SS-01053
(Replaces SS-01028)

Iowa Department of Transportation

SUPPLEMENTAL SPECIFICATIONS
FOR
SEGMENTAL RETAINING WALL

Effective Date
October 16, 2007

THE STANDARD SPECIFICATIONS, SERIES 2001, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SUPPLEMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

01053.01 DESCRIPTION.
This work includes furnishing and installing segmental retaining wall units, wall fill, and granular backfill to the lines and grades shown on the plans. Segmental retaining walls are defined as systems which usually require mesh or strips in the backfill behind the wall facing to limit backfill stresses by reinforcing the soil structure.

01053.02 DESIGN.

A. Wall Design Engineer.
The wall design shall be performed by a Professional Engineer licensed in the State of Iowa that prepares and seals the design submittals as defined in this Supplemental Specification.

B. Minimum Design Requirements.
Retaining walls shall be designed in accordance with ASTM C 90 and recommendations of the National Concrete Masonry Association (NCMA) Design Manual for Segmental Retaining Walls. The following table summarizes the minimum design criteria and is based upon the structure being critical:

External Stability	Minimum Factor of Safety
Sliding, Fs_{sl}	1.5
Overturning, Fs_{ot}	2.0
Bearing Capacity, Fs_{bc}	2.0

Internal Stability	Minimum Factor of Safety
Tensile Overstress, Fs_{to}	1.2
Pullout, Fs_{po}	1.5

Local Stability	Minimum Factor of Safety
Fs_{sl} (Maximum Unreinforced Height)	1.5
Fs_{ot} (Maximum Unreinforced Height)	2.0
Shear Facing Units, Fs_{sc}	1.5
Facing Connection Strength, Fs_{cs}	1.5
Global Stability	1.5

C. Submittals.
Prior to the beginning of reinforced SRW construction, ~~T~~the Contractor shall, in accordance with Article 1105.03 of the Standard Specifications, submit for review ~~to the Engineer~~ detailed design calculations including soil bearing pressure, construction drawings, and shop drawings prepared and sealed by the Wall Design Engineer ~~for approval at least 30 days prior to the beginning of reinforced SRW construction~~. A detailed explanation of the design properties for the geogrid reinforcement shall be submitted with the design. Additionally, the quality control test limits for the geogrid meeting those design requirements shall be submitted.

01053.03 MATERIALS.
The wall shall be manufactured by a company on the approved manufacturer's list in Materials I.M. 445.04.

The supplier of all substantial material components and the Wall Design Engineer shall have demonstrated experience in reinforced soil-reinforced SRWs for previous projects.

A. Concrete Units.
Concrete segmental units and cap blocks shall conform to the requirements of ASTM C 1372 except that they shall have a minimum 28 day compressive strength of 5500 psi (40 MPa) for any one individual unit, and 6000 psi (41 MPa) for the average of three units. The 24 hour water absorption rate shall not exceed 5%. The top surface of cap blocks shall be sloped 10:1 from front to back or from a crown at the center.

Sampling and testing of block shall conform to ASTM C 140, except that Section 6.2.4 shall be replaced with:

> The specimens shall be coupons cut from a face shell of each unit and sawn to remove any face shell projections. The coupon size shall have a height to thickness ratio of 2 to 1 before capping and a length to thickness ratio of 4 to 1. The coupon shall be cut from the unit such that the coupon height dimension is in the same direction as the unit height dimension. Compressive testing of full size units shall not be permitted. The compressive strength of the coupon shall be assumed to represent the net area compressive strength of the whole unit.

Freeze-thaw durability testing will be required as described in ASTM C 1372 Sections 4.2, 4.2.1, and 7.3. Testing shall be in accordance with ASTM C 1262.

Specimens shall meet weight (mass) loss limits for testing in water as required in ASTM C 1372 Section 4.2.1.

Specimens shall also be tested in a 3% saline solution and conform with either of the following:

1. The weight (mass) loss of each of five test specimens at the conclusion of 40 cycles shall not exceed 1% of its initial weight (mass); or
2. The weight (mass) loss of four out of five specimens at the conclusion of 50 cycles shall not exceed 1.5% of its initial weight (mass).

