

Presto Geosystems

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PRODUCT SPECIFICATION (CSI FORMAT)

Specifier Note: 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.

Contract Documents shall refer to the drawings and specifications prepared and approved by the Engineer.

Delete all "Specifier Notes" while editing this section.

SECTION 32 32 00
RETAINING WALLS

Specifier Note: 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® Clips, ATRA® Anchors, ATRA Key connection device, 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

- A. Work Included: This Section includes providing all material, labor, tools and equipment for installation of Cellular Confinement System as shown in the Contract Documents and as specified in this Section.
- B. The Cellular Confinement System shall be used for earth retention system.

1.2 RELATED SECTIONS AND DIVISIONS

Specifier Note: 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 Note: 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 Society of Testing and Materials (ASTM)
 - 1. ASTM D1505 - Density of Plastics by the Density-Gradient Technique.
 - 2. ASTM D1603 – Standard Test for Carbon Black in Olefin Plastics
 - 3. ASTM D1693 – Environmental Stress-Cracking of Ethylene Plastics.
 - 4. ASTM D5199 – Measuring Nominal Thickness of Geotextiles and Geomembranes.
 - 5. ASTM E41 – Terminology Relating to Conditioning.

1.4 SUBMITTALS

- A. Submit Manufacturer's shop drawings in accordance with Section 0130000 including Manufacturer's product data, samples and section layout.
- B. Manufacturer's Certificate of Analysis: Manufacturer shall supply certificate of analysis containing the following test results for the cellular confinement material used for project: Base Resin Lot Number(s), Resin Density per ASTM-1505, Production Lot Number(s), Material Thickness, Short Term Seam Peel Strength, and percentage of Carbon Black.

Specifier Note: Delete Manufacturer's certification if black front fascia is chosen.

- 1. Manufacturer's certification of hindered amine light stabilizer (HALS).

Specifier Note: Delete installer qualifications if not desired.

- C. Submit qualifications certifying the installer is experienced in the installation of the specified products.

Specifier Note: Delete Manufacturer's field representative if not desired.

- D. Submit qualifications of Manufacturer's field representative certifying the field representative is experienced in the installation of the specified products.
- E. No material will be considered as an equivalent to the Geoweb 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. Any substitute materials submitted shall be subject to independent lab testing at the Contractor's expense.

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 9001:2015 and CE certification. Any substitute materials submitted shall provide a certification that their cellular confinement manufacturing process is part of an ISO program and a certification will be required specifically stating that their testing facility is certified and in accordance with ISO. An ISO certification for the substitute material will not be acceptable unless it is proven it pertains specifically to the geocell manufacturing operations.
- 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 Note: Delete pre-installation meeting if not required.

- 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.

Specifier Note: Delete section if Manufacturer's field representative is not required.

- E. Manufacturer's Field Representative Qualifications
 - 1. Manufacturer shall provide a qualified field representative on site at the start of construction to ensure the Geoweb system is installed in accordance with the Contract Documents.
 - 2. Manufacturer's field representative shall have a minimum 5 years installation experience with the specified products in the specified application.
 - 3. Manufacturer of any substitute materials to be used shall certify that a representative can meet the above criteria and will be on site for initial construction start up. Manufacturers other than Presto shall be required to provide proof the representative meets these qualifications.

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

- A. Manufacturing Certification
 - 1. The Manufacturer shall have earned a certificate of registration, which demonstrates that its quality-management system for its Geoweb cellular confinement system is currently registered to the ISO 9001:2008 and CE quality standards.
- B. Base Materials
 - 1. Polyethylene Stabilized with Carbon Black
 - a. Density shall be 58.4 to 60.2 pound/ft³ (0.935 - 0.965 g/cm³) in accordance with ASTM D1505.
 - b. ESCR shall be 5000 hours in accordance with ASTM D1693.
 - 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.
 - f. The manufacturer must have an in-place quality control to prevent irregularities in strip material.

Specifier Note: Tan or green colored front fascia is typical for Geoweb walls. Delete the following section if a colored front fascia is NOT required.

- 2. Polyethylene Colored and Stabilized with HALS (Front Wall Fascia)
 - a. Density shall be 58.4 to 60.2 pound/ft³ (0.935 to 0.965 g/cm³) in accordance with ASTM

D1505.

- b. ESCR shall be 5000 hours in accordance with ASTM D 1693.

Specifier Note: Select the desired wall color. If a colored front fascia is not desired, delete c through g.

