quality shall be reviewed by the Engineer.
    d. Indicate where formwork release agent will be used as applicable.
    e. Where a mock-up is required, submit shop drawings of the mock-up.

G. Contractor’s Quality Control Plan and Quality Control Inspector qualifications. The Contractor shall submit a Quality Control Plan that addresses all inspection issues, including testing and inspection per ACI.

H. The Quality Control Plan shall be reviewed by the Testing Agency but will be retained for information only by the Engineer.

I. Field quality-control reports to be provided to Engineer.

J. Contractor’s concrete placement and curing plan. The Contractor shall submit a Concrete Placement and Curing Plan that addresses all concrete delivery, placement and curing processes and lists additional requirements for concrete placements occurring in hot and cold weather.

K. Contractor’s concrete repair plan. The Contractor shall submit a Concrete Repair Plan that addresses all potential concrete defects and corresponding repair procedures.

L. Mill Test Reports: Submit steel producer's certificates of mill analysis for each heat or melt of reinforcing steel, including steel source, description, heat number, yield point, ultimate tensile strength, elongation percent, bend test and the chemical composition of each heat as determined by ladle analysis, before delivery of steel to site. Where steel is required to be welded, mill reports shall be used to help verify the weldability of the steel.

M. Minutes of preinstallation conference to be provided to Engineer.

1.6 ACTION SUBMITTALS

A. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates: Include service record data where required elsewhere in this Section. Include results of tests required by ASTM C33 and/or ASTM C330.
2. Other concrete materials for which material testing is specified in this Section.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
2. Quality Control personnel with responsibility for concrete mixtures shall document qualifications demonstrating knowledge and experience with concrete technology and development of performance-based concrete mixtures, certified as an NRMCA Concrete Technologist Level 2, or equivalent. Details covered in equivalent certification program shall be documented in the submittal.
3. When requested, the manufacturer shall furnish a Quality Plan.

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

E. Adhesive Anchor Installer Qualification: Installation of adhesive anchors horizontally or upwardly inclined shall be performed by personnel certified by the ACI/CRSI Adhesive Anchor Installer Certification program.

F. Contractor's Quality Control Plan: Quality Control includes the functions performed by the Contractor to ensure that the material and workmanship of concrete construction meets the project specifications and applicable standards. The verification testing and inspection carried out by the Testing Agency does not relieve the contractor of the responsibility for conducting their own quality control/inspection program to ensure the requirements of the Contract Documents have been met.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement, if present.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. A minimum of 50% of the wood materials used for formwork (e.g., dimensional lumber, plywood, other engineered wood products) shall be “FSC Certified” products which have been harvested in accordance with the rules of the Forest Stewardship Council (www.fscus.org). List of North American FSC-certified companies can be found at https://info.fsc.org/certificate.php.

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

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

F. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

G. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
2. VOC content of form-release compounds shall not exceed 100g/L.

H. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.

2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Concrete reinforcement shall contain a minimum of 25% combined post-industrial and post-consumer recycled content where the percentage of recycled content is based on the weight of the component materials.

B. See Drawings for reinforcing material grade specifications. All reinforcing steel shall be epoxy coated.

2.3 REINFORCEMENT ACCESSORIES

A. See Drawings for material grade specifications for dowel bars, mechanical couplers, deformed bar anchors and welding electrodes.

B. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A775/A775M.

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

1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

2.4 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer, when required by the Engineer or for architectural concrete.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I or Type II, or as required by Exposure Class.
2. Fly Ash: ASTM C618, Class F or C.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
4. Blended Hydraulic Cement: ASTM C595/C595M. Submitted blended hydraulic cement shall offer adequate resistance to assigned Exposure Class.
5. Silica Fume: ASTM C1240, amorphous silica.
6. Metakaolin: ASTM C618, Class N.
7. Natural Pozzolans: ASTM C618, Class N.
8. Ground Glass Pozzolan: ASTM C1866.

9. Pozzolanic blended materials: ASTM D5370.
10. In case of alkali-reactive aggregates (R1 or R2 per ASTM C1778) Cementitious material used shall demonstrate lack of detrimental expansion, based on testing to ASTM C1293 or C1567. Length change shall not exceed 0.10% at 16 days per ASTM C1567 or Length change shall not exceed 0.10% after 2 years per ASTM C1293.
11. Alkali content shall not exceed 0.6% when tested in accordance with ASTM C114.
12. The temperature of cement delivered to the plant shall not exceed 150 degrees F.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Aggregates shall be from the same source as that used for the tested mix.

1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal, unless noted otherwise.
2. The maximum size used in a particular location shall be consistent with the form and dimensions of the section being placed, with the location and spacing of the reinforcing steel and with the method of vibration. The aggregate sizes shall be such as will produce dense, uniform concrete, free of rock pockets, honeycombs, or other irregularities.
3. Aggregate shall contain no thin or elongated pieces. Any piece having a major dimension more than 2-1/2 times the average thickness shall be considered thin or elongated.
4. If shrinkage-controlled concrete, Coarse Aggregate shall be crushed limestone, granite, or accepted equal.
5. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
6. Aggregate types shall conform to the requirements of the fire-rated assemblies to be used on the Project.
7. Reactivity of the aggregates shall be verified through testing by ASTM C1260 or ASTM C1293, and through petrographic analysis of the aggregates per ASTM C295. Test results shall be less than 18 months old. Alkali-carbonate reactive aggregates and R3 reactive aggregates shall not be used.
8. Crushed air-cooled iron blast furnace slag aggregates or recycled concrete aggregates shall not be used, unless approved.
9. If petrography detects the presence of iron pyrites or pyrrhotites a maximum total sulfur content of 0.1 % apply.

D. Lightweight Aggregate: ASTM C330/C330M, 3/4-inch (19-mm) nominal maximum aggregate size, unless noted otherwise.

1. Aggregate types shall conform to the requirements of the fire-rated assemblies to be used on the Project.
2. The maximum size used in a particular location shall be consistent with the form and dimensions of the section being placed, with the location and spacing of the reinforcing steel and with the method of vibration. The aggregate sizes shall be such as will produce dense, uniform concrete, free of honeycombs, or other irregularities.

E. Recycled (Reclaimed) Aggregates:

1. Use only in below grade work or concrete to be covered in its final condition. Do not use in integrally colored concrete.
2. Maximum % of total aggregates shall be established by testing. Testing per Greenbook Standard Specifications for Public Works Construction.
3. Use one source for each required type throughout the project.

F. Air-Entraining Admixture: ASTM C260/C260M, certified by manufacturer to be compatible with other admixtures.

G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Accelerating Admixture or Water-Reducing and Accelerating Admixture: ASTM C494/C494M, Type C or Type E.
4. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
5. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
6. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
7. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
8. Workability-Retaining Admixture: ASTM C494/C494M, Type S.
9. Shrinkage-Reducing Admixture: ASTM C494C494M, Type S.
10. Alkali-Silica Reaction-Inhibiting Admixture: ASTM C494/C494M, Type S. Shall contain a nominal lithium nitrate content of 30 percent.
11. Viscosity-Modifying Admixture: ASTM C494/C494M, Type S.
12. Corrosion-Inhibiting Admixture: ASTM C1582/C1582M.

H. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C and ASTM C1582/C1582M.

I. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C1582/C1582M.

J. Water: ASTM C94/C94M and ASTM C1602 clean, free from deleterious matter. Non-potable water is acceptable if meets the chemical content limits of ASTM C1602.

K. Lake water from the project site shall not be used in concrete mix.

2.5 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm). Acceptable products (or approved equal):

1. CETCO: Waterstop-RX
2. Sika Corporation: Sika Swellstop.
3. Henry Company: Hydro-Flex.
4. JP Specialties, Inc.: Earthshield.
5. Carlisle Coatings and Waterproofing: CCW Mirastop.

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D4397, not less than 10 mils (0.25 mm) thick.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete. VOC content shall not exceed 20g/L.

1. Acceptable Products (or approved equal):

   a. BASF Corporation: MasterKure ER 50.
   b. W.R. Meadows, Inc.: EVAPRE.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering. Meet VOC content limit of 100g/L, or local regulations, whichever is more stringent.

1. Acceptable Products and Manufacturers (or approved equal):

   a. The Euclid Chemical Company: Diamond Clear VOX or Super Diamond Clear VOX.
   b. W.R. Meadows: VOCOMP-20

2.8 RELATED MATERIALS

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

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 according to ASTM D2240.

C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, nonload bearing or Types IV and V, load bearing, as directed by engineer for bonding hardened or freshly mixed concrete to hardened concrete.
2. Acceptable Products and Manufacturers (or approved equal):

   a. The Euclid Chemical Company: Duralcrete Series.
   b. Sika Corporation: Sikadur Hi-Mod Series.
   c. BASF Corporation: MasterEmaco ADH Series.

E. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 REPAIR MATERIALS

A. Patching Mortar:

1. Horizontal repairs, ASTM C928. Acceptable products (or approved equal):

   a. Euclid Chemical Co.: Euco Thin Top Supreme, Concrete-Top Supreme
   b. Sika Chemical Corp.: SikaTop 121 or 122
   c. BASF Corporation: MasterEmaco T 310CI

2. Vertical or Overhead repairs, ASTM C928. Use as recommended by manufacturer for overhead use. Acceptable products (or approved equal):

   a. Euclid Chemical Co.: Verticoat, Verticoat Supreme or Speed Crete Red Line
   b. Sika Chemical Corp.: SikaTop 123
   c. BASF Corporation: MasterEmaco N 350CI or MasterEmaco N 425

Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations. Repair Underlayment shall be compatible with substrate concrete Exposure Class. Repair materials shall provide adequate resistance to expected field exposures as defined in ACI 318 / 301

3. Cement Binder: ASTM C150/C150M, portland cement or approved hydraulic or blended hydraulic cement as defined in ASTM C595. Cement binder shall be compatible with assigned Exposure Class.
4. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
5. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer. Aggregate shall be non-reactive per ASTM C1778.
6. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C109/C109M.
7. Acceptable products (or approved equal):
   a. Euclid Chemical Company, The: Super Flo-Top.
   b. BASF Corporation: MasterTop 110 SL.
8. Water: potable.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations. Repair Overlayment shall be compatible with substrate concrete Exposure Class.

1. Cement Binder: ASTM C150/C150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C595. Cement binder shall be compatible with assigned Exposure Class.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.Aggregate shall be non-reactive per ASTM C1778.
4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C109/C109M.
5. Acceptable products (or approved equal):
   a. Euclid Chemical Company, The: Thin Top Supreme or Tammspatch II.
   b. BASF Corporation: MasterEmaco N 300CI.
6. Water: potable.

C. Drypack Mortar for form holes at non-Architectural grade surfaces: Composed of 1 part Portland cement and 2 parts of fine aggregate and water. Match color of adjacent surfaces.

2.10 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, according to ACI 301 (ACI 301M).

1. Procurement of concrete mix design is responsibility of the Contractor.
2. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
3. At the discretion of the Engineer of Record a manufacturer’s laboratory may also be approved to generate mix designs and perform trial batching. The Manufacturer’s lab must be run under the direct supervision of a Professional Engineer and technicians performing the proportioning and tests must be NRMCA Concrete Technologist Level 2, ACI Concrete Field Testing Technician Grade 1, and Laboratory Testing Technician Grade I certified. The facilities must be adequate to properly perform the testing required. Age of testing is 28 days.

B. Cementitious Materials: Use supplementary cementitious materials as needed to reduce the total amount of portland cement to meet limits specified in mix design performance specifications. Refer to ACI 301 (ACI 301M) and ACI 318 (ACI 318M) for limits on the amounts of these ingredients based on exposure class.

C. Limit water-soluble, chloride-ion content in hardened concrete as specified in ACI 301 (ACI 301M) and as tested using ASTM C1218 and required based upon ACI 318 Exposure Class C pending type of exposure.

D. Limit water-to-cement ratio based on assigned Exposure Class as defined in ACI 318 and ACI 301.

E. Air content shall satisfy ACI 301 and ACI 318 requirements for assigned exposure and for selected maximum aggregate size.

A. Average shrinkage shall not exceed 0.040 percent when measured in accordance with ASTM C157/C157M and ASTM C490/C490M after 21 Days of drying. Drying should start at 7 Days from the casting of specimens (1 Day inside the mold and 6 Days of moist curing). Initial length shall be measured at 24 hours from casting, after the specimens are removed from the molds.

B. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, or high-range water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. See Drawings for required properties of each type of concrete mix.

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice," except where noted otherwise.

B. Bending:

1. In case of fabrication errors do not rebend or straighten reinforcement in a manner that will injure or weaken the material.
2. Reinforcing bars are to be bent cold, do not preheat, unless approved by Engineer .Do not rebend reinforcement that has previously been bent within 6 inches of existing bend except as allowed by ACI 301.

C. Spirals: Provide a minimum of 1-1/2 finishing turns top and bottom.

D. Unacceptable Materials: Reinforcement with any of the following defects shall not be permitted in the Work and will be replaced without cost:

1. Bar lengths, depths and bends exceeding specified fabrication tolerances.
2. Bend or kinks not shown on the Drawings or final shop drawings.
3. Bars with reduced cross-section due to rusting or other cause.
4. Bars with dirt, mud, grease or form release agent.

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M (and ASTM C1116/C1116M where fiber reinforced concrete is used), and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 PRECONSTRUCTION MEETING

A. Prior to commencement of concrete work, relevant participants shall meet at the Project site to review the proposed mix designs, methods and sequence of concrete construction, standard of workmanship, material selection, testing and quality control requirements, placement procedures, off-site batching requirements, coordination of the work with other trades and other pertinent topics related to the Work. The following participants shall be represented as a minimum:

1. Owner’s Representative
2. Architect/Engineer
3. Construction Manager/General Contractor
4. Concrete Subcontractor
5. Owner’s Testing Laboratory
6. Ready Mix Concrete Supplier
7. Any other relevant subcontractor and/or material supplier including plumbing, waterproofing and electrical suppliers

B. Review the following:

1. Special inspection and testing and inspecting agency procedures for field quality control.
2. Construction joints, control joints, isolation joints, and joint-filler strips.
3. Anchor rod and anchorage device installation tolerances.
4. Cold and hot weather concreting procedures.
5. Concrete finishes and finishing.
6. Curing procedures.
7. Forms and form-removal limitations.
8. Shoring and reshoring procedures.
9. Methods for achieving specified floor and slab flatness and levelness.
10. Floor and slab flatness and levelness measurements.
11. Concrete repair procedures.

C. The Contractor shall take minutes from this meeting and share them with the Owner. The minutes shall include a statement by the concrete contractor indicating that the proposed mix design and placing techniques shall produce the concrete quality required by these specifications.

3.2 PREPARATION

A. Prior to Work specified in this Section, the Contractor shall carefully inspect the installed Work of other trades and verify that such Work is complete to the point where this installation may properly commence.

B. The Contractor shall verify that forms may be constructed in accordance with all applicable codes and regulations, the referenced standards, and the design documents.

1. Ensure Excavations are sufficient to permit placement, inspection, and removal of forms.
2. Verify reinforcing steel has been inspected prior to concealing with formwork.
3. Verify geotechnical engineer has approved all foundation excavations.

C. The Contractor shall verify all dimensions prior to starting construction.

D. Contractor coordination:

1. Obtain necessary information for coordination of formwork with items to be embedded in concrete.
2. Coordinate size and location of openings in concrete. Obtain Engineers approval for openings not shown on Structural Drawings.

E. Discrepancies:

1. Notify the Engineer of any discrepancies or inconsistencies.
2. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved

3.3 FORMWORK INSTALLATION

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

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

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

3. Bolts, rods, and other devices when used for internal ties and spreaders shall be of such construction that when the forms are removed, no metal shall be within 1 inch of the exterior concrete surfaces or within 1/2 inch of interior concrete surfaces.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer or fillet exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.4 EMBEDDED ITEMS

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

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
2. 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. Install dovetail anchor slots in concrete structures as indicated.

B. Provide pipe sleeves when pipes pass through concrete. Fill voids in sleeves, inserts and anchor slots with readily removable material to prevent entry of concrete into voids.

C. No conduit shall be cast in concrete unless specifically indicated on the Structural Drawings.

D. Coring of concrete after placement is not permitted without prior approval by the Engineer of Record.

3.5 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete shall be hard enough to not be damaged by form-removal operations and curing and protection operations shall be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its specified design compressive strength. Use of the maturity age method per ASTM C1075 to estimate early strength is permitted.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer. All forms below ground surface, along with all shores and braces, shall be removed before backfilling.

3.6 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 (ACI 318M) and ACI 301 (ACI 301M) for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.7 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E1643 and manufacturer's written instructions.

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.8 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
2. Wherever embedded items interfere with placing of reinforcement notify the Engineer and obtain approval before placing any concrete. Do not bend or field cut bars around openings or sleeves.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

C. Accurate position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Where Drawings do not show the spacing of the reinforcing, the minimum clear spacing shall conform to ACI 318/318M.

E. Field bending or straightening of reinforcement shall be in accordance with ACI 301 (ACI 301M).

1. Reinforcing partially embedded in concrete shall not be field bent except as shown on the Drawings or accepted by the Engineer.
2. Reinforcement greater than #5 bars shall not be field bent except as shown on the Drawings or accepted by the Engineer.

F. Wherever conduits, piping, inserts, sleeves, etc., interfere with placing of reinforcing steel, obtain acceptance of method of procedure before any concrete is placed. Bending of bars around openings or sleeves not permitted.

G. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

H. Splicing: Make splices only at those locations shown on the Drawings or as accepted by the Engineer. Splice locations not shown on the Drawings shall be approved in shop drawings before fabrication. Stagger splices in adjacent bars wherever possible.

I. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

J. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

K. Install deformed bar anchors, mechanical splices and reinforcing couplers in accordance with the manufacturer's recommendations.

3.9 JOINTS

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

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

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls or 30 feet on center maximum. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

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

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.10 WATERSTOP INSTALLATION

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.11 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).

1. Water is permitted to be added to a batch of concrete at the project site before placement provided that the amount of water added does not exceed the allowed amount indicated on the delivery ticket and the maximum approved w/c. Water addition shall only be permitted before any portion of the load is discharged. Samples for quality assurance tests shall be obtained after water addition and additional mixing in accordance with ASTM C94/C94M.

C. 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. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. 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.

D. 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. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Fill Over Steel Deck:

1. At floor slabs, increase fill thickness as required to compensate for deflection of beams and deck at no additional cost to Owner. Obtain specified fill thickness at high points of the deck. Finish floor to specified tolerances for floor flatness and levelness, including at suspended fill on steel deck floors.
2. At roof, maintain specified thickness of concrete uniformly over deck. Slab need not conform to flatness and levelness tolerances.

F. Hot and Cold Weather Placement: Comply with ACI 301. Additionally, comply with ACI 306.1 for cold-weather placement and ACI 305.1 (ACI 305.1M) for hot-weather placement.

3.12 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed 1/4 inch (6 mm) on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

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

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part Portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours. Apply grout-cleaned finish at surfaces to receive paint, unless otherwise indicated.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix 1 part Portland cement and 1 part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

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

3.13 FINISHING FLOORS AND SLABS

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

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.

1. Apply scratch finish to surfaces indicated to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. 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.
2. Finish surfaces to the following tolerances, according to ASTM E1155 (ASTM E1155M), for a randomly trafficked floor surface:

    a. Minimum criteria: Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch (6 mm).
    b. At floors for high-speed forklifts or air pallets: Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.

3. Slabs supporting modular office partitions, adhered flooring systems, or compact storage shelving must also comply with the manufacturer’s tolerance requirements. Slabs scheduled to receive wood flooring must also comply with tolerances required for installation of wood flooring.
4. Fill or grind completed floors as necessary to achieve specified finish tolerances. Fill shall be with a self-leveling cementitious product capable of being tapered to a feathered edge.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish. Then, while concrete is still plastic, slightly scarify surface with a fine broom.

1. Apply trowel and fine-broom finish to surfaces indicated where ceramic or quarry tile is to be installed by either thickset or thinset method.

2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

1. Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate or aluminum granule finish according to manufacturer's written instructions and as follows.

1. Apply slip-resistive finish where indicated and to concrete stair treads, platforms, and ramps.
2. Uniformly spread 25 lb/100 sq. ft. (12 kg/10 sq. m) of dampened slip-resistive aggregate or aluminum granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
3. After broadcasting and tamping, apply float finish.
4. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate or aluminum granules.

H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows.

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. (49 kg/10 sq. m) unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.
4. Apply non-oxidizing metallic dry-shake hardener to loading dock slabs unless indicated otherwise.

3.14 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. See Drawings for base details.
3. Set anchor bolts at correct elevations, complying with diagrams or templates from manufacturer furnishing equipment.

B. Post-Installed Concrete Anchors

1. Install in accordance with the manufacturer’s recommendations and ICC-ES reports.
2. Use washers on all bolts.
3. Use care to avoid cutting or damaging reinforcing bars.
4. When exposed to view in the final structure, bolts shall be of a length that will extend entirely through but not more than 1/4-inch beyond the nuts unless otherwise shown on the Drawings.

