

Presto Geosystems

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PRODUCT SPECIFICATION (CSI FORMAT)

Specifier Notes: This product guide specification is written according to the Construction Specifications Institute (CSI) Format, including *Master Format* (1995 Edition), *Section Format*, and *Page Format*, contained in the *CSI Manual of Practice*.

The section shall be carefully reviewed and edited by the Engineer to meet specific project requirements and all applicable building codes. Coordinate with corresponding specification sections, details and drawings.

Delete all "Specifier Notes" while editing this section.

SECTION 313200

SOIL STABILIZATION SYSTEM

Specifier Notes: This section covers Presto Geosystems' Geoweb® (geocell) Cellular Confinement System. The system consists of geocell material into which specific infill materials may be placed. The complete system includes Geoweb sections, infill materials, and some or all of the following components: ATRA anchors, ATRA Key connection device, ATRA Clips, geotextiles, geogrids, earth anchoring devices, geomembrane, polymer tendons, geocomposite drainage materials, and surface treatments.

Contact Presto Geosystems for assistance in editing this section.

PART 1 GENERAL

1.1 SUMMARY

Specifier Notes: Edit the following as required for the type of project.

- A. Work Included: This Section includes providing all material, labor, tools and equipment for installation of the Cellular Confinement System as shown on the Contract Drawings and as specified in this Section.
- B. The Cellular Confinement System shall be used for [load support] [slope protection] [earth retention] [channel protection].

1.2 RELATED SECTIONS AND DIVISIONS

Specifier Notes: Edit the following list as required for the project. List other sections with work directly related to the cellular confinement system.

- A. The applicable provisions of the General Conditions shall govern the work in this Section.
- B. Section 0130000 – Administrative Requirements
- C. Section 0220000 – Site Preparation
- D. Section 312000 – Earth Moving
- E. Section 312500 - Erosion and Sedimentation Control

1.3 REFERENCES

Specifier Notes: List standards referenced in the section, complete with designations and titles. This article does not require compliance with standards, but is merely a listing of those used.

- A. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO M 218 - Steel Sheet, Zinc-Coated (Galvanized) for Corrugated Steel Pipe.
 - 2. AASHTO M 288 - Geotextile Specification for Highway Applications
- B. American Society of Testing and Materials (ASTM)
 - 1. ASTM D 1505 - Density of Plastics by the Density-Gradient Technique.
 - 2. ASTM D 1603 – Standard Test for Carbon Black in Olefin Plastics
 - 3. ASTM D 1693 – Environmental Stress-Cracking of Ethylene Plastics.
 - 4. ASTM D 5199 – Measuring Nominal Thickness of Geotextiles and Geomembranes.
 - 5. ASTM E 41 – Terminology Relating to Conditioning.

1.4 SUBMITTALS

- A. Submit manufacturer's shop drawings in accordance with Section 0130000, Submittals including Manufacturer's product data, section layout, and [anchor stake locations] [tendon locations,] [ATRA Clip locations][anchorage requirements].

Specifier Notes: Revise submittal samples required.

- B. Submit manufacturer's samples including
 - 1. [Geoweb sections]
 - 2. [ATRA Keys]
 - 3. [ATRA Clips]
 - 4. [ATRA Anchors]
 - 5. [Tendons]
 - 6. Related geosynthetic components.
- C. Submit manufacturer's certification of polyethylene used to make geocell material including
 - 1. Manufacturer's certification of percentage of [carbon black] [HALS].
 - 2. Resin manufacturer's certification of polyethylene density and ESCR.

Specifier Notes: Delete installer and manufacturer's field representative qualifications if not required.

- D. Submit qualifications certifying the installer is experienced in the installation of the specified products.
- E. Submit qualifications of Manufacturer's field representative certifying the field representative is experienced in the installation of the specified products.
- F. No material will be considered as an equivalent to the geocell material specified herein unless it meets all requirements of this specification, without exception. Manufacturers seeking to supply what they represent as equivalent material must submit records, data, independent test results, samples, certifications, and documentation deemed necessary by the Engineer to prove equivalency. The Engineer shall approve or disapprove other Manufacturers materials in accordance with the General Conditions after all information is submitted and reviewed.

1.5 QUALITY ASSURANCE AND CONTROL

- A. The cellular confinement system material shall be provided from a single Manufacturer for the entire project.
- B. The Manufacturer's Quality management system shall be certified and in accordance with ISO 9001:2000.
- C. The Manufacturer shall provide certification of compliance to all applicable testing procedures and related specifications upon the customer's written request. Request for certification shall be submitted no later than the date of order placement. The Manufacturer shall have a minimum of 20 years experience producing cellular confinement systems.

Specifier Notes: Describe requirements for a meeting to coordinate the installation of the cellular confinement system and to sequence related work.

- D. Pre-Installation Meeting: Prior to installation of any materials, conduct a pre-installation meeting to discuss the scope of work and review installation requirements. The pre-installation meeting shall be attended by all parties involved in the installation of the cellular confinement system.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in Manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and Manufacturer.
- B. The materials shall be stored in accordance with Manufacturer's instructions. The materials shall be protected from damage and out of direct sunlight.
- C. The materials shall be delivered, unloaded and installed in a manner to prevent damage.

