SEGMENTAL RETAINING WALL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
1. Segmental retaining wall (SRW) units, soil reinforcement, and appurtenant.

B. Contractor Voluntary Alternates: Proposals for alternate SRW systems may be submitted by the Contractor for consideration and approval by the Owner. Submittal shall be designed and stamped by a NYS licensed engineer. Owner reserves the right to accept or reject any proposed Contractor Voluntary Alternates. Costs associated with submission of Contractor Voluntary Alternate shall be at the expense of Contractor. Proposed alternate SRW systems shall meet the requirements of the "Segmental Retaining Wall Alternate Proposal Requirements" included at the end of this Section.

1. Base Bids submitted shall be based on the provisions of this Section only. Construction costs for the Alternate shall not be included in the Bid Form.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM) Standards
1. ASTM C 140 - Methods of Sampling and Testing Concrete Masonry Units
2. ASTM C 1262 - Freeze - Thaw Test for Masonry
3. ASTM C 1372 - Standard Specification for Segmental Retaining Wall Units
4. ASTM D 2166 - Triaxial Shear Test
5. ASTM D 3080 - Direct Shear Test
6. ASTM G 51 - Alkalinity
7. ASTM G 57 - Resistivity

B. National Concrete Masonry Association (NCMA)1. NCMA - Design Manual for Segmental Retaining Walls
2. NCMA SRWU-2 - Shear Strength between Segmental Concrete units

C. American Association of Highway and Transportation Officials (AASHTO)

1. AASHTO - Standard Specifications for Highway Bridges

1.3 DEFINITIONS

A. Soil Reinforcement: Structural geogrid or steel strips 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 structural reinforcement.

1. Geosynthetic (extensible) Soil Reinforcement: Polymer product specifically manufactured as soil reinforcement element that meets requirements of this specification.
2. Steel (inextensible) Soil Reinforcements: Steel strips, wires, or bars specially configured and coated for soil reinforcement applications.

B. Segmental Concrete Facing Unit: A modular concrete facing unit machine-made from Portland cement, water, and mineral aggregates.

C. Cap Unit: A modular concrete cap unit machine-made.

D. Unit Drainage Fill: Free draining "open" aggregate fill which is within and between the segmental concrete facing units, and extends a minimum of 12" behind the units.

E. Reinforced Backfill: Compacted soil which is within the reinforced soil volume as outlined on Construction Drawings.

F. Foundation Soil: Compacted import or in-situ soil beneath entire wall.

G. Retained Soil: Compacted import or in-situ soil behind reinforced zone of retaining wall.

H. Leveling Pad: Level compacted gravel or unreinforced concrete footing upon which first course of segmental concrete facing units are placed.

1.4 SUBMITTALS

A. Certificates of Compliance: Submit manufacturer's certification to the Geotechnical Engineering Consultant of Record and the Owner prior to start of work stating that the following meet requirements of this specification.

1. Soil reinforcement
2. Reinforced backfill materials
3. Drainage materials

B. Samples: Submit samples of SRW units showing finish and color to the Owner for selection prior to delivery of materials as required on Construction Drawings.

1.5 QUALITY ASSURANCE

A. Qualifications: SRW system installer shall have a minimum of 100,000 square feet of documentable experience installing SRW systems over eight feet in height on minimum of five projects over the previous two years. Provide the Owner a project list with current references and telephone numbers for the proposed SRW Installer substantiating the required experience.

B. Pre-Construction Meeting: A pre-construction meeting shall be conducted by the General Contractor prior to beginning construction on segmental retaining walls. Owner's Construction Manager shall be notified of the date, time, and location of the meeting. Mandatory attendees include the General Contractor, the wall design engineer of record, the project geotechnical engineer, the Contractor's testing agency, and representatives of all sub-contractors involved with the foundation preparation, erection, and backfilling of the SRW. Meeting topics shall include, but are not limited to, schedule and phasing of wall construction, coordination with other on-site construction activities, responsibilities of parties, sources, quality, and acceptance of materials

1.6 DELIVERY, STORAGE AND HANDLING

A. Segmental Concrete Facing Units:

1. Check the materials upon delivery to assure the specified type, grade, color and texture of units have been received.
2. Prevent excessive mud, wet concrete, epoxies, and like materials which may affix themselves from coming in contact with the materials.
3. Protect the materials from damage.