- c. Color shall be [Tan][Green].
d. Colorants shall be non-heavy metal types homogeneously distributed throughout the material.
e. Ultra-Violet Light Stabilization with HALS.
f. HALS Content shall be 2.0 percent by weight, through addition of a carrier with a certified HALS concentrate.
g. HALS shall be homogeneously distributed throughout material.

C. Cell Properties-GW30V

1. Individual cells shall be uniform in shape and size when expanded.
2. Individual cell dimension (nominal) shall be plus or minus 10 percent.
a. Length shall be 10.5 inches (267 mm).
b. Width shall be 13.0 inches (330 mm).
c. Nominal area shall be 68.3 in² (440 cm²) plus or minus 1 percent.
d. Nominal depth shall be 6 inches (150 mm).

D. Strip Properties and Assembly

Specifier Note: Perforated textured strips are used for interior wall sections. Non-perforated textured strips are used for the front wall fascia. Both sections below are necessary. Contact Presto Geosystems for assistance.

1. Perforated Textured Strip/Cell
a. Strip sheet thickness shall be 50 mils (1.27 mm), minus 5 percent, plus 10 percent in accordance with ASTM D5199. 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 mils ± 6 mils (1.52 mm ± 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 inches (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 inches (8 mm).
i. Centerline of spot weld to nearest edge of perforation shall be a minimum of 0.7 inches (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 mils (1.27 mm), minus 5 percent, plus 10 percent in accordance with ASTM D5199. Determine thickness flat, before surface disruption.

- c. Textured sheet thickness shall be 60 mils \pm 6 mils (1.52 mm \pm 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 to 200 per in² (22 to 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.
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.
 - d. Weld spacing for GW30V-cell sections shall be 17.5 inches ± 0.10 inch (445 mm ± 2.5 mm).

E. GW30V Section Types and Sizes:

Specifier Note: Select the desired Geoweb section length. The design may include more than one section length. Contact Presto Geosystems for assistance.

- 1. Section length shall be 3-cells long: 2.63 feet (0.80 meters), 4-cells long: 3.50 feet (1.07 meters) or 5-cells long: 4.38 feet (1.33 meters). Wall configuration shall be as shown in the Contract Documents.
- 2. Section Width for all lengths: 8.67 feet (2.64 meters)
- 3. Face Area for all sections: 4.33 square feet (0.40 square meters)

F. Cell Seam Strength Tests

- 1. Minimum seam strengths are required by design and shall be reported in test results. Materials submitted with average or typical values will not be accepted. Written certification of minimum strengths must be supplied to the Engineer at the time of submittals.
- 2. 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 480 lbf (2,130 N) for 6 inch (150 mm) depth.
- 3. 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°F (54°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.

Specifier Note: Delete the following if a colored front fascia is not desired. Contact Presto Geosystems for assistance.

- e. Test sample consisting of a carbon black stabilized strip and HALS stabilized strip shall support a 140 pound (63.5 kg) load for test period.
4. 10,000 Hour Seam Peel-Strength Test
- a. Manufacturer shall provide data showing that the high-density polyethylene resin used to

produce the Geoweb sections has been tested using an appropriate number of seam samples and varying loads to generate data indicating that the seam peel strength shall survive a loading of at least 160 lbf (73 kg) for a minimum of 10,000 hours.

2.3 INTEGRAL COMPONENTS

Specifier Note: Select all components that apply and delete the others. ATRA anchors may be used to temporarily hold Geoweb wall sections during infilling and are typically not required for permanent anchoring. ATRA keys shall be used to connect adjacent cells. Staples may also be used.

Contact Presto Geosystems for assistance.

- A. ATRA® Clips / Anchors
 - 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 Anchors shall consist of standard (0.5 inch) or metric (10 to 12 mm) steel reinforcing rod with an ATRA® Clip attached as an end cap.
 - 3. 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.
- B. ATRA® Key
 - 1. ATRA keys shall be constructed of polyethylene and provide a high strength connection with minimum pull-through of 420 lbs (191 kg).
 - 2. ATRA keys shall be used to connect Geoweb panels together at each interleaf and end to end connection for all applications, including the front face of the walls.
- C. Staples
 - 1. Staples may also be used for connections.
 - 2. The staples shall be ½ inch, Stanley Bostitch, SL5035.

