

## CONCRETE SEGMENTAL RETAINING WALL SYSTEM

### PART 1: GENERAL SPECIFICATIONS

#### 1.01 Work Included

- A. Work shall consist of furnishing and constructing a Rockwood Sapphire™ unit segmental retaining wall in accordance with these specifications to the lines and grades shown on the construction plans and drawings. Alternate wall systems will not be considered.
- B. Work includes preparing foundation soil, furnishing and installing leveling pad, unit drainage fill, and backfill to the lines and grades shown on the construction plans and drawings.
- C. Work includes furnishing and installing geogrid soil reinforcement of the type, size, location, and lengths as designated on the construction drawings.

#### 1.02 Related Sections

- A. Section \_\_\_\_\_ - Site Preparation
- B. Section \_\_\_\_\_ - Earthwork

#### 1.03 Reference Documents

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM C 1372 Standard Specification for Segmental Retaining Wall Units
  - 2. ASTM C 140 Sampling and Testing Concrete Masonry Units
  - 3. ASTM D 422 Particle Size Analysis
  - 4. ASTM D 698 Laboratory Compaction Characteristics of Soil -Standard Effort
  - 5. ASTM D 4318 Liquid Limit, Plastic Limit and Plasticity Index of Soils
  - 6. ASTM D 4595 Tensile Properties of Geotextiles - Wide Width Strip
  - 7. ASTM D 5262 Unconfined Tension Creep Behavior of Geosynthetics
  - 8. ASTM D 3034 Polyvinyl Chloride Pipe (PVC)
  - 9. ASTM D 1248 Corrugated Plastic Pipe
  - 10. ASTM D 1262 Freeze-Thaw Durability of Concrete Units
  - 11. ASTM D 6638 Determining Connection Strength Between Geogrid and Segmental Unit
- B. Geosynthetic Research Institute (GRI)
  - 1. GRI-GG4 Determination of Long Term Design Strength of Geogrid
  - 2. GRI-GG5 Determination of Geogrid (soil) Pullout
- C. National Concrete Masonry Association (NCMA)
  - 1. NCMA SRWU-2 Test Method for Determining Shear Strength of SRW

#### 1.04 Submittals/Certification

- A. Prior to the start of work, the Owner shall obtain construction drawings and design calculations prepared and stamped by a Professional Engineer registered in the state of the proposed retaining wall. The Owner or Contractor should have the proposed retaining wall permitted by the appropriate governing authorities.

- B. Prior to start of work, the Contractor shall submit a manufacturer's certification for each of the retaining wall system components. The certification shall state that the component meets the requirements of this specification.

#### **1.05 Quality Assurance**

- A. The Contractor shall be competent and experienced in the construction of reinforced segmental retaining walls. The Contractor's competency and experience shall be determined by the Owner thru demonstration of successfully completed projects and/or completion of a nationally recognized course of instruction, such as the NCMA's *Segmental Retaining Wall Installers Education Program*.
- B. The Design Engineer shall be competent and experienced in the design and analysis of reinforced segmental retaining walls. The Design Engineer shall provide proof of current professional liability insurance with an aggregate coverage limit of not less than \$1,000,000.
- C. The Owner or Contractor shall provide independent soil testing and quality assurance inspection and testing during earthwork and wall construction operations. The Owner's quality assurance program does not relieve the Contractor of responsibility for quality control and wall performance.

#### **1.06 Delivery, Storage and Handling**

- A. The Contractor shall check all materials upon delivery to assure that the proper type, grade, color, and certification have been received.
- B. The Contractor shall protect all materials from damage due to jobsite conditions and in accordance with manufacturer's recommendations. Damaged materials shall not be incorporated into the work.

### **PART 2: COMPONENTS**

#### **2.01 Definitions**

**Block** - a Rockwood Sapphire™ concrete segmental retaining wall unit.

**Cap** - a Rockwood Classic Universal Cap™ concrete segmental retaining wall unit.

**Geogrid** - a geosynthetic material manufactured for the primary purpose to reinforce soil. Same as *geosynthetic reinforcement* and *soil reinforcement*.

**Filter Fabric** – a geosynthetic material manufactured for the primary purpose to filter soils from water. Same as *geosynthetic fabric*.

**Drainage Fill** – crushed rock aggregate that is placed within and immediately behind the block. Same as *core fill* and *drainage rock*.