1.7 WARRANTY

- A. The Manufacturer shall warrant each Geoweb section that it ships to be free from defects in materials and workmanship at the time of manufacture. The Manufacturer's exclusive liability under this warranty or otherwise will be to furnish without charge to the original f.o.b. point a replacement for any section which proves to be defective under normal use and service during the 10-year period which begins on the date of shipment. The Manufacturer reserves the right to inspect any allegedly defective section in order to verify the defect and ascertain its cause.
- B. This warranty shall not cover defects attributable to causes or occurrences beyond the Manufacturer's control and unrelated to the manufacturing process, including, but not limited to, abuse, misuse, mishandling, neglect, improper storage, improper installation, improper alteration or improper application.
- C. In no event shall the Manufacturer be liable for any special, indirect, incidental or consequential damages

for the breach of any express or implied warranty or for any other reason, including negligence, in connection with the cellular confinement system.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Presto Geosystems, PO Box 2399, Appleton, Wisconsin 54912-2399. Toll Free (800) 548-3424. Phone (920) 738-1328. Fax (920) 738-1222. E-Mail info@prestogeo.com. Website www.prestogeo.com.

2.2 GEOWEB CELLULAR CONFINEMENT SYSTEM

Specifier Notes: All measurements are subject to manufacturing tolerances, unless otherwise specified.

A. Base Materials

Specifier Notes: Specify either polyethylene stabilized with carbon black or polyethylene colored and stabilized with HALS. Polyethylene stabilized with carbon black is used for most applications. Polyethylene colored and stabilized with HALS is generally used for the fascia strip for earth retention systems.

1. Polyethylene Stabilized with Carbon Black
 - a. Density shall be 58.4 to 60.2 pound/ft³ (0.935 to 0.965 g/cm³) in accordance with ASTM D 1505.
 - b. Environmental Stress Crack Resistance (ESCR) shall be 5000 hours in accordance with ASTM D 1693.
 - c. Ultra-Violet light stabilization with carbon black.
 - d. Carbon Black content shall be 1.5 to 2 percent by weight, through addition of a carrier with certified carbon black content.
 - e. Carbon black shall be homogeneously distributed throughout material.
2. Polyethylene Colored and Stabilized with HALS
 - a. Density shall be 58.4 to 60.2 pound/ft³ (0.935 to 0.965 g/cm³) in accordance with ASTM D 1505.
 - b. Environmental Stress Crack Resistance (ESCR) shall be 5000 hours in accordance with ASTM D 1693.

Specifier Note: For earth retention fascia panels, specify the desired color.

- c. Color shall be [Tan] [Green] [Black].
- d. Colorants shall be non-heavy metal types homogeneously distributed throughout the material.
- e. Ultra-Violet Light Stabilization with hindered amine light stabilizer (HALS).
- f. HALS Content shall be 1.0 percent by weight, through addition of a carrier with a certified HALS concentrate.
- g. HALS shall be homogeneously distributed throughout material.

B. Strip Properties and Assembly

Specifier Notes: The Specifier shall state the desired strip/cell type: Perforated Textured or Non-Perforated Textured. Perforated and textured strips are recommended for ALL applications except for the front fascia of walls. Delete Non-Perforated Textured Strip/Cell section if not earth retention system.

1. Perforated Textured Strip/Cell
 - a. Strip sheet thickness shall be 50 mil (1.27 mm), minus 5 percent, plus 10 percent in accordance with ASTM D 5199. Determine thickness flat, before surface disruption.
 - b. Polyethylene strips shall be textured surface with a multitude of rhomboidal (diamond shape) indentations.

- c. Textured sheet thickness shall be 60 mil plus or minus 6 mil (1.52 mm plus or minus 0.15 mm).
 - d. Indentation surface density shall be 140 to 200 per in² (22 to 31 per cm²).
 - e. Perforated with horizontal rows of 0.4 inch (10 mm) diameter holes.
 - f. Perforations within each Row shall be 0.75 inch (19 mm) on-center.
 - g. Horizontal rows shall be staggered and separated 0.50 inches (12 mm) relative to hole centers.
 - h. Edge of strip to nearest edge of perforation shall be a minimum of 0.3 inch (8 mm).
 - i. Centerline of spot weld to nearest edge of perforation shall be a minimum of 0.7 inch (18 mm).
 - j. A slot with a dimension of 3/8 inch x 1-3/8 inch (10 mm x 35 mm) is standard in the center of the non-perforated areas and at the center of each weld.
2. Non-Perforated Textured Strip/Cell
- a. Non-perforated textured strip/cells shall only be used on the front face of earth retention systems.
 - b. Strip sheet thickness shall be 50 mil (1.27 mm), minus 5 percent, plus 10 percent in accordance with ASTM D 5199. Determine thickness flat, before surface disruption.
 - c. Textured sheet thickness shall be 60 mil plus or minus 6 mil (1.52 mm plus or minus 0.15 mm).
 - d. Polyethylene strips shall be textured surface with a multitude of rhomboidal (diamond shape) indentations.
 - e. Indentation surface density shall be 140 – 200 per in² (22 - 31 per cm²).
 - f. The thickness of the textured sheet shall be 60 mil ±6 mil (1.52 mm ±0.15 mm) determined in accordance with ASTM D5199.
 - g. A slot with a dimension of 3/8 in x 1 3/8 in (10 mm x 35 mm) may be punched in the center of the non-perforated areas and at the center of each weld.
3. Assembly of Cell Sections
- a. Fabricate using strips of sheet polyethylene each with a length of 142 inches (3.61 m) and a width equal to cell depth.
 - b. Connect strips using full depth ultrasonic spot-welds align perpendicular to longitudinal axis of strip.
 - c. Ultrasonic weld melt-pool width shall be 1.0 inch (25 mm) maximum.

Specifier Notes: Select cell type GW20V Cell, GW30V Cell, or GW40V Cell and delete others.

