

32 32 24 VEGETATED SEGMENTAL RETAINING WALLS

PART 1: GENERAL

1.01. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Manufacturer Specification Sections, apply to this Section
- B. Related requirements specified elsewhere include:
 - 1. Division 31 Section “Earth Moving”

1.02. SUMMARY

- A. This Section includes a complete Vegetated Segmental Retaining Wall System, as shown on the Drawings and described herein. This section includes components of the Vegetated Segmental Retaining Wall System.
- B. This Section includes warranty and maintenance of the Vegetative Segmental Retaining Wall System.

1.03. SYSTEM DESCRIPTION

- A. Provide a precast concrete modular retaining wall. Each module is designed as a planting container which faced at the front and unbounded at the rear. Planting spaces within wall are filled with high quality growth media and plants. Each module allows for a mechanical connection to reinforcement strap which is embedded in structural fill behind the wall.

1.04. PERFORMANCE REQUIREMENTS:

- A. Vegetated Segmental Retaining Wall System shall:
 - 1. Meet or exceed all structural calculations as prepared by the project engineer.
 - 2. Support a perennial plant landscape.
 - 3. Provide efficient drainage of moisture that is in excess of moisture required for the vigorous growth of the installed vegetation.

1.05. DEFINITIONS

- A. Standard Definitions
 - 1. Backfill: Soil behind the plantable modules.
 - 2. Captured Water: Water that is retained in the growth media of a vegetated segmental retaining wall after new water additions have ceased and that cannot escape the wall except through evaporation or plant transpiration.
 - 3. Desirable Plant Species: Plants that contribute toward a low-maintenance, continuous and year-round vegetative cover that is predominantly perennial in nature, but which may accommodate some annual plants. Plants that grow and spread at a pace that does not diminish species diversity and that does not require excessive maintenance.
 - 3. Desirable Plant Species: Plant species which are listed on the design drawings or specifications, or plant species which are approved for use in the vegetated segmental retaining wall by the Owner.
 - 4. Growth Media: Blended soil or soil-like material which is placed within the planting pocket of each module.
 - 5. Vegetative Coverage: Coverage of the wall area by any part of living and rooted vegetation, as measured in elevation from the tips of vegetation during the period of greatest growth (typically summer). Full vegetative coverage is achieved when at least ninety percent (90%) of the wall is covered by desirable species of vegetation, as measured during periods of non-dormancy.

6. Vegetated Segmental Retaining Wall System Installer (Installer): Company that installs the full system described in this Section. If deemed necessary, installer may be certified by the Manufacturer to install the specified system.
7. Vegetated Segmental Retaining Wall Manufacturer (Manufacturer): Company that provides the segmented retaining wall modules and reinforcement strap described in this Section, and which provides warranty of the system components described in this Section.
8. Wall Design Engineer of Record: Engineer licensed to practice in the jurisdiction in which the retaining wall is to be installed. Engineer who prepares the Wall Design Submittal.
9. Wall Design Submittal: Engineering package prepared by Wall Design Engineer of Record that includes calculations and specifications for soil and wall reinforcement, including spacing and length of reinforcement strap (if any), specifications for base course and compacted backfill, seismic analysis, and global stability analysis.
10. Weed: Plants which are aggressively spreading or very fast-growing that, if not removed would destabilize the desired plant community or diminish the quality or quantity of desirable species. Plants that are considered noxious or invasive. Plants whose ultimate size or type would pose damage to the vegetated segmental retaining wall.