Testing shall be continued until one of the following occurs:

1. The weight (mass) loss each of five test specimens exceeds 2% of its initial weight (mass); or
2. The weight (mass) loss of one of the five test specimens exceeds 2.5% of its initial weight (mass); or
3. The specimens have been tested for at last 100 cycles.

Complete durability test reports for water and saline conditions, including the cycle number at which failure occurred, shall be submitted to the Engineer.

All units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or significantly impair the strength of permanence of the construction.

SRW units dimension shall not differ more than ±1/16 inch (±1.5 mm).

B. Leveling Pad.
The type of materials used for the leveling pad shall be as recommended by the supplier/manufacturer. If granular material is recommended for the leveling pad, it shall be specific backfill meeting the requirements of Section 4132 of the Standard Specifications. If unreinforced concrete is recommended for the leveling pad, it shall be Class C concrete meeting the requirements of the Materials I.M. 529 and Section 2403 of the Standard Specifications.

C. Unit Fill.
If required by the construction drawings, fill of concrete units in place shall be Porous Backfill meeting the requirements of Section 4131 of the Standard Specifications.

D. Subdrains.
The subdrains shall be a minimum of 4 inches (100 mm) in diameter and meet the requirements of Article 4143.01, B, of the Standard Specifications.

Standard Road Plan ~~RF-19E~~ RF-19F Type A outlet shall be provided and fitted with a Standard Road Plan RF-19E rodent guard.

E. Backfill.
The fill soil material in the entire reinforced earth zone shall be Granular Backfill meeting the requirements of Section 4133 of the Standard Specifications.

F. Geogrid Reinforcement.
The type, strength, and placement location of the reinforcing geogrid reinforcement shall be determined by the Wall Design Engineer. The design properties of the reinforcement shall be determined according to the procedures outlined in NCMA Section 3.5. Detailed test data shall be submitted to the Engineer for approval at least 30 days prior to construction and shall include strength, creep, site damage, and pullout testing.

Geogrid reinforcement shall be of a type recommended by the block supplier to be compatible with the facing units, with a minimum long term design strength of 1500 pounds per foot (1000 kg/m). The geogrid shall be a regular grid structure having an aperture geometry and rib and junction cross-sections sufficient to permit significant mechanical interlock with the granular backfill material. The geogrid shall have high continuity of tensile strength through all ribs and junctions of the grid structure. The geogrid shall have high resistance to deformation under sustained long term design load while in service and shall also be resistant to ultraviolet degradation, to damage under normal construction practices, and to all forms of biological or chemical degradation normally encountered in the granular backfill material.

G. Certifications.
Contractor shall submit to the Engineer a notarized manufacturer's certification, at least 14 days prior to the preconstruction conference, stating that the SRW units meet the requirements of this Supplemental Specification.

Contractor shall submit a notarized manufacturer's certification signed and sealed by an officer of the manufacturer, prior to start of work, stating that the geogrid reinforcement meets the requirements of the SRW unit manufacturer and this Supplemental Specification.

01053.04 CONSTRUCTION.

A. Construction Supervision.

SRW units and geogrid reinforcement material suppliers shall provide a qualified and experienced representative on site at beginning of wall construction for up to 3 days at no additional cost to the Contracting Authority.

The Contractor's field construction supervisor shall have demonstrated experience and be qualified to direct all work at the site.

B. Excavation.

Contractor shall excavate to the lines and grades shown as the reinforced earth zone on the construction drawings. Contractor shall take precautions to minimize over-excavation. Excavation support, if required, shall be designed and at no additional cost to the Contracting Authority.

C. Foundation Soil Preparation.

Foundation soil shall be excavated as required for base course leveling pad dimensions and limits of reinforced earth zone as shown on the construction drawings.

Foundation soil shall be examined by the Engineer to assure that the actual foundation soil strength meets or exceeds the assumed design bearing strength. Soils not meeting required strength shall be removed and replaced with soil meeting the design criteria.

The earth foundation shall have a density equal to or greater than 90 percent Standard Proctor Density. The earth foundation shall be stepped at the required intervals to keep it a minimum 2 foot (600 mm) below the finished grade.