**Backfill** - compacted soil that is placed behind the blocks and drainage fill and within the reinforced soil volume of the retaining wall as outlined on the plans. Same as *reinforced backfill* and *infill soil*.

**Base Leveling Pad** – aggregate base material or concrete used as a foundation for the blocks. Same as *leveling pad*.

**Drainage Pipe** – typically, a 4” diameter PVC or corrugated HDPE pipe, that is perforated or slotted to accept water from the surrounding soils. Same as *drain tile*.

**2.02 Blocks and Caps**

- A. Blocks shall be Rockwood Sapphire™ concrete segmental retaining wall units. The Owner shall specify the color and face finish.
- B. Caps shall be Rockwood Classic Universal Cap™ concrete segmental retaining wall units.
- C. Blocks and caps shall conform to the following requirements:
  - 1. Block dimensions shall be:
    - a) Sapphire™ Straight Split Unit: H = 6”, L = 17.25”, D = 12”
    - b) Sapphire™ Radius Split Unit: H = 6”, L = 15.75”, D = 12”
  - 2. Blocks shall have a built in “lip” creating a 1” setback per course.
  - 3. Cap dimensions shall be: H = 4”, L<sub>FRONT</sub> = 18”, L<sub>REAR</sub> = 14”, W = 10.5”
  - 4. Permissible variations in block/cap dimensions shall be per ASTM C1372.
  - 5. The finish and appearance of blocks/caps shall be per ASTM C 1372.
  - 6. Strength and absorption requirements shall be per ASTM C 1372.
  - 7. The unit weight (weight per unit volume) of an in-filled block shall be greater than 115 pcf.

**2.04 Base Leveling Pad Material**

- A. Base leveling pad material shall consist of compacted aggregate base or non-reinforced concrete, as shown on the construction drawings and/or determined based upon field conditions. Aggregate base material shall meet the following gradation in accordance with ASTM D-422:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 inch	100
no. 4	35 - 70
no. 200	0 - 15

**2.05 Drainage Fill Material**

- A. Drainage fill material shall consist of crushed rock meeting the following gradation in accordance with ASTM D-422:

<u>Sieve Size</u>	<u>Percent Passing</u>
3 inch	100
¾ inch	75-100
no. 4	0 - 25
no. 200	0 - 5

**2.06 Backfill**

- A. Backfill shall consist of soil that is free of debris and deleterious material. Unless the Designer specifies otherwise and accounts for in his/her design analysis, backfill shall meet the following gradation in accordance with ASTM D-422:

<u>Sieve Size</u>	<u>Percent Passing</u>
3 inch	100
1 inch	50 - 100
no. 4	20 – 100
no. 40	0-75
no. 200	0-35

- B. Backfill shall have a Plasticity Index (PI) < 15 and Liquid Limit (LL) < 40 per ASTM D 4318.
- C. The Contractor shall obtain independent laboratory test results to verify that the backfill meets the requirements of 2.06 A. and 2.06 B.

**2.07 Geogrid**

- A. The geogrid, as specified in the construction plans and drawings, shall be manufactured specifically for soil reinforcement applications.

**2.08 Drainage Pipe**

- A. If required, drainage pipe shall be PVC pipe manufactured in accordance with ASTM D-3034 or corrugated HDPE pipe manufactured in accordance with ASTM D-1248. Drainage pipe shall be perforated, slotted, or non-perforated as shown in the construction drawings.

**PART 3: EXECUTION**

**3.01 Excavation**

- A. The Contractor shall excavate to the lines and grades shown on the construction drawings. The Contractor and/or Owner's representative shall inspect the excavation and approve/disapprove its competency as a foundation soil prior to placement of the leveling pad or backfill.
- B. If remedial work is required to improve the foundation soil, the Owner shall compensate the Contractor as mutually agreed.
- C. The foundation soil shall be compacted to a minimum of 95 % of the maximum density per ASTM D-698.
- D. If seepage or evidence of past seepage is observed in the excavation, the Contractor shall consult the Owner and Design Engineer in order to add or modify a drainage system to mitigate future seepage.

**3.02 Base Leveling Pad**

- A. Leveling pad material shall be placed to the lines and grades shown on the construction drawings, to a minimum thickness of 6 inches, extending laterally a minimum of 6", both in front of and behind the block.
- B. Leveling pad materials shall be compacted to a minimum of 95 % of the maximum density per ASTM D-698.

- C. Leveling pad shall be prepared to insure full contact to the base surface of the block.