1.07. QUALITY ASSURANCE

- A. Installer shall:
 1. Have a minimum of five (5) years of documented successful experience in installation of projects of similar complexity and scale;
 2. Have the facilities capable of meeting all requirements of Contract Documents;
 3. If deemed necessary, provide full-time site supervision during all phases of installation; Site Supervisor must have a minimum of two (2) years documented experience in successful installation of projects of similar complexity and scale; Site Supervisor must be able to communicate effectively with Owner, Architect and installation crews; Site Supervisor must be a full-time employee of Installer;
- B. Source Limitations: The installer or landscape maintenance provider will supply backfill, leveling pad material, and drainage aggregate. The Manufacturer will supply the segmented retaining wall modules and reinforcement strap.
- C. Geotechnical Engineer Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.
 1. If deemed necessary, owner may engage Geotechnical Engineering inspection services during construction. These inspection services shall, at a minimum, include foundational soil inspection, soil and backfill testing, verification of design parameters, and observation of construction for general compliance with the design drawings and specifications. This does not relieve Contractor from securing necessary construction control testing.
 2. Field inspection and testing shall be performed by the Wall Design Engineer of Record or the Geotechnical Engineer.
- D. Tests for reinforcement strap shall be conducted by an independent laboratory with the experience and capabilities to prepare each test listed for reinforcement strap in Part 2, as well as melt flow index and molecular weight (polyester).
- E. Tests for precast concrete modules shall be conducted by an independent laboratory with experience and capabilities of testing precast concrete materials.
- F. Tests for growth media shall be conducted by an independent laboratory recognized by the Department of Agriculture of the state in which the wall will be installed. Laboratory must be experienced in conducting the tests indicated.
- G. Comply with all local, state and federal laws regarding earthwork, including the project's approved erosion and sediment control plan.

- H. Provide a mockup in a location as approved by the Engineer. Mockup shall illustrate typical construction craftsmanship and construction tolerances which are acceptable for this project. Maintain mockup during all Work of this Section. Mockup may remain in-place as part of the completed Work as allowed by the Engineer.
- I. Pre-Construction Meeting: At least one week prior to the commencement of work described under this section, the Installer and Manufacturer shall meet with the general contractor to discuss project sequence, procedures for methods for protecting the work, and review completed work for compliance with the specifications.

1.08. SUBMITTALS

- A. Qualification Data of Installer, including resumes of key personnel assigned to this project. Include certification issued by the Manufacturer.
- B. Product Data for the vegetated segmental retaining wall system provided by the Manufacturer. Include MSDS sheets for all materials.
- C. Wall Design Submittal: Shop Drawings showing typical sections, full elevations, connection details, terminations, transitions and other unusual or project-specific details. Shop Drawings shall bear the approval of the Wall Design Engineer of Record and the approval of the Manufacturer.
 - 1. Include retaining wall design calculations and global stability analysis stamped by a registered Professional Engineer licensed in the state in which the wall is to be installed.
- D. Planting Plan:
 - 1. Include a planting plan indicating species to be planted in each module.
- E. Delegated design submittal: Irrigation shop drawings and calculations showing controllers, mainline, all drip zones and valves. Calculations must demonstrate compliance with performance requirements as noted below.
 - 1. XXXXXXXXXXXXXXXX
- F. Samples:
 - 1. Except as indicated, provide three (3) sets of samples indicated below.
 - 2. Five pound container of planting media
 - 3. Six-inch by six-inch sample of filter fabric
 - 4. Submit one (1) precast concrete module
 - 5. Six-inch sample of reinforcement strap
 - 6. Six-inch sample of irrigation tubing
- G. Warranty: Sample warranty. Include with the sample warranty options for the Owner to extend the terms of the warranty. Include details of warranty phase Stewardship program.
- H. LEED Submittals:
 - 1. Product Data for Credit MRc4: For products having recycled content, documentation indicating percentages by weight of post-consumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Data for Credit MRc5: Documentation of percentages of materials of each product produced within 500 miles of the project site.
- I. Warranty Submittals: Stewardship reports, media tests and other warranty phase submittals per Part 3 of this Section.

1.09. DELIVERY, HANDLING AND STORAGE

- A. Deliver plants to the jobsite in undamaged boxes or pallets that are clearly marked with the project name, contractor name, name of nursery, and plant species included.
- B. Store plants in a sun-lit but shaded outdoor area. Irrigate as needed and in accordance with directions of the nursery. Install plants within 24 hours of receipt or unpackage and care for before installation.
- C. Each delivery of bulk materials shall be accompanied by a delivery ticket indicating the specific product delivered, weight of delivery, name and address of manufacturer or place of origin, shipper, recipient, date and time of delivery, and project name. Unless installing bulk materials immediately

upon receipt, place bulk materials on a tarp or in a container; cover with a tarp to minimize contamination, protect from weed seed infiltration, and maintain in a dry condition.