D. Leveling Pad.

The Contractor shall place the leveling pad a minimum of 6 inches (150 mm) in thickness.

The Contractor shall construct the leveling pad to insure complete contact of the retaining wall unit with the leveling pad. Gaps shall not be allowed between the retaining wall unit and the leveling pad.

E. Unit Installation.

Materials shall be installed at the proper elevation and orientation shown in the plans. The concrete segmental units and geogrid reinforcement shall be installed in general accordance with the approved submittals in Section 01053.02, B. The plans shall govern in any conflict between the two requirements.

F. Subdrains.

Subdrains shall be installed as shown in the construction drawings to maintain gravity flow of water to outside of the reinforced earth zone. The subdrains shall outlet into a storm sewer access or along a slope at an elevation lower than the lowest point of the pipe within the SRW reinforced earth zone.

Porous backfill, in accordance with Article 01053.03, C, shall be placed around the subdrain to a minimum cover of 3 inches (75 mm).

G. Backfill Placement.

The granular backfill shall be compacted in accordance with Article 2107.08 of the Standard Specifications. The granular backfill shall be placed as shown on the construction drawings in maximum 8 inch (200 mm) lifts and compacted to a minimum 95% of standard Proctor density (ASTM D 698). The moisture limits shall be between 3% under optimum moisture to not more than the

optimum moisture content. Backfill shall be placed, spread, and compacted in such a manner that eliminates the development of wrinkles and/or movement of the geogrid reinforcement.

Only hand-operated compaction equipment shall be allowed within 3 feet (1 m) of the front of the wall face.

Tracked construction equipment shall not be operated directly on the geogrid reinforcement. A minimum backfill thickness of 6 inches (150 mm) is required prior to operation of tracked vehicles over the geogrid reinforcement. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid reinforcement.

Rubber-tired equipment may pass over the geogrid reinforcement, if in accordance with the manufacturer's recommendations. Sudden braking and sharp turning should be avoided.

H. Geogrid Installation.
Overlap of the geogrid in the design strength direction shall not be permitted. The design strength direction is that length of geogrid reinforcement perpendicular to the wall face and shall be one continuous piece of material. Adjacent sections of geogrid shall be butted in a manner to assure 100% coverage after placement.

Geogrid reinforcement should be installed under tension. Apply a nominal tension to the reinforcement and maintain it by staples, stakes, or hand tensioning. The tension applied may be released after the geogrid reinforcement has been covered and held in place with soil fill.

01053.05 METHOD OF MEASUREMENT.

A. Segmental Retaining Wall.
The Engineer will measure the area of Segmental Retaining Wall in square feet (square meters), from measurements of the front face of the wall in place. The height will be measured from the top of the leveling pad to the top of the wall, including coping or cap block.

B. Granular Backfill Material.
The quantity of granular backfill material hauled and placed in the reinforced earth zone will be measured in tons or cubic yards (megagrams or cubic meters) as stipulated in the contract documents.

C. Excavation.
Excavation for preparing the reinforced earth zone for construction of the wall will be classed and measured according to Section 2102 of the Standard Specifications.

01053.06 BASIS OF PAYMENT.

A. Segmental Retaining Wall.
For the quantity of Segmental Retaining Wall constructed, the Contractor will be paid the contract unit price per square foot (square meter). This payment shall be full compensation for furnishing all materials, tools, and labor for the performance of all work necessary to construct the wall, in accordance with the contract documents, including the design, foundation preparation, leveling pad, geogrid fabric, porous backfill, and subdrains.

B. Granular Backfill Material.
For Contractor furnished granular backfill material for the reinforced earth zone, the Contractor will be paid for the quantity of material furnished, hauled, placed, and compacted for the contract unit price per ton or cubic yard (megagram or cubic meter) as stipulated in contract documents.

C. Excavation.

For the quantity of each class of excavation for preparing the reinforced earth zone for construction of the wall, the Contractor will be paid as provided in Article 2102.14, A, of the Standard Specifications. This will normally be included for payment with other excavation required by the contract documents.