### **3.03 Block Installation**

- A. First course of units shall be placed on the leveling pad at the appropriate line and grade as shown on the construction drawings. Alignment and level shall be checked in all directions. Ensure that all units are in full contact with the leveling pad and properly seated.
- B. Place the front of units side-by-side. Do not leave gaps between adjacent units. Layout of corners and curves shall be in accordance with manufacturer's recommendations.
- C. Place drainage fill within and behind blocks. Place backfill behind drainage fill in lifts no greater than 6 to 12 inches and compact to a minimum of 95 % of the maximum density per ASTM D-698. After placement of backfill, compact drainage fill by probing.
- D. Do not stack more than two courses of block prior to placing and compacting drainage fill and backfill.

### **3.04 Geogrid Installation**

- A. Geogrid shall be oriented with the highest strength axis perpendicular to the wall alignment.
- B. Geogrid shall be placed at the type, lengths, and elevations shown on the construction drawings or as directed by the Design Engineer.
- C. The geogrid shall be laid horizontally from within 2 inches of the face of the block back across compacted backfill. Place the next course of blocks over the geogrid. The geogrid shall be pulled taut and anchored prior to placing additional drainage fill or backfill.
- D. Geogrid shall be continuous throughout their embedment length. Geogrid shall be placed side-by-side or overlapped with 3" backfill between to provide 100% coverage at each designed geogrid level where possible. Geogrid shall not be spliced along its designed embedment length.

### **3.05 Backfill Placement**

- A. Backfill shall be placed, spread, and compacted in such a manner that minimizes the development of slack and installation damage in the geogrid.
- B. Backfill shall be placed and compacted in lifts not to exceed 6 inches where hand compaction is used, or 8 to 12 inches (depending on soil type and soil processing) where heavy compaction equipment is used. Lift thickness shall be decreased to achieve the required compaction.
- C. Backfill shall be compacted to 95% of the maximum density per ASTM D698. The moisture content of the backfill material, prior to and during compaction, shall be uniformly distributed throughout each layer and shall be within 20% of the optimum moisture content as determined by ASTM 698.

- D. Only lightweight hand-operated equipment shall be allowed within 4 feet from the face of the block.
- E. Tracked construction equipment shall not be operated directly upon the geogrid. A minimum of 6 inches of backfill is required over the geogrid prior to operation of tracked vehicles over the geogrid. Tracked vehicle turning should be kept to a minimum to prevent tracks from displacing the backfill and damaging the geogrid.
- F. Rubber tired equipment may pass over geogrid at slow speeds, less than 10 mph. Sudden braking and sharp turning shall be avoided.
- G. At the end of each day's operation, the Contractor shall slope the last lift of backfill away from the blocks and drainage fill in order to direct runoff away from wall face. The Contractor shall ensure surface runoff from adjacent areas does not enter the wall construction site.

### **3.06 Drainage System Installation**

- A. Drainage systems, both internal to the wall and surficial, shall be determined based upon site conditions by the Contractor in consultation with the Owner and the Design Engineer.
- B. Within the time of construction, the Contractor must ensure that all surficial drainage is directed away from the wall system by use of drainage swales, area drains, or other competent measures.
- C. Within the lifetime of the wall, the Owner must ensure that all surficial drainage is directed away from the wall system.

### **3.07 Cap Installation**

- A. Caps shall be adhered to underlying blocks and caps with Super-Stik™.

### **3.08 As-Built Construction Tolerances**

- A. **Vertical Alignment:** the top of wall shall be within 2" from design grade.
- B. **Wall Batter:** within 2.5 degrees of design batter, excluding a negative batter.
- C. **Horizontal alignment:** the bottom of the wall (B.W.), at design B.W. grade, shall within 1 foot of design line.
- D. **Maximum horizontal gap** between erected blocks shall be 1/2 inch.

### **3.09 Field Quality Control**

- A. The Owner and Contractor shall engage inspection and testing services (quality control) during construction to ensure project specifications are met. The lack of quality control by the Owner does not relieve the Contractor from meeting project specifications.
- B. Quality control should include, but not be limited to: foundation soil inspection; verification of geotechnical design parameters; and verification that construction is in general compliance with the design drawings and project specifications. (*Quality Assurance is usually best performed by the site geotechnical engineer.*)
- C. Only qualified and experienced technicians and engineers shall perform testing and inspection services.