- D. Maintain rolled and sheet goods in manufacturer's original packaging; store in a safe and secure location until installation. Do not expose reinforcement strap to sunlight for periods longer than 15 days.
- E. Maintain modules and other palletized goods on pallets with protective covering until they are installed. Protect concrete modules from damage such as chips, cracks or staining.

1.10. PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit work to be performed when optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements. Do not planting herbaceous materials when planting media temperatures are below freezing or when ice or snow is present.

1.11. WARRANTIES

- A. Warranty shall include all coverages listed below.
- B. Terms: All terms begin immediately upon installation and continue through Substantial Completion. Terms listed below are terms which commence upon Substantial Completion.
 - 1. Workmanship Warranty: One year
 - 2. System Warranty: Fifteen years
 - 3. Plant Performance: Five years
- C. Workmanship Warranty: Installer agrees to repair or replace portions of the vegetated segmental retaining wall system that fail in workmanship within specified warranty period.
- D. System Warranty: Manufacturer agrees to repair or to provide replacement materials for portions of the vegetated segmental retaining wall components that fail in structural integrity within specified warranty period.
- E. Plant Performance: Installer or subsequently selected landscape maintenance provider shall act as steward of the vegetated segmental retaining wall system as described in Part 3.
 - 1. Vegetative Coverage:
 - a. Achieve full vegetative coverage within 24 months of Substantial Completion.
 - b. Maintain full vegetative coverage for the duration of the warranty period. Replace or supplement plants in areas that do not achieve the specified coverages within the warranty period. Immediately remove dead plants and replace as soon as growing conditions permit.
 - 2. Failures include, but are not limited to, death and unsatisfactory growth except for defects resulting from abuse or incidents that are beyond Manufacturer's control.

PART 2: PRODUCTS

2.01. VEGETATED SEGMENTAL RETAINING WALL SYSTEM

- A. Subject to compliance with requirements, provide one of the following:
 - 1. SmartSlope C110 by Furbish.
 - 2. Or Approved Equivalent.

2.02. PLANTS

- A. Species:
 - 1. Include the following:
 - XXXXXXX
 - 2. Include at least one of the following:
 - XXXXXXX
 - 3. Include at least three of the following:
 - XXXXXXX

4. Provide other plant species per approved submittals.
- B. Plugs:
 1. Vigorous, well rooted, and established in the plug cells in which they are growing. Tops shall be of good quality. Root system shall be well-established root system and reaching the sides of the container to maintain a firm ball. Plants shall be free of disease.
 2. Manufacturer will provide the appropriate size plug for each species indicated. Minimum size: 72-cell trays (1-1/2 inches x 3 inches).
- C. Bulbs: Top Size, including corresponding designation of "Jumbo", "Giant" or "Extra Large", per ANSI Z60.1.
- D. Seed:
 1. Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
 2. Manufacturer's standard seed mix as approved by the Architect, with not less than 85 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed.

2.03. MODULES

- A. SmartSlope C110
 1. Material: Wet-cast concrete
 2. Color: Manufacturer's standard charcoal gray integrated into concrete mix.
 3. Dimensions: Each module is fifteen inches (15") wide, six inches (6") tall, and twelve inches (12") deep.
 4. Configuration: Each module contains one face, two side walls, a floor, and an unbounded rear and top opening.
 - a. A slot exists near the center of each module floor. The slot allows reinforcement strap to be laced through the module for a mechanical connection between concrete modules and structural reinforcement.
 - b. Planting pocket ratio: .88 cubic feet of growth media planting zone per square foot of wall face.
 5. Weight: Approximately 50 lbs. per module.
 6. Compressive strength: Minimum 5,000 psi at 28 days.
 7. Concrete is mixed with air entrainment appropriate to the region in which the modules will be installed.

2.04. REINFORCEMENT STRAP

- A. Material: Polymeric strap formed of high tenacity polyester yarns placed in tension and co-extruded with polyethylene.
 1. Polyester molecular weight:minimum 25,000 Meg/m
 2. Carboxyl end group values less than 30
- B. Dimensions: Four-inch (nominal) width.
- C. Long-Term Allowable Tensile Design Load..... Per the Wall Design Submittal
- D. Soil Interaction Coefficient (Ci) displacement values shall be determined per GRI-GG5.