3.15 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces complying with ACI 308.1 (ACI 308.1M), including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days or until the concrete has reached 70% of the design strength, whichever greater, with the one or more of the following materials:

a. Water.
b. Continuous water-fog spray.
c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days or until the concrete has reached 70% of the design strength, whichever greater. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.
5. Applicable curing methods:

a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings or penetrating liquid floor treatments except as permitted below.
b. Strippable or dissipating curing compounds may be used for trowel finished surfaces to receive resilient flooring, or if the manufacturer certifies that the curing compound does not interfere with bonding of floor covering used on Project.

6. Exterior Flatwork: Apply 1 coat of curing/sealing compound as soon as possible after finishing.

3.16 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.17 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer’s approval. Defective Concrete is defined as concrete which is under strength, out of line, level or plumb, or shows objectionable cracks, honeycombing, rock pockets voids, spalling, exposed reinforcement, that has any sawdust, wood, or debris embedded in it, and in the Engineer’s judgment these defects impair the proper strength or appearance of the work. Any concrete work not in accordance with the Specification and Drawings will be deemed to be defective. Repair and replacement work shall be done at Contractor’s expense.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part Portland cement or approved equivalent to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement, or approved equivalent, so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Engineer’s approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Engineer’s approval.

3.18 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections: See Drawings for extent of special inspections required on this project.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 50 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day. At least one sample per day.

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

2. Slump: ASTM C143/C143M; 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. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M, pressure method, for normal-weight concrete; ASTM C173/C173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Unit Weight: ASTM C138/C138M; 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.
5. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Compression Test Specimens: ASTM C31/C31M.

    a. Cast and laboratory cure two sets of three standard 4 by 8 cylinder specimens for each composite sample.
    b. Cast and field cure two sets of three standard 4 by 8 cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C39/C39M; test one set of three laboratory-cured specimens at 7 days and one set of three specimens at the age corresponding to the specified design strength.

    a. Test one set of three field-cured specimens at 7 days and one set of three specimens at the age corresponding to the specified design strength.
    b. A compressive-strength test shall be the average compressive strength from a set of three specimens obtained from same composite sample and tested at28 days.

8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. 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 (3.4 MPa).
10. Test results for each specified test shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength, concrete mixture proportions and materials, compressive breaking strength and type of break, and the sample age in days.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.

12. Additional Tests: Testing and inspecting agency shall 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 Engineer.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Reinforcing Steel

1. Contractor shall notify the testing agency and the Engineer at least 48 hours before concrete is to be poured or reinforcing is covered up.
2. Before any concrete is poured on any particular portion of the building, the reinforcing steel and form dimensions will be inspected by the Testing Agency. Any errors or discrepancies shall be corrected before concrete is placed.
3. A special inspector shall be present during all field bending of reinforcement.
4. Installation of deformed bar anchors to be tested in accordance with Section 7.1 of AWS D1.1.
5. Welding of Reinforcement: There shall be continuous inspection during all welding of reinforcement. All butt welds to be inspected using radiographic testing. At the Owners option recognized non-destructive tests such as resistance, Magnetic Particle Examination, and Liquid Penetrant Inspection may be used to inspect the welds.
6. Comply with ICC-ES approvals with respect to special inspection required during installation.
7. Testing and inspection of mechanical splices and reinforcing couplers to conform to manufacturer's recommendations and ICC-ES approval.
8. Unidentifiable Reinforcing Steel: Tested by Testing Agency; paid for by Contractor. Test reinforcing delivered to site which cannot be properly identified by heat number and mill mark for compliance with ASTM A615 as follows:

   a. No. 8 Bar and Smaller: One tensile test and one bend test of each size per 7-1/2 tons, or portion thereof.
   b. No. 9 Bar and Larger: One tensile test of each size per 10 tons, or portion thereof.

F. Survey and Adjustment: Continuously observe formwork operations, record such observations on a daily basis, and submit reports of the results. Instrument check forms before and during concrete placement to assure no movement has taken place. Make appropriate corrections to reposition displaced forms. Certify, by written report submitted on a weekly basis, for each level and story that the elevations, finish lines and building lines of the hardened concrete are within tolerances.

G. Contractor shall correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.19 CONSTRUCTION SITE WASTE MANAGEMENT (CONCRETE)

A. Segregate materials by types for recycling, such as wood, stone, metal, etc.

1. Designate areas for materials that can be reused on site such as formwork, rebar cutoffs, and fill.

B. Ready-Mix supplier shall have gray water system to use recycled water in plant operations. Contractor shall document that the supplier has this capability, or demonstrate due diligence in trying to locate a ready-mix supplier with this type of facility.

1. Control truck wash-out and water run-off.
2. Designate dump-out sites where fill is required.

SAMPLE GWP REPORTING FORM

Information from Engineer:					Information from Contractor:			
Concrete Mixture Name	Design strength, f'c per spec (psi)	Used for	Volume esti-mated (cy)	GWP limit per bench-mark (kgCO2e /cy)	Volume supplied (cy)	Concrete Supplier Name	Concrete batch code	Actual GWP (kgCO2e /cy)
Concrete GWP reduction target								*20%*
Total GWP target [GWP limit x volume supplied] x [100% - GWP reduction target] (kgCO2e)								
Actual GWP [Actual GWP x volume supplied] (kgCO2e)								

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials, services, equipment, and apparatus necessary to complete all structural steel work shown on the Contract Drawings and specified herein. This item includes the steel pile for the navigation light foundations.

1.2 APPLICABLE PUBLICATIONS

A. American Institute of Steel Construction (AISC) Publications:

1. AISC 348 (2004) Specification for Structural Joints Using ASTM A325 or A490 Bolts
2. Manual of Steel Construction, 16th Edition

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

1. A572/A572M Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
2. ASTM A 36/A 36M (2008) Standard Specification for Carbon Structural Steel
3. ASTM A 53/A 53M (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
4. ASTM A 325 (2009) Standard Specification for Structural Bolts, Steel, Heat Treated,120/105 ksi Minimum Tensile Strength
5. A563 Carbon and Alloy Steel Nuts
6. A436 Hardened Steel Washers
7. A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
8. A722 Uncoated High strength Steel Bar for Prestressing Concrete

C. American Welding Society (AWS) Publications:

1. D1.1 Structural Welding Code – Steel

1.3 SUBMITTALS

A. Materials, the Contractor shall furnish the Engineer with three copies of all mill certificates, or a high-quality electronic copy for materials. The Contractor at the time of submittal of shop drawings, shall furnish a list designating the material to be used for each item. The Contractor shall furnish a shipping bill (Bill of Lading) or memorandum of each shipment of finished pieces or members to the project site, giving the designation mark and weight of each piece, the number of pieces, the total weight, and if shipped by rail in carload lots, the car initial and number.

B. Certificates

1. Miscellaneous Metal Materials Certificates for material tests and analysis.

2. Qualification of Welders and Welding Operators; A copy of current welder's certificates shall be submitted; position of the weld certificate shall be noted on the certificate.

PART 2 - PRODUCTS

2.1 STEEL

A. Materials shall conform to the respective specifications specified herein and shown on the drawings. Materials not otherwise specified herein on the drawings shall conform to the AISC "Manual of Steel Construction". the Contractor shall furnish the Engineer with three copies (or a high-quality electronic copy) of all mill certificates for materials. All materials shall be new and without splices.

B. Structural Steel: ASTM A572 Grade 50 with a minimum yield strength of 50,000 psi (as required on the Contract Drawings). Pipe for navigation light foundations shall comply with ASTM A252 Grade 3 with physical and chemical requirements that meet ASTM A572 Grade 50.

C. Miscellaneous steel plates and beams shall comply with ASTM A572 Grade 50. Bolts shall comply with ASTM A325, Nuts shall comply with ASTM A563 and Washers with ASTM A436.

PART 3 – EXECUTION

3.1 CLEANING

A. Wash surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean.

3.2 ERECTION

A. Erect steel in accordance with the AISC "Manual of Steel Construction".

B. Make provision for erection loads, and for enough temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Do not field cut or alter structural members without approval of the Engineer.

D. Tolerances: In accordance with the "Code of Standard Practice" of the AISC "Manual of Steel Construction".

E. All electrodes used on the project shall be E70XX, unless noted otherwise (UNO).

3.3 WELDING

A. Follow all requirements as defined by AWS D.1.1.

3.4 PAYMENT

A. Payment for structural steel will be based on the unit prices and quantities bid, for each individual steel bid item.

END OF SECTION

SECTION 05 73 00

METAL GUARDRAIL

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 the following:

1. Galvanized steel posts and rails
2. Stainless-steel cable infill
3. Wood top rail

B. Related Sections include the following:

1. Division 03 Section Cast-In-Place Concrete for guardrail base

1.3 REFERENCES

A. ASTM A53/A53M: Standard for galvanized steel pipe.

B. ASTM A36/A36M: Standard for carbon structural steel plates.

C. ASTM A123/A123M-24: Standard for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A153/A153M: Standard for galvanizing hardware/fasteners.

1.4 DEFINITIONS

A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

1.5 PERFORMANCE REQUIREMENTS

A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
1. Stainless Steel: 60 percent of minimum yield strength.

2. Galvanized Steel: 72 percent of minimum yield strength.

B. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Top Rails of Guards:
    a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
    b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Infill of Guards:
    a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.6 SUBMITTALS

A. Product Data: For the following:

1. Grout, anchoring cement,

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts – Pieces 12” in length max.
2. Fittings and brackets. – Two of each type
3. Welded connections.- One of each type, 12” max.
4. Stainless steel cables and fittings – One of each type, 12” in length max.
5. Wood top rail – 12” in length max.

D. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

E. Qualification Data: For professional engineer.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.

B. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by structural analysis.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of railings and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

D. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build up to five full size by 15’ length guardrail as directed by Architect.
2. Mockups shall show form and finish of all railing components.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating railings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

1.9 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails, unless otherwise indicated.

1. Provide galvanized metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
2. Provide galvanized metal brackets with predrilled hole for exposed bolt anchorage.
3. Provide galvanized steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.

2.2 STAINLESS STEEL

A. Wire Rope: 1-by-19 wire rope made from wire complying with ASTM A 492, Type 316.

B. Wire-Rope Fittings: Connectors of types indicated, fabricated from stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

2.3 GALVANIZED STEEL

A. Galvanized Steel Pipe: ASTM A53, Grade B, Schedule 40 (minimum), hot-dip galvanized

B. Galvanized Steel Plates: ASTM A36, hot-dip galvanized.

C. Galvanized Finish

1. Hot-Dip Galvanizing: Apply after fabrication per ASTM A123/A123M-24.
2. Smooth Finish: The coating must be continuous, uniform, and free from blisters, flux deposits, or gross dross inclusions.
3. Exterior Suitability: Fill vent holes and grind welds smooth before galvanizing to prevent corrosion traps.
4. Fabrication: Remove burrs and ease exposed edges to a 1/32" radius before coating.

2.4 GALVANIZED FASTENERS

A. General: Provide the following:

1. Galvanized Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work, unless otherwise indicated.

1. Provide square or hex socket flat-head machine screws for exposed fasteners, unless otherwise indicated.

D. Anchors: Provide chemical or torque-controlled expansion anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

2.5 MISCELLANEOUS MATERIALS

A. Wood Top Rail: Hardwood top rail of species and profile indicated.

1. Species: Alaskan Yellow Cedar (Cupressus nootkatensis),
2. Profile: As shown on drawings.

B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Make up wire-rope assemblies in the shop to field-measured dimensions with fittings machine swaged. Minimize amount of turnbuckle take-up used for dimensional adjustment so maximum amount is available for tensioning wire ropes. Tag wire-rope assemblies and fittings to identify installation locations and orientations for coordinated installation.

D. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

E. Form work true to line and level with accurate angles and surfaces.

F. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

G. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

J. Form changes in direction as follows:

1. As detailed.

K. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of hollow railing members with prefabricated end fittings.

M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 GALVANIZED STEEL FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication.
2. Hot-dip galvanize indicated steel and iron railings, including hardware, after fabrication.
3. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
4. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.

B. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to 1 side, and locate joint within 6 inches (150 mm) of post.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Payment for these services will be made by Contractor.

B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Railings will be tested according to ASTM E 894 and ASTM E 935 for compliance with performance requirements.

C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and will comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

B. Clean wood top rail by wiping with a damp cloth and then wiping dry.

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

3.5 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in field to shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057300

SECTION 31 05 22

GEOTEXTILE FILTER FABRIC

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. This item shall consist of furnishing all labor, equipment and materials necessary to install geotextile filter fabric, as shown on the Contract Drawings.

1.2 RELATED WORK

A. Section 02 41 00 – Site Preparation

B. Section 03 30 00 – Cast-in-Place Concrete

C. Section 32 13 13 – Concrete Paving

D. Section 32 15 43 – Crushed Stone Paving

E. Section 33 42 00 – Stormwater Conveyance

1.3 SUBMITTALS

A. Submit manufacturer's literature and sample of geotextile fabric to the Engineer for approval prior to purchasing material.

PART 2 – PRODUCTS

2.1 MATERIALS

A. ODOT Type "B" geotextile filter fabric, or approved equal, shall be a nonwoven, needle-punched polypropylene fabric with the following listed minimum properties:

Fabric Property	Unit	Test Method	Physical Properties
Minimum tensile strength	LBS	ASTM D 4632	200
Minimum elongation	%	ASTM D 4632	15%
Minimum puncture strength	LBS	ASTM D 6241	440
Minimum tear strength	LBS	ASTM D 4533	50
Apparent opening size	Mils	ASTM D 4751	24
Minimum permittivity	Sec^{-1}	ASTM D 4491	0.2 sec^{-1}

PART 3 – EXECUTION

3.1 SHIPMENT AND STORAGE

A. During all periods of shipment and storage, the fabric shall be protected from direct sunlight, ultraviolet rays, temperatures greater than 140° F, mud, dirt, dust and debris. The fabric shall be stored in an area where it is protected from wave energy, splashing and overwash spray from Lake Erie. To the extent possible, the fabric shall be maintained wrapped in a heavy-duty protective covering.

3.2 INSTALLATION

A. The geotextile filter fabric shall be placed as shown on the Contract Drawings. At the time of installation, fabric shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage. Rejected products shall be replaced at no additional cost to the Owner.

Overlap – Geotextile filter fabric shall be overlapped a minimum of two (2) feet at each seam.

END OF SECTION

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. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, abandoning site utilities in place, and removing site utilities

B. Related Requirements:

1. Section 024100 “Site Preparation” for selective demolition of site elements.
2. Section 312000 "Earth Moving" for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "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; 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 larger than 2-inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.

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

E. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

A. Unless otherwise notified by the Owner or indicated in the Specifications or Drawings to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site. Disposal of any removed materials shall be in accordance with all applicable regulations.

1.5 INFORMATIONAL 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 video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

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

1.6 FIELD 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 and signage around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Salvageable Improvements:

1. Carefully remove items indicated to be salvaged and store on Owner's premises.
2. Confirm with Owner if any additional items indicated to be removed are to be salvaged.

C. Utility Locator Service: Notify Dig Safe System for area where Project is located before site clearing.

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

E. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

B. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #23 (surface-tolerant, anticorrosive metal primer)] or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify benchmarks and survey control points prior to start of construction.

B. Protect and maintain benchmarks and survey control points from disturbance during construction.

C. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed.

D. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations.

3.3 EXISTING UTILITIES

A. Field locate existing electrical utilities identified on the Drawings prior to start of construction.

B. Identify and notify the Engineer of any conflicts between existing utilities and structures and the proposed work.

C. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.

D. 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 two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

E. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, 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 larger than 2-inches in diameter, obstructions, and debris to a depth of 18-inches below exposed subgrade.
3. Use only hand methods or air spade for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8-inches, and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

A. Remove sod, grass, and plants before stripping topsoil.

B. Strip topsoil 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 larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. 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.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.6 SITE IMPROVEMENTS

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. Saw-cuts shall be parallel or perpendicular to direction of travel to the maximum extent possible.
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.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION

SECTION 31 20 00

EARTH MOVING

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. Preparing subgrades for slabs-on-grade, footings, piers, walks, pavements, lawns and grasses, and exterior plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Subbase and base course for asphalt paving.
6. Subsurface drainage backfill for trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:

1. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
2. Section 312319 "Dewatering" for lowering and disposing of ground water during construction.
3. Section 329200 "Lawns and Meadow Grasses" for finish grading in grass areas.
4. Section 312500 “Erosion and Sedimentation Controls” for temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material 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. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Independent Soils Testing Laboratory: A qualified, third-party geotechnical testing laboratory, engaged by the Owner, meeting the requirements of ASTM E329 and experienced in earthwork field testing and inspection. The independent soils testing laboratory shall perform testing of soil and aggregate materials, and shall provide full-time or part-time field inspection services for foundations, subgrade preparation, placement and compaction of fills, and related earthwork activities. All inspections and testing shall be conducted under the supervision of a Professional Engineer (PE) licensed in the jurisdiction of the Project.

F. 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 Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
3. Unauthorized Excavation: Excavation below subgrade 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.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom.
2. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. 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.

K. 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.

L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Controlled low-strength material, including design mixture.
2. Warning tapes.
3. Soil materials
4. Geotextile

B. Samples: 12-by-12-inch (300-by-300-mm) Sample of subdrainage and separation geotextile.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D2487 of each on-site and borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D1557 of each on-site and borrow soil material proposed for fill and backfill.

C. Pre-excavation Photographs or Videotape: 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.

1.6 FIELD CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify Engineer not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer’s written permission.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

C. 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.

D. Utility Locator Service: Notify "Dig Safe System" for area where Project is located before beginning earth-moving operations.

E. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in and Section 311000 "Site Clearing" are in place.

F. Do not commence earth-moving operations until plant-protection measures are in place.

G. The following practices are prohibited within protection zones:

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.

H. Do not direct vehicle or equipment exhaust towards protection zones.

I. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

1. Material shall be obtained from required on-site excavation, to the extent that suitable material is available, and from off-site sources, to the extent that suitable material is not available from on-site excavation.
2. In addition to the criteria above, on-site excavated materials that are classified as regulated shall be considered as Satisfactory Soils if they are found to meet the requirements of Section 311001, Section 311002, Section 311003, and Section 311004.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487 or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of crushed stone or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.

I. Sand: ASTM C33/C33M; fine aggregate.

J. Impervious Fill / Clay: Clayey gravel and sand mixture capable of compacting to a dense state.

K. Crushed Stone: ¾” – 2” Clean, Crushed Stone.

L. Testing Requirements: Where classification of soils is necessary to meet specified requirements, perform laboratory tests in accordance with ASTM D2487.
1. Moisture–Density Relationship: ASTM D1557, Method D
2. Moisture Content: ASTM D2216
3. Relative Density: ASTM D4253/D4254
4. Liquid Limit: ASTM D4318
5. Plastic Limit and Plasticity Index: ASTM D4318
6. Dry Change (Volumetric Change): ASTM D427
7. Percentage of Wear: ASTM C131 or C535
8. Sieve Analysis: ASTM D422 and ASTM C136
9. Percent Passing No. 200 Sieve: ASTM D1140
10. Soil Classification: ASTM D2487

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 157 lbf (700 N); ASTM D 4632.
3. Sewn Seam Strength: 142 lbf (630 N); ASTM D 4632.
4. Tear Strength: 56 lbf (250 N); ASTM D 4533.
5. Puncture Strength: 56 lbf (250 N); ASTM D 4833.
6. Apparent Opening Size: [No. 40 (0.425-mm)] [No. 60 (0.250-mm)] No. 70 (0.212-mm) sieve, maximum; ASTM D 4751.
7. Permittivity: [0.2] per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf (1100 N); ASTM D 4632.
3. Sewn Seam Strength: 222 lbf (990 N); ASTM D 4632.
4. Tear Strength: 90 lbf (400 N); ASTM D 4533.
5. Puncture Strength: 90 lbf (400 N); ASTM D 4833.
6. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; 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. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Provide dewatering system per specifications set in Section 312319 "Dewatering."

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 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, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

   a. 6 inches outside of minimum required dimensions of concrete cast against grade.
   b. 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches wide.
3. Provide excavation protection where excavation depth exceeds 5 ft.

3.5 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.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, 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. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

C. If excavation below existing structures or foundation of adjacent structures, to be performed in a manner to minimize loss of ground effects/damage from settlements induced by excavation. When structures fall within the influence line from the excavation, they may require underpinning.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 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. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: As indicated.

C. Trench Bottoms: Excavate trenches 6 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. 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. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.8 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.

3.9 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 Engineer.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer.

3.10 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.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Surveying locations of underground utilities for Record Documents.
2. Testing and inspecting underground utilities.
3. Removing trash and debris.
4. Removing temporary shoring, bracing, and sheeting.
5. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Roadways: Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

D. Backfill voids with satisfactory soil while removing shoring and bracing.

E. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

   a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

G. Warning Tape: Install warning tape directly above utilities, 12 inches above utility.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use engineered fill.
3. Under steps and ramps, use engineered fill.
4. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry density.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry density according to ASTM D698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

D. Compaction of original ground and cut subgrade:
1. Before placement of fill or base materials, the exposed original ground, proof-cut subgrade, or cut-to-grade surfaces shall be evaluated by the Independent Soils Testing Laboratory. The subgrade shall be:
    a. Scarified to a minimum depth of 6 inches (150 mm), unless otherwise directed by the Geotechnical Engineer.
    b. Moistened or dried as necessary to achieve within ±2 percent of optimum moisture content.
    c. Recompacted to not less than 95 percent of maximum dry density (ASTM D1557) under building slabs, pavements, steps, ramps, and structural areas.

d. Recompacted to not less than 92 percent of maximum dry density in walkways and non-structural hardscape.
e. Recompacted to not less than 85 percent of maximum dry density in landscaped, turf, or unpaved areas.

