

**Presto Geosystems**

September 2022

670 N Perkins Street, PO Box 2399  
Appleton, Wisconsin 54912-2399  
Toll Free (800) 548-3424  
Phone (920) 738-1328  
E-Mail [info@prestogeo.com](mailto:info@prestogeo.com)  
Website [www.prestogeo.com](http://www.prestogeo.com)

**PRODUCT SPECIFICATION (CSI FORMAT)**

Specifier Note: This product guide specification is in accordance with the Construction Specifications Institute (CSI) Format, including *Master Format*, *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 all specific project and applicable code requirements. 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" after editing this section.

**SECTION \_\_\_\_\_**

**SOIL STABILIZATION SYSTEM**

Specifier Note: This section covers Presto Geosystems' GEOWEB® Geocell System. The system consists of geocell material into which specific infill materials shall be placed. The complete system includes GEOWEB® sections, infill materials, and ATRA® Key connection devices. ATRA® Stake Clips, ATRA® Anchors, ATRA® Speed Stakes, geotextiles, tendons, and surface treatments may be required depending on site conditions.

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 the GEOWEB® geocell system as shown in the Contract Documents and as specified in this Section.
- B. The GEOWEB® geocell system shall be used for load support.

## 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 GEOWEB® geocell 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 02070 – Geosynthetics
- F. 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 Association of State Highway and Transportation Officials (AASHTO)
  - 1. AASHTO M218 – Steel Sheet, Zinc-Coated (Galvanized) for Corrugated Steel Pipe.
  - 2. AASHTO M288 – 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 D 5394 – Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
  - 6. ASTM D 5596 – Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
  - 7. ASTM D 5721 – Standard Practice for Air-Oven Aging of Polyolefin Geomembranes.
  - 8. ASTM D 5885 – Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry.
  - 9. ASTM D 6693 (Type IV) – Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.
  - 10. ASTM D 7328 – Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus
  - 11. ASTM E 41 – Terminology Relating to Conditioning.
- C. US Army Corps of Engineers (USACE)
  - 1. Technical Report GL-86-19, Appendix A.
- D. International Organization for Standardization (European Union) (EN-ISO)
  - 1. ISO 6721 – Plastics – Determination of Dynamic Mechanical Properties

2. EN ISO 10319 – Geosynthetics – Wide-Width Tensile Test
3. EN 12224 – Geotextiles and geotextile-related products – Determination of the resistance to weathering
4. EN ISO 13426 – Geotextiles and geotextile-related products – Strength of Internal Structural Junctions – Part 1: Geocells
5. EN ISO 13438 – Screening Test Method for Determining the Resistance of Geotextiles and Geotextile-Related Products to Oxidation

## 1.4 SUBMITTALS

- A. Submit manufacturer's shop drawings in accordance with Section 00 13 00, Submittals including Manufacturer's product data, samples and section layout.
- B. Design Calculations and Drawings. Provide a complete set of design calculations including a description of the analysis performed to determine load support requirements.
  1. The calculations shall be submitted at the time of bid.
  2. The calculation method shall be based on computer software developed through research and testing at an accredited laboratory. Manufacturer shall provide compliance at time of bid.
  3. Minimum overall design factor of safety shall be 1.4.
  4. At a minimum; include design conditions, load support calculations, calculated factors of safety and friction angles.
  5. If required, provide a description of the recommended geotextile separation layer and include in the calculations.
  6. If required, provide calculations for the recommended anchorage system. The calculations shall be based on testing at an accredited laboratory facility based on the specific material design values and panel connectors.
  7. The calculations shall be in Microsoft Excel converted to Adobe PDF format.
  8. Cross section and plan view drawings shall be in AutoCAD converted to Adobe PDF format.
- C. Manufacturer's Certificate of Analysis: Manufacturer shall supply certificate of analysis containing the following test results for the GEOWEB® geocell 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 installer and Manufacturer's field representative qualifications if not required.

- D. Submit qualifications certifying installer experience in the installation of GEOWEB® system.
- E. Submit qualifications of Manufacturer's field representative certifying field representative experience in the installation of GEOWEB® system.
- 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 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 submission and review of provided information. All substitute materials submitted shall be subject to independent lab testing at the contractor's expense.

## **1.5 QUALITY ASSURANCE AND CONTROL**

- A. The GEOWEB® geocell 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. Substitute materials submitted shall provide a certification that the manufacturing process is part of an ISO program. Certification is required specifically stating that the 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 GEOWEB® geocell material.
- 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 GEOWEB® geocell system.
  - 1. Manufacturer shall provide a qualified field representative on site at the start of construction to ensure the GEOWEB® geocell system is installed in accordance with the Contract Documents.
  - 2. Manufacturer's field representative shall have a minimum of 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 specified GEOWEB® geocell system will 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® geocell 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 GEOWEB® geocell 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.  
E-Mail [info@prestogeo.com](mailto:info@prestogeo.com). Website [www.prestogeo.com](http://www.prestogeo.com).