B. Soil Reinforcement:

1. Check the soil reinforcement upon delivery to assure the proper grade and type of material been received. Provide a product certification with each shipment.
2. Store soil reinforcement material in accordance with manufacturer's recommendations.

C. Drainage Materials:

1. Store plastic pipe in accordance with the manufacturer's recommendations to prevent deleterious materials from becoming affixed or deterioration from sun exposure.
2. Store drainage aggregate to prevent contamination with other materials.

PART 2 - PRODUCTS

2.1 SEGMENTAL CONCRETE FACING UNITS

A. Manufacturers: Provide one of the following

1. KEYSTONE
2. VERSA-LOK
3. REINFORCED EARTH COMPANY
4. ANCHOR
5. ROCKWOOD
6. MESA

B. Color and finish shall be as directed by the Owner or as shown in the Drawings.

C. Facing units shall meet the following structural requirements:

1. SRW Shear Capacity: Concrete units shall have a demonstrated shear capacity to withstand laterally applied shear loads as defined in the design calculations. Shear capacity shall be demonstrated through full-scale testing of SRW facing system according to NCMA SRWU-2 test method. Shear capacity shall be defined both with and without the soil reinforcement present at the interface.
2. Units shall be manufactured in accordance with ASTM C1372.
3. Concrete wall units including cap units shall have minimum 28-day compressive strength of 4,000 psi on the net area and have a maximum absorption rate of 6 percent.
4. Cementitious materials used in manufacture of units shall be Type I, Type II or Type III Portland cement in accordance with ASTM C150.
5. In areas where repeated freezing and thawing under saturated conditions occur, freeze-thaw durability shall be demonstrated by testing per ASTM C1262. Testing shall be conducted for a minimum 100 cycles, and weight loss shall not exceed one percent.
6. Other Constituents: Air entraining agents, coloring pigments, integral water repellents, finely ground silica and other constituents shall be previously established as suitable for use in retaining wall units or shall be shown by test or experience not to be detrimental to the durability of segmental concrete facing units or to any material used in masonry construction.
7. Dimensional tolerances for exterior molded units shall be in accordance with ASTM C1372. SRW concrete facing unit molded dimensions shall not differ more than ± 1/8 inch from the manufacturer's published dimensions, except for height which shall be ± 1/16 inch Maximum differential shall be no more than 1/8 inch in height from front to back of unit.
8. SRW units shall provide minimum effective in-place weight equivalent to 100 pcf. Fill placed within dimensions of units may be considered as integral to the effective unit weight. This in-place weight shall be determined by testing and used for all design calculations.
9. 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 or permanence of the construction.

2.2 BASE LEVELING PAD MATERIAL

A. Base leveling pad material shall be crushed dense aggregate base material or lean non-reinforced 2,000 psi concrete.

2.3 UNIT FILL

A. Unit fill shall be free-draining crushed stone or crushed gravel conforming to SRW manufacturer's recommendations.

2.4 SOIL REINFORCEMENT

A. Geosynthetic Soil Reinforcement:

1. Properties: The geosynthetic soil reinforcement shall possess minimum strength and durability required by design as determined by product specific testing as defined in the NCMA Design Manual for Segmental Retaining Walls (Section 3.5), including provisions for minimum partial safety factors. Design submittal shall indicate the index tensile strength for each reinforcement type to be used in construction.

2. Geogrid:
a. Stratagrid
b. Nicolon/Mirafi
c. Tensar (Black Sb Series Geogrids Only)

2.5 DRAINAGE MATERIALS

A. Drainage collection pipe shall be perforated/slotted PVC or corrugated HDPE pipe as specified in Section 02630.

B. Drainage aggregate shall be free-draining material, relative to the surrounding soil conforming to the SRW manufacturer's recommendations in order to prevent build-up of hydrostatic pressure.