- d. Weld spacing for GW20V-cell sections shall be 14.0 inches plus or minus 0.10 inch (356 mm plus or minus 2.5 mm).
- e. Weld spacing for GW30V-cell sections shall be 17.5 inches plus or minus 0.10 inch (445 mm plus or minus 2.5 mm).
- f. Weld spacing for GW40V-cell sections shall be: 28.0 inches plus or minus 0.10 inch (771 mm plus or minus 2.5 mm).

C. Cell Properties

- 1. Individual cells shall be uniform in shape and size when expanded.
- 2. Individual cell dimensions (nominal) shall be dimensions ± 10%.

Specifier Notes: Specify either GW20V-Cell Section, GW30V-Cell Section, or GW40V-Cell Section. Specify required cell depth and delete the others. Consult Presto Geosystems for recommendations.

- 3. GW20V-Cell Section
 - a. Length shall be 8.8 inches (224 mm).
 - b. Width shall be 10.2 inches (259 mm).
 - c. Nominal area shall be 44.8 in² (289 cm²) plus or minus 1%.
 - d. Nominal depth shall be [8 inches (200 mm)] [6 inches (150 mm)] [4 inches (100 mm)] [3 inches (75 mm)].
- 4. GW30V-Cell Section

- a. Length shall be 11.3 inches (287 mm).
 - b. Width shall be 12.6 inches (320 mm).
 - c. Nominal area shall be 71.3 in² (460 cm²) plus or minus 1%.
 - d. Nominal depth shall be [8 inches (200 mm)] [6 inches (150 mm)] [4 inches (100 mm)] [3 inches (75 mm)].
5. GW40V-Cell Section
- a. Length shall be 18.7 inches (475 mm).
 - b. Width shall be 20.0 inches (508 mm).
 - c. Nominal area shall be 187.0 in² (1206 cm²) plus or minus 1%.
 - d. Nominal depth shall be [8 inches (200 mm)] [6 inches (150 mm)] [4 inches (100 mm)] [3 inches (75 mm)].

D. Cell Seam Strength Tests

Specifier Notes: Specify the Short-Term Seam Peel-Strength Test (Appendix A) and the Long-Term Seam Peel-Strength Test (Appendix B).

There are 3 possibilities for seams for a Geoweb section:

1. Two carbon-black stabilized strips welded together. This is most typical for Geoweb sections used in all application areas.
2. A carbon black stabilized strip welded to a HALS stabilized strip. This is typically used when a colored facia is desired on the Geoweb earth retention system.
3. Two HALS stabilized strips welded together. However, this is uncommon and would apply only to fully colored Geoweb sections. Consult Presto Geosystems for seam strength test results.

Consult Presto Geosystems for recommendations.

1. Short-Term Seam Peel-Strength Test
 - a. Cell seam strength shall be uniform over full depth of cell.
 - b. Minimum seam peel strength shall be [640 lbf (2,840 N) for 8 inch (200 mm) depth] [480 lbf (2,130 N) for 6 inch (150 mm) depth] [320 lbf (1,420 N) for 4 inch (100 mm) depth] [240 lbf (1060 N) for 3 inch (75 mm) depth].
2. Long-Term Seam Peel-Strength Test
 - a. Conditions: Minimum of 7 days in a temperature-controlled environment that undergoes change on a 1-hour cycle from room temperature to 130 degrees F (54 degrees C).
 - b. Room temperature shall be in accordance with ASTM E41.
 - c. Test samples shall consist of two, 4 inch (100 mm) wide strips welded together.
 - d. [Test sample consisting of 2 carbon black stabilized strips shall support a 160 pound (72.5 kg) load for test period.] [Test sample consisting of a carbon black stabilized strip and a HALS stabilized strip shall support a 140 pound (63.5 kg) load for test period.]

E. Section Types and Sizes

Consult Presto Geosystems for assistance in specifying section types and sizes for the specific application. Section length, section width and section area are optional.

1. Cell size shall be [GW20V Cell] [GW30V Cell] [GW40V Cell].
2. Section length shall be _____ ft (_____ m).
3. Section width shall be _____ ft (_____ m).
4. Section area shall be _____ ft² (_____ m²).

2.3 INTEGRAL COMPONENTS

A. ATRA® Clip

1. The ATRA Clip is a molded, high-strength polyethylene device available in standard (0.5 inch) and metric (10 – 12 mm) versions.

2. ATRA clips can be installed as an end cap on standard (0.5 inch) and metric (10 – 12 mm) steel reinforcing rods to form ATRA Anchors.
 3. ATRA clips can be connected to tendons with Moore Hitch knots to provide load transfer from filled Geoweb sections to tendons and anchorage system.
- B. ATRA® Key
1. ATRA keys shall be constructed of high strength, aluminized metal.
 2. ATRA keys shall be used to connect Geoweb panels together at each interleaf and end to end connection for all applications, except for the front face of walls.
 3. ATRA keys shall provide minimum break strength of 265 lbf.
 4. [Hot dipped galvanizing shall be in accordance with AASHTO M 218.]
- C. Staples
1. Staples shall be used to connect the adjoining front fascia sections of walls.
 2. The staples shall be ½ inch, Stanley Bostitch, SL5035, or equal.

2.4 STAKE ANCHORAGE

Specifier Notes: Specify required stake anchorage and delete the others. Consult Presto Geosystems for assistance in determining requirements.