2. If the subgrade exhibits pumping, rutting, excessive moisture, unsuitable material, or insufficient bearing capacity, the Contractor shall over-excavate to competent material and replace with compacted engineered fill or other remediation measures as directed by the Geotechnical Engineer.
3. All verification of subgrade preparation shall be performed under the supervision of a licensed Professional Engineer.

3.16 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 elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Planted or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Finish Grading:

1. Planted or Unpaved Areas: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Refer to Section 329300, PLANTING. Limit finish grading to areas that can be planted in the immediate future.

a. Contractor shall set grade lines for Architect’s review and approval.

1) Final surface of topsoil immediately before seeding shall be within + 1/2 in. of required elevation, with no ruts, mounds, ridges, or other faults, and no pockets or low spots in which water can collect. Stones, roots, and other debris greater than 1 in. in any dimension, which are visible at the surface, shall be removed and the resulting holes filled with topsoil, leaving a uniform planar surface.

b. Finish grade surface with a drag or rake. Smooth down all lumps and ridges, fill in all holes and crevices. Rolling with a light roller is acceptable, if the surface is scarified afterward.

1) Grade Breaks located on the plans indicate crisp transitions, not blended or rounded edges. These should be clean, sharp, and uniform in line and curve as indicated on the plans.
2) Planting Bed: Planting soil shall be spread in lifts not greater than 8 inches and compacted to a density of 85% Standard Proctor Maximum Dry Density in accordance with ASTM D698. The surface

area of each lift, including the subgrade after it has been compressed by a backhoe, shall be scarified by raking prior to placing the next lift.

3) In the event of settlement, the Contractor shall readjust the work to required finished grade.

2. Walks: Shape the surface of areas under walks to line, grade and cross-section, with the finish surface not more than 0.00 ft. above or 0.10 ft. below the required subgrade elevation, compacted as specified, and graded to prevent ponding of water after rains.
3. Pavements: Shape the surface of the areas under pavement to line, grade and cross-section, with the finish surface not more than 1/2 in. above or below the required subgrade elevation, compacted as specified, and graded to prevent ponding of water after rains. Include such operations as plowing, discing, and any moisture or aerating required to provide the optimum moisture content for compaction. Fill low areas resulting from removal of unsatisfactory soil materials, obstructions, and other deleterious materials, using satisfactory soil material. Shape to line, grade, and cross-section as shown on the Drawings.

3.17 SUBSURFACE DRAINAGE

A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch (150-mm) course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches (300 mm) of filter material, placed in compacted layers 6 inches (150 mm) thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698, with a minimum of two passes of a plate-type vibratory compactor.

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches (300 mm) of final subgrade, in compacted layers 6 inches (150 mm) thick. Overlay drainage backfill with 1 layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698, with a minimum of two passes of a plate-type vibratory compactor.
2. Place and compact impervious fill over drainage backfill in 6-inch- (150-mm-) thick compacted layers to final subgrade.

3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase course under hot-mix asphalt pavement.

3. Shape subbase course and base course to required crown elevations and cross-slope grades.
4. Place subbase course and base course 6 inches (150 mm) or less in compacted thickness in a single layer.
5. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry density according to ASTM D698.

3.19 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Engineer.

D. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2922, and ASTM D2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than 3 tests.
2. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet (46 m) or less of trench length, but no fewer than 2 tests.

E. 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 to depth required; recompact and retest until specified compaction is obtained.

3.20 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.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 32 39

BIOENGINEERING PRACTICES FOR SHORELINE STABILIZATION

PART 1 – GENERAL

1.1 SUMMARY

A. The work described in this section consists of furnishing, storing, and installing bioengineered features and structures.

B. The work described in this section includes all necessary evaluation, design, materials, labor, supervision, and equipment for installation of a complete system and after construction maintenance.

C. The Contractor shall submit to the Engineer a list of all equipment and tools that will be used for the construction of the bioengineered features and structures. Include information on products used in equipment such as fuel, hydraulic fluids, and the like.

D. The Contractor shall coordinate this section with the requirements of the related sections listed below.

1.2 REFERENCES

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

1. U.S. ARMY CORPS OF ENGINEERS (USACE):

   TR-EL-97-8 (1997) – Bioengineering for Streambank Erosion Control; Report 1, Guidelines

1.3 SUBMITTALS

A. The Contractor shall submit the following to the Engineer for approval:

1. <u>Preconstruction submittals</u>: Establishment period and, if needed, dewatering.
2. <u>Operation and Maintenance Data</u>: Maintenance Instructions.

B. The Contractor shall submit the following to the Engineer for reference:

1. Product Data:

   a. Materials
   b. Equipment
   c. Erosion Control Blanket

2. Samples: Physical samples of erosion control fabric
3. Certificates:

a. Installer's Qualification
b. Personnel Qualifications
c. Binders

4. All submittals noted under “Quality Assurance” and “Maintenance” below.

1.4 QUALITY ASSURANCE

A. All Contractor and subcontractor personnel shall be fully qualified to perform the specified work and shall provide the Engineer with such documentation no less than 10 calendar days after the Notice of Award. Work shall not start until the Contracting Office is satisfied that the Contractor meets or exceeds all required qualifications. All Contractor records, documents, and work may be inspected by the Contracting Officer or designated representative at any time. Replace or repair immediately items not meeting quality requirements at no cost to the Owner.

B. Regulatory Compliance: Perform the specified work in accordance with all applicable Federal, State, and local regulations and regulatory permits.

C. Preconstruction Conference: Coordinate and conduct meetings with the Owner, the Engineer, and all subcontractors prior to the start of any work to ensure all work requirements are fully understood and will be performed. All of these meetings shall take place in the presence of the Engineer.

D. Substitutions: Substitutions will not be allowed.

E. Qualifications:

1. Installer's Qualification: Submit the installer's company name and address; training and experience and or certification. The installer shall be certified by the manufacturer for any special training and/or experience required for installation.

2. Personnel Qualifications: Submit a list of personnel working on the project including name, title, and statements of their current positions and previous experiences. Selected personnel shall have been involved in bioengineering design and construction efforts similar to the proposed site work within the last 2 years.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Submit a list of nonvegetative materials to be used in the construction of bioengineered features and structures. Include manufacturer's literature regarding physical characteristics, limitations, and application or installation instructions. Store materials in designated areas as recommended by the manufacturer and that are protected from direct exposure to the elements, moisture, and any potential damage. Containers shall not be dropped from trucks. Material shall be free of defects that would void required performance or warranty. Deliver manufactured items in the manufacturer's original sealed containers and stored in a secure area.

B. Prior to delivery of materials, submit certificates of compliance attesting that those materials meet the specified requirements. Certified copies of the material certificates shall include the following for items listed in this section:

1. Certification of recycled content or statement of recycled content.
2. Certification of origin including the name, address and telephone number of manufacturer.
3. Certification for binders showing EPA registered uses, toxicity levels, and application hazards.

C. Erosion Control Blankets: Furnish erosion control blankets in rolls with suitable wrapping to protect against moisture and extended ultraviolet exposure prior to placement. Erosion control blanket rolls shall be labeled to provide identification sufficient for inventory and quality control purposes.

1.6 SEQUENCING AND SCHEDULING

A. Conduct all work in accordance with all Federal, State, and local requirements for waterfront construction. The construction sequence shall result in successful completion of the features shown on the Contract Drawings. Submit a construction work sequence schedule detailing the work tasks and order of completion to the Engineer for approval by the due date specified in Section 01 31 19, Preconstruction Conferences. Work shall not commence without the approval of the schedule and construction sequence by the Contracting Officer. Construction shall not occur if climatic conditions threaten the survivability of plants or worker safety.

PART 2 – PRODUCTS

2.1 STAPLES (NOT ALLOWED)

A. Do not use metal or plastic staples.

2.2 SYNTHETIC GRID AND SHEET SYSTEMS

B. Do not use synthetic grid and sheet systems.

2.3 EROSION CONTROL BLANKET

A. The erosion control blanket to be used shall be CM 700 EM Mat constructed with coconut fibers at a density of 700 grams per square meter.

Approved suppliers are: RoLanka, International, Inc. Jute mat – Natural, Temporary Erosion Control Mat (https://rolanka.com/product/jute-mat-natural-temporary-erosion-control-mat/) or an Engineer-approved equal.

B. Erosion control blankets with plastic netting are not allowed.

C. Erosion fabric shall be secured in place using wooden stakes only.

PART 3 – EXECUTION

3.1 SITE VERIFICATION OF CONDITIONS

A. Coordinate, through the work schedule, the timing of land disturbing activities with the provision of erosion control measures. Perform erosion control operations under favorable weather conditions. When excessive moisture, frozen ground, or other unsatisfactory conditions prevail, stop the work as directed. Bioengineering materials shall not be applied in adverse weather conditions, which could affect their performance. Complete all tasks necessary for the required submittals.

3.2 BIOENGINEERED STRUCTURES

A. Erosion Control Blanket:

1. Site Preparation: Grade and shape the area of installation. Apply fertilizer if specified in the contract documents prior to installation of the erosion control blankets. Make sure top layer soil is free of clods, rocks, wood, and other obstructions so that the erosion control blanket is in direct contact with soil. Include a 12” deep and 12” wide initial anchor trench along the top side of the erosion control blanket as shown on the Contract Drawings.

2. Embed the top side of the erosion control blanket in the initial anchor trench as shown on the Contract Drawings. Then, unroll the erosion control blanket down slope. The blanket should not be stretched but should have full contact with the soil. Anchor blanket using stakes as noted in “Anchoring” below.

3. Overlap edges of adjacent parallel rolls by a minimum of 6” and anchor with stakes at 24” spacing.

4. Where blankets have to be spliced, place upper blanket end over lower blanket end (shingle style) with 12” overlap and anchor with two staggered rows of stakes at 12” spacing.

5. Anchoring: Use wooden stakes (at least 12” long) at roughly 2 feet on-center to anchor the erosion control blanket to the ground. Keep a minimum edge distance of 2” from the edge of the erosion control blanket to the center of the stakes.

3.3 FIELD QUALITY CONTROL

A. The work site will be inspected by the Engineer and Owner prior to final acceptance of work. A punch list noting deficiencies will be compiled by the Engineer and provided to the Contractor. Perform, repair, adjust, align, or otherwise comply with the specified work on the punch list to the satisfaction of the Engineer. Notify the Engineer at least 14 days prior to the inspection that work shall be ready for inspection. Work will not be accepted until all punch list items are resolved and all work meets or exceeds contract requirements. Final acceptance of work shall not be provided by the Contracting Officer until all defects or deficiencies are corrected. Final Acceptance shall occur only after all corrective actions and supplemental viable plantings are complete and the project meets performance standards and all contract requirements. Comply with necessary repairs to the to the new project features installed by the Contractor as stated in the warranty.

3.4 CLEAN-UP

A. Excess material, debris, and waste materials shall be disposed of offsite at an approved landfill or recycling center. Adjacent paved areas shall be cleared. The site shall be restored to preexisting conditions to the extent reasonably possible and to the satisfaction of the Engineer.

3.5 PROTECTION

A. Immediately upon the start of the installation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed by the Engineer or Owner. Protect the work site and vegetation by others under separate contract with the Owner from damage and vandalism until final acceptance by the Engineer.

3.6 DOCUMENTATION

A. Establish and maintain documentation for bioengineering practices to record the desired information and to assure compliance with contract requirements.

END OF SECTION

SECTION 32 15 43

CRUSHED STONE 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.

1.2 SUMMARY

A. Provide all equipment and materials, and do all work necessary to construct crushed stone paving surfacing, as indicated on the Drawings and as specified.

1.3 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Division 03 Section Earth Moving

1.4 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Society for Testing and Materials (ASTM): D 1557 Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lb. (4.54-kg) Rammer and 18-in. (475-mm) Drop

1.5 SUBMITTALS

A. Samples: Samples of crushed stones shall be "range samples" provided from the supplier to be used on the final work. Samples of the following shall be submitted:

1. ODOT #12 Stone – 5 lb bag
2. ODOT #304 Stone Mix – 5 lb bag
3. Filter Fabric – 6”x6” piece

B. Manufacturer's Product Data: Manufacturer's product data shall be submitted for the following items:

1. Stone Material – Type, Sizes and Source
2. Filter Fabric – Type, Sizes and Source

1.6 PROJECT/SITE CONDITIONS

A. Field Measurements: Each bidder is required to visit the site of the Work to verify the existing conditions. No adjustments will be made to the Contract Sum for variations in the existing conditions.

2. Where surfacing is indicated to fit with other construction, verify dimensions of other construction by field measurements before proceeding with the work.

B. Environmental Limitations: Do not install crushed stone paving during rainy conditions or below 40 degrees Fahrenheit and falling.

1.7 TESTING AND INSPECTION

A. The Owner reserves the right to test and inspect materials and construction of crushed stone paving.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has crushed stone paving installations similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations: Obtain crushed stone and subbase material from one source with resources to provide materials and products of consistent quality in appearance and physical properties.

C. Mock-ups: Provide up to four (4) 5 ft. X 5 ft. mockups of the crushed stone paving system for Architect review at a location specified by Owner's Representative.

D. Compaction testing to be provided by contractor, one test per 2,000 square feet of base course.

PART 2 – PRODUCTS

2.1 AGGREGATE BASE

A. Material for aggregate base course shall be a graded, granular, non-frost susceptible, free draining material, consisting of either durable stone and coarse sand or of blast furnace slag, practically free from loam and clay, and which can be readily compacted to form a stable foundation.

1. Material shall conform to ODOT #12 Stone.

2.2 CRUSHED STONE PAVING

A. Crushed Stone Paving - Surfacing material shall be crushed stone consisting of inert materials that are hard and durable, with stone free from surface coatings and deleterious materials. Gradation requirements shall be as follows:

1. Crushed Stone Paving shall conform to ODOT #304 Stone.

2.3 FILTER FABRIC

A. Filter Fabric shall be non-woven polypropylene geotextile meeting AASHTO M288 Class3 for elongation > 50%. Providing high water flow rates and excellent soil retention.

PART 3 – EXCUTION

3.1 GRADING

A. Areas to be paved will be compacted and brought approximately to subgrade elevation under Section 312000 Earth Moving before work of this section is performed. Final fine grading, filling, and compaction of subgrade to receive paving, as required to form a firm, uniform, accurate, and unyielding subgrade at required elevations and to required lines, shall be done under this Section.

B. Existing subgrade material which will not readily compact as required shall be removed and replaced with satisfactory materials. Additional materials needed to bring subgrade to required line and grade and to replace unsuitable material removed shall be aggregate base material conforming to this Section.

C. Subgrade of areas to be paved shall be recompacted as required to bring top 8 in. of material immediately below gravel base course to a compaction of at least 90% of maximum density, as determined by ASTM D 1557, Method D. Subgrade compaction shall extend for a distance of at least 1 ft. beyond pavement edge.

D. Excavation required in pavement subgrade shall be completed before fine grading and final compaction of subgrade are performed. Where excavation must be performed in completed subgrade or subbase subsequent backfill and compaction shall be performed as directed by the Architect as specified in Section 312000 Earth Moving. Completed subgrade after filling such areas shall be uniformly and properly graded.

E. Areas being graded or compacted shall be kept shaped and drained during construction. Ruts greater than or equal to 2 in. deep in subgrade, shall be graded out, reshaped as required, and recompacted before placing pavement.

F. Materials shall not be stored or stockpiled on subgrade.

G. Disposal of debris and other material excavated and/or stripped under this section, and material unsuitable for or in excess of requirements for completing work of this Section shall be legally disposed of off-site.

H. Prepared subgrade will be inspected by the Architect. Subgrade shall be approved by the Architect before installation of paving base course. Disturbance to subgrade caused by inspection procedures shall be repaired under this Section of the specification.

3.2 AGGREGATE BASE COURSE

A. Aggregate base course for paving and the spreading, grading, and compaction methods employed shall conform to standard requirements for usual base course of this type for first class road work, and the following:

1. ODOT #12 Stone

B. Compaction of aggregate base course shall be to 95% of maximum density as determined by ASTM D 1557, Method D. Stone greater than 2-1/2 in. shall be excluded from course.

C. Width of base course shall be greater than or equal to the width of pavement surface, if continuous lateral support is provided during rolling, and shall extend at least 2 x base thickness beyond edge of the course above, if not so supported.

D. Aggregate material shall be applied in lifts less than or equal to 4 in. thick, compacted measure. Each lift shall be separately compacted to specified density, using a 6-ton steel wheel roller or vibratory roller equivalent to a 6-ton static roller, or an approved equivalent.

1. Material shall be placed adjacent to wall, manhole, catch basin, and other structures only after they have been set to required grade and level.
2. Rolling shall begin at sides and progress to center of crowned areas, and shall begin on low side and progress toward high side of sloped areas. Rolling shall continue until material does not creep or wave ahead of roller wheels.
3. Surface irregularities which exceed 1/2 in. measured by means of a 10 ft. long straightedge shall be replaced and properly compacted.

E. Subgrade and base course shall be kept clean and uncontaminated. Less select materials shall not be permitted to become mixed with gravel. Materials spilled outside pavement lines shall be removed and area repaired.

F. Portions of subgrade or of construction above which become contaminated, softened, or dislodged by passing of traffic, or otherwise damaged, shall be cleaned, replaced, and otherwise repaired to conform to the requirements of this specification before proceeding with next operation.

3.3 FILTER FABRIC

A. Filter fabric shall be placed on compacted subgrade in accordance with manufacturer's printed instructions. Line trench on bottom and up the sides as indicated on the Drawings. Where fabric edges meet, they shall overlap a minimum of 12 in.

3.4 CRUSHED STONE SURFACING

A. Crushed stone surfacing shall be done only after excavation and construction work which might injure it has been completed. Damage caused during construction shall be repaired before acceptance.

B. Crushed stone surfacing shall be constructed on a compacted aggregate base as indicated on the Drawings.

C. Crushed stone paving mix shall be spread evenly over the base in 1-1/2 in. maximum lifts. Final compacted thickness shall be as indicated on the Drawings. Utilize machinery for placement as recommended by stabilizer product manufacturer based on scale and scope of paving.

1. Place the crushed stone mix on prepared aggregate base and rake smooth using a steel tine rake to desired grade and cross section.
2. Do not install deeper than 2 inches in one lift and install in equal lifts. Compact each lift separately. Allow each layer after compaction to dry out.
3. Compaction: Roll each lift with a 2 ton (or larger) double drum or single static drum roller, or equivalent. Do not use a vibratory plate compactor or vibratory setting on the compactor. Compaction of the crushed stone paving will be complete when no further visible roller marks can be seen on the surface.

D. The surface of the compacted crushed stone paving surfacing shall be true to elevation and shall not vary by more than 1/4” tested with a straight edge at any location on surfaces. Surfaces shall be crowned at a minimum of 2% and about flush with adjacent materials and/or edge restraint. The surface shall be sloped a minimum of 1% to drain away from structures.

E. Crushed stone paving surface shall comply with ADA Requirements for accessibility.

3.5 INSPECTION

A. Finished aggregate surfacing shall be smooth, uniform and solid. Compacted aggregate shall be firm throughout profile with no spongy areas. Aggregates shall remain stable underneath loose crushed stone paving on top. Surfacing shall appear “natural” yet stable throughout. Any significant irregularities in surfacing shall be repaired to the uniformity of the entire installation.

3.6 REPAIRS

A. Excavate damaged area to the depth of the coarse crushed stone paving and square off sidewalls.

B. Any significant irregularities shall be smoothed out prior to final acceptance of work.

3.8 MAINTENANCE

A. Remove debris, such as paper, grass clippings, leaves or other organic material by mechanically blowing or hand raking the surface as needed. Any plowing program required during winter months shall involve the use of a rubber baffle on the plow blade or wheels on the plow that lifts the blade 1/4" off the paving surface.

END OF SECTION

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:

1. Sandstone Blocks
2. Stone Boulders

B. Related Requirements:

1. Section 312000 "Earth Moving" for grading and compaction below and around furnishings.

1.3 ACTION SUBMITTALS

A. Product Data: Quarry source and stone type.

B. Photos of each type of product specified.

1.4 QUALITY ASSURANCE

A. Architect shall tag/mark individual stone blocks and boulders at manufacturer’s yard or quarry. Notify Architect of availability of stone at source. Provide Architect with 14 days advanced notice of availability to schedule visit.

PART 2 - PRODUCTS

2.1 SANDSTONE BLOCK

A. Manufacturer:

1. Keeney Sand & Stone, Inc.
13320 Girdled Rd., Painesville, OH 44077
Keeney Sand & Stone

440-254-4582
office@keeneysandandstone.com
Material: Sandstone
Size: 7’ L x 4’ W x 4’ H
Finish: Rough Cut
Color: Natural (Tan)

2. Or Approved Equal

2.2 STONE BOULDER

A. Manufacturer:

1. Keeney Sand & Stone, Inc.
13320 Girdled Rd., Painesville, OH 44077
Keeney Sand & Stone
440-254-4582
office@keeneysandandstone.com
Material: Granite
Size: Varies (4-6’ L x 4-6’ W x 2-3’ H)
Finish: Natural
Color: Natural (Gray)

2. Or Approved Equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install site furnishings level, plumb, true, and positioned at locations indicated on Drawings.