C. Drainage geotextile shall be Synthetic Industries 401.

D. Drainage composite shall be J-DRain 400 Dimple Core Drainage Composite by JDR Enterprises, Inc., Alpharetta, GA, (800) 843-7569.

2.6 REINFORCED WALL BACKFILL

A. Reinforced soil shall possess the following characteristics:
1. Less than 15% passing the No. 200 sieve per ASTM D 422 with a maximum size of 3/4 inches (4 inch maximum for steel reinforced systems)
2. A liquid limit < 40 and a plasticity index < 10 per ASTM D 4318
3. An effective angle of internal friction > 30° per ASTM D 2166 or D 3080 at the compaction standard. Use of an effective friction angle greater than 30 degrees for design shall be verified by appropriate testing submitted to and approved by the owner's engineer prior to construction.
4. No organic, deleterious or frozen material

B. Backfill reinforced with geosynthetic shall have a pH in the range of 4 to 8 per ASTM G 51.

2.7 RETAINED BACKFILL OR COMMON BACKFILL

A. Soil placed behind the reinforced backfill shall be satisfactory fill material as specified in Section 02300.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with federal, state and local requirements for execution of the work, including local building codes, NYS Department of Labor and current OSHA excavation regulations. Provide excavation support as required to maintain stability of the area during excavation and wall construction and to protect existing structures, utilities, landscape features, or property or improvements.

B. Prior to grading or excavation of the site, confirm the location of the retaining walls and all underground features, including utility locations within the area of construction. Ensure surrounding structures are protected from effects of wall excavation.

C. Coordinate installation of underground utilities with wall installation.

D. Control surface water drainage and prevent inundation of the retaining wall area during construction.

3.2 EXCAVATION

A. Excavate to lines and grades shown on the Construction Drawings. Take precautions to minimize over-excavation. Over-excavation shall be backfilled with approved compacted material.

B. Inspect excavation prior to placement of leveling pad material.

C. In areas where soft, disturbed or otherwise unsuitable soils are encountered within the zone of the wall loading in the excavations, such unsuitable soils shall be over-excavated to the depths and extents required and replaced with select material and compacted per the contract documents.

D. Fill over-excavated areas in front of wall face with approved compacted material before wall construction reaches 4 feet in height.

E. In areas where a retaining wall or portion of a retaining wall is to be installed into cut, the required excavation shall extend horizontally to the extent of the reinforced zone and vertically to the elevation of the top of the leveling pad. The retained zone shall be bench cut in order to permit controlled placement of retained backfill.

3.3 LEVELING PAD CONSTRUCTION

A. Place leveling pad as shown on the Construction Drawings with 6 inches of crushed dense aggregate base or 8 inches of lean concrete. The leveling pad shall extend laterally a minimum distance of 6 inches from the toe and heel of the lower-most SRW Unit in accordance with manufacturer's recommendations.

B. Foundation soil shall be proofrolled and the top 12 inches compacted to minimum 95 % Modified Proctor Maximum Dry Density (ASTM D 1557) and tested prior to placement of leveling pad materials.

C. Compact granular leveling pad material to provide a level hard surface on which to place the first course of units. Compact with mechanical plate compactors to minimum 95 % of Modified Proctor Maximum Dry Density (ASTM D 1557).

3.4 SRW UNIT INSTALLATION

A. Place first course of SRW units on the leveling pad. Level units side-to-side, front-to-rear and aligned with adjacent units.

B. Ensure units are in full contact with base.

C. Place the front of the units side-by-side without gaps between the fronts of adjacent units. Layout of curves and corners shall be in accordance with SRW manufacturer's installation guidelines.