- A. ATRA® Anchors
1. ATRA Anchors shall consist of standard (0.5 inch) or metric (10 – 12 mm) steel reinforcing rod with an ATRA® Clip attached as an end cap.
 2. ATRA anchors shall be assembled by inserting the ATRA Clip onto the reinforcing rod so that the end is flush with the top of the ATRA Clip. Prior to attaching the ATRA Clip, the reinforcing rod shall be free from all burrs and beveled.
 3. Stake length shall be as shown on the Construction Drawings.
 4. [Hot dipped galvanizing shall be in accordance with AASHTO M 218.]
- B. ATRA® Glass Fiber Reinforced Polymer (GFRP) Anchors
1. ATRA GFRP Anchors shall be pre-assembled units consisting of ATRA Clip inserted onto a GFRP stake.
 2. The glass reinforcement content shall be 75% minimum by weight and shall be continuous longitudinal filament.
 3. Polymer shall be vinyl ester, isophthalic polyester or other matrix material.
 4. The outer surface shall be sand coated and deformed by a helical wrap of glass.
 5. The minimum compressive strength shall be 95 kips (655 MPa) in accordance with ASTM D 638.
 6. The stake shall be non-magnetic, non-conducting and corrosion resistant.
 7. The stake length shall be as shown on the Construction Drawings.
- C. Straight Steel Stakes
1. Steel stakes shall be fabricated from mild steel or reinforcing rod.
 2. Diameter shall be 0.3125 inches (8 mm), 0.375 inches (10 mm), 0.50 inches (12 mm), 0.625 inches (16 mm) or 0.75 inches (20 mm).
 3. The stake length shall be as shown on the Construction Drawings.
- D. Wood Stakes
1. Wood stakes shall be (wood type) and free from knots that may reduce strength.
 2. The wood stakes shall be _____ inches wide by _____ inches thick.
 3. The stake length shall be as shown on the Construction Drawings.

2.5 TENDON ANCHORAGE

Specifier Notes: Delete this section if tendons are not required for anchorage. Select the desired tendon and delete the others. Consult Presto Geosystems for assistance.

A. Tendon Type

1. Woven Polyester - [TP-31] [TP-67] [TP-93]:
 - a. Material shall be bright, high-tenacity, industrial-continuous-filament, polyester yarn woven into a braided strap.
 - b. Elongation shall be 9 to 15 percent at break.
 - c. Minimum break strength shall be [700 lbf (3.11 KN) for TP-31][1506 lbf (6.70 KN) for TP-67][2090 lbf (9.30 KN) for TP-93].
2. Woven Kevlar - [TK-89] [TK-133], [TK-178]:
 - a. Material shall be Kevlar® Aramid material woven into a strap.
 - b. Minimum break strength shall be [2000 lbf (8.90 KN) for TK-89][3000 lbf (13.34 KN) for TK-133][4000 lbf (17.8 KN) for TK-178].
3. Woven Polypropylene - TPP-44:
 - a. Material shall be Polypropylene 3-strand twisted rope.
 - b. Minimum break strength shall be 990 lbf (4.40 KN).

B. Type of Anchorage

Specifier Notes: Select the anchorage system being used with the tendons and delete the others. Consult Presto Geosystems for assistance.

1. Tendons and ATRA Anchors.
2. Tendons and Deadman Pipe Anchorage.
3. Tendons and Earth Anchors.

C. Tendon Anchorage

1. [ATRA Clip can be connected to tendons with Moore Hitch knots to provide load transfer from filled Geoweb sections to the tendons].
2. [The arm of the ATRA Clip installed on an ATRA Anchor is engaged with the tendon to transfer the load from the Geoweb section to the tendon and ATRA Anchor.]

2.6 CELL INFILL MATERIALS

Specifier Notes: Specify desired infill material. Refer to specification section. Consult Presto Geosystems for assistance. Infill materials include, but are not limited to:

1. Sand.
2. Gravel and crushed rock or stone with a maximum particle size of 3 inches (75 mm) for erosion control applications, 2.5 inches (65 mm) for load support applications, and 2 inches (50 mm) in retaining walls or multi-layer retention structures.
3. Concrete shall have a minimum strength of 3000 psi and air content of 2 to 4% in accordance with ACI and ASTM standards.
4. Clays, silts, and organic soils are not acceptable infill material for load support, hydraulic applications, and internal cells for retaining walls or multi-layer retention structures.
5. For earth retention structures, infill exposed outer cells with soil that supports vegetative cover, clear stone, or cast-in-place concrete to suit specific functional or aesthetic requirements.
6. For vegetated slope stabilization applications, infill with screened topsoil free of any foreign material.

- A. Cell infill material(s) shall include _____ as specified in Section _____.
- B. Infill material shall be free of any foreign material.
- C. Infill material shall be free-flowing and not frozen when placed in the Geoweb sections.

2.7 ADDITIONAL COMPONENTS

Specifier Notes: Revise the following for specific project requirements and delete those items that do not apply.

- A. Vegetation
 - 1. Vegetation shall be as specified in Section _____.
 - 2. Vegetation shall be installed immediately after the infill is placed and protected with mulch.
- B. Geotextile
 - 1. The geotextile underlayer shall be as specified in Section _____.
 - 2. The geotextile shall be installed and secured per the Manufacturer's instructions.
- C. Surface Protection
 - 1. Surface protection shall consist of [ECB][TRM] as specified in Section _____.
 - 2. The surface protection shall be installed and secured per the Manufacturer's instructions.
 - 3. The [ECB][TRM] shall be installed immediately after placement of the infill material.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions are as indicated on the drawings. Notify the Engineer if site conditions are not acceptable. Do not begin preparation or installation until unacceptable conditions have been corrected.
- B. Verify layout of structure is as indicated on the drawings. Notify the Engineer if layout of structure is not acceptable. Do not begin preparation or installation until unacceptable conditions have been corrected.

Specifier Notes: Edit the installation requirements as required for the project. Consult Presto Geosystems for assistance.