2.4 CELL INFILL MATERIALS

Specifier Note: Specify the desired infill material. Contact Presto Geosystems for assistance. Typical infill material include; but are not limited to:

- 1. Free draining granular material such as sand, gravel, crushed rock or fine grained cohesive soils.
- 2. Vegetated Wall: Infill the outer cells with screened topsoil that supports vegetation.
- 3. Non-Vegetated Wall: Infill the outer cells with granular material, gravel, crushed rock, grout or concrete.

- A. Front fascia infill material shall be [_____] as specified in the Contract Documents.
- B. Geoweb infill material shall be [_____] as specified in the Contract Documents.
- C. Infill material behind the Geoweb shall be [_____] as specified in the Contract Documents.
- D. Infill material shall be free of any foreign material.
- E. Clays, silts, and organic soils are not acceptable infill material.
- F. Infill material shall be free-flowing and not frozen when placed in the Geoweb sections.

2.5 SURFACE TREATMENTS

Specifier Note: Specify the desired surface treatment. Contact Presto Geosystems for assistance. Degradable revegetative blankets may be used to wrap Geoweb sections to prevent loss of infill material from the outer cells. Concrete and surface grouts may be applied to the outer cells in a stacked channel .

- A. Surface treatment includes one or a combination of the following:
 - 1. Vegetation.
 - 2. Degradable revegetative blankets.
 - 3. Concrete
 - 4. Surface grouts.
 - 5. Other.

2.6 ADDITIONAL COMPONENTS

Specifier Note: Specify the desired components. Contact Presto Geosystems for assistance.

- A. Drainage System
 - 1. Drainage system shall be as specified in the Contract Documents.
- B. Geotextile Separation Layer
 - 1. The geotextile separation layer shall be as specified in the Contract Documents.

Specifier Note: Delete the following section if a gravity wall is desired.

- C. Geogrid Reinforcement
 - 1. The geogrid reinforcement shall be as specified in the Contract Documents.

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.

3.2 INSTALLATION OF EARTH RETENTION SYSTEM

- A. Prepare subgrade as specified and install earth retention system in accordance with Manufacturer's instructions.

Specifier Note: Delete section if on-site installation assistance is not desired. If required, specify the numbers of day(s).

- B. On-site time for installation assistance by the Manufacturer's field representative shall be ____ day(s) with one trip. All travel and expense costs for Manufacturer's field representative installation assistance shall be included in the base bid price.
- C. Subgrade Preparation
 - 1. Excavate, shape or fill foundation soils to elevations 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 affected areas and replace with suitable quality material as directed by the Engineer.

Specifier Note: Delete section if a geotextile separation layer is not required.

- 3. Install geotextile separation layer as shown in the Contract Documents. Ensure outer edges of geotextile are buried a minimum of 6 inches (150 mm) and install in accordance with the Manufacturer's instructions.
- D. Base and Spread Footing Installation
 - 1. Place and shape granular base materials. If a free draining granular base is utilized, encapsulate in a non-woven geotextile. Compact to a minimum 95 percent Standard Proctor.
 - 2. Expand Geoweb sections into place and temporarily anchor at corners with ATRA anchors.
 - 3. Overfill Geoweb cells with specified granular infill. Maximum particle size shall be 2 inches (50 mm). Level surface approximately 2 inches (50 mm) above cell walls.
 - 4. Compact fill in Geoweb cells to a minimum 95 percent Standard Proctor.
 - 5. Place and compact fill to a minimum 95 percent Standard Proctor along each side of footing.
 - 6. Screed off excess infill to be level with top of cells.

Specifier Note: An effective drainage system is essential for proper design of Geoweb earth retention systems. Generally, the granular infill provides adequate drainage for relief of hydrostatic pressure. A more comprehensive drainage system may be required for walls where groundwater is a concern.

- E. Drainage System Installation
 - 1. Install perforated subdrain and outlet pipes in accordance with the drawings. The subdrain pipe shall be wrapped with non-woven geotextile or backfilled with clear stone to prevent plugging.
 - 2. Provide a minimum slope of 1 percent for all drainage piping.
 - 3. Wrap outlet pipes which pass through wall fascia with non-woven geotextile to prevent loss of cell infill materials.
 - 4. Ensure outlets for all discharge piping will not cause localized erosion that could undermine the wall.

Specifier Note: Delete this section if a Gravity Geoweb Retaining Wall is not desired. Contact Presto Geosystems for assistance.