END OF SECTION

SECTION 32 91 00

PLANTING PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. The work described in this section consists of furnishing, placing, and preparing the planting bed across the project site.

B. The work described in this section includes all necessary laboratory testing, soil amendments, materials, labor, supervision, and equipment for the preparation of a planting bed suitable for the installation of native plantings across the project site.

C. The contractor shall coordinate with the engineer to ensure that all requirements for a suitable planting bed are met prior to the installation of native plants.

D. The contractor shall coordinate the requirements of this section with the requirements of all related sections listed below.

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. The following references are relative to the testing and quality of topsoil required for this project and are part of this specification:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T 267-22: Determination of Organic Content in Soils by Loss on Ignition

OHIO DEPARTMENT OF TRANSPORTATION (ODOT) – CMS 2024 EDITION

ODOT Item 653: Topsoil Furnished and Placed

OHIO ENVIRONMENTAL PROTECTION AGENCY (OEPA) – RAINWATER AND LAND DEVELOPMENT – OCTOBER 2021

Section 1.4: Soil Restoration

1.3 CONTENTS

A. Section Includes:

1. Topsoil Requirements

2. Coordination of Dredge Material Placement
3. Soil Amendments
4. Landscape Grading
5. Warranty and Performance

B. Related Requirements:

1. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
2. Section 312000 “Earth Moving” for preparing subgrades for lawns and grasses and exterior plants.
3. Section 312319 "Dewatering" for lowering and disposing of ground water during construction.
4. Section 3129200 “Lawn and Meadow Grasses” for all lawn and meadow seeding across the project site.
5. Section 329300 “Plants” for other exterior plantings.

1.4 SUBMITTALS

A. The contractor shall submit the following to the engineer for approval:

1. Dredge material laboratory soil testing information
2. Laboratory testing information for any required soil amendments
3. Laboratory soil testing information for any imported topsoil

B. Samples

1. Prior to the placement of dredge material, the contractor shall coordinate with the engineer to determine if the material is suitable for use as planting bed material.
2. Engineer shall have the opportunity to review and approve or reject all imported soil amendments or imported topsoil prior to placement.

1.5 DELIVERY, STORAGE, AND HANDLING

A. All materials shall be delivered, stored, and handled as recommended by the manufacturer. Materials shall be protected from direct exposure to the elements, moisture, and any potential damage. Materials shall be free of defects that would void required performance or warranty. Any items sealed by the manufacturer shall be delivered in the manufacturer's original sealed containers and stored in a secure area.

1.6 SEQUENCING AND SCHEUDLING

A. Conduct all work in accordance with all Federal, State, and local requirements for waterfront construction. The construction sequence shall result in successful completion of the features shown on the Contract Drawings. Submit a construction work sequence schedule detailing the work tasks and order of completion to the Engineer for approval by the due date specified in Section 01 31 19, Preconstruction Conferences. Work shall not commence without the approval of the schedule and construction sequence by the Contracting Officer. Construction shall not occur if climatic conditions threaten the survivability of plants or worker safety.

1.7 QUALITY ASSURANCE

A. All Contractor and subcontractor personnel shall be fully qualified to perform the specified work and shall provide the Engineer with such documentation no less than 10 calendar days after the Notice of Award. Work shall not start until the Contracting Office is satisfied that the Contractor meets or exceeds all required qualifications. All Contractor records, documents, and work may be inspected by the Contracting Officer or designated representative at any time. Replace or repair immediately items not meeting quality requirements at no cost to the Owner.

B. Regulatory Compliance: Perform the specified work in accordance with all applicable Federal, State, and local regulations and regulatory permits.

C. Preconstruction Conference: Coordinate and conduct meetings with the Owner, the Engineer, and all subcontractors prior to the start of any work to ensure all work requirements are fully understood and will be performed. All of these meetings shall take place in the presence of the Engineer.

D. Substitutions will not be allowed.

1.8 PROJECT CONDITIONS

A. This project will be built primarily using recycled dredge material from the Cuyahoga River shipping channel. This material is variable by nature. Material deemed suitable for planting bed material, by engineer review or laboratory testing, may be stockpiled for placement across the site after final grades have been reached.

B. Material deemed unsuitable for planting bed material shall not be placed in the upper one (1) foot of material placed in the designated planting areas.

C. If unsuitable material is placed in the upper one (1) foot of material placed in the designated planting areas, soil amendments or imported topsoil shall be utilized to augment the planting bed and create a suitable medium for native plantings.

D. If no dredge material is deemed to be suitable for planting areas, by engineer review or laboratory testing, imported topsoil shall be placed from 8” below finish grade to finish grade in all designated planting areas.

E. Close coordination with the engineer will be required to ensure the suitability of the topsoil within the designated planting areas.

PART 2 - PRODUCTS

2.1 DREDGE MATERIAL

A. All dredge material shall be sourced from the Port of Cleveland's Cuyahoga River dredging operation.

B. For dredge material to be utilized as planting bed material, dredge material shall have a fraction passing the No. 10 (2.0 mm) sieve less than 40% clay, as determined by laboratory testing, and consist of 4-20% organic matter as determined by loss on ignition of samples oven dried to constant weight at 212 F (100 C).

2.2 SOIL AMENDMENTS

A. Soil amendments shall be utilized on an as-needed basis if dredge material is deemed to be unsuitable for planting bed material.

B. Soil amendments shall be determined based on laboratory soil testing and recommendations of a certified soil scientist.

C. Any soil amendments shall be sourced from reputable suppliers with laboratory testing provided to the engineer to ensure suitability.

D. Samples of all soil amendments shall be made available to the engineer.

2.3 TOPSOIL

A. Any topsoil imported for the project shall be sourced from a reputable supplier.

B. Laboratory soil testing of imported topsoil (provided by the supplier) shall be provided to the engineer for review to ensure suitability of planting bed material.

C. Samples of any imported topsoil shall be made available to the engineer.

D. Imported topsoil shall be free of large rocks, rubble, and debris.

E. Imported topsoil shall consist of loose, friable, loamy material without admixture of subsoil or refuse. For topsoil to be considered loamy, ensure that the fraction passing the No. 10 (2.00 mm) sieve does not contain more than 40 percent clay. Furnish topsoil consisting of not less than 4 percent and not more than 20 percent organic matter as determined by loss on ignition of samples oven dried to constant weight at 212 F (100 C).

F. Furnish topsoil that is free of grass, brush, and, roots.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and embankment are specified in Section 312000 "Earth Moving."

3.2 PLACEMENT OF PLANTING SOIL

A. The plans shall dictate the planting areas designated for placement of topsoil or suitable planting bed material.

B. All designated planting areas shall be rough graded to within 8-12” of finish grade using dredge material prior to the placement of suitable planting bed material. The engineer shall review the site prior to the placement of suitable planting bed material.

C. Suitable planting material shall be installed to reach finish grades at a depth of 8-12”.

D. The planting surface shall be scarified and tilled to a depth of 6” to prevent compaction.

E. Upon the placement of planting media, all portions of the site should be within 0.2’ of finish grade as per the contract documents.

F. The engineer shall review all designated planting areas to ensure the satisfactory placement of planting media prior to the installation of any native plants or permanent seed mixes.

3.3 SITE SPECIFIC CONDTIONS

A. All planting soil shall be placed during favorable weather conditions. Stop work as directed when excessive rainfall, groundwater, or lake levels lead to saturated conditions, cold temperatures create frozen ground, or other conditions occur which could lead to poor performance of the planting soil.

B. All earthwork, placement of planting soil, erosion control measures, temporary seeding, and permanent seeding and planting should be coordinated to comply with applicable federal, state, and local regulations.

3.4 CONSTRUCTION QUALITY CONTROL

A. The work site will be inspected by the engineer and owner prior to final acceptance of work. A punch list noting deficiencies will be compiled by the engineer and provided to the contractor. Perform, repair, adjust, align, or otherwise comply with the specified work on the punch list to the satisfaction of the engineer. Notify the engineer at least 14 days prior to the inspection that work shall be ready for inspection. Work will not be accepted until all punch list items are resolved and all work meets or exceeds contract requirements. Final acceptance of work shall not be provided by the contracting officer until all defects or deficiencies are corrected. Final acceptance shall occur only after all corrective actions and supplemental viable plantings are complete and the project meets performance standards and all contract requirements. Comply with necessary repairs to the new project features installed by the contractor as stated in the warranty.

3.5 SITE CLEAN UP

A. All excess material, debris, waste, rubbish, and equipment shall be removed by the contractor and disposed of at an approved location. All paved areas adjacent to the project site shall be cleaned of dirt and debris. The site shall be restored to its preconstruction condition as directed by the owner or the engineer.

3.6 SITE PROTECTION

A. The contract shall be responsible for protecting the project site from incursion of vehicle and foot traffic until the site has reached the predetermined vegetation establishment goal. The contract shall install barricades and signage at the direction of the owner or engineer. All planting surfaces shall be protected from damage or vandalism until final site acceptance by the engineer or owner.

3.7 DOCUMENTATION

A. The contractor shall maintain records of material placement of planting media including materials utilized, composition of planting media (dredge material, soil amendments, topsoil, etc.), soil amendments utilized, and topsoil imported. All documentation shall be provided to the owner and engineer for incorporation into the site’s long term management plan.

END OF SECTION

SECTION 32 92 00

LAWNS AND MEADOW GRASSES

PART 1 – GENERAL

1.1 SUMMARY

A. The scope of work includes all labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with furnishing, delivery, and installation of lawns and meadow grasses complete as shown on the drawings and as specified herein.

B. The scope of work in this section includes, but is not limited to, the following:

1. Seeding
2. Hydroseeding
3. Sodding
4. Erosion-control material(s).

1.2 REFERENCES

A. Related Documents:

1. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
   a. ODOT Current Standards ITEM 659 SEEDING AND MULCHING
2. Related Specification Sections
   a. Section 32 91 00 – Planting Preparation
   b. Section 32 93 00 – Planting
3. American Association of State Highway and Transportation Officials (AASHTO)
   a. AASHTO T 267-22: Determination of Organic Content in Soils by Loss on Ignition
4. OHIO DEPARTMENT OF TRANSPORTATION (ODOT) – CMS 2024 EDITION
   a. ODOT Item 653: Topsoil Furnished and Placed
5. OHIO ENVIRONMENTAL PROTECTION AGENCY (OEPA) – RAINWATER AND LAND DEVELOPMENT – OCTOBER 2021
   a. Section 1.4: Soil Restoration

1.3 SUBMITTALS

A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

B. Product Certificates: For fertilizers, from manufacturer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either

the Professional Landcare Network or the American Nursery and Landscape Association.

2. Pesticide Applicator: State licensed, commercial.

3. Seeding, Mulching, Sodding and Weed Control shall comply with ODOT Department of Transportation (ODOT), most recent edition.

1.5 WARRANTY

A. Warranty:

1. The Contractor agrees to replace defective work and defective seed. The Owner's Representative shall make the final determination if seed meet these specifications or that plants are defective.
2. Plants warranty shall begin on the date of Substantial Completion Acceptance and continue for the following periods:
   a. 1 Year(s).
3. When the work is accepted in parts, the warranty periods shall extend from each of the partial Substantial Completion Acceptances to the terminal date of the last warranty period. Thus, all warranty periods for each class of plant warranty, shall terminate at one time.
4. All seeding shall be warrantied to meet all the requirements for seed quality at installation in this specification. Defective seed shall be defined as seed not meeting these requirements. The Owner's representative shall make the final determination that seed is defective.
5. Seed determined to be defective shall be replaced without cost to the Owner, as soon as weather conditions permit and within the specified seeding period.
6. The Contractor is exempt from replacing seed, after Substantial Completion Acceptance and during the warranty period, that is removed by others, lost or damaged due to occupancy of project, lost or damaged by a third party, vandalism, or any natural disaster.
7. Replacement seed shall closely match the same seed species. Replacements shall be subject to all requirements stated in this specification. Make all necessary repairs due to plant replacements. Such repairs shall be done at no extra cost to the Owner.
8. The warranty of all replacement seed shall extend for an additional one-year period from the date of their acceptance after replacement.

B. End of Warranty Final Acceptance - Acceptance of seed at the end of the warranty period.

1. At the end of the warranty period, the Owner's Representative shall observe all warranted work, upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date for final observation.
2. End of Warranty Final Acceptance will be given only when all the requirements of the work under this specification been met.

1.6 SEED SUBSTITUTIONS FOR PLANTS NOT AVAILABLE

A. Submit all requests for substitutions of seed species to the Owner's Representative, for approval, prior to purchasing the proposed substitution. Request for substitution shall be accompanied with a list of suppliers contacted in the search for the required seed and a record of other attempts to locate the required material.

1.7 SITE CONDITIONS

A. It is the responsibility of the Contractor to be aware of all surface and sub-surface conditions, and to notify the Owner's Representative, in writing, of any circumstances that would negatively impact the health of seeding. Do not proceed with work until unsatisfactory conditions have been corrected.

1. Should subsurface drainage or soil conditions be encountered which would be detrimental to growth or survival of seed, the Contractor shall notify the Owner's Representative in writing, stating the conditions and submit a proposal covering cost of corrections. If the Contractor fails to notify the Owner's Representative of such conditions, he/she shall remain responsible for seeded material under the warranty clause of the specifications.

B. It is the responsibility of the Contractor to be familiar with the local growing conditions, and if any specified species will be in conflict with these conditions. Report any potential conflicts, in writing, to the Owner's Representative.

C. This specification requires that all Planting Soil and Irrigation (if applicable) work be completed and accepted prior to the installation of any plants.

1. Planting operations shall not begin until such time that the irrigation system is completely operational for the area(s) to be planted, and the irrigation system for that area has been preliminarily observed and approved by the Owner's Representative.

D. Actual seeding shall be performed during those periods when weather and soil conditions are suitable in accordance with locally accepted horticultural practices.

1. Do not install seeds into saturated or frozen soils. Do not install seeds during inclement weather, such as rain or snow or during extremely hot, cold or windy conditions.

PART 2 – PRODUCTS

2.1 SEEDS: GENERAL

A. Grass Seed: Furnish grass seed from a grass seed dealer or grower whose brands are grades registered or licensed by the State of Ohio, Department of Agriculture or from the approved list of grass seed dealers or growers on file with the Ohio Department of Transportation per ODOT Supplement 1022. Furnish the kind and type of grass seed required that meets current specifications on file with ODOT as to percentage purity, percentage weed seed, and percentage germination.

B. Topsoil, Compost, and Fertilizers used must comply with ODOT ITEM 659 SEEDING AND MULCHING

C. Meadow Seed: The following providers are pre-approved to supply Native Seeds for this project:

1. Ernst Conservation Seeds
8884 Mercer Pike
Meadville, PA 16335
www.ernstseed.com
1 (800) 873-3321

PART 3 – EXECUTION

3.1 SITE EXAMINATION

A. Examine the surface grades and soil conditions to confirm that the requirements of the Planting Soil Specification Section 32 91 00 – Planting Preparation and the soil and drainage modifications indicated on the Planting Soil Plan and Details (if applicable) have been completed. Notify the Owner's Representative in writing of any unsatisfactory conditions.

3.2 DELIVERY, STORAGE AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and federal laws, as applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates

3.1 SEEDING SEASON

A. Seeding shall only be performed when weather and soil conditions are suitable for germination in accordance with locally accepted practice.

3.2 ADVERSE WEATHER CONDITIONS

A. No seeding shall take place during extremely hot, dry, or windy weather.

3.3 COORDINATION WITH PROJECT WORK

A. The Contractor shall coordinate with all other work that may impact the completion of the work.

B. Prior to the start of work, prepare a detailed schedule of the work for coordination with other trades.

3.4 SOIL PROTECTION

A. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.5 TURF AND MEADOW AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to ODOT ITEM 659 SEEDING AND MULCHING.

B. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before seeding. Do not create muddy soil.

D. Before seeding, obtain Authority's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.6 SEEDING

A. General: Seed according to specifications and rate tables located in ODOT ITEM 659 SEEDING AND MULCHING

B. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
2. Do not use wet seed or seed that is moldy or otherwise damaged.
3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

C. Sow seed at a total rate per ODOT ITEM 659 SEEDING AND MULCHING specifications.

D. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

E. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.

F. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.

G. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal/1,000 sq. ft. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.
3. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch and roll surface smooth.

3.7 HYDROSEEDING

A. Hydroseeding shall comply with ODOT ITEM 659 SEEDING AND MULCHING

3.8 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf.

B. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

C. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches, if required by Authority.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

D. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.

3.9 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Engineer:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

C. At the end of the Warranty and Maintenance period the Owner’s Representative shall observe the work and establish that all provisions of the contract are complete and the work is satisfactory.

1. If the work is satisfactory, the maintenance period will end on the date of the final observation.
2. If the work is deemed unsatisfactory, the maintenance period will continue at no additional expense to the Owner until the work has been completed, observed, and approved by the Owner’s Representative.

D. FAILURE TO PASS OBSERVATION: If the work fails to pass final observation, any subsequent observations must be rescheduled as per above. The cost to the Owner for additional observations will be charged to the Contractor at the prevailing hourly rate of the Owners Representative.

3.10 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with the Authority’s operations and others in proximity to the Work. Notify owner before each application is performed

B. Only Selective Post-Emergent Herbicides may be used. Apply only as necessary to treat already germinated weeds according to manufacturer’s written recommendations. Notify owner before each application is performed.

3.11 CLEAN-UP

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period

END OF SECTION

SECTION 32 93 00

PLANTING

PART 1 – GENERAL

1.1 SUMMARY

A. The scope of work includes all labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with furnishing, delivery, and installation of plant (also known as "landscaping") complete as shown on the drawings and as specified herein.

B. The scope of work in this section includes, but is not limited to, the following:

1. Locate, purchase, deliver and install all specified plants.
2. Water all specified plants.
3. Mulch, fertilize, stake, and prune all specified plants.
4. Maintenance of all specified plants until the beginning of the warranty period.
5. Plant warranty.
6. Clean up and disposal of all excess and surplus material.
7. Maintenance of all specified plants during the warranty period.

1.2 REFERENCES

A. Related Documents:

1. Drawings and general provisions of contract including general and supplementary conditions and Division I specifications apply to work of this section
2. Related Specification Sections
   a. Section 32 92 00 – Lawns and Meadow Grasses
   b. Section 32 91 00 – Planting Preparation

B. References: The following specifications and standards of the organizations and documents listed in this paragraph form a part of the specification to the extent required by the references thereto. In the event that the requirements of the following referenced standards and specification conflict with this specification section the requirements of this specification shall prevail. In the event that the requirements of any of the following referenced standards and specifications conflict with each other the more stringent requirement shall prevail or as determined by the Owners Representative.

1. ANSI Z60.1 American Standard for Nursery Stock, most current edition.
2. ANSI A 300 – Standard Practices for Tree, Shrub and other Woody Plant Maintenance, most current edition and parts.
3. Interpretation of plant names and descriptions shall reference the following documents. Where the names or plant descriptions disagree between the several documents, the most current document shall prevail.
   a. USDA - The Germplasm Resources Information Network (GRIN) http://www.ars- grin.gov/npgs/searchgrin.html
   b. Manual of Woody Landscape Plants; Michael Dirr; Stipes Publishing, Champaign, Illinois; Most Current Edition.
   c. The New Sunset Western Garden Book, Oxmoor House, most current edition.
4. Glossary of Arboricultural Terms, International Society of Arboriculture, Champaign IL, most current edition.

1.3 SUBMITTALS

A. See contract general conditions for policy and procedure related to submittals.

B. Submit all product submittals 4 weeks prior to installation of plantings.

C. Product data: Submit manufacturer product data and literature describing all products required by this section to the Owner's Representative for approval. Provide submittal four weeks before the installation of plants.

D. Plant growers' certificates: Submit plant growers' certificates for all plants indicating that each meets the requirements of the specification, including the requirements of tree quality, to the Owner's Representative for approval. Provide submittal eight weeks before the installation of plants.

E. Samples: Submit samples of each product and material where required by the specification to the Owner's Representative for approval. Label samples to indicate product, characteristics, and locations in the work. Samples will be reviewed for appearance only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

F. Plant sources: Submit sources of all plants as required by Article – "Selection of Plants" to the Owner's Representative for approval.

G. Close out submittals: Submit to the Owner's Representative for approval.

1. Plant maintenance data and requirements.

H. Warranty period site visit record: If there is no maintenance during the warranty period, after each site visit during the warranty period, by the Contractor, as required by this specification, submit a written record of the visit, including any problems, potential problems, and any recommended corrective action to the Owner's Representative for approval.

1.4 QUALITY ASSURANCE

A. Substantial Completion Acceptance - Acceptance of the work prior to the start of the warranty period:

1. Once the Contractor completes the installation of all items in this section, the Owner's Representative will observe all work for Substantial Completion Acceptance upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date of the observation.
2. Substantial Completion Acceptance by the Owner's Representative shall be for general conformance to specified size, character and quality and not relieve the Contractor of responsibility for full conformance to the contract documents, including correct species.
3. Any plants that are deemed defective as defined under the provisions below shall not be accepted.