3.2 INSTALLATION OF EARTH RETENTION SYSTEMS

- A. Prepare subgrade as specified and install earth retention system in accordance with Manufacturer's instructions.
- B. Subgrade Preparation
 - 1. Excavate or fill foundation soils as required to footing grades, elevations, and dimensions as indicated on the drawings or as directed by the Engineer.
 - 2. Ensure foundation soil meets minimum strength requirements through proof rolling or other conventional method and is examined by the Engineer. If unacceptable foundation soils are encountered, excavate affected areas and replace these areas with suitable quality material as directed by the Engineer.
 - 3. Install geotextile underlayer on prepared surfaces in accordance with Manufacturer's instructions. Ensure outer edges of geotextile are buried a minimum of 6 inches (150 mm).
- C. Base and Spread Footing Installation
 - 1. Place and shape granular base materials, complete with non-woven geotextile encapsulation if required. Compact to a minimum of 95 percent Standard Proctor.

2. Expand specified Geoweb footing sections into required position on prepared base and temporarily anchor at corners and edges.
3. Overfill Geoweb cells with selected granular infill. Maximum particle size of granular material shall not be greater than 2 inches (50 mm). Level surface approximately 2 inches (50 mm) above cell walls.
4. Compact fill in Geoweb cells to a minimum of 95 percent Standard Proctor.
5. Place and compact fill to a minimum of 95 percent Standard Proctor along each side of footing.
6. Screed off excess infill to be level with top of cells.

D. Drainage System Installation

1. Install perforated sub drain pipe wrapped with nonwoven geotextile or backfill with clear stone adjacent to footing as indicated on the drawings. Ensure a minimum longitudinal gradient of 1 percent is maintained. Connect sub drain pipes to specified outlets with T-connectors. Wrap outlet pipes which pass through footing or wall fascia with geotextile to prevent loss of cell infill materials. Connect outlet pipes to site drainage system if present. Ensure discharge at outlet will not cause localized erosion. Compact fill surrounding drainage system.
2. If specified, place geotextile over base and extend up face of excavation. Anchor and overlap sections in accordance with Manufacturer's instructions. Where geocomposite drainage materials are specified, ensure each sheet or strip is continuous and fully encapsulated with geotextile and unrestricted outlet is provided.

E. Installation of Gravity Retaining Walls

1. Expand Geoweb sections, dimensioned as indicated on the drawings, into position. Hold individual sections in their expanded positions with stretcher frames, stretcher bars, or other suitable anchors positioned inside selected outer cells. Confirm each Geoweb section is expanded uniformly to required dimensions and outer cells of each layer are correctly aligned. Interleaf or overlap edges of adjacent sections in each layer, according to which side wall profiles abut. Ensure upper surfaces of adjoining Geoweb sections are flush at joint and adjoining cells are fully connected. Connect adjoining sections side-to-side with ATRA keys on all connections except the front fascia panels. Use staples for connecting interleaved front fascia panels.
2. Overfill cells with granular infill and level surface approximately 2 inches (50 mm) above cell walls.
3. Compact cell infill and backfill materials to a minimum of 95 percent Standard Proctor. Screed off excess infill so that the infill is level with top of cells. Limit amount of compaction within 3 feet (1 m) of Geoweb sections by using walk-behind compaction equipment. Confirm compaction procedures are not laterally displacing Geoweb sections.
4. When topsoil or special infill materials are specified for exposed face cells of Geoweb sections, confirm filling procedures with the Engineer before construction. These may include, but are not limited to:
 - a. Temporarily cover outer cells with a moveable board to prevent unwanted spillage during placement of internal fill materials as each layer is installed. Place topsoil or special infill in empty outer cells as each layer is completed.
 - b. Partial spillage of internal infill material into outer cells may be permitted depending on tolerance of special outer cell infill material. Dressing of outer cells can be a separate procedure following installation of several Geoweb section layers.
5. Ensure subsequent layers are set back to produce required front face slope and side-to-side alignment is such that loss of infill materials is prevented. Place select backfill material behind Geoweb sections in maximum lifts of 8 inches (200 mm).
6. Fill and compact subsequent layers as specified herein.
7. Installation of freestanding Geoweb structures and vertical walls may require strips of non-woven geotextile along outer edge of infilled Geoweb section before placing next layer.

F. Installation of Reinforcement and Backfill (if required)

1. Install specified geosynthetic reinforcement, (geogrid or geotextile), between Geoweb sections and extend horizontally into compacted backfill zone.

2. Place precut sections of reinforcement at specified elevations, dimensioned and oriented as indicated on the drawings. Place reinforcement horizontally, with high-strength axis perpendicular to wall face at elevation indicated on the drawings or as directed by the Engineer. Extend outer edges of reinforcement to within 6 inches (150 mm) of the front face of in-place Geoweb sections.
3. Place and infill next Geoweb layer as specified in paragraph "Installation of Gravity Retaining Walls".
4. Manually tension reinforcement layer by pulling it away from back of Geoweb sections so it is taut. If necessary, pin reinforcement to eliminate loose folds during placement of backfill over reinforcement. Lay reinforcement layer flat when pulled back perpendicular to back of Geoweb section.
5. Do not operate tracked equipment directly on top of reinforcement layer until a minimum thickness of 6 inches (150 mm) of backfill has been placed over reinforcement layer. Rubber-tired equipment may drive on top of reinforcement at slow speeds. Exercise care and avoid sudden stops and sharp turns.
6. Place backfill within reinforced zone in approximate lifts of 8 inches (200 mm) and compact to a minimum of 95 percent Standard Proctor. Ensure excessive displacement of reinforcement does not occur during fill placement. Place backfill near Geoweb section and spread toward back of reinforced soil zone. Shape and compact backfill level with Geoweb section before placing subsequent layers of reinforcement.
7. Place and compact retained soils, for fill situations, behind reinforced soil zone in approximate lifts of 8 inches (200 mm) and compact to a minimum of 95 percent Standard Proctor.