### **2.2 GEOWEB® GEOCELL SYSTEM**

- A. Manufacturing Certification
1. The Manufacturer shall have earned a certificate of registration, which demonstrates that its quality-management system for its GEOWEB® geocell system is currently registered to the ISO 9001:2015 and CE quality standards.
- B. Base Materials
1. Polyethylene Stabilized with Carbon Black
    - a. Density shall be 58.4 to 60.2 pound/ft<sup>3</sup> (0.935 to 0.965 g/cm<sup>3</sup>) in accordance with ASTM D 1505.
    - b. Environmental Stress Crack Resistance (ESCR) shall be 5000 hours in accordance with ASTM D 1693.
    - c. Resistance to Oxidation shall be minimum of 100 years in accordance with EN ISO 13438.
    - d. 100% of original strip tensile strength shall be retained following exposure to accelerated weathering in in accordance with EN 12224.
    - e. The Flexural Storage Modulus shall be a minimum of 800 MPa in accordance with ISO 6721.
    - f. Ultra-Violet light stabilization with carbon black.
    - g. Carbon Black content shall be 1.5 to 2 percent by weight, through addition of a carrier with certified carbon black content, in accordance with ASTM D 1603.
    - h. Carbon black shall be homogeneously distributed throughout material, in accordance with ASTM D 5596.
    - i. The manufacturer shall have an in-place quality control to prevent irregularities in strip material.
- C. Cell Properties
1. Individual cells shall be uniform in shape and size when expanded.
  2. Individual cell dimensions (nominal) shall be dimensions  $\pm 10\%$ .

Specifier Note: Select GW20V-Cell or GW30V-Cell and nominal depth and delete the others. Contact Presto Geosystems for assistance.

3. GW20V-Cell
  - 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 in<sup>2</sup> (289 cm<sup>2</sup>) plus or minus 1%.
  - d. Nominal cell depth shall be [8 inches (200 mm)] [6 inches (150 mm)] [4 inches (100 mm)] [3 inches (75 mm)].
4. GW30V-Cell

- 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 in<sup>2</sup> (460 cm<sup>2</sup>) plus or minus 1%.
- d. Nominal cell depth shall be [8 inches (200 mm)] [6 inches (150 mm)] [4 inches (100 mm)] [3 inches (75 mm)].

**D. Strip Properties and Assembly**

**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 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 mils, plus or minus 6 mils (1.52 mm plus or minus 0.15 mm).
- d. Indentation surface density shall be 140 to 200 per in<sup>2</sup> (22 to 31 per cm<sup>2</sup>).
- 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. 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 aligned perpendicular to longitudinal axis of strip.
- c. Ultrasonic weld melt-pool width shall be 1.0 inch (25 mm) maximum.

**Specifier Note:** Select the desired cell type and delete the other. Coordinate with 2.2.C above.

- 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).

**E. 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.

**Specifier Note:** Select the minimum seam peel strength for the specified cell size and delete the others. Coordinate with 2.2.C above.



- 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].
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 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.
4. Internal Junction Efficiency
  - a. Junction efficiency determined as a ratio of junction performance to perforated strip performance, as determined by EN ISO 10319 and EN ISO 13426-1.
  - b. Minimum internal junction efficiency shall be  $\geq 100$  percent.
5. Mechanical Junction Efficiency
  - a. Junction efficiency determined as a ratio of junction performance to perforated strip performance, as determined by EN ISO 10319EN and ISO 13426-1.
  - b. Minimum mechanical junction efficiency shall be  $\geq 100$  percent.
  - c. Connection type shall be with integral components as designated by the Manufacturer.
6. 10,000-hour Seam Peel Strength Certification
  - a. 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 209 lbf (95 kg) for a minimum of 10,000 hours.

## **2.3 INTEGRAL COMPONENTS**

- A. ATRA® Tendon Clips
  1. The ATRA® Tendon Clip is a molded, high-strength polyethylene device with a locking member and post with minimum pull-through of 420 lbs (191 kg).
  2. The ATRA® Tendon Clip is the recommended anchorage connection method for securing sections with tendons for additional system hold-down.
- B. ATRA® Stake Clip
  1. The ATRA® Stake Clip is a molded, high-strength polyethylene device available in standard (0.5 inch) and metric (10–12 mm) versions.
  2. ATRA® Stake Clips are installed as an end cap on standard (0.5 inch) and metric (10–12 mm) steel reinforcing rods to form ATRA® Anchors.
- C. ATRA® Key
  1. ATRA® Keys shall be constructed of polyethylene and provide a high strength connection with minimum pull-through of 275 lbs (125 kg).
  2. ATRA® Keys shall be used to connect GEOWEB® panels together at each interleaf and end-to-end connection.
  3. Metal staples and zip ties are not an acceptable panel connection method.

## 2.4 STAKE ANCHORAGE

Specifier Note: Select the desired stake anchorage and delete the others. ATRA® Anchors or ATRA® Speed Stakes may be used for temporary or permanent anchoring. Anchors may be required for securing GEOWEB® sections in-place based on site conditions, especially for saturated soils or sloped applications. Contact Presto Geosystems for an evaluation include calculations, drawings and specifications.

The ATRA® GFRP Anchor and ATRA® Speed Stakes are suitable for environments that may degrade steel rebar. These anchors are impervious to pH degradation.

No permanent stake anchorage may be necessary. Contact Presto Geosystems for assistance. Coordinate with 3.2.F - H.

### A. ATRA® Anchors

1. ATRA® Anchors shall consist of standard (0.5 inch) or metric (10–12 mm) steel reinforcing rod with an ATRA® Stake Clip attached as an end cap.
2. ATRA® Anchors shall be assembled by inserting the ATRA® Stake Clip onto the reinforcing rod so that the end is flush with the top of the ATRA® Stake Clip. Prior to attaching the ATRA® Stake Clip, the reinforcing rod shall be free from all burrs and beveled.
3. Stake length shall be as shown in the Contract Documents.

### B. ATRA® Speed Stake

1. ATRA® Speed Stake shall be one piece, injection-molded design with integral flanged arms and barbs.
2. The stake shall be constructed of a specialty based HDPE polymer alloy.
3. The minimum tensile strength shall be 14.5 kips (100 mPa).
4. The minimum bending strength shall be 575 lbs (2.55 kN).
5. The stake shall be non-magnetