SECTION 02830

SPECIFICATION FOR SEGMENTAL RETAINING WALLS

Mesa Retaining Wall System

THIS SECTION IS WRITTEN IN CSI 3-PART FORMAT AND IN CSI PAGE FORMAT. NOTES TO THE SPECIFIER, SUCH AS THIS, ARE INDICATED WITH A ## SYMBOL AND MUST BE DELETED FROM THE FINAL SPECIFICATION.

IT IS ASSUMED THAT THE GENERAL CONDITIONS BEING USED ARE AIA A201-87. SECTION NUMBERS ARE FROM THE 1995 EDITION OF MASTERFORMAT.

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes - Mechanically Stabilized Earth (MSE) retaining wall system having high density polyethylene geogrids positively connected to Mesa Segmental Concrete Facing Units.

EDIT LIST BELOW TO CONFORM TO PROJECT REQUIREMENTS. VERIFY SECTION NUMBERS AND TITLES.

B. Related Sections
   1. Section 02200 - Site Preparation
   2. Section 02300 - Earthwork

1.02 REFERENCES

DELETE REFERENCES NOT USED IN PART 2 OR PART 3.

A. American Association of State Highway and Transportation Officials (AASHTO)
   1. T289 - Determining pH of Soil for Use in Corrosion Testing
   2. M288-96 - Standard Specification for Geotextiles
   3. Standard Specification for Highway Bridges (2002 Interim)

B. American Society for Testing and Materials (ASTM)
   1. C1372-98 - Standard Specification for Segmental Retaining Wall Units
   2. C140-98b - Standard Test Methods of Sampling and Testing Concrete Masonry Units
   3. C150-97a - Standard Specification for Portland Cement
   4. C33-99 - Standard Specification for Concrete Aggregates
   5. C331-98b - Standard Specification for Lightweight Aggregates for Concrete Masonry Units
   6. C595-98/C595M-97 - Standard Specification for Blended Hydraulic Cements
   7. C618-98 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
   8. C90-98 - Standard Specification for Load-Bearing Concrete Masonry Units
   9. C989-97b - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
   10. D698-98 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort
   11. D4355-92 - Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
   12. D4716-95 - Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products

13. D5035-95 - Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
14. D6637 – Determining Tensile Properties of Geogrids by the Single or Multi-Rib Test Method
15. F904-91 - Standard Test Method for Comparison of Bond Strength or Ply Adhesion of Similar Laminates Made from Flexible Materials

C. Geosynthetic Research Institute (GRI)
1. GG2-87 - Standard Test Method for Geogrid Junction Strength
2. GG4-91 - Determination of the Long-Term Design Strength of Geogrids
3. GG5-91 - Standard Test Method for "Geogrid Pullout"

D. National Concrete Masonry Association (NCMA)
1. TEK 2-4A - Specification for Segmental Retaining Wall Units
2. Design Manual for Segmental Retaining Walls, Second Edition, 1997.

E. Tensar Earth Technologies, Inc. (TET)
1. "Design Guidelines for Tensar Geogrid Reinforced Soil Walls with Mesa Segmental Concrete Facing Units," TTN:MESA-DG.

1.03 DEFINITIONS

A. Ultimate Tensile Strength - Breaking tensile strength when tested in accordance with ASTM D6637. Values shown are minimum average roll values.

B. Junction Strength - Breaking tensile strength of junctions when tested in accordance with GRI GG2-87 tested at a strain rate of 10 percent per minute based on this gauge length. Values shown are minimum average roll values.

C. Tensar Structural Geogrids - A polymeric grid formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock or earth and function primarily as reinforcement.

D. Mesa Segmental Concrete Facing Units - A segmental concrete facing unit, machine-made from Portland Cement, water, and mineral aggregates.

E. Mesa Connector - A mechanical connection device made of high density polyethylene or polypropylene with fiberglass inclusions to positively connect the Tensar Structural Geogrid to the Mesa Segmental Concrete Facing Units.

F. Unit Fill (Core Fill) - Free-draining, coarse-grained soil which is placed within the empty cores of the Segmental Concrete Facing Unit.

G. Drainage Fill - Free-draining, coarse-grained soil which is placed behind and in the openings between the Mesa Segmental Concrete Facing Units as specified on the Plans.

H. Reinforced Backfill - Compacted structural fill placed behind the Drainage Fill or directly behind the Mesa Segmental Concrete Facing Units as outlined on the Plans.

I. Long-Term Design Strength (LTDS or T_{al}) - The maximum allowable stress level of the polymeric grid used in the internal stability design calculations of the retaining wall. Ultimate Tensile Strength reduced by the effects of polymer creep, installation damage, and durability.

J. Long-Term Allowable Design Strength (T_a) - The Long-Term Design Strength (LTDS or T_{al}) reduced by the Factor of Safety for design uncertainties ($T_a = T_{al}/FS_{UNC}$).

1.04 SYSTEM DESCRIPTION

A. Design Requirements - Engage and pay for the services of a Designer to design and develop Design Data for the retaining wall system.

B. Performance Requirements - Design the retaining wall system in accordance with the design guidelines of Tensar Earth Technologies, Inc.

1.05 SUBMITTALS

A. Product Data - Manufacturer's materials specifications, installation instructions, and general recommendations.
B. Certifications - The Mesa Retaining Wall System supplier shall provide certification that the ultimate strength of the Tensar Structural Geogrid, per Section 1.03 of GG1, is equal to or greater than the ultimate strength specified on the Plans.
C. Plans - Engineering drawings, elevations, and large scale details of elevations, typical sections, details, and connections.
D. Samples
    1. Geogrid - 4-in. by 18-in. piece
    2. Mesa Segmental Concrete Facing Unit – supply one facing unit showing selected color and texture
    3. Connector – supply one connector
E. Quality Control Submittals
    1. Design Data - Design calculations and plans for the retaining wall system sealed by the Designer.
    2. Certificates - Manufacturer's certification that the properties of the geogrid are equal to or greater than those specified in Section 2.02A.

1.06 QUALITY ASSURANCE

A. Designer - A Professional Engineer, registered in the State where the project is located, who is employed by a firm that has designed at least 500,000 square feet of segmental retaining walls, and who can provide a certificate of Errors and Omissions insurance to the Engineer and/or Architect with a minimum value of $3,000,000 per occurrence and in the aggregate.
B. Mock-Ups
    1. Prior to erection of retaining walls, erect a sample wall using materials shown and specified. Build mock-up at the site, where directed, approximately 4 feet by 4 feet.
    2. Do not start masonry work until the mock-up is approved by the Architect and/or Engineer. Retain mock-up during construction as a standard for judging completed work. Do not alter or destroy mock-up until work is completed.
C. Pre-Construction Conference - Prior to erection of retaining walls, hold a meeting at the site with the retaining wall materials supplier, the retaining wall installer, and the Designer to review the retaining wall requirements. Notify the Owner, the Engineer and/or Architect at least 3 days in advance of the time of the meeting.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection
    1. General
        a. Prevent excessive mud, fluid concrete, epoxy, or other deleterious materials from coming in contact with and affixing to retaining wall materials.
    2. Polymeric Materials
        a. Store at temperatures above -20 degrees F (-29 degrees C).
        b. Rolled materials may be laid flat or stood on end.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The Mesa Segmental Concrete Facing Unit shall be manufactured by EP Henry, an approved Mesa Licensee and authorized manufacturer of the Mesa Retaining Wall System.
B. Tensar Structural Geogrid shall be manufactured by The Tensar Corporation, Morrow, GA.

2.02 MATERIALS

A. Tensar Structural Geogrids

SELECT ONE OR MORE OF THE FOLLOWING:

1. UX1100MSE:
    a. Long-Term Design Strength (Sand, Silt and Clay): 1,620 plf
    b. Junction Strength: 3,690 plf
2. UX1400MSE:
    a. Long-Term Design Strength (Sand, Silt and Clay): 2,070 plf
    b. Junction Strength: 4,520 plf
3. UX1500MSE:
    a. Long-Term Design Strength (Sand, Silt and Clay): 3,100 plf
    b. Junction Strength: 7,200 plf
4. UX1600MSE:
    a. Long-Term Design Strength (Sand, Silt and Clay): 4,110 plf
    b. Junction Strength: 9,250 plf
5. UX1700MSE:
    a. Long-Term Design Strength (Sand, Silt and Clay): 5,140 plf
    b. Junction Strength: 10,970 plf

LIGHTWEIGHT AND HEAVYWEIGHT UNITS ARE ALSO AVAILABLE. WEIGHTS BELOW ARE FOR NORMAL WEIGHT UNITS. APPROXIMATE UNIT WEIGHTS ARE BASED ON THE ACTUAL DENSITY OF THE MESA SEGMENTAL CONCRETE FACING UNITS. DENSITIES MAY VARY DUE TO LOCAL RAW MATERIALS. UNITS CAN BE MANUFACTURED IN CUSTOM COLORS. INSERT COLOR DESIGNATION.

B. Mesa Segmental Concrete Facing Units - Hollow load-bearing units, ASTM C90-98, normal weight, Type II, minimum compressive strength of 4,000 psi, and produced by an approved Mesa System Licensee conforming to TEK 2-4A, Section 3.1. Mesa Segmental Concrete Facing Units shall have a maximum absorption rate of 8 percent by weight and shall have a minimum face shell of 2 inches. For climates that exhibit daily low temperatures of 32° Fahrenheit or below for a total of 30 days or more in any calendar year, the maximum water absorption by weight shall be 6%.

1. Mesa Standard Unit
    a. Size: 8 in. by 18 in. by 11 in.
    b. Weight: 75 lbs., nominal
    c. Color: Harvest, Pewter, Dakota Blend, or Buff

C. Mesa Connectors - High density polyethylene or polypropylene with fiberglass inclusions

2.03 ACCESSORIES

A. Drainage Composite - 6 oz. per sq. yd. polypropylene non-woven geotextile, AASHTO M288-96, Class 2, bonded to both sides of a polyethylene net structure.
   1. Minimum Allowable Transmissivity - Not less than 1.5 gal. per min. per ft. of width when tested in accordance with ASTM D4716-95 at a confirming pressure of 10,000 lbs. per sq. ft.
   2. Minimum Allowable Peel Strength of Geotextile from the Polyethylene Net - Not less than 250 gm. per in. of width when tested in accordance with ASTM F904-91.

B. Geotextile - 6 oz. per sq. yd. polypropylene non-woven geotextile, AASHTO M288-96, Class 2.

C. Turf Reinforcement Mat – Permanent turf reinforcement mat shall be used on all soil structures/slope facings adjacent to the retaining walls. Turf reinforcement mat shall be Tensar TB1000.

D. Adhesive - As recommended by Tensar Earth Technologies, Inc.

2.04 BACKFILL MATERIALS

A. Fill Materials
   1. Unit Fill (Core Fill) - Free draining, coarse-grained soil that is placed within the empty cores of the Segmental Concrete Facing Units.
      a. 100 to 75 percent passing a 1-in. sieve
      b. 50 to 75 percent passing a 3/4-in. sieve
      c. 0 to 60 percent passing a No. 4 sieve
      d. 0 to 50 percent passing a No. 40 sieve
      e. 0 to 5 percent passing a No. 200 sieve

   2. Drainage Fill - Free-draining, coarse-grained soil which is placed behind and in the openings between the Mesa Segmental Concrete Facing Units as specified on the Plans.
      a. 100 to 75 percent passing in a 1-in. sieve
      b. 50 to 75 percent passing in a 3/4-in. sieve
      c. 0 to 60 percent passing in a No. 4 sieve
      d. 0 to 50 percent passing in a No. 40 sieve
      e. 0 to 5 percent passing in a No. 200 sieve
   3. Reinforced Backfill - Granular fill with a pH range of 2 to 12 and graded as follows:
      a. 100 to 75 percent passing a 2-in. sieve
      b. 100 to 75 percent passing a 3/4-in. sieve
      c. 100 to 20 percent passing a No. 4 sieve
      d. 0 to 60 percent passing a No. 40 sieve
      e. 0 to 35 percent passing a No. 200 sieve

      Note: The Mesa Retaining Wall System shall include a Drainage Composite located behind the Reinforced Backfill volume (as defined on the Plans) together with an associated outlet pipe system whenever the percentage of Reinforced Backfill material passing the No. 200 sieve exceeds 15 percent.

PART 3 CONSTRUCTION

3.01 QUALIFICATION

A. Contractor and site supervisor shall have proven qualified experience to complete the installation of the segmental retaining wall system.