2.05. SOILS

- A. Backfill: Division 31 Section "Earth Moving".
- B. Leveling Pad: Acceptable subbase material per Division 31 Section "Earth Moving".
- C. Drainage Aggregate: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2- inch sieve and 0 to 5 percent passing a No. 8 sieve.
- D. Growth Media: Installer or landscape maintenance providers' standard mid-Atlantic blended growth media, consisting of manufactured topsoil blended with organic matter and slow-release nutrients.

- D. Growth Media: Installer or landscape maintenance providers' standard rain-garden blended growth media, consisting of manufactured topsoil blended with aggregates, organic matter and slow-release nutrients.
- D. Growth Media: Installer or landscape maintenance providers' standard succulent-garden blended growth media, consisting of manufactured topsoil blended with aggregates, organic matter and slow-release nutrients.

2.06. ACCESSORIES

- A. Filter Fabric (Separation Fabric). Root-permeable, non-woven geotextile which is used to separate growth media from backfill and drainage aggregate. Inert to biological degradation and resistant to naturally occurring chemicals, alkalis and acids.
 - 1. Material Polypropylene
 - 2. Recycled content.....>=30%
 - 3. Unit Weight: 4-6 oz/yd2 ASTM-D3776
 - 4. Grab tensile strength:>= 60 lb ASTM-D4632
 - 5. Grab tensile elongation:>= 50% ASTM-D4632
 - 6. Trapezoid tear strength>= 50 lb ASTM D4533
 - 7. CBR puncture strength.....>= 70 lb ASTM D6241
 - 8. Permittivity:>= 0.9 sec-1 ASTM-D4491
 - 9. Flow rate>= 100 gpm / ft2 ASTM D4491
 - 10. UV Resistance at 500 hours>= 70% ASTM D4355
- B. Landscape Stone: #2 landscape stone.
- C. Drainage Pipe: Perforated schedule 40 PVC pipe, per ASTM D-3034.
- D. Irrigation: Standard drip tubing of approximately 0.50 inch diameter with emitters, installed into receptor slots of each module on an irrigated course.

PART 3: EXECUTION

3.01. EXAMINATION

- A. Examine site conditions for compliance with drawings and other conditions which may affect the Work of this Section.
- B. Confirm that subbase has been graded per drawings and specifications or as directed by the design engineer. Ensure that exposed subbase soil shall be observed by the Geotechnical Engineer prior to construction to verify that the exposed material has been compacted to at least 95% standard Proctor Density and is suitable for the net design bearing pressure of the wall. Ensure that the base of the excavation is free of loose soil, non-compacted fill, water, or frozen material.
- C. Notify the Engineer immediately if any conditions are present that may be detrimental to the performance of the Work. Proceed only after unsatisfactory conditions have been corrected.

3.02. GENERAL

- A. Install each component of the vegetated cover system in accordance with approved submittals and the Contract Documents.
- B. Protect adjacent work from damage during all phases of installation.

3.03. BACKFILL ZONE, REINFORCEMENT AND COMPACTION

- A. Sequence backfill, reinforcement and compaction to occur concurrent with wall construction.
- B. Backfill and compact reinforcement zone to at least 95% Standard Proctor Density and per Earth Moving specifications in six-inch (6") lifts (one lift per wall course).
- C. Install reinforcement strap per the approved Wall Design Submittal.
- D. Lay straps horizontally at the same elevation as the floor of the modules through which they are laced. Gently pull slack out of strap before placing backfill. Position straps in a V-shaped

formation so that terminal ends of straps are 25 inches (25") apart, per the drawings and Installation Manual.

- E. Place and compact backfill in a manner that minimizes wrinkles and movement of the reinforcement.
- F. Do not operate equipment over reinforcement strap except rubber-tired or rubber-tracked equipment as approved by the Geotechnical Engineer. Do not operate any equipment other than vibratory plates within three feet (3') of the rear of modules.
- G. Geotechnical Engineer shall test field density and approve of backfill, reinforcement and compaction. Correct unsatisfactory work.
- H. Provide a drainage swale at the top of the wall, per the drawings, to prevent surface runoff from flowing along the face of the wall.
- H. Provide an infiltration swale at the top of the wall, per the drawings, to direct surface runoff into the drainage aggregate behind the wall, and to prevent surface runoff from flowing along the face of wall.