B. The Owner's Representative will provide the Contractor with written acknowledgment of the date of Substantial Completion Acceptance and the beginning of the warranty period and plant maintenance period (if plant maintenance is included).

C. Contractor's Quality Assurance Responsibilities: The Contractor is solely responsible for quality control of the work.

D. Qualifications:

1. Installer's Qualification: Submit the installer's company name and address; training and experience and or certification. The installer shall be certified by the manufacturer for any special training and/or experience required for installation.
2. Personnel Qualifications: Submit a list of personnel working on the project including name, title, and statements of their current positions and previous experiences. Selected personnel shall have been involved in bioengineering design and construction efforts similar to the proposed site work within the last 2 years.

1.5 PLANT WARRANTY

A. Plant Warranty:

1. The Contractor agrees to replace defective work and defective plants. The Owner's Representative shall make the final determination if plants meet these specifications or that plants are defective.
   Plants warranty shall begin on the date of Substantial Completion Acceptance and continue for the following periods, classed by plant type:
   a. Trees – 1 Year(s).
   b. Shrubs – 1 Year(s).
   c. Ground cover and perennial flower plants – 1 growing season
2. When the work is accepted in parts, the warranty periods shall extend from each of the partial Substantial Completion Acceptances to the terminal date of the last warranty period. Thus, all warranty periods for each class of plant warranty, shall terminate at one time.
3. All plants shall be warrantied to meet all the requirements for plant quality at installation in this specification. Defective plants shall be defined as plants not meeting these requirements. The Owner's representative shall make the final determination that plants are defective.
4. Plants determined to be defective shall be removed immediately upon notification by the Owner's Representative and replaced without cost to the Owner, as soon as weather conditions permit and within the specified planting period.
5. Any work required by this specification or the Owner's Representative during the progress of the work, to correct plant defects including the removal of roots or branches, or planting plants that have been bare rooted during installation to observe for or correct root defects shall not be considered as grounds to void any conditions of the warranty. In the event that the Contractor decides that such remediation work may compromise the future health of the plant, the plant or plants in question shall be rejected and replaced with plants that do not contain defects that require remediation or correction.
6. The Contractor is exempt from replacing plants, after Substantial Completion Acceptance and during the warranty period, that are removed by others, lost or damaged due to occupancy of project, lost or damaged by a third party, vandalism, or any natural disaster.
7. Replacements shall closely match adjacent specimens of the same species. Replacements shall be subject to all requirements stated in this specification. Make all necessary repairs due to plant replacements. Such repairs shall be done at no extra cost to the Owner.
8. The warranty of all replacement plants shall extend for an additional one-year period from the date of their acceptance after replacement. In the event that a replacement plant is not acceptable during or at the end of the said extended warranty period, the Owner's Representative may elect one more replacement items or credit for each

item. These tertiary replacement items are not protected under a warranty period.

9. During and by the end of the warranty period, remove all tree wrap, ties, and guying unless agreed to by the Owner's Representative to remain in place. All trees that do not have sufficient caliper to remain upright, or those requiring additional anchorage in windy locations, shall be staked or remain staked, if required by the Owner's Representative.

B. End of Warranty Final Acceptance - Acceptance of plants at the end of the warranty period.

1. At the end of the warranty period, the Owner's Representative shall observe all warranted work, upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date for final observation.
2. End of Warranty Final Acceptance will be given only when all the requirements of the work under this specification and in specification sections Planting Soil and Irrigation have been met.

1.6 SELECTION AND OBSERVATION OF PLANTS

A. The Owner's Representative may review all plants subject to approval of size, health, quality, character, etc. Review or approval of any plant during the process of selection, delivery, installation and establishment period shall not prevent that plant from later rejection in the event that the plant quality changes or previously existing defects become apparent that were not observed.

B. Plant Selection: The Owner's Representative reserves the right to select and observe all plants at the nursery prior to delivery and to reject plants that do not meet specifications as set forth in this specification. If a particular defect or substandard element can be corrected at the nursery, as determined by the Owner's Representative, the agreed upon remedy may be applied by the nursery or the Contractor provided that the correction allows the plant to meet the requirements set forth in this specification. Any work to correct plant defects shall be at the contractor's expense.

1. The Owner's Representative may make invasive observation of the plant's root system in the area of the root collar and the top of the root ball in general in order to determine that the plant meets the quality requirements for depth of the root collar and presence of roots above the root collar. Such observations will not harm the plant.
2. Corrections are to be undertaken at the nursery prior to shipping.

C. The Contractor shall bear all cost related to plant corrections.

D. All plants that are rejected shall be immediately removed from the site and acceptable replacement plants provided at no cost to the Owner.

E. Submit to the Owner's Representative, for approval, plant sources including the names and locations of nurseries proposed as sources of acceptable plants, and a list of the plants they will provide. The plant list shall include the botanical and common name and the size at the time of selection. Observe all nursery materials to determine that the materials meet the requirements of this section.

F. The Contractor shall require the grower or re-wholesale supplier to permit the Owner's Representative to observe the root system of all plants at the nursery or job site prior to planting including random removal of soil or substrate around the base of the plant. Observation may be as frequent and as extensive as needed to verify that the plants meet the requirements of the specifications and conform to requirements.

G. The Owner's Representative may choose to attach their seal to each plant, or a representative sample. Viewing and/or sealing of plants by the Owner's Representative at the nursery does not preclude the Owner's Representative's right to reject material while on site. The Contractor is responsible for paying any up charge for the Owner's Representative to attach their seal to specific plants.

H. Where requested by the Owner's Representative, submit photographs of plants or representative samples of plants. Photographs shall be legible and clearly depict the plant specimen. Each submitted image shall contain a height reference, such as a measuring stick. The approval of plants by the Owner's Representative via photograph does not preclude the Owner's Representative's right to reject material while on site.

1.7 PLANT SUBSTITUTIONS FOR PLANTS NOT AVAILABLE

A. Submit all requests for substitutions of plant species, or size to the Owner's Representative, for approval, prior to purchasing the proposed substitution. Request for substitution shall be accompanied with a list of nurseries contacted in the search for the required plant and a record of other attempts to locate the required material. Requests shall also include sources of plants found that may be of a smaller or larger size, or a different shape or habit than specified, or plants of the same genus and species but different cultivar origin, or which may otherwise not meet the requirements of the specifications, but which may be available for substitution.

1.8 SITE CONDITIONS

A. It is the responsibility of the Contractor to be aware of all surface and sub-surface conditions, and to notify the Owner's Representative, in writing, of any circumstances that would negatively impact the health of plantings. Do not proceed with work until unsatisfactory conditions have been corrected.

1. Should subsurface drainage or soil conditions be encountered which would be detrimental to growth or survival of plant material, the Contractor shall notify the Owner's Representative in writing, stating the conditions and submit a proposal covering cost of corrections. If the Contractor fails to notify the Owner's Representative of such conditions, he/she shall remain responsible for plant material under the warranty clause of the specifications.

B. It is the responsibility of the Contractor to be familiar with the local growing conditions, and if any specified plants will be in conflict with these conditions. Report any potential conflicts, in writing, to the Owner's Representative.

C. This specification requires that all Planting Soil and Irrigation (if applicable) work be completed and accepted prior to the installation of any plants.

1. Planting operations shall not begin until such time that the irrigation system is completely operational for the area(s) to be planted, and the irrigation system for that area has been preliminarily observed and approved by the Owner's Representative.

D. Actual planting shall be performed during those periods when weather and soil conditions are suitable in accordance with locally accepted horticultural practices.

1. Do not install plants into saturated or frozen soils. Do not install plants during inclement weather, such as rain or snow or during extremely hot, cold or windy conditions.

1.9 PLANTING AROUND UTILITIES

A. Contractor shall carefully examine the civil, record, and survey drawings to become familiar with the existing underground conditions before digging.

B. Determine location of underground utilities and perform work in a manner that will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until parties concerned mutually agree upon removal.

PART 2 – PRODUCTS

2.1 PLANTS: GENERAL

A. Standards and measurement: Provide plants of quantity, size, genus, species, and variety or cultivars as shown and scheduled in contract documents.

1. All plants including the root ball dimensions or container size to trunk caliper ratio shall conform to ANSI Z60.1 “American Standard for Nursery Stock” latest edition, unless modified by provisions in this specification. When there is a conflict between this specification and ANSI Z60.1, this specification section shall be considered correct.
2. Plants larger than specified may be used if acceptable to the Owner’s Representative. Use of such plants shall not increase the contract price. If larger plants are accepted the root ball size shall be in accordance with ANSI Z-60.1. Larger plants may not be acceptable if the resulting root ball cannot be fit into the required planting space.
3. If a range of size is given, no plant shall be less than the minimum size and not less than 50 percent of the plants shall be as large as the maximum size specified. The measurements specified are the minimum and maximum size acceptable and are the measurements after pruning, where pruning is required.

B. Proper Identification: All trees shall be true to name as ordered or shown on planting plans and shall be labeled individually or in groups by genus, species, variety and cultivar.

C. Compliance: All trees shall comply with federal and state laws and regulations requiring observation for plant disease, pests, and weeds. Observation certificates required by law shall accompany each shipment of plants.

D. Plant Quality:

1. General: Provide healthy stock, grown in a nursery and reasonably free of die-back, disease, insects, eggs, bores, and larvae. At the time of planting all plants shall have a root system, stem, and branch form that will not restrict normal growth, stability and health for the expected life of the plant
2. Plant quality above the soil line:
   a. Plants shall be healthy with the color, shape, size and distribution of trunk, stems, branches, buds and leaves normal to the plant type specified. Tree quality above the soil line shall comply with the project Crown Acceptance and the following:
      1.) Crown: The form and density of the crown shall be typical for a young specimen of the species or cultivar pruned to a central and dominant leader.
         a.) Crown specifications do not apply to plants that have been specifically trained in the nursery as topiary, espalier, multi-stem, clump, or unique selections such as contorted or weeping

cultivars.

2.) Leaves: The size, color, and appearance of leaves shall be typical for the time of year and stage of growth of the species or cultivar. Trees shall not show signs of prolonged moisture stress or over watering as indicated by wilted, shriveled, or dead leaves.

3.) Branches: Shoot growth (length and diameter) throughout the crown should be appropriate for the age and size of the species or cultivar. Trees shall not have dead, diseased, broken, distorted, or otherwise injured branches.

a.) Main branches shall be distributed along the central leader not clustered together. They shall form a balanced crown appropriate for the cultivar/species.

b.) Branch diameter shall be no larger than two-thirds (one-half is preferred) the diameter of the central leader measured 1 inch above the branch union.

c.) The attachment of the largest branches (scaffold branches) shall be free of included bark.

4.) Trunk: The tree trunk shall be relatively straight, vertical, and free of wounds that penetrate to the wood (properly made pruning cuts, closed or not, are acceptable and are not considered wounds), sunburned areas, conks (fungal fruiting bodies), wood cracks, sap leakage, signs of boring insects, galls, cankers, girdling ties, or lesions (mechanical injury).

5.) Temporary branches, unless otherwise specified, can be present along the lower trunk below the lowest main (scaffold) branch, particularly for trees less than 1 inch in caliper. These branches should be no greater than 3/8-inch diameter. Clear trunk should be no more than 40% of the total height of the tree.

b. Trees shall have one central leader. If the leader was headed, a new leader (with a live terminal bud) at least one-half the diameter of the pruning cut shall be present.

6.) All trees are assumed to have one central leader trees unless a different form is specified in the plant list or drawings.

c. All graft unions, where applicable, shall be completely closed without visible sign of graft rejection. All grafts shall be visible above the soil line.

d. Trunk caliper and taper shall be sufficient so that the lower five feet of the trunk remains vertical without a stake. Auxiliary stake may be used to maintain a straight leader in the upper half of the tree.

3. Plant quality at or below the soil line:

a. Plant roots shall be normal to the plant type specified. Root observations shall take place without impacting tree health. Root quality at or below the soil line shall comply with the project Root Acceptance details and the following:

1.) The roots shall be reasonably free of scrapes, broken or split wood.

2.) The root system shall be reasonably free of injury from biotic (e.g., insects and pathogens) and abiotic (e.g., herbicide toxicity and salt injury) agents. Wounds resulting from root pruning used to produce a high quality root system are not considered injuries.

3.) A minimum of three structural roots reasonably distributed around the trunk (not clustered on one side) shall be found in each plant. Root distribution shall be uniform throughout the root ball, and growth shall be appropriate for the species.

a.) Plants with structural roots on only one side of the trunk (J roots) shall be rejected.

4.) The root collar shall be within the upper 2 inches of the substrate/soil. Two structural roots shall reach the side of the root ball near the top surface of the root ball. The grower may request a modification to this requirement for species with roots that rapidly descend, provided that the grower removes all stem girdling roots above the structural roots across the top of the root ball.

5.) The root system shall be reasonably free of stem girdling roots over the root collar or kinked roots from nursery production practices.

6.) At time of observations and delivery, the root ball shall be moist throughout. Roots shall not show signs of excess soil moisture conditions as indicated by stunted, discolored, distorted, or dead roots.

E. Submittals: Submit for approval the required plant quality certifications from the grower where plants are to be purchased, for each plant type. The certification must state that each plant meets all the above plant quality requirements.

1. The grower's certification of plant quality does not prohibit the Owner's Representative from observing any plant or rejecting the plant if it is found to not meet the specification requirements.

2.2 ROOT BALL PACKAGE OPTIONS: The following root ball packages are permitted. Specific root ball packages shall be required where indicated on the plant list or in this specification. Any type of root ball packages that is not specifically defined in this specification shall not be permitted.

A. BALLED AND BURLAPPED PLANTS

1. All Balled and Burlapped Plants shall be field grown, and the root ball packaged in a burlap and twine and/or burlap and wire basket package.
2. Plants shall be harvested with the following modifications to standard nursery practices.
   a. Prior to digging any tree that fails to meet the requirement for maximum soil and roots above the root collar, carefully removed the soil from the top of the root ball of each plant, using hand tools, water or an air spade, to locate the root collar and attain the soil depth over the structural roots requirements. Remove all stem girdling roots above the root collar. Care must be exercised not to damage the surface of the root collar and the top of the structural roots.
   b. Trees shall be dug for a minimum of 4 weeks and a maximum of 52 weeks prior to shipping. Trees dug 4 to 52 weeks prior to shipping are defined as hardened-off. Digging is defined as cutting all roots and lifting the tree out of the ground and either moving it to a new location in the nursery or placing it back into the same hole. Tress that are stored out of the ground shall be placed in a holding area protected from extremes of wind and sun with the root ball protected by covering with mulch or straw and irrigated sufficiently to keep moisture in the root ball above wilt point and below saturation
   c. If wire baskets are used to support the root ball, a "low profile" basket shall be used. A low profile basket is defined as having the top of the highest loops on the basket no less than 4 inches and no greater than 8 inches below the shoulder of the root ball package.
      1.) At nurseries where sandy soils prevent the use of "low profile baskets", baskets that support the entire root ball, including the top, are allowable.
      2.) Baskets will be removed prior to planting if root ball conditions allow for removal without significant loss of root ball structure
3. Twine and burlap used for wrapping the root ball package shall be natural, biodegradable material. If the burlap decomposes after digging the tree then the root ball shall be re- wrapped prior to shipping if roots have not yet grown to keep root ball intact during shipping.

B. SPADE HARVESTED AND TRANSPLANTED

1. Spade Harvested and Transplanted Plants shall meet all the requirements for field grown trees. Root ball diameters shall be of similar size as the ANSI Z60.1 requirements for Balled and Burlapped plants.
2. Trees shall be harvested prior to leafing out (bud break) in the spring or during the fall planting period except for plants know to be considered as fall planting hazards. Plants that are fall planting hazards shall only be harvested prior to leafing out in the spring.
3. Trees shall be moved and planted within 48 hours of the initial harvesting and shall remain in the spade machine until planted.

C. CONTAINER (INCLUDING ABOVE-GROUND FABRIC CONTAINERS AND BOXES) PLANTS

1. Container plants may be permitted only when indicated on the drawing, in this specification, or approved by the Owner’s Representative.
2. Provide plants shall be established and well rooted in removable containers.
3. Container class size shall conform to ANSI Z60.1 for container plants for each size and type of plant.

D. BARE ROOT PLANTS

1. Harvest bare root plants while the plant is dormant and a minimum of 4 weeks prior to leaf out (bud break).
2. The root spread dimensions of the harvested plants shall conform to ANSI Z60.1 for nursery grown bare root plants for each size and type of plant. Just prior to shipping to the job site, dip the root system into a slurry of hydrogel (cross linked polyacrylamide) and water mixed at a rate of 15 oz. of hydrogel in 25 gallons of water. Do not shake off the excess hydrogel. Place the root system in a pleated black plastic bag and tie the bag snugly around the trunk. Bundle and tie the upper branches together.
3. Keep the trees in a cool dark space for storage and delivery. If daytime outside temperatures exceeds 70 degrees F, utilize a refrigerated storage area with temperature between 35 and 50 degrees.
4. Where possible, plan time of planting to be before bud break. For trees to be planted after bud break, place the trees before bud break in an irrigated bed of pea gravel.
   a. The pea gravel bed shall be 18 inches deep over a sheet of plastic.
   b. Space trees to allow the unbundled branches to grow without shading each other.
   c. Once stored in pea gravel, allow the trees sufficient time for the new root system to flush and spring growth of leaves to fully develop before planting.
   d. Pea gravel stored trees may be kept for up to one growing season.
   e. Pea gravel stored trees shall be dipped, packaged and shipped similar to the requirements for freshly dug bare root trees above.

E. PLANTING SOIL

1. Planting Soil as used in this specification means the soil at the planting site, or imported as modified and defined in specification Section Planting Soil. If there is no Planting Soil specification, the term Planting Soil shall mean the soil at the planting site within the planting hole.

2.3 MULCH

A. Mulch shall be "Walk on" grade, coarse, ground, from tree and woody brush sources. The size range shall be a minimum (less than 25% or less of volume) fine particles 3/8 inch or less in size, and a maximum size of individual pieces (largest 20% or less of volume) shall be approximately 1 to 1-1/2 inch in diameter and maximum length approximately 4 to 8".

Pieces larger than 8 inch long that are visible on the surface of the mulch after installation shall be removed.

1. It is understood that mulch quality will vary significantly from supplier to supplier and region to region. The above requirements may be modified to conform to the source material from locally reliable suppliers as approved by the Owner's Representative.

B. Submit supplier's product specification data sheet and a one gallon sample for approval.

2.4 TREE STAKING

A. Stakes shall be lodge pole stakes free of knots and of diameters and lengths appropriate to the size of plant as required to adequately support the plant.

2.5 WATERING BAGS

A. Plastic tree watering bags holding a minimum of 15 gallons of water and with a slow drip hole(s) water release system, specifically designed to water establishing trees. Water should release over a several day period, not within a few hours.

B. Watering bags shall be:

1. Treegator Irrigation Bags sized to the appropriate model for the requirements of the plant, manufactured by Spectrum Products, Inc., Youngsville, NC 27596.
2. Ooze Tube sized to the appropriate model for the requirements of the plant, manufactured by Engineered Water Solutions, Atlanta, GA.
3. Or approved equal.

C. Submit manufacturer's product data for approval.

PART 3 – EXECUTION

3.1 SITE EXAMINATION

A. Examine the surface grades and soil conditions to confirm that the requirements of the Specification Section – Planting Soil - and the soil and drainage modifications indicated on the Planting Soil Plan and Details (if applicable) have been completed. Notify the Owner's Representative in writing of any unsatisfactory conditions.

3.2 DELIVERY, STORAGE AND HANDLING

A. Protect materials from deterioration during delivery and storage. Adequately protect plants from drying out, exposure of roots to sun, wind or extremes of heat and cold temperatures. If planting is delayed more than 24 hours after delivery, set plants in a location protected from sun and wind. Provide adequate water to the root ball package during the shipping and storage period.

1. All plant materials must be available for observation prior to planting.
2. Using a soil moisture meter, periodically check the soil moisture in the root balls of all plants to assure that the plants are being adequately watered. Volumetric soil moisture shall be maintained above wilting point and below field capacity for the root ball substrate or soil.

B. Do not deliver more plants to the site than there is space with adequate storage conditions.

Provide a suitable remote staging area for plants and other supplies.

1. The Owner's Representative or Contractor shall approve the duration, method and location of storage of plants.

C. Provide protective covering over all plants during transporting.

3.3 PLANTING SEASON

A. Planting shall only be performed when weather and soil conditions are suitable for planting the materials specified in accordance with locally accepted practice. Install plants during the planting time as described below unless otherwise approved in writing by the Owner's Representative. In the event that the Contractor request planting outside the dates of the planting season, approval of the request does not change the requirements of the warranty.

1. Deciduous trees and shrubs March to November
2. Evergreen trees and shrubs March to November

3.4 ADVERSE WEATHER CONDITIONS

A. No planting shall take place during extremely hot, dry, windy or freezing weather.

3.5 COORDINATION WITH PROJECT WORK

A. The Contractor shall coordinate with all other work that may impact the completion of the work.

B. Prior to the start of work, prepare a detailed schedule of the work for coordination with other trades.

C. Coordinate the relocation of any irrigation lines, heads or the conduits of other utility lines that are in conflict with tree locations. Root balls shall not be altered to fit around lines. Notify the Owner's Representative of any conflicts encountered.