3.3 INSTALLATION OF LOAD SUPPORT SYSTEMS

- A. Prepare subgrade and install load support system in accordance with Manufacturer's instructions.
- B. Subgrade Preparation
 1. Excavate and shape foundation soils as indicated on the drawings.
 2. Ensure foundation soil meets minimum strength requirements through proof rolling or other conventional method and is approved by the Engineer. If unacceptable foundation soils are encountered, excavate and replace with suitable quality material as directed by the Engineer.

Specifier Notes: Delete the separation layer and base materials below if not required.

- C. Separation Layer and Base Materials Installation
 1. Place geotextile over subgrade, when separation between subgrade soil and infill is required, according to geotextile manufacturer's recommendations.
 2. Place additional base materials to the required depth and compact to a minimum 95 percent Standard Proctor.
- D. Geoweb Section Placement and Connection
 3. Expand Geoweb sections, dimensioned as indicated on the drawings, into position. Hold individual sections in their expanded positions with ATRA® anchors or other suitable methods. Stretcher frames may be required for underwater applications.
 4. Confirm each Geoweb section is expanded uniformly to required dimensions and are correctly aligned. Interleaf or overlap edges of adjacent sections in each layer. Ensure upper surfaces of adjoining Geoweb sections are flush at joint and adjoining cells are fully anchored.
 5. Connect the Geoweb sections with ATRA keys at each interleaf and end to end connection. Insert the ATRA key through the slot in the cell wall before inserting through the adjacent cell. Turn the ATRA key 90 degrees to lock the panels together.

Specifier Notes: Permanent anchors and tendons may be required for additional system hold-down, especially in saturated soil conditions, or with loading on a grade. Delete Permanent Anchoring and Tendon Placement if not required. Contact Presto Geosystems for assistance.

E. Permanent Anchoring

1. Drive ATRA anchor so that the arm of the ATRA clip is through the internal slot in the Geoweb cell wall and the anchor does not protrude over top of the cell wall.

F. Tendon Placement

1. Thread the specified tendon type through the Geoweb slots in accordance with Contract Drawings. Drive ATRA anchors so that the tendon is engaged under the arm of the ATRA Clip and drive the ATRA Anchor flush with the base of the cell.

Specifier Notes: Delete section if aggregate infill is not specified. Contact Presto Geosystems for assistance.

G. Aggregate Infill

1. Overfill cells with selected granular infill. Limit the drop height of infill material to 3 feet (1 meter) to avoid damage or displacement of the cell wall.
2. Level surface approximately 2 inches (50 mm) above cell walls. Maintain the 2 inch wear surface over the Geoweb sections to prevent damage to the cell walls.

Specifier Note: Add compaction specification number or delete if not required.

3. Compact infill to a minimum of 95 percent Standard Proctor in accordance with Specification Section _____.
4. Shape compacted surface to required elevation as indicated on the drawings.

Specifier Notes: Delete if concrete infill is not specified. Contact Presto Geosystems for assistance.

H. Concrete Infill

Specifier Notes: Add concrete specification number and revise as required.

1. Concrete shall be placed, finished and cured in accordance with Specification Section _____.
2. Once placing operation commences, it shall be carried out as a continuous operation until a designated section is completed or as approved by the Engineer.
3. Limit the drop height of concrete to 3 feet (1 meter) to avoid damage or displacement of the cell wall. Elephant trunks and/or tremies shall be used to prevent free fall of concrete.
4. Where concrete chutes are used, the end of the chute shall be baffled to prevent segregation of the concrete.
5. The concrete shall be thoroughly compacted by means of an approved vibrator, with the period of vibration being not less than 2 seconds nor more than 5 seconds at any one point.
6. Finish the concrete flush with the top of the Geoweb walls.

Specifier Notes: Delete the following section if a base stabilization wearing surface, such as asphalt or paving stones is not required.

I. Base Stabilization Wearing Surface

1. Overfill and compact the infill material over the Geoweb sections by a minimum of 2 inches (50 mm) prior to placing the wearing surface. The infill shall be compacted to a 95 percent Standard Proctor in accordance with Section _____.
2. The wearing surface shall consist of _____ as specified in Section _____.

3.4 INSTALLATION OF SLOPE AND CHANNEL PROTECTION SYSTEMS

- A. Prepare subgrade and install Geoweb protection system in accordance with Manufacturer's instructions.
- B. Subgrade Preparation:
 - 1. Excavate or fill foundation soils so top of installed Geoweb section is flush with or slightly lower than adjacent terrain or final grade as indicated on the drawings or as directed by the Engineer.

Specifier Note: Delete Geotextile and/or Geomembrane sections below if not required. Contact Presto Geosystems for assistance.

- 2. Install geotextile underlayer on prepared surfaces ensuring required overlaps are maintained and outer edges of geotextile are buried in accordance with the Manufacturer's recommendations.
 - 3. Install geomembrane underlayer on prepared surface ensuring required overlaps are maintained and outer edges of geomembrane are buried in accordance with the Manufacturer's recommendations.
- C. Geoweb Section Anchorage
 - 1. Anchorage requirements for the Geoweb sections shall be as shown on the Contract Drawings and as directed by the Engineer.

Specifier Notes: Specifier shall select the preferred anchorage method and delete the others. Consult Presto Geosystems for assistance.