3.02 EXCAVATION

A. The subgrade shall be excavated vertically to the plan elevation and horizontally to the designed geogrid lengths.
B. Overexcavated and filled areas shall be compacted to a minimum of 95% Standard Proctor Dry Density in accordance with ASTM D698 and inspected by an Engineer.
C. Excavated materials that are used for backfilling the reinforcement zone shall be protected from the weather.

3.03 FOUNDATION PREPARATION

A. Foundation trench shall be excavated to the dimensions indicated on the construction drawings.
B. The reinforced zone and leveling pad foundation soil shall be inspected by an Engineer to ensure proper bearing strength.
C. Soils not meeting required strength shall be removed and replaced with the materials as approved by the Engineer.
D. Foundation materials shall be compacted to a minimum of 95 percent Standard Proctor Dry Density in accordance with ASTM D698-98 before placing the leveling pad.

3.04 LEVELING PAD

A. The leveling pad shall consist of unreinforced concrete or 3/4-inch minus well-graded aggregate, as indicated in the contract documents.
B. The leveling pad shall be level both horizontally and front-to-back to ensure the first course of units, and subsequent courses, are level.

3.05 UNIT INSTALLATION

A. The first course of Mesa Segmental Concrete Facing Units shall be carefully placed onto the leveling pad.
B. The first row of units shall be level from unit-to-unit and from front-to-back.
C. A string line can be used to align a straight wall, or flexible pipes can be used to establish a smooth convex or concave curved wall.
D. Use the tail of the units for alignment and measurement.
E. All units shall be laid snugly together and parallel to the straight or curved line of the wall face.
F. The Mesa Segmental Concrete Facing Units shall be swept clean of all debris before installing the next course of units and/or placing the geogrid materials.
G. A string line should be pulled after each course has been set to ensure that the wall's geometry is being maintained. The string line can be referenced from the connector slot, edges of the interior void, or tail of the unit.

3.06 CONNECTOR AND GEOGRID INSTALLATION

A. Place the grid on the block, insert the connector teeth through the apertures of the grid into the slot in the underlying block, pull the grid snug against the teeth, hammer the connector into the slot.
B. The fingers of the geogrid should extend forward to within 1" from the face of the block (in accordance with Tensar Earth Technologies, Inc. recommendations) to maintain facing alignment and a level block surface.
C. For the Mesa Standard System:
    i. The grid shall be positioned laterally on the blocks such that all four Standard Connector teeth are driven into the slots.
    ii. The flags of the connectors shall be positioned forward for vertical walls and rearward for battered walls.
    iii. In the next course, each block shall be centered over the two underlying blocks such that the flags of the connectors extend up into the void of the overlying blocks.

3.07 DRAINAGE FILL

A. Fill the Mesa Segmental Concrete Facing Unit voids, and Drainage Fill, placed between the units and to a depth of 12" (inches) behind the units with free-draining, coarse-grained soil meeting the requirements of Section 2.04.
B. Drainage Fill shall be placed behind the wall before placing the geogrid materials.

3.08 BACKFILL

A. The Reinforced Backfill material shall be placed in maximum loose lifts of 8" (inches) and shall be compacted to a minimum of 95 percent Standard Proctor Dry Density in accordance with ASTM D698-98.
B. Only hand-operated compaction equipment shall be used within 3 feet of the tail of the Mesa Segmental Concrete Facing Units.
C. Soil density testing shall not be performed within 3 feet of the tail of the Mesa Segmental Concrete Facing Units.
D. The backfill shall be smooth and level so that the geogrid lays flat.
E. The toe of the wall shall be filled and compacted as the wall is being constructed.

3.09 CAP INSTALLATION

A. The Mesa Cap Units, if required, shall be installed by attaching them to the units below using an approved exterior concrete adhesive.
B. Mesa Cap Units can be placed such that a nominal 1-inch overhang is achieved.
C Mesa Cap Units and Segmental Concrete Facing Units shall be clear of all debris and standing water before placing the approved adhesive.
D. String line or flexible pipes shall be used to align cap units.

3.10 TOLERANCES

A. Variation from Batter Indicated: Plus or minus 1/8 in. per ft., maximum.

END OF SECTION