3.6 LAYOUT AND PLANTING SEQUENCE

A. Relative positions of all plants and trees are subject to approval of the Owner's Representative.

B. Notify the Owner's Representative, one (1) week prior to layout. Layout all individual tree and shrub locations. Place plants above surface at planting location or place a labeled stake at planting location. Layout bed lines with paint for the Owner's Representative's approval. Secure the Owner's Representative's acceptance before digging and start of planting work.

C. When applicable, plant trees before other plants are installed.

D. It is understood that plants are not precise objects and that minor adjustments in the layout will be required as the planting plan is constructed. These adjustments may not be apparent until some or all of the plants are installed. Make adjustments as required by the Owner's Representative including relocating previously installed plants.

3.7 SOIL PROTECTION DURING PLANT DELIVERY AND INSTALLATION

A. Protect soil from compaction during the delivery of plants to the planting locations, digging of planting holes and installing plants.

1. Where possible deliver and plant trees that require the use of heavy mechanized equipment prior to final soil preparation and tilling. Where possible, restrict the driving lanes to one area instead of driving over and compacting a large area of soil.
2. Till to a depth of 6 inches, all soil that has been driven over during the installation of plants.

3.8 SOIL MOISTURE

A. Volumetric soil moisture level, in both the planting soil and the root balls of all plants, prior to, during and after planting shall be above permanent wilting point and below field capacity for each type of soil texture within the following ranges.

Soil type	Permanent wilting point	Field capacity
Sand, Loamy sand, Sandy loam	5-8%	12-18%
Loam, Sandy clay, Sandy clay loam	14-25%	27-36%
Clay loam, Silt loam	11-22%	31-36%
Silty clay, Silty clay loam	22-27%	38-41%

1. Volumetric soil moisture shall be measured with a digital moisture meter. The meter shall be the Digital Soil Moisture Meter, DSMM500 by General Specialty Tools and Instruments, or approved equivalent.

B. The Contractor shall confirm the soil moisture levels with a moisture meter. If the moisture is too high, suspend planting operations until the soil moisture drains to below field capacity.

3.9 INSTALLATION OF PLANTS: GENERAL

A. Observe each plant after delivery and prior to installation for damage of other characteristics that may cause rejection of the plant. Notify the Owner’s Representative of any condition observed.

B. No more plants shall be distributed about the planting bed area than can be planted and watered on the same day.

C. The root system of each plant, regardless of root ball package type, shall be observed by the Contractor, at the time of planting to confirm that the roots meet the requirements for plant root quality in Part 2 Products: Plants General: Plant Quality. The Contractor shall undertake at the time of planting, all modifications to the root system required by the Owner’s Representative to meet these quality standards.

1. Modifications, at the time of planting, to meet the specifications for the depth of the root collar and removal of stem girdling roots and circling roots may make the plant unstable or stress the plant to the point that the Owner’s Representative may choose to reject the plant rather than permitting the modification.
2. Any modifications required by the Owner’s Representative to make the root system conform to the plant quality standards outlined in Part 2 Products: Plants General: Quality, or other requirements related to the permitted root ball package, shall not be considered as grounds to modify or void the plant warranty.

3. The resulting root ball may need additional staking and water after planting. The Owner's Representative may reject the plant if the root modification process makes the tree unstable or if the tree is not healthy at the end of the warranty period. Such plants shall still be covered under the warranty
4. The Contractor remains responsible to confirm that the grower has made all required root modifications noted during any nursery observations.

D. Container and Boxed Root Ball Shaving: The outer surfaces of ALL plants in containers and boxes, including the top, sides and bottom of the root ball shall be shaved to remove all circling, descending, and matted roots. Shaving shall be performed using saws, knives, sharp shovels or other suitable equipment that is capable of making clean cuts on the roots. Shaving shall remove a minimum of one inch of root mat or up to 2 inches as required to remove all root segments that are not growing reasonably radial to the trunk.

E. Exposed Stem Tissue after Modification: The required root ball modifications may result in stem tissue that has not formed trunk bark being exposed above the soil line. If such condition occurs, wrap the exposed portion of the stem in a protective wrapping with a white filter fabric. Secure the fabric with biodegradable masking tape. DO NOT USE string, twine, green nursery ties or any other material that may girdle the trunk if not removed.

F. Excavation of the Planting Space: Using hand tools or tracked mini-excavator, excavate the planting hole into the Planting Soil to the depth of the root ball measured after any root ball modification to correct root problems, and wide enough for working room around the root ball or to the size indicated on the drawing or as noted below.

1. For trees and shrubs planted in soil areas that are NOT tilled or otherwise modified to a depth of at least 12 inches over a distance of more than 10 feet radius from each tree, or 5 feet radius from each shrub, the soil around the root ball shall be loosened as defined below or as indicated on the drawings.
   a. The area of loosening shall be a minimum of 3 times the diameter of the root ball at the surface sloping to 2 times the diameter of the root ball at the depth of the root ball.
   b. Loosening is defined as digging into the soil and turning the soil to reduce the compaction. The soil does not have to be removed from the hole, just dug, lifted and turned. Lifting and turning may be accomplished with a tracked mini excavator, or hand shovels.
2. If an auger is used to dig the initial planting hole, the soil around the auger hole shall be loosened as defined above for trees and shrubs planted in soil areas that are NOT tilled or otherwise modified.
3. The measuring point for root ball depth shall be the average height of the outer edge of the root ball after any required root ball modification.
4. If motorized equipment is used to deliver plants to the planting area over exposed planting beds, or used to loosen the soil or dig the planting holes, all soil that has been driven over shall be tilled to a depth of 6 inches.

G. For trees to be planted in prepared Planting Soil that is deeper than the root ball depth, compact the soil under the root ball using a mechanical tamper to assure a firm bedding for the root ball. If there is more than 12 inches of planting soil under the root ball excavate and tamp the planting soil in lifts not to exceed 12 inches.

H. Set top outer edge of the root ball at the average elevation of the proposed finish. Set the plant plumb and upright in the center of the planting hole. The tree graft, if applicable, shall be visible above the grade. Do not place soil on top of the root ball.

I. The Owner's Representative may request that plants orientation be rotated when planted based on the form of the plant.

J. Backfill the space around the root ball with the same planting soil or existing soil that was excavated for the planting space. See Specification Section Planting Soil, for requirements to modify the soil within the planting bed.

K. Brace root ball by tamping Planting Soil around the lower portion of the root ball. Place additional Planting Soil around base and sides of ball in six-inch (6") lifts. Lightly tamp each lift using foot pressure or hand tools to settle backfill, support the tree and eliminate voids. DO NOT over compact the backfill or use mechanical or pneumatic tamping equipment. Over compaction shall be defined as greater than 85% of maximum dry density, standard proctor or greater than 250 psi as measured by a cone penetrometer when the volumetric soil moisture is lower than field capacity.

1. When the planting hole has been backfilled to three quarters of its depth, water shall be poured around the root ball and allowed to soak into the soil to settle the soil. Do not flood the planting space. If the soil is above field capacity, allow the soil to drain to below field capacity before finishing the planting. Air pockets shall be eliminated and backfill continued until the planting soil is brought to grade level.

L. Where indicated on the drawings, build a 4 inch high, level berm of Planting Soil around the outside of the root ball to retain water. Tamp the berm to reduce leaking and erosion of the saucer.

M. Thoroughly water the Planting Soil and root ball immediately after planting.

N. Remove all nursery plant identification tags and ribbons as per Owner’s Representative instructions. The Owner’s Representative’s seals are to remain on plants until the end of the warranty period.

O. Remove corrugated cardboard trunk protection after planting.

P. Follow additional requirements for the permitted root ball packages.

3.10 PERMITTED ROOT BALL PACKAGES AND SPECIAL PLANTING REQUIREMENTS

A. The following are permitted root ball packages and special planting requirements that shall be followed during the planting process in addition to the above General planting requirements.

B. BALLED AND BURLAPPED PLANTS

1. After the root ball has been backfilled, remove all twine and burlap from the top of the root ball. Cut the burlap away; do not fold down onto the Planting Soil.
2. If the plant is shipped with a wire basket that does not meet the requirements of a “Low Rise” basket, remove the top 6 - 8 inches of the basket wires just before the final backfilling of the tree.
3. Earth root balls shall be kept intact except for any modifications required by the Owner’s Representative to make root package comply with the requirement in Part 2 Products.

C. CONTAINER (INCLUDES BOXED AND ABOVE-GROUND FABRIC CONTAINERS) PLANTS

1. This specification assumes that most container plants have significant stem girdling

and circling roots, and that the root collar is too low in the root ball.
2. Remove the container.
3. Perform root ball shaving as defined in Installation of Plants: General above.
4. Remove all roots and substrate above the root collar and the main structural roots according to root correction details so root system conforms to root observations detail.
5. Remove all substrate at the bottom of the root ball that does not contain roots.
6. Using a hose, power washer or air excavation device, wash out the substrate from around the trunk and top of the remaining root ball and find and remove all stem girdling roots within the root ball above the top of the structural roots.

D. BARE ROOT PLANTS.

1. Dig the planting hole to the diameter of the spread of the roots to a depth in the center that maintains the root collar at the elevation of the surrounding finished grade and slightly deeper along the edges of the hole.
2. Spread all roots out radial to the trunk in the prepared hole making the hole wider where needed to accommodate long roots. Root tips shall be directed away from the trunk. Prune any broken roots removing the least amount of tissue possible.
3. Maintain the trunk plumb while backfilling soil around the roots.
4. Lightly tamp the soil around the roots to eliminate voids and reduce settlement.

3.11 GROUND COVER, PERENNIAL AND ANNUAL PLANTS

A. Assure that soil moisture is within the required levels prior to planting. Irrigation, if required, shall be applied at least 12 hours prior to planting to avoid planting in muddy soils.

B. Assure that soil grades in the beds are smooth and as shown on the plans.

C. Plants shall be planted in even, triangularly spaced rows, at the intervals called out for on the drawings, unless otherwise noted. The first row of Annual flower plants shall be 6 inches from the bed edge unless otherwise directed.

D. Dig planting holes sufficiently large enough to insert the root system without deforming the roots. Set the top of the root system at the grade of the soil.

E. Schedule the planting to occur prior to application of the mulch. If the bed is already mulched, pull the mulch from around the hole and plant into the soil. Do not plant the root system in the mulch. Pull mulch back so it is not on the root ball surface.

F. Press soil to bring the root system in contact with the soil.

G. Spread any excess soil around in the spaces between plants.

H. Apply mulch to the bed being sure not to cover the tops of the plants with or the tops of the root ball with mulch.

I. Water each planting area as soon as the planting is completed. Apply additional water to keep the soil moisture at the required levels. Do not over water.

3.12 STAKING AND GUYING

A. Do not stake or guy trees unless specifically required by the Contract Documents, or in the event that the Contractor feels that staking is the only alternative way to keep particular trees plumb.

1. The Owner's Representative shall have the authority to require that trees are staked or to reject staking as an alternative way to stabilize the tree.
2. Trees that required heavily modified root balls to meet the root quality standards may become unstable. The Owner's Representative may choose to reject these trees rather than utilize staking to temporarily support the tree.

B. Trees that are guyed shall have their guys and stakes removed after one full growing season or at other times as required by the Owner's Representative.

C. Tree guying shall utilize the tree staking and guying materials specified. Guying to be tied in such a manner as to create a minimum 12-inch loop to prevent girdling. Refer to manufacturer's recommendations and the planting detail for installation.

1. Plants shall stand plumb after staking or guying.
2. Stakes shall be driven to sufficient depth to hold the tree rigid.

3.13 STRAIGHTENING PLANTS

A. Maintain all plants in a plumb position throughout the warranty period. Straighten all trees that move out of plumb including those not staked. Plants to be straightened shall be excavated and the root ball moved to a plumb position, and then re-backfilled.

B. Do not straighten plants by pulling the trunk with guys.

3.14 INSTALLATION OF FERTILIZER AND OTHER CHEMICAL ADDITIVES

A. Do not apply any soluble fertilizer to plantings during the first year after transplanting unless soil test determines that fertilizer or other chemical additives is required. Apply chemical additives only upon the approval of the Owner's Representative.

B. Controlled release fertilizers shall be applied according to the manufacturer's instructions and standard horticultural practices.

3.15 PRUNING OF TREES AND SHRUBS

A. Prune plants as directed by the Owner's Representative. Pruning trees shall be limited to addressing structural defects as shown in details; follow recommendations in "Structural Pruning: A Guide For The Green Industry" published by Urban Tree Foundation, Visalia CA.

B. All pruning shall be performed by a person experienced in structural tree pruning.

C. Except for plants specified as multi-stemmed or as otherwise instructed by the Owner's Representative, preserve or create a central leader.

D. Pruning of large trees shall be done using pole pruners or if needed, from a ladder or hydraulic lift to gain access to the top of the tree. Do not climb in newly planted trees. Small trees can be structurally pruned by laying them over before planting. Pruning may also be performed at the nursery prior to shipping.

E. Remove and replace excessively pruned or malformed stock resulting from improper pruning that occurred in the nursery or after.

F. Pruning shall be done with clean, sharp tools.

G. No tree paint or sealants shall be used.

3.16 MULCHING OF PLANTS

A. Apply 3 inches of mulch before settlement, covering the entire planting bed area. Install no more than 1 inch of mulch over the top of the root balls of all plants. Taper to 2 inches when abutting pavement. For trees planted in lawn areas the mulch shall extend to a 3 foot radius around the tree or to the extent indicated on the plans.

B. Lift all leaves, low hanging stems and other green portions of small plants out of the mulch if covered.

3.17 PLANTING BED FINISHING

A. After planting, smooth out all grades between plants before mulching.

B. Separate the edges of planting beds and lawn areas with a smooth, formed edge cut into the turf with the bed mulch level slightly lower, 1 and 2 inches, than the adjacent turf sod or as directed by the Owner's Representative. Bed edge lines shall be a depicted on the drawings.

3.18 WATERING

A. The Contractor shall be fully responsible to ensure that adequate water is provided to all plants from the point of installation until the date of Substantial Completion Acceptance. The Contractor shall adjust the automatic irrigation system, if available, and apply additional or adjust for less water using hoses as required.

B. Hand water root balls of all plants to assure that the root balls have moisture above wilt point and below field capacity. Test the moisture content in each root ball and the soil outside the root ball to determine the water content.

C. The Contractor shall install 15 gallon watering bag for each tree to be maintained and used for tree watering during the warranty period.

1. The watering bags shall remain the property of the Owner at the completion of the work.

3.19 CLEAN-UP

A. During installation, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris in containers from the site no less than once a week.

1. Immediately clean up any spilled or tracked soil, fuel, oil, trash or debris deposited by the Contractor from all surfaces within the project or on public right of ways and neighboring property.

B. Once installation is complete, wash all soil from pavements and other structures. Ensure that mulch is confined to planting beds and that all tags and flagging tape are removed from the site. The Owner's Representative's seals are to remain on the trees and removed at the end of the warranty period.

C. Make all repairs to grades, ruts, and damage by the plant installer to the work or other work at the site.

D. Remove and dispose of all excess planting soil, subsoil, mulch, plants, packaging, and other material brought to the site by the Contractor.

3.20 PROTECTION DURING CONSTRUCTION

A. The Contractor shall protect planting and related work and other site work from damage due to planting operations, operations by other Contractors or trespassers. Maintain protection during installation until Substantial Completion Acceptance. Treat, repair or replace damaged work immediately.

B. Damage done by the Contractor, or any of their sub-contractors to existing or installed plants, or any other parts of the work or existing features to remain, including roots, trunk or branches of large existing trees, soil, paving, utilities, lighting, irrigation, other finished work and surfaces including those on adjacent property, shall be cleaned, repaired or replaced by the Contractor at no expense to the Owner. The Owner's Representative shall determine when such cleaning, replacement or repair is satisfactory.

3.21 PLANT MAINTENANCE PRIOR TO SUBSTANTIAL COMPLETION ACCEPTANCE

A. During the project work period and prior to Substantial Completion Acceptance, the Contractor shall maintain all plants.

B. Maintenance during the period prior to Substantial Completion Acceptance shall consist of pruning, watering, cultivating, weeding, mulching, removal of dead material, repairing and replacing of tree stakes, tightening and repairing of guys, repairing and replacing of damaged tree wrap material, resetting plants to proper grades and upright position, and furnishing and applying such sprays as are necessary to keep plantings reasonably free of damaging insects and disease, and in healthy condition. The threshold for applying insecticides and herbicide shall follow established Integrated Pest Management (IPM) procedures. Mulch areas shall be kept reasonably free of weeds, grass.

3.22 SUBSTANTIAL COMPLETION ACCEPTANCE

A. Upon written notice from the Contractor, the Owners Representative shall review the work and make a determination if the work is substantially complete.

1. Notification shall be at least 7 days prior to the date the contractor is requesting the review.

B. The date of substantial completion of the planting shall be the date when the Owner's Representative accepts that all work in Planting, Planting Soil, and Irrigation installation sections is complete.

C. The Plant Warranty period begins at date of written notification of substantial completion from the Owner's Representative. The date of substantial completion may be different than the date of substantial completion for the other sections of the project.

3.23 MAINTENANCE DURING THE WARRANTY PERIOD BY OTHERS

A. After Substantial Completion Acceptance, the Contractor shall make sufficient site visits to observe the Owner's maintenance and become aware of problems with the maintenance in time to request changes, until the date of End of Warranty Final Acceptance.

1. Notify the Owner's Representative in writing if maintenance, including watering, is not sufficient to maintain plants in a healthy condition. Such notification must be made in a timely period so that the Owner's Representative may take corrective action.
    a. Notification must define the maintenance needs and describe any corrective action required.
2. In the event that the Contractor fails to visit the site and or notify, in writing, the Owner's Representative of maintenance needs, lack of maintenance shall not be used as grounds for voiding or modifying the provisions of the warranty.

3.24 END OF WARRANTY FINAL ACCEPTANCE / MAINTENANCE OBSERVATION

A. At the end of the Warranty and Maintenance period the Owner's Representative shall observe the work and establish that all provisions of the contract are complete and the work is satisfactory.

1. If the work is satisfactory, the maintenance period will end on the date of the final observation.
2. If the work is deemed unsatisfactory, the maintenance period will continue at no additional expense to the Owner until the work has been completed, observed, and approved by the Owner's Representative.

B. FAILURE TO PASS OBSERVATION: If the work fails to pass final observation, any subsequent observations must be rescheduled as per above. The cost to the Owner for additional observations will be charged to the Contractor at the prevailing hourly rate of the Owners Representative.

END OF SECTION

SECTION 33 42 00

STORMWATER CONVEYANCE

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. HDPE Pipe and fittings
2. Filter Fabric
3. Flared End Section
4. Crushed Stone

1.3 ACTION SUBMITTALS

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

B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Dry Wells: Include plans, elevations, sections, details, frames, covers, and grates.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type pipe and fitting, from manufacturer.

B. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes in accordance with manufacturer's written rigging instructions.

D. Handle stormwater inlets in accordance with manufacturer's written rigging instructions.

1.8 SEQUENCING AND SCHEUDLING

A. Coordinate with other utility work.

B. The Contractor is responsible for coordinating and scheduling the inspection of the work by the jurisdictional authority. All permits and inspection costs and fees shall be included in the bid prices and no additional costs will be paid to the Contractor.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's written permission.

B. Site Information: Perform site inspection and survey, research utility records, and verify existing utility locations and elevations. Verify that storm drainage system structures and piping may be installed in compliance with Contract Drawings and referenced standards.

PART 2 - PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE PIPE (HDPE) AND FITTINGS

A. Pipe shall be in accordance with ASSHTO M252 Type S and M294 Type S, smooth interior/ annular exterior. Use only where specifically indicated on drawings.

B. Pipe Joints and fittings shall conform to AASHTO M252 and M294. Maximum deflection of pipe joints with ceramic tolerance rings shall be 3 percent.

2.2 FILTER FABRIC

A. Filter Fabric used as a drainage medium shall be a needle-punched, non-woven geotextile made from polypropylene or polyethylene filaments or yarns.

B. Filter fabric shall be inert to organic chemicals commonly encountered in the soil.

C. Filter fabric shall be meet AASHTO M288 Survivability Class 2 Standards.

D. The edges of filter fabric shall overlap a minimum of one foot.

2.3 FLARED END SECTION

A. The Flared End Section shall be high density polyethylene meeting ASTM D3350 minimum cell classification 213320C; contact manufacturer for additional cell class information. When provided, the metal threaded fastening rod shall be stainless steel.

2.4 CRUSHED STONE

A. Crushed stone shall consist of durable crushed rock or durable crushed gravel stone, free from ice and snow, sand, clay, loam, or other deleterious or organic material. The crushed stone shall be uniformly blended and shall conform to the following requirements.

Percent Passing by Weight		
Sieve Size	**3/4-inch Stone**	**1/2-inch Stone**
1-inch	100	---
3/4-inch	90-100	---
5/8-inch	---	100
1/2-inch	10-50	85-100
3/8-inch	0-20	15-45
No. 4	0-5	0-15
No. 8	---	0-5

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gashets, seals, sleeves, and couplings according to manufacturer’s written instructions for use of lubricants, cements, and other installation requirements.

C. Install cleanouts for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.
2. Install pipe and fittings as indicated on plans. Install in accordance with manufacturer’s recommendations.
3. Install HDPE piping according to ASTM D 2321.