- 2. Anchorage with ATRA Anchors (No Crest Trench)
 - a. Position collapsed Geoweb sections at the crest of the slope.
 - b. Drive Atra anchors at the crest of the slope to secure the Geoweb sections in place and allow expansion of the Geoweb sections into position.
 - c. After the Geoweb sections are expanded as desired, drive ATRA Anchors so the arm of the ATRA Clip is through the internal slots in the Geoweb cell wall and do not protrude over the top of the cell wall.
 - d. Anchorage pattern and stake length shall be as indicated on the Contract Drawings.
 - e. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.
 - 3. Anchorage with Tendons and ATRA Anchors
 - a. Excavate the trench at the top of the slope to the depth as shown on the Contract Drawings.
 - b. Position collapsed Geoweb sections at the crest of the slope.
 - c. Feed precut lengths of specified tendon material through the integral slots in Geoweb cell walls before expanding individual sections into position. Leave the trailing length of the tendon on the upslope side of the Geoweb section for connection to the ATRA anchors.
 - d. Place Geoweb sections into the trench and expand as described below.
 - e. Anchor Geoweb sections with ATRA Anchors. Drive ATRA Anchors so that the arm of ATRA Clip is through the internal slots in the Geoweb cell wall and does not protrude over the top of the cell wall.
 - f. The length of the ATRA Anchors shall be as indicated on the Contract Drawings.
 - g. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.
 - 4. Anchorage with Tendons and Pipe Deadman Anchorage
 - a. Excavate the anchor trench at the top of the slope to the depth as shown on the Contract Drawings.
 - b. Install pipe Deadman in anchor trench. Pipe type, diameter and thickness shall be as shown on the Contract Drawings.
 - c. Position collapsed Geoweb sections at the crest of the slope.
 - d. Feed precut lengths of specified tendon material through the integral slots in Geoweb cell

- walls before expanding individual sections into position. Leave the trailing length of the tendon on the upslope side of the Geoweb section for connection to the pipe Deadman.
- e. Secure tendons to the pipe Deadman and expand Geoweb sections down the slope as described below.
 - f. Attach ATRA Clips to the tendons with the prescribed knot to secure the Geoweb sections. Pull the tendon toward the top of the slope to ensure the ATRA Clip bears against the upslope side of the cell wall. ATRA Clip locations shall be as indicated on the Contract Drawings.
 - g. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.
5. Anchorage with Tendons and Earth Anchors
- a. Position the collapsed Geoweb sections at the crest of the slope.
 - b. Feed precut lengths of specified tendon material through the integral slots in Geoweb cell walls before expanding individual sections into position. Leave the trailing length of the tendon on the upslope side of the Geoweb section for connection to the earth anchor.
 - c. Install earth anchors in accordance with Manufacturer's recommendations and instructions. Earth anchor type and strength shall be as shown on the Contract Drawings.
 - d. Secure tendons to earth anchors and expand Geoweb sections down slope as described below.
 - e. Attach ATRA Clips to the tendons with the prescribed knot to secure the Geoweb sections. Pull the tendon toward the top of the slope to ensure the ATRA Clip bears against the upslope side of the cell wall. The ATRA Clip locations shall be as indicated on the Contract Drawings.
 - f. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.
- D. Geoweb Section Placement and Connection
- 1. Place unexpanded Geoweb sections at the crest of the slope and expand Geoweb sections down slope. Verify each Geoweb section is expanded uniformly to required dimensions and outer cells of each layer are correctly aligned. Interleaf or overlap edges of adjacent sections in each layer. Ensure upper surfaces of adjoining Geoweb sections are flush at joint and adjoining cells are fully connected.
 - 2. Connect the Geoweb sections with ATRA keys at each interleaf and end to end connection. Insert the ATRA key through the slot in the cell wall before inserting through the adjacent cell. Turn the ATRA key 90 degrees to lock the panels together

Specifier Notes: Delete section if soil or aggregate is not required. Contact Presto Geosystems for assistance.

E. Soil and Aggregate Infill

- 1. Place specified infill in expanded cells with suitable material handling equipment, such as a backhoe, front-end loader, conveyor, or crane-mounted skip.
- 2. Limit drop height to a maximum of 3 feet (1 m) to avoid damage or displacement of the cell walls.
- 3. Fill Geoweb sections from the crest of the slope to toe or in accordance with Engineer's direction.
- 4. Infill material shall be free-flowing and not frozen when placed into the Geoweb sections.

Specifier Notes: Add specification number.

- 5. Compact infill material to a minimum 95 percent Standard Proctor in accordance with Specification Section _____.
- 6. Ensure the infill will be flush with the Geoweb cell walls after compaction.

Specifier Notes: Delete if concrete infill is not required. Contact Presto Geosystems for assistance.

F. Concrete Infill

Specifier Notes: Add concrete specification number and revise as required.

1. Concrete shall be placed, finished and cured in accordance with Specification Section _____.
2. Once placing operation commences, it shall be carried out as a continuous operation until a designated section is completed or as approved by the Engineer.
3. Limit the drop height of concrete to 3 feet (1 meter) to avoid damage or displacement of the cell wall. Elephant trunks and/or tremies shall be used to prevent free fall of concrete.
4. Where concrete chutes are used, the end of the chute shall be baffled to prevent segregation of the concrete.
5. The concrete shall be thoroughly compacted by means of an approved vibrator, with the period of vibration being not less than 2 seconds nor more than 5 seconds at any one point.
6. Finish the concrete flush with the top of the Geoweb walls.

G. Surface Treatment

Specifier Notes: Revise as required.

1. Surface treatments shall be as shown on the plans.
2. Install and maintain surface treatments as specified in Section _____.

Appendix A
Short-Term Seam Strength Test Procedure

Frequency of Test

The short-term seam peel strength test (referred to as the ‘test’ in this section) shall be performed on a geocell section randomly taken directly from the production line each two hours.