- F. Installation of Gravity Geoweb Retaining Wall System
 - 1. Expand Geoweb sections into place. Hold individual sections in their expanded position with stretcher

- frames, stretcher bars or ATRA anchors positioned inside selected outer cells.
2. Confirm each Geoweb section is expanded uniformly to required dimensions and outer cells of each layer are correctly aligned and upper surfaces are flush.
 3. Interleaf edges of adjacent sections and connect with ATRA keys on all connections including the front fascia panels. Staples may also be used. ATRA Keys are the most expedient connection method.
 4. Overfill cells with granular material and level surface approximately 2 inches (50 mm) above cell walls.
 5. Compact cell infill material to a minimum 95 percent Standard Proctor with a walk-behind-compactator. Avoid using heavy compaction equipment within 3 feet (1 meter) of the front face of the wall.
 6. Place the backfill material behind the Geoweb sections in maximum 8 inch (200 mm) lifts and compact as specified.
 7. Screed off excess infill so the infill is level with the top of the cells.
 8. When topsoil or special infill materials are specified for exposed face cells of Geoweb sections, 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. Partial spillage of internal infill material into outer cells may be permitted.
 9. When positioning subsequent layers, ensure specified set back of each layer and the vertical alignment of the outer cells are maintained to prevent the loss of infill materials.

Specifier Note: Delete this section if a Reinforced Geoweb Retaining Wall is not desired. Contact Presto Geosystems for assistance.

G. Installation of Reinforced Geoweb Retaining Wall System

1. Expand Geoweb sections into place. Hold individual sections in their expanded position with stretcher frames, stretcher bars or ATRA anchors positioned inside selected outer cells.
2. Confirm each Geoweb section is expanded uniformly to required dimensions and outer cells of each layer are correctly aligned and upper surfaces are flush.
3. Interleaf edges of adjacent sections and connect with ATRA keys. Staples may also be used. ATRA keys are the most expedient connection method.
4. Place precut sections of reinforcement at specified elevations as indicated on the drawings and temporarily hold in-place with pins or fill. The reinforcement shall be placed horizontally, with high-strength axis perpendicular to wall face.
5. Extend outer edges of reinforcement to within 6 inches (150 mm) of the front face of in-place Geoweb sections and extend horizontally into the backfill zone.
6. Overfill cells with granular material and level surface approximately 2 inches (50 mm) above cell walls.
7. Compact cell infill material to a minimum 95 percent Standard Proctor with a walk-behind-compactator. Avoid using heavy compaction equipment within 3 feet (1 meter) of the front face of the wall.
8. 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.

9. 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.
10. Place backfill within reinforced zone in maximum lifts of 8 inches (200 mm) and compact to a minimum 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.
11. 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 95 percent Standard Proctor.
12. When topsoil or special infill materials are specified for exposed face cells of Geoweb sections, confirm filling procedures with the Engineer prior to 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.
13. When positioning subsequent layers, ensure specified set back of each layer and the vertical alignment of the outer cells are maintained to prevent the loss of infill materials.

H. Surface Treatment

Specifier Note: Delete the sections that do not apply.

1. Vegetation shall be as specified in the Contract Documents and installed immediately after the Geoweb cell infill is placed and protected with mulch.
2. Degradable revegetative blankets shall be as specified in the Contract Documents and installed during installation of the Geoweb wall sections. Place the appropriate length of blanket under the Geoweb layer leaving material length such that once the Geoweb layer is infilled and compacted, the blanket is wrapped up and over the front wall section, sandwiching the Geoweb layer between the blanket. Repeat this process for each subsequent layer. If vegetation is specified, it must be applied in the outer cells prior to wrapping the fascia with the blanket.
3. Concrete shall be as specified in the Contract Documents and installed immediately after the Geoweb cell infill is placed.
4. Surface grout shall be as specified in the Contract Documents and installed immediately after the Geoweb cell infill is placed.
5. Other.

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.

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.

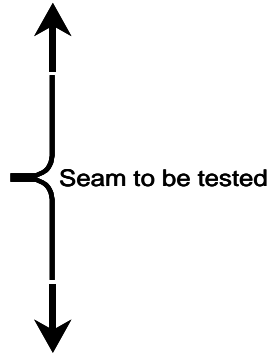


Figure A1

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.

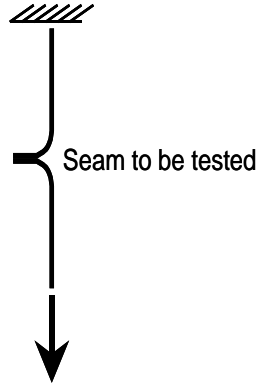


Figure B1

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