3.3 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems in accordance with requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test in accordance with requirements of authorities having jurisdiction, UNI-B-6, and the following:

   a. Exception: Piping with soil tight joints unless required by authorities having jurisdiction.
   b. Option: Test plastic piping in accordance with ASTM F1417.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

3.4 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION

SECTION 35 31 19

ARMOR STONE BREAKWATERS

PART 1 - GENERAL

The work required in this section is for the construction of stone breakwater structures to facilitate habitat creation and restoration in the East Basin of Cleveland Harbor.

Furnish all labor, materials, equipment, and transportation to construct the armor stone breakwaters as shown on the Contract Documents.

1.1 REFERENCES

The following references are related to the testing and quality of the stone required for this project and are part of this specification.

ASTM INTERNATIONAL (ASTM)

ASTM C127	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C131	(2020) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136/C136M	(2014) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D75/D75M	(2014) Standard Practice for Sampling Aggregates
ASTM D3740	(2012a) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used
ASTM D4992	(2014; E 2015) Evaluation of Rock to be Used for Erosion Control
ASTM D5312	(2013) Standard Test Method for Evaluation of Durability of Rock for Erosion Control Under Freezing and Thawing Conditions
ASTM D5313	(2013) Standard Test Method for Evaluation of Durability of Rock for Erosion Control Under Wetting and Drying Conditions
ASTM D5519	(2014) Particle Size Analysis of Natural and Man-Made Riprap Materials

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CRD-C 144 (1992) Standard Test Method for Resistance of Rock to Freezing and Thawing

CRD-C 169 (1997) Standard Test Method for Resistance of Rock to Wetting and Drying

RTH 108 (1993) Method of Determining Density of Solids

1.2 SUBMITTALS

Engineer of Record (EOR) approval is required for the following submittals.

A. Preconstruction Submittals

1. A plan for Stone Materials Control (SMC)
2. Any revision of the SMC Plan or Inspection Staffing
3. SMC Supervisor or lead QC Personnel
4. Copies of Scale certificates are current for overland trucks.
5. Displacement Gauges for barges and scows used.
6. Gauging tables for barges and scows used.

B. Shop Drawings

1. Preconstruction surveys of the site, including hydrographic surveys.
2. Photographs of the landside portions of the site and contiguous area including roadways used. Underwater photographs are not required unless specifically listed in the Contract Documents.
3. Perform surveys of the following areas:
   a. Footprint the structure including 50 feet past the furthest extent of material placement.
   b. Perform surveys of the bedding stone placed including core stone placed as a surcharge load.
   c. Post surcharge settlement surveys approximately 15 days after initial placement, and as needed to demonstrate sufficient material settlement, as required in 3.4 F.
   d. Core Stone placement surveys.
   e. Underlayer Stone surveys
   f. Intermediate Stone lifts, if used
   g. Geotextile fabric placement, if used
   h. Filter Stone surveys
   i. Lakeside Armor Stone placement or fill side stone placement surveys.
   j. Cap Stone over special or architectural constructs.
   k. Surveys of existing breakwaters and revetments prior to relocation of stone materials per 2.1 C.
   l. Data from settlement gauges or piezometers, if used.
   m. Surveys of the material after placement

C. Product Data

1. Quarry QC/SMC records and reports
2. Stone Placement Records

3. Land and marine based equipment to be used including equipment for vibratory compaction.

D. Post Construction Submittals

1. Final as-built topographic and hydrographic surveys

2. Data from settlement gages or piezometers for review by the Engineer.

E. Certificates and certifications

1. Stone Sources to be used.
2. Bulk Specific Gravity of stone

F. Sample Submittal Form

1. In the attachments at the end of this section is a sample “SUBMITTAL FORM”, other forms containing relevant can be used if approved by the EOR.

1.3 PRE-PRODUCTION QUALITY CONTROL FOR ARMOR STONE

1. Submit in written format, a Stone Materials Control (SMC) Plan. Include the means and methods to be used for effective inspection of material quality control (QC) and gradation testing of stone materials in a manner which will result in a satisfactory quality of in-place stone construction.
2. Include written procedures for guiding and instructing the Contractor's SMC Inspectors in the techniques and criteria to be used for examining each individual armor stone unit for quality and acceptability. Instruct the SMC Inspectors on the techniques and criteria to be used for testing for the proper production gradations. Describe methods of cleaning the armor stone surface of dirt and dust for visual inspection.
3. Make this submittal to the EOR at least 30 calendar days in advance of the date stone materials are to be shipped from the stone source site. Designate, in the plan, a Stone Material Control Supervisor that is responsible for implementation of all functions of the Stone Material Control program. In the plan include a blank weekly SMC/QC inspection schedule, which will be used during stone material production. The Stone Material Control Supervisor may not have collateral project duties or responsibilities assigned by the Contractor except those specified in the Stone Material Control submittal during the duration of the project.
4. If the prime Contractor acquires stone products required for this project through subcontracts, the Stone Material Supervisor is not permitted to be an employee of the subcontracted company or subcontracted corporation producing these stone materials or products. The Stone Material Control Inspectors, however, may be employed by the subcontracted entities directly involved in production of armor stone material. Engineering approval of the submittal will not be provided until after the Contractor has produced satisfactory demonstration stockpiles, but not later than five calendar days after all requirements for the demonstration stockpile are met, including the Contractor's laboratory testing results and prior stone source submittals.

A. Material Quality

1. Before selecting a source for preparation of a demonstration stockpile, be reasonably certain that the source is capable of meeting the quality and source requirements specified in the paragraphs "STONE MATERIALS" and "STONE MATERIAL SOURCES."

2. During all SMC activities, submit daily SMC reports of all work performed under the approved SMC Plan. Deliver them to the EOR not later than the day following the SMC activity. Include with each daily report for each inspector, not less than the following information:

   a. SMC Inspector's name.
   b. Identification of the stone handling equipment and name of equipment operator used to accommodate the stone inspection if it appeared that the equipment or operator was a factor in producing unacceptable stone.
   c. Date of stone inspection.
   d. Weather conditions.
   e. Date stone was removed from quarry face, and date and details of blasting.
   f. Location and strata within quarry where stone removal took place (horizontally and vertically).
   g. Color(s) and character(s) used by inspector for spray paint marks and the applicable code for stones which are individually sorted (versus mechanically sorted) and for any rejected stone.
   h. Breakdown of the approximate quantity, per gradation range, of accepted and rejected stone processed for the project during the day, and the disposition of the rejected stone materials.
   i. A one-sentence summary of the causes or causes for most of the rejections of stone occurring during the day.
   j. Running total of the quantity of each gradation range of stone shipped from the source to date.
   k. Running average of the approximate per stone weight per gradation range for stones, which are individually picked for the project. (i.e., excludes stones graded by use of a screen or grizzly).
   l. Any noticeable change in bulk specific gravity of the stone being produced or in the percentage of voids after the stone is placed.

3. At least 30 calendar days in advance of shipment of stone to the work site, submit a copy of bulk specific gravity test results for each gradation range of stone proposed to be furnished. Furnish the information prior to preparation of preproduction demonstration stockpiles.

B. Demonstration Stockpile

1. Following submittal of the Contractor's Stone Materials Control (SMC) Plan, and the Contractor's selection of a source, but prior to the Engineer's approval of a source and the SMC Plan, make arrangements to provide a pre-production demonstration stockpile for each of the stone size ranges for the project. If the Contractor proposes a revision of SMC Plan or Inspection Staffing of its own accord, submit the proposed revision not later than 7 calendar days prior to the date it proposes to implement the revision and do not implement the revision prior to the EOR approval. Submit changes to SMC Inspector staffing levels or names or working hours, for approval. Follow the procedures prescribed elsewhere in this Section for Engineer required revisions of the SMC Plan or Contractor staffing.

2. Quantity determinations are contingent upon the range of bulk specific gravity (saturated surface dry (SSD) basis) of stone to be supplied. During the process of selecting a source or sources of stone for the project, make an investigation to determine the lowest and highest bulk specific gravity (SSD) of the stone available at the source or sources it proposes to utilize for each gradation range of stone. Perform tests at an Engineer approved testing laboratory, or a certified independent library in accordance with RTH 108, from the specific lifts within the quarry proposed, and have been sampled within the last 5 years. Submit the testing results in accordance with paragraph "SUBMITTALS." Test results which display an extraordinarily wide range of values may necessitate additional testing to determine whether the source contains

stratums with stones of an acceptable range of bulk specific gravity. For Category I sources which have been acceptably tested not more than two years ago, and the material is of acceptable quality and bulk specific gravity, the EOR may waive the requirement for bulk specific gravity testing.

Size of Individual Stones Within a Range	Demonstration Stockpile Quantity Based on Project Quantity for Size Range 0 to 10k T*	10k to 100k T*	Over 100k T*
1 lb. to 500 lbs.	3 Tons	5 Tons	10 Tons
500 lbs. to 2000 lbs.	20 Tons	30 Tons	50 Tons
1 Ton to 5 Tons	100 Tons	150 Tons	300 Tons
5 Tons to 20 Tons	500 Tons	750 Tons	1000 Tons

* k = 1000, T = Tons

3. Use stones for the stockpile that have been preselected by the Contractor's SMC Inspector or Supervisor and mark, acceptable stones over 500 pounds, with spray paint on three mutually perpendicular sides with a coded mark to denote acceptability for a certain size range. Maintain a stockpile of representative reject stones marked with a red X at the site as examples of unacceptable materials or shapes.

C. Bulk Specific Gravity

1. Quantity determinations are contingent upon the range of bulk specific gravity (saturated surface dry (SSD) basis) of stone to be supplied. During the process of selecting a source or sources of stone for the project, make an investigation to determine the lowest and highest bulk specific gravity (SSD) of the stone available at the source or sources it proposes to utilize for each gradation range of stone. Perform tests at an Engineer approved testing laboratory, or a certified independent library in accordance with RTH 108, from the specific lifts within the quarry proposed, and have been sampled within the last 5 years. Submit the testing results in accordance with paragraph "SUBMITTALS." Test results which display an extraordinarily wide range of values may necessitate additional testing to determine whether the source contains stratums with stones of an acceptable range of bulk specific gravity. For Category I sources which have been acceptably tested not more than two years ago, and the material is of acceptable quality and bulk specific gravity, the EOR may waive the requirement for bulk specific gravity testing.

D. Evaluation of Demonstration Stockpile

1. Notify the EOR when stockpiles are ready for evaluation. The approved SMC Supervisor and all SMC Inspectors are required to accompany the EOR during the Engineer's evaluation of the demonstration stockpiles. The Engineer's evaluation will not begin without their presence. Arrange to have individual stones turned as necessary to accommodate the EOR's evaluation. The EOR will mark rejected stones with a red X. Remove the stones with the red X and place them in the reject stockpile or in a crusher if one is available. If more than 2 unacceptable stones are found within a stockpile, the entire stockpile will be rejected by the Engineer and a replacement stockpile created for re-evaluation. If the replacement stockpile is rejected, revise and resubmit its SMC Plan and create another replacement demonstration stockpile for evaluation. If the third demonstration stockpile for a particular size range at a single source is found unacceptable, the source will be disapproved for such size range and submit a new source for approval. In addition, submit the name and qualifications for a person to replace the SMC Supervisor. The Contractor may, of its own accord, choose a replacement source at the

time a first or second demonstration stockpile is found unacceptable. Replace demonstration stockpiles or stone sources with no change in the time of completion.

E. Borderline Material Quality

1. If the EOR's evaluation of a demonstration stockpile results in not being able to determine by visual examination whether the material is acceptable or unacceptable, the EOR will select at least one but not more than 3 representative stones from the demonstration stockpile to be prepared for shipment to an approved testing laboratory for testing (see paragraph "Stone Sampling and Laboratory Testing"). Where specified sizes are in excess of 2,000 pounds, cut or break a representative piece, weighing approximately 2,000 pounds each, off of the selected stones. For specified stone sizes of less than 2,000 pounds but more than 500 pounds, use individual samples the size of the largest stone specified for the size range. Provide samples of stone groupings with a maximum size less than 500 pounds that contain at least two (2) stones representative of the higher limit of the stone weights specified. In addition, provide a sample representative of the gradation specified and the minimum weight of the total sample is 500 pounds. Repeat the sampling and testing procedures for each stratum being quarried. Ship the samples to the EOR's laboratory as specified in paragraph "Stone Sampling and Laboratory Testing." If the laboratory testing reveals the materials are unacceptable, submit a replacement source for approval and proceed with the demonstration stockpile procedures anew.

F. Approval of Demonstration Stockpile

1. At the time the EOR finds the contents of a demonstration stockpile to be acceptable, either through visual examination or through laboratory testing, the Contractor will be notified in writing that the source, the SMC Plan and SMC Staff are approved, whereupon the Contractor may proceed with production of materials for the project provided they are consistent with the demonstration stockpiles.

G. Duration of Demonstration Stockpile

1. Other than for being shipped as the final quantities of materials to be placed in the work, maintain each demonstration stockpile as unchanged at the source until all other required material of the size range represented by the stockpile has been shipped from the source.

1.4 SMC SUPERVISOR AND INSPECTION PERSONNEL QUALIFICATIONS

1. Submit the names and qualifications of each person to be used as SMC Supervisor and Inspector. Include evidence that the Stone Material Control (SMC) Supervisor meets the qualifications stipulated in paragraph "Qualifications and Duties of Stone Materials Control (SMC) Supervisor. Include data on all applicable experience (names and locations of projects), training (names and locations of courses) and education (names and locations of schools), with names, addresses, and phone numbers of references for verification of each item of data. Make the submittal not less than 30 calendar days in advance of the date stone materials are to be shipped from the site. Engineer's approval of the submittal will not be provided until after the Contractor has produced satisfactory demonstration stockpiles, but not later than five calendar days after all requirements for the demonstration stockpile are met, including Engineer's laboratory testing if applicable.

A. Qualifications and Duties of Stone Materials Control (SMC) Supervisor

1. A college degreed Geologist with not less than two (2) years' experience in assessing stone quality or a State Licensed/Certified Geologist with at least one (1) year experience in assessing stone quality.

2. The Supervisor is not permitted to have collateral project duties or responsibilities assigned by the Contractor except those specified herein during the duration of this contract.
3. Prepare the weekly SMC inspection schedule, quality of all stone construction materials at the stone source and at the project site, the proper execution of the SMC Plan and oversee the work of all SMC Inspectors.
4. Be present at all times that stone production; handling, hauling or placement are taking place at the stone source or project site.
5. Train the SMC Inspectors in the proper performance of their duties, offer advice and assistance to the inspectors, and may, if necessary, perform duties also applicable to SMC Inspectors.
6. Maintain a qualified and adequate inspection staff and replace any persons not performing satisfactorily.

B. Qualifications and Duties of SMC Inspectors

1. Persons with sufficient training and experience to competently and independently perform the tasks itemized below while under the general supervision of the SMC Supervisor. A minimum of one year of comparable experience is required.

   a. Participate in the selection of stone for the preproduction demonstration stockpile and in the evaluation of stone placed in the stockpile.
   b. Complete and submit daily inspection reports in a timely manner.
   c. Perform visual inspections of all stones, with particular attention to individually picked stones (i.e. stones not graded with a screen or grizzly). Focus the examination on hairline width fractures, defective stone geology and other indicators that the stone may deteriorate into smaller pieces after it is in place in the work. Inspection duties include identifying and marking pieces that do not meet the criteria for acceptability, including size and shape. Mark unacceptable stones with a spray painted red "X".
   d. Place an identifying paint spray mark or marks on each acceptable individually picked stone greater than 500 pounds. Unless otherwise directed, place one mark on each of the 3 axis of a stone.
   e. Assure that the Contractor places the accepted pieces of stone into the appropriate stockpiles and placement locations in accordance with the respective gradation ranges.
   f. Assure that rejected stone materials are either placed in a "reject" stockpile, are sent directly to a crusher, or are removed from the site immediately after they are so marked. Assures rejected stones are not mingled with accepted stones at any time.
   g. Conduct scheduled and impromptu stone gradation tests and evaluations and make elongation and size measurements.
   h. Provide seven calendar days advance notification to the EOR each time a gradation test is scheduled.
   i. Maintain a running average of the per stone weight per gradation range for individually picked stones as they are transported from the site. The net weight of truckloads divided by the number of stones on the load may be used to determine an average stone weight in lieu of weighing individual stones.
   j. Be on the alert for possible changes in bulk specific gravity of the material being produced or in the percentage of voids in the material being placed. Require the material to be tested if it is determined the changes may be detrimental to the design life of the project or that the Bidding Schedule Quantities may require revision.
   k. Monitor and record the date and location of stone blasting to document whether or not the materials offered for use on the project comply with applicable blasting period restrictions, if any.

PART 2 - PRODUCTS

2.1 STONE SOURCES

1. For each type of stone material, the Contractor proposes to furnish, designate in writing one source or one combination of sources, within 10 calendar days after receipt of the "Notice to Proceed,"

A. No Engineer Warranty

1. The Engineer does not warrant that the list of sources are the only potential sources for furnishing the stone required for this project. The listing of sources are potential sources and may not be construed as implying that sources listed herein are interested in or capable of producing or offering stone in the size, gradation, weights, quantities, or schedules required or that transportation from the source to the project is available. It is the responsibility of the Contractor to determine whether a selected source can produce the required quantity, quality, sizes, gradation, or weights specified, and in a timely manner.

B. Material Acceptability

1. The right is reserved to not approve use of materials from certain localized areas, zones, strata, or channels of any approved source, when such materials are determined by the EOR to be unsatisfactory based upon quality requirements herein. Rejection or disapproval of any source or any material by the EOR will not be grounds for a time extension or a change in the contract price.

C. Re-use of Stone Onsite

Stone from the partial demolition of the existing breakwaters onsite may be re-used for the construction of the new breakwaters. Stone shall only be re-used if it meets or exceeds the size requirements for the gradation of stone placed in the new structures. If stone fractures during demolition, relocation, or re-use it shall be re-sized to meet or exceed the grade requirements for the gradation of stone placed in the new structures (i.e. used as core stone).

Stone collected from the nearshore that has been displaced from the existing breakwaters onsite may be re-used for the construction of the new breakwaters. Stone shall only be re-used if it meets or exceeds the size requirements for the gradation of stone placed in the new structures. If stone fractures during demolition, relocation, or re-use it shall be re-sized to meet or exceed the grade requirements for the gradation of stone placed in the new structures (i.e. used as core stone).

D. Stone Sources

1. This paragraph is applicable for the armor stone.
2. Designate in writing, one source or one combination of sources.
   Submitted information to include:

   a. areas and lifts of the quarry or pit to be worked,
   b. the specific geological strata or strata's to be utilized,
   c. available laboratory testing records,
   d. bulk specific gravity range,

e. previous use records.

3. If a proposed source is disapproved, submit the required data for a replacement source.

4. The following listed stone sources have previously furnished materials that meet the quality requirements stipulated in the specifications. Their listing is not an endorsement by the Owner. Each source shown contained, at the time of inspection and testing and/or previous use, suitable in-place stone from which the specified material quality and type could be or was produced. Listing a source in this section is provided for the contractor's reference only and does not guarantee that the source is able to provide material of suitable size or quality at the time of contract performance. The contractor is required to ensure that the proposed stone source is able to furnish materials meeting the criteria listed in paragraph 'STONE GRADATIONS'.

5. Potential sources for the stone materials are listed below:

   a. Hanson Aggregates, 3945 Centennial Road, Sylvania, OH 43560; (419) 841-3014; rock formation, Niagaran limestone; Inspected by the Buffalo District in May 1993 and tested for stone use by the Ohio River Division Laboratory in August 1993.
   b. Amrize US, Marblehead Quarry, 522 Limestone Drive, Marblehead, OH 44131; (419) 798-4486; quarry at Marblehead, OH; rock formations: Columbus limestone, Lucas and Amherstberg dolomites. Inspected by the Buffalo District in July 2005 and tested for stone use by Ohio River Division Laboratory in July 1991.
   c. Wagner Quarries Co., 4203 Milan Road, Sandusky, OH 44870; (419) 625-8141; rock formation: similar to the Amherstberg member of the Detroit River group. Inspected by the Buffalo District in July 2001 and tested for stone use in September 2001.
   d. Sandusky Crushed Stone, 9220 Portland Road, Castalia, OH 44824; (419) 483-4390; rock formation: Delaware Group limestone and Columbus Formation dolomite and dolomitic limestone. Inspected by the Buffalo District in August 1990 and tested for stone use by Ohio River Division Laboratory in June 1992.
   e. Rock of Ages Quarry, Northeast Materials Group, 558 Graniteville Road, Barre (Graniteville), VT 05641; (802) 477-3140. Rock formation: Barre Pluton Granite. Inspected by the Buffalo District in April 2015.

6. Commercially Active Non-Listed Source(s) or Non-Commercially Active Non-Listed Source(s). If after awarding a contract the Contractor proposes to use a commercially active non-listed source(s) of material or a non-commercially active non-listed source(s) of material, the Contractor shall make a submittal indicating the proposed source. The EOR will inspect the selected non-listed source to verify that it may contain some material that meets the requirements specified. If the proposed source appears that it has the potential of supplying satisfactory stone, then the Contractor shall proceed with making the submittals and performing the tasks specified in this Section for stone quality control. Commercially active non-listed sources and non-commercially active non-listed sources shall not be used unless the requested use of such source(s) is approved by the EOR in accordance with the applicable provisions of the contract. As appropriate, the EOR will adjust the applicable contract unit prices downward to protect the Owner’s interest if the requested commercially active non-listed source(s) or non-commercially active non-listed source(s) are approved for use.