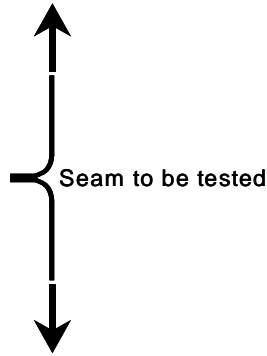


Figure A1

Test Sample Preparation

Randomly choose 10 welds within the selected section and cut those welds from the section such that 10 cm (4 in) of material exist on each side of the weld. The test sample shall have a general appearance as illustrated in Figure A1. Prior to testing, the test samples shall have air cool for a minimum of 30 minutes from the time the selected geocell section was manufactured.

Short-term Seam Peel Strength Test

The apparatus used for testing the short-term seam peel strength shall be of such configuration that the jaws of the clamp shall not over stress the sample during the test period. Load shall be applied at a rate of 12 in (300 mm) per minute and be applied for adequate time to determine the maximum load. The date, time and load shall be recorded.

Short-term seam peel strength shall be defined as the maximum load applied to the test sample. Minimum required short-term seam peel strength shall be:

- 640 lbf (2840 N) for the 8 in (200 mm) depth cell
- 480 lbf (2130 N) for the 6 in (150 mm) depth cell
- 320 lbf (1420 N) for the 4 in (100 mm) depth cell
- 240 lbf (1060 N) for the 3 in (75 mm) depth cell.

Definition of Pass / Failure

Two methods shall be used to determine acceptability of the manufactured geocell sections. The successful passing of the short-term seam peel test shall not be used to determine acceptable of the polyethylene for use in manufacturing of the geocell sections. Acceptability of the polyethylene shall be determined through tests conducted in Appendix B.

The Tested Value

If more than one of the tested seam samples fails to meet the minimum peel strength, all sections manufactured after the previously successful test shall be rejected.

If all tested seam samples meet the minimum peel strength, all geocell sections manufactured since the last successful test shall be considered to have passed the test.

When one of the tested seam samples fails to meet the minimum peel strength, another 10 samples shall be randomly selected and cut from the previously selected section. If more than one of these samples fails, all sections manufactured after the previously successful test shall be rejected. Otherwise, all geocell sections manufactured since the last successful test shall be considered to have passed the test.

Visual Failure Mode

After each sample is tested, the seam shall be examined to determine the failure mode. Two failure modes are possible.

- Material failure within and adjacent to the weld indicated by material strain and
- Weld failure resulting in complete separation of the seam and shows little or no material strain.

Upon examination, when the failure mode results in complete separation of the seam and indicates little or no material strain, product manufactured shall be rejected.

Appendix B
Long-Term Seam-Strength Test Procedure

Frequency of Test

The long-term seam peel strength test (referred to as the ‘test’ in this section) shall be performed:

1. on each new resin lot number if the geocell manufacturer extrudes the sheet or strip used to produce the geocell material.
2. on each new order of sheet and/or strip if the geocell manufacturer does not extrude the sheet and/or strip used to produce the geocell material.

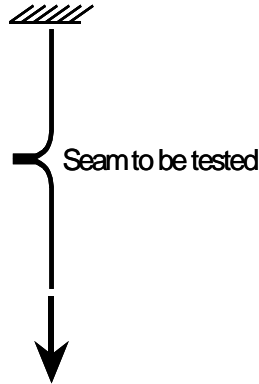


Figure B1

Test Sample Preparation

A test sample shall be made using two sets of two strips meeting all aspects of the material portion of this specification. Testing shall be done on non-perforated samples to obtain the true seam strength of the bond. One set of two strips are to be welded in welder position “A” and the other set of two strips are to be welded in welder position “B” producing two 1-cell long sections of geocell product. Welding should be done using a warm welder. The welded samples shall be labeled “A” and “B” and the weld seams of each sample shall be numbered consecutively from left to right starting with the number 1 (one) and corresponding to the welding head number.

The samples shall air cool for a minimum of 30 minutes. Randomly choose 10 welds from samples “A” and “B” and cut those welds from the geocell samples such that 4 in (10 cm) of material exist on each side of the weld. These samples shall be cut to a width of 4 in

(10 cm). Properly identify each weld using the sample letter and weld seam number.

These samples are now ready to be tested.

Long-term Seam Peel Strength Test

The long-term seam peel strength test shall take place within an environmentally controlled chamber that undergoes temperature change on a 1-hour cycle from room temperature to 130°F (54°C). Room temperature shall be defined per ASTM E41.

Within the environmentally controlled chamber, one of the ends of the samples (10 samples in total) shall be secured to a stationary upper clamp. The jaws of the clamp shall be of such configuration that the grip does not over stress the sample during the test period. The sample shall be secured so that its axis is vertical and the welds being tested are horizontal as the sample hangs within the environmentally controlled chamber.

A weight of 160 lb (72.5 kg) shall be lifted via a hoist or lift platform and attached to the free lower end, of the sample. The weight shall be lowered in a way so that no impact load occurs on the sample being tested. The weight shall be sufficient distance from the floor of the chamber so that the weight will not touch the floor of the chamber as the sample undergoes creep during the test period. The date and hour the weight is applied shall be recorded.

The temperature cycle shall commence immediately within the environmentally controlled chamber. The test period for the applied load shall be 168 hours.

Definition of Pass / Failure

If any of the 10 seams fail prior to the end of the 168-hour (7-day) period, the date and hour of the failure shall be recorded and the polyethylene resin and strip material shall be considered unsuitable for geocell manufacturing.

END OF SECTION