D. Install mechanical fascia connections per SRW manufacturer's recommendations.

E. Place and compact unit drainage fill within, between, and behind units. Place and compact infill soil behind drainage fill. Mechanical vibrating plate compactors shall not be used on top of the units. Compact fill between units and the three-foot zone behind the units by running hand-operated compaction equipment just behind units. Compact to minimum 80 % Relative Density (ASTM D 2949).

F. Place core drainage fill in the previous course of units prior to stacking of subsequent segmental retaining wall units.

G. Clean excess debris from top of units.

H. Repeat procedure to the extent of wall height.

3.5 SOIL REINFORCEMENT INSTALLATION

A. Soil reinforcement shall be oriented with the highest strength axis perpendicular to the wall alignment.

B. Install soil reinforcement to wall height, horizontal location, and extent as shown on the Drawings.

C. Lay the soil reinforcement horizontally on compacted backfill. Pull geogrid taut and connect to concrete SRW units according to connection detail shown on the Drawings or as recommended by manufacturer prior to backfill placement on geosynthetic reinforcement.d all

D. Soil reinforcements shall be continuous throughout their embedment lengths. Spliced connections between shorter pieces will not be allowed.

E. Do not operate tracked construction equipment directly upon soil reinforcement. Provide a minimum fill thickness of 6 inches prior to operation of tracked equipment over soil reinforcement. Keep tracked vehicle turning to minimum to prevent tracks from displacing the fill and damaging soil reinforcement.

F. Rubber-tired equipment may pass over soil reinforcement at low speeds, less than 10 mph, if permitted by the manufacturer. Avoid sudden braking and sharp turning.

G. Changes to soil reinforcement layout, including, but not limited to, length, soil reinforcement type (strength), or elevation, may be made subject to approval of the Engineer.

H. Verify orientation (Roll direction) of geosynthetic reinforcement.

3.6 REINFORCED BACKFILL PLACEMENT

A. Place reinforced backfill, spread and compact in such a manner that will not develop slack in the soil reinforcement in accordance with Manufacturers recommendations.

B. Place and compact reinforced backfill in lifts not to exceed 8 inches in compacted thickness.

C. Compact reinforced backfill to a minimum of 95 % Modified Proctor Maximum Dry Density (ASTM D 1557) at a moisture content from 2 % below to 2 % above optimum

D. Compact reinforced backfill in all areas to the lines and grades shown on the Construction Drawings including all sloped areas above walls.

E. At the end of each day's operation, slope the last lift of reinforced backfill away from the wall facing to rapidly direct runoff away from the wall face. Do not allow surface runoff from adjacent areas to enter the wall construction site.

15573.7 RETAINED BACKFILL PLACEMENT

A. Retained backfill shall be placed in maximum 8 inch thick compacted lifts and compacted to minimum 95 % Modified Proctor Maximum Dry Density (ASTM D 1557).

INCHES
Town of Bethlehem, NY

STATE OF NEW YORK
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043178
LICENSED PROFESSIONAL ENGINEER
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BETHLEHEM TOWN CENTER II

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REVISIONS

NO.	DATE	DESCRIPTION	REV.	CKD
1	4/4/05	NEW DRAWING	DGC	PVG
2	08/01/05	REDATE ONLY	DGC	PVG
3	09/26/05	REDATE ONLY	DGC	PVG
4	10/14/05	REDATE ONLY	DGC	PVG

NOTE:
Unauthorized alteration or addition to this drawing is a violation of the New York State Education Law Article 145, Section 7209.

PLANNING BOARD
TOWN OF BETHLEHEM
ALBANY COUNTY, NEW YORK
This Site Plan Approved.
Title CHAIRMAN
Date 5/16/05

RETAINING WALL NOTES

RECEIVED
MAY 6 2005
PLANNING BOARD
TOWN OF BETHLEHEM

Project Manager: P. Giovenco, PE
Designed by:
Drawn by: D. Christopher
Checked by: P. Giovenco, PE
Date Issued: MAY 13, 2004
Scale: No Scale
Date:
Project Number: 6092.00
File Name: I:\nigro\6092\..\6092retwallnotes1.dwg
Drawing Number: C506