E. If the source(s) designated by the Contractor is not approved for use by the EOR, furnish the materials from another source and in compliance with contract requirements at no additional cost to the Owner.

F. General

1. Provide materials that meet all requirements specified in this Section of the specifications. Perform the required inspection and testing of materials as stated throughout this Section. Optional inspections of materials at the quarry and job site by the EOR are as specified in paragraph, "QUALITY ASSURANCE." The EOR will, at any time during the contract, reject materials not meeting specified requirements at the source or job site. Remove materials which have been delivered to the project site and are rejected, whether in stockpile or in-place in the structure, from the project site at the Contractor's expense. When directed to do so by the EOR, return rejected materials to the source, for the purpose of visually showing the quarry operators examples of stones which will not be acceptable on future projects or, in lieu thereof, the quarry operators may be brought to the project site at the Contractor's expense for the same purpose.
2. All other requirements for stone materials (not related to underlayer stone and stone fill), stated here in Part 2, are for the armor stone.

G. Material Quality

1. Provide stone that is:

   a. of a quality to ensure permanence of the structure in the climate in which it is to be used. Selected granite, quartzite, gabbro, diabase, dolomite, some dolomitic limestones, limestone, and certain sandstones will generally meet the requirements of these specifications.
   b. durable, sound, free from detrimental cracks, blast fractures, seams, bedding, and other defects which tend to increase deterioration from natural causes or cause breakage during handling and placing. Inspection, by visual examination, for cracks, fractures, seams, defects, and deterioration. If, by visual examination, it is determined that 20% or more of the stone produced contains blast-induced hairline cracks or induced hairline cracks that will tend to migrate over time, reject all stone produced by the means and methods which caused the fractures.
   c. free of detrimental geologic features such as, but not limited to, clay or shale seams, argillaceous material, weak stylites, detrimental vugs and adverse diagenetic features. Inclusion of objectionable quantities of dirt, sand, clay, chert and rock fines or other deleterious material will not be permitted.
   d. highly resistant to weathering and disintegration under freezing and thawing and wetting and drying conditions and, for prior suppliers, passed each of three criteria tests consisting of:

      i. A demonstrated history of superior performance on prior projects (service records).
      ii. Required samples and historic samples consistently pass laboratory tests for quality.
      iii. Materials at the source and the project site consistently pass visual examination tests.

2. Determine initial acceptability of stone material based on visual inspections, service records and applicable laboratory tests. The EOR may direct the Contractor to have the stone tested at the EOR approved laboratory if the source does not have a prior use or testing history, if the prior use history of the stone is less than satisfactory or if there is uncertainty about the acceptability of the material when the EOR conducts its quality assurance evaluations and

inspections. The Owner may also conduct independent laboratory tests, conduct visual inspection of the material, and verify prior service records as part of its quality assurance program. Field and laboratory tests to which the material may be subjected are listed in the paragraph "MATERIAL TESTS."

H. Bulk Specific Gravity Range

1. The minimum allowable bulk specific gravity for all stone is 2.14 and the maximum bulk specific gravity is 2.95 based on water having a unit weight of 62.4 pounds per cubic foot.

I. Proportional Dimension Limitations

1. The maximum aspect ratio (greatest dimension: least dimension) of any piece of stone for size ranges which are not graded with a screen or grizzly, may not be greater than 3:1 when measured across mutually perpendicular axis. Not more than 25 percent (25%) of the stones within a gradation range may have an aspect ratio greater than 2.5:1.

J. Stone Sampling and Laboratory Testing

1. Sampling and Testing Procedures

a. For stone sources which have not had samples previously tested at the EOR's approved testing laboratory, or sources which have not had samples tested within the past 5 years or which produced stones of questionable quality for the required pre-production demonstration stockpile, the EOR will require that samples be delivered to the EOR's laboratory for testing. Sample and ship materials for laboratory testing as follows:

i. Not later than 90 calendar days prior to shipment of the materials from the source to the work site, furnish and deliver properly selected samples of the materials from the pre-production demonstration stockpile for testing at the EOR's laboratory. The 90-calendar-day time begins at the time the samples are received at the laboratory. The EOR will be present during sampling and approve the selection of all samples before shipment. The EOR may elect to personally select all samples. Perform sampling and shipping of sample(s) at no cost to the Owner.

ii. Testing for the purpose of evaluating the proposed source or combination of sources will be made at the expense of the Contractor. Testing will be performed by or under the supervision of the Owner in accordance with applicable standards as listed in the paragraph "MATERIAL TESTS". A maximum of 90 calendar days will be allotted by the Owner's laboratory to complete evaluation of stone material. The stated contract completion time will not be extended for sampling, testing and supplying from any originally designated sources nor any replacement sources. Tests which will normally be made include, but are not limited to,
(1) petrographic examination.
(2) specific gravity, wetting and drying per ASTM D5313.
(3) freezing and thawing per ASTM D5312.
(4) compressive strength.
(5) expansion.
(6) tensile strength; elastic moduli.
(7) Los Angeles abrasion per ASTM C131.
(8) direct shear.

(9) and any other tests deemed necessary to assure that the stone is satisfactory for its intended use.

iii. Variations of the referenced ASTM, CRD, and RTH tests, as developed by the U.S. Army Engineer Research and Development Center, Waterways Experiment Station Site (CEERD), may be used when applicable for local conditions.

iv. Securely bind each sample or combination of samples with metal straps to a wooden pallet for arrival at the EOR’s testing laboratory within 10 business days after the EOR has identified a specific item or items to be shipped for testing.

v. Notify the EOR’s testing laboratory at least one working day in advance of the pending arrival of the sample.

K. Quarry Operations

1. Conduct quarry operations in a manner that will produce stone conforming to the requirements specified and may involve selective quarrying, handling, processing, blending, and loading as necessary, describing all of them in detail in the SMC Plan. Control blasting and handling of rock to produce rock of the size ranges and quality specified. Techniques such as the use of proper hole diameter, hole depth, hole angle, burden and spacing distances, types and distribution of explosives, delay intervals and sequence, removal of muck piles between each shot, and special handling techniques are required as necessary to produce the specified materials. Specifically design all aspects of blasting operations so that the end product is not damaged from the blasting technique and that the stone is suitable for the intended purpose.

L. Curing Stone

1. Stockpile all armor stone, dimensioned to final size, at the quarry at least 15 calendar days prior to delivery to the project site to insure that unloading-type fractures caused by the release of stored energy concentrations will not take place and that natural moisture has time to escape. A 45-day stockpiling for case hardening purposes is required for sandstone placed 2 feet and deeper below low water datum (LWD-IGLD 1985) and 90 calendar days curing for sandstone placed above this elevation. These requirements may be waived or reduced by the EOR if service records and/or other evidence is submitted by the Contractor to conclusively support such a change.

M. Supply Dates

1. It has been found that stone from several quarries is subject to considerable fracturing in freezing or freeze-thaw weather type conditions, if its original moisture is present. Therefore, stone quarried (dimensioned to final size) between 15 September and 15 April will not be considered for acceptance until 1 May (this includes a 15-day non-freezing curing period, 15 April to 1 May). If delivered later than 15 September, only stone quarried (dimensioned to final size) and cured 15 calendar days prior to the 15 September date is acceptable. Sandstone will be considered for placement 2 feet and deeper below low water datum (LWD-IGLD 1985) on June 1 (this includes a 45-day non-freezing curing period). Sandstone placed above this elevation will be considered for placement on 15 July. Sandstone cured appropriately using 15 September as the non-freezing cut-off date may be placed later than 15 September. The requirement may be waived for stone sources whose histories show conclusively that the stone is durable irrespective of the time of year that it was quarried.

N. Temporary Storage

1. Storage of stone material on the lake bottom, prior to permanent placement, will be subject to approval of the EOR and will include appropriate weight adjustments for losses. The Owner will not provide compensation for the losses. Storage in other areas of the project site will be subject to approval of the EOR.

O. Gradation - Armor Stone

1. Provide the type of armor stone meeting the corresponding minimum and maximum weight and dimension ranges as shown on the contract drawings.

P. Gradation - Underlayer Stone

1. Provide the type of underlayer stone meeting the corresponding minimum and maximum weight ranges as shown on the contract drawings.

Q. Bedding Stone and Core Stone Material

1. Comply with the gradation requirements specified below for the State of Ohio Department of Transportation - Type "D" Dumped Rock Fill (ODOT 601.08). Provide stone that is predominantly angular in shape and having a length not more than 3.0 times the breadth or thickness. Type "D" stone consists of sizes that are at least 85 percent of the total material by weight that are larger than a 3-inch but less than a 12-inch square opening. Provide at least 50 percent of the total material by weight larger than a 6-inch square opening. For any material smaller than a 3-inch square opening, provide material consisting of rock spalls and rock fines and free of soil. The gradation of bedding stone is the same for any specific gravity.

   Core stone consists of quarried limestone with a median stone weight of 550 pounds and maximum stone weight of 1400 pounds. Core stone consists of sizes that are at least 50 percent of the total material by weight that are larger than a 12-inch and at least 85 percent of the total material by weight are larger than 6”. For any material smaller than a 3-inch square opening shall consist of rock spalls and rock fines and free of soil.

R. Production Quality Control

1. Visual Inspections

   a. Perform random daily checks, by the SMC Inspector(s), of all stone produced at the quarry for size, gradation, elongation, cracks, deterioration and other defects visible to the naked eye on the entire surface area of the stone. Include in the random daily checks comparing the material being produced to that which exists in the pre-production demonstration stockpile. Initiate corrective action, by the SMC Supervisor, if any significant reduction in overall stone quality, gradation mix, or required sizes is observed to be occurring. Each day, wet and reinspect for minute cracks, five or more of the largest stones with the lowest potentially acceptable quality, to determine if additional inspections are necessary on all stone. Mark stones with cracks or defects that are detrimental to a long-lasting product or that are otherwise unsatisfactory for the work, with a reject symbol and are not permitted to be shipped to the project site.

2. Project Site Inspection and Tests

a. At the project site, perform random visual inspections (by an SMC Inspector) of all materials, for size, gradation, elongation, fractures, deterioration and other defects to assure that handling during loading, transporting, unloading and placement has caused damage to the materials and to assure they are placed in accordance with the requirements of this Section.
b. Perform weighing of stones or remeasuring them to verify computed weights when the EOR brings the size of specific stones into question or when the SMC Inspector observes the need to do so. Except as allowed by gradation tolerances, remove and replace any material broken, cracked, out of gradation or weight limitation or improperly placed in the work with satisfactory stones and corrective action taken at no additional expense to the Owner.
c. Promptly remove rejected material from the project site or dispose of at the project site in a location established by the EOR. Such materials are excluded from measurement for payment.

S. Quality Assurance

1. During the contract period, both prior to and after materials are delivered to the job site, visual inspections and measurements of the stone materials may be performed by the EOR.

a. If the EOR, during the inspections, finds that the stone quality, gradation or weights of stone being furnished are not as specified or are questionable, re-sampling and re-testing by the Contractor will be required. Perform sampling of the delivered stone for testing, in the manner of testing as directed by the EOR. Perform this additional sampling and testing when test results indicate that the materials do not meet specified requirements.
b. When test results indicate that materials meet specified requirements, an equitable adjustment in the contract price will be made for the sampling and testing. Remove or dispose of as specified, any material rejected.

T. Retests

1. The Owner reserves the right to test or retest any of the material produced from the sources listed or used on the project at Owners expense.

PART 3 - EXECUTION

3.1 EXCLUSION ZONE – Not Used

3.2 BEFORE SURVEY

A. Perform the survey and make and provide all the required submittals.

3.3 EXCAVATION

A. Perform excavation of material as required and shown on plans and/or permits. All-natural lake bottom material excavated may be side cast away from the site of excavation, to a location that will not affect the placement of any stone. See paragraph 'Debris' for removal of other materials.

3.4 PLACEMENT OF STONE

B. For all surveys, submit all the file types, in the required format, for each survey, as stated in section 31 00 00 PROJECT SURVEYS.

The Contractor shall be responsible for all damages to work performed under this contract, which occur during the optional non-work periods (when the contractor chooses not to work) and periods of no in-water work. All repairs to this damage shall be at no cost to the Owner.

A. General

1. All materials shall be placed uniformly within the slope lines and grades indicated on the drawings. Material shall be placed by equipment capable of handling materials of the size specified. All stone shall be placed beginning at the bottom of the section and in such a manner as to produce a graded mass of stone with maximum interlocking and minimum voids. No grading or excavation of the lake bottom will be required for installation of the breakwater structure.

B. Debris

1. Any timbers, flotsam, unsatisfactory material and debris within the reaches of construction or footprint of the structure shall be removed except as otherwise directed by the EOR, and upon removal shall become the property of the Contractor. All materials shall be properly disposed of in conformance with the requirements of Section 01 57 20.00 10, "ENVIRONMENTAL PROTECTION," including any applicable local requirements.

C. Limitations of Placement Procedures

1. Stone construction in advance of completed permanent protection except as specified herein shall be at the Contractor's risk. The Contractor shall keep the EOR informed as to any and all situations that may result in a possible interruption of work.

D. Interruptions

1. If the Owner can reasonably anticipate that the stone construction will be interrupted for more than four (4) continuous days, including weekends and holidays, the Contractor may be required to complete the placement of underlayer and armor stone and provide protection of the exposed ends prior to the start of the interruption. The above-required protection for the exposed ends of the rubble mound structure shall consist of the same type of stone protection required on the lake side of the structure. All material used for protecting the exposed ends of the structure shall be removed after the need has ended and shall be appropriately incorporated into the required permanent construction. All materials which are removed and placed in the permanent construction, in accordance with the provisions of this Section, will be measured and paid for, only once. When temporary protection of exposed ends of construction in progress is ordered or directed by the Owner, an equitable adjustment will be made for the work of temporarily placing and removing the stone materials. The Owner has no obligation to order that exposed end be protected. If the Owner takes no action to have exposed ends protected, then the provisions of the paragraph titled "Material Placement in Advance" shall apply.

E. Material Placement in Advance

1. The breakwater rehabilitation and new breakwater construction shall not be constructed more

than 50 feet in advance of completed placement of the armor stone. The contractor shall protect their work at all times. Any work left unprotected or not yet accepted by the EOR, that is damaged by a storm or other event, shall be repaired by the contractor at no cost to the Owner.

F. Bedding Stone, Core Stone (Quarry Run Stone)

1. Stone shall be placed to the lines, grades and thickness shown on the drawings. The method used in placement shall be such that any soft and organic materials on the lake floor will be displaced outward towards the extreme outside toes of the required sections of the structure and in the direction of the construction. Placement shall be with reasonably systematic care that segregation of particle sizes will not occur. If the materials are placed by clam shell, dragline, or other similar equipment, the stone shall not be dropped from a height exceeding two (2) feet above the existing lake bottom or previously placed material. The use of bottom dump scows and self-unloading vessels will be permitted, as long as the vessel is in motion parallel to the centerline of the structure and the material is dropped as near to and directly over its final location as possible. The finished surface of the stone shall be reasonably smooth and shall be free of mounds or windrows. The finished work shall be free of clusters of small stones and clusters of larger stones.
Bedding and core stone shall be placed in maximum lifts of 8 feet. A check survey shall be performed after each lift. The Contractor shall wait a minimum of 15 days between placement of each lift of bedding and core stone to allow for stone settlement. A single layer of armor stone meeting the gradation requirements of Section 2.4.K.4 shall be placed over each lift of bedding and core stone.

At the Contractor’s option, monitoring surveys may be performed during the settlement period. Monitoring surveys shall be submitted to the EOR. If the monitoring surveys demonstrate that the structure has settled by a minimum of 12 inches, the Contractor may proceed with placement of the next lift of stone.

G. Underlayer Stone

1. Place stone to a full zone thickness in one operation in a manner to avoid displacing the underlying material or placing undue impact force on underlying materials and supporting subsoils, and as shown. Place the underlayer stone in a manner to produce a resultant graded mass of stone with minimum voids. Rearranging of individual stones may be required to achieve this result. Placement by any method which is likely to cause segregation of the various sizes will not be permitted. Lower unsegregated stone in a bucket or container and placed in a systematic manner directly on the underlying material. Begin placement at the bottom of the slope and proceed upward. Casting or dropping of stone over two (2) feet or moving by drifting and manipulating down the slope will not be permitted. Perform the final finish of the slope as the material is placed.

H. Armor Stone

1. Stone shall be placed individually, in a tightly knit fashion in the locations and at the thickness shown without deviating from the lines and grade shown on the drawings, including allowance for tolerances. Final shaping of the slope shall be performed concurrently with the initial

placement of the stones. Stones shall be randomly selected and set in contact with each other so that the interstices between adjacent stones shall be as small as the character of the stone will permit. The face of stone having the largest area shall be placed against the surface of the underlying material. Placement shall begin at the bottom of the slope with placement proceeding up-slope. The heaviest stones shall be placed as toe stones. Stones shall be placed in a manner to avoid displacing underlying materials or placing undue impact force on underlying material that would cause the breaking of stones. Unless otherwise specified, stone shall not be dropped from a height of greater than two (2) feet. The equipment used in placing the stone shall be suitable for handling materials of the sizes required including the ability to place the stone over its final position before release and if necessary, pick up and reposition the stone. Dragline buckets and skips shall not be used in placement. Moving stone by drifting or manipulating down the slope will not be permitted. The finished work shall be a well distributed mass, free of pockets of either smaller or larger stone, having a minimum of voids and with the maximum of interlocking of stones. All stones when placed shall be stable, keyed and interlocked with no overhanging or perched stones. It should be anticipated that rehandling of individual stones after initial placement will be required to achieve the above requirements.

I. Special Placement Areas

1. Areas may exist where the new work will be tying into existing revetements, and the elevation of the existing slope may not accommodate the stone layer thickness and maintain the finish structure surface shown on the drawings. Any additional survey work, cross-sections, etc. required to determine placement of stone in these areas shall be the responsibility of the Contractor. Layer thickness, stone selection, slope lines and grades shall be determined by the EOR’s on-site inspector for those areas that are not typical.

J. Underlayer Stone

1. Stone shall be placed to a full zone thickness in one operation in a manner to avoid displacing the underlying material or placing undue impact force on underlying materials and supporting subsoils. The underlayer stone shall be placed in a manner to produce a resultant graded mass of stone with minimum voids. Rearranging of individual stones may be required to achieve this result. Placement by any method which is likely to cause segregation of the various sizes will not be permitted. Unsegregated stone shall be lowered in a bucket or container and placed in a systematic manner directly on the underlying material. Placement shall begin at the bottom of the slope and proceed upward. Casting or dropping of stone over two (2) feet or moving by drifting and manipulating down the slope will not be permitted. The final finish of the slope shall be performed as the material is placed.

K. Stone Placement

1. At the time of completion of stone placement operations, prepare a document which graphically shows, for each layer of stone, the source of the stone for each reach and the time periods during which it was quarried and during which it was placed. Include attachments to the document that include a copy of the Contractor's gradation data and test results for each gradation range as well as a copy of the EOR's evaluation and test results that has been furnished to the Contractor.

L. Slides

1. In the event of the sliding or failure of any part of the structure during its construction, or after its completion, but prior to its acceptance, upon written order of the EOR, cut out and remove the slide from the structure and then rebuild that portion of the structure with new materials or reuse the displaced materials for rebuilding if deemed appropriate. The EOR will determine the nature and cause of the slide. In case the slide is caused through the fault of the Contractor, perform the foregoing operations without cost to the Owner. In case the slide is due to no fault or negligence of the Contractor, the work will be paid for in accordance with the applicable contract clause.

M. Tolerances

1. Do not deviate the finished surface and stone layer thickness from the lines and grades shown on the contract drawings by more than the tolerances listed below. Tolerances are measured vertically to the indicated neatlines. Extreme limits of the tolerances that are continuous in any direction for more than five times the nominal stone dimension nor for an area greater than 1000 square feet of the structure surface, are not permitted.

NEATLINE TOLERANCES

Stone	Above Neatline (Inches)	Below Neatline (Inches)
Bedding	6	6
Underlayer	12	9
Armor	18	12

2. The intention is that the work will be built generally to the required elevations, slope and grade and that the outer surfaces are even and present a neat appearance. Excess underlayer or armor stone above the neatline tolerance will be permitted to stay in place by the EOR but will not be paid for. Excess stone fill that is between the upper limit of the tolerance, and up to 24 inches above the neatline will be permitted to remain in place but not paid for. Remove or rework placed material not meeting these limits.

N. Tie-ins

1. Construct tie-ins to the existing wall or structures as shown on the contract drawings, based upon the cross sections provided.

3.5 PLACEMENT QUALITY CONTROL

1. Establish and maintain quality control for all work performed at the job site under this Section to assure compliance with contract requirements. Maintain records of its quality control tests, inspections and corrective actions. Use quality control measures that cover all construction operations including, but not limited to, the placement of all materials to the slope and grade lines shown on the contract drawings and in accordance with this Section of the specifications. Surveying, plotting and data submission are detailed in section 31 00 00.00 02 "PROJECT SURVEYS".

END OF SECTION