3.03. BACKFILL ZONE COMPACTION (GRAVITY WALL CONSTRUCTION)

- A. Sequence backfill and compaction to occur concurrent with wall construction.
- B. Backfill and compact reinforcement zone to at least 95% Standard Proctor Density and per Earth Moving specifications in six-inch (6") lifts (one lift per wall course).
- C. Do not operate any equipment other than vibratory plates within three feet (3') of the rear of modules.
- D. Geotechnical Engineer shall test field density and approve of backfill and compaction. Correct unsatisfactory work.
- E. Provide a drainage swale at the top of the wall, per the drawings, to prevent surface runoff from flowing along the face of the wall.
- E. Provide an infiltration swale at the top of the wall, per the drawings, to direct surface runoff into the drainage aggregate behind the wall, and to prevent surface runoff from flowing along the face of wall.

3.04. VEGETATED SEGMENTAL RETAINING WALL INSTALLATION

- A. Install leveling pad to lines and grades per drawings or as directed by the Engineer. Level to receive first course of modules. Compact leveling pad to minimum 95% Standard Proctor Density.
- B. Sequence wall construction to occur concurrent with backfill, reinforcement and compaction.
- C. Install drainage aggregate behind modules per drawings. Separate drainage aggregate from backfill and from growth media with filter fabric.
- D. Install vegetated segmental retaining wall in accordance with Manufacturer's most current Installation Manual. Project-specific installation conditions include:
 - C. Construction Tolerances:
 - 1. Vertical alignment of wall face: ± 1.5 inch (37 mm) over any 10 ft (3 m) distance.
 - 2. Horizontal alignment of wall face: ± 1.5 inches (37 mm) over any 10 ft (3 m) distance.
 - 3. Wall Batter: within 2 degrees of design batter.
 - 4. Maximum horizontal gap between erected units: 10 inches (25.5 cm).
 - 5. Lippage: maximum vertical distance between rails of adjacent units: 1/8 inch
 - 6. Corners, bends, curves: ± 1 ft (0.3 m) to theoretical location.
 - D. Growth Media Placement:
 - 1. Place media within each module. Lightly tamp into place using small, handheld tools, in conformance with approved mockup.

3.04. PLANTING

- A. Install plants in accordance with accepted horticultural practice, the Contract Documents and approved Submittals.
- A. Broadcast seed in accordance with accepted horticultural practice, the Contract Documents and approved Submittals.
- B. Soak growth media immediately after planting.

3.05. PLANT PERFORMANCE WARRANTY (STEWARDSHIP)

- A. General: Stewardship will be provided by the Installer or landscape maintenance provider. During stewardship period, maintain plantings by cultivating, weeding, fertilizing, and performing other operations as required to establish healthy, viable plantings and maintain continuous vegetative coverage, conforming with Warranty requirements.
- B. Maintain the plant palette as indicated on the drawings and approved submittals.
 - 1. Remove weeds and facilitate growth of intended species. Supplement quantities of intended species as needed.
 - 2. In areas where the existing plant palette is not performing optimally, determine the reason for poor performance, and suggest planting or management changes to the Owner. Implement planting changes to the extent that planting changes are covered by the Warranty.
- B. Facilitate natural adaptation of the plant palette to the unique microclimate of the project site.
 - 1. As volunteer plant species emerge, distinguish between desirable species and weeds.
 - 2. Remove weeds and facilitate growth of desirable species. Supplement desirable species as needed.
 - 3. In areas where the existing plant palette is not performing optimally, determine the reason for poor performance, and suggest planting changes to the Owner. Implement planting changes.
- C. Apply treatments as required to keep plant materials, planted areas, and growing medium free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.
- D. Replace growing medium that becomes displaced or eroded because of settling, wind or water scour, or other processes.
- E. Test planting soil annually for nutrient levels, salt levels, pH and other conditions as necessary. Maintain a permanent log of all test results.
 - 1. Ensure that nutrient, salt, organic matter, and pH levels remain within ranges suitable for optimal plant growth.

END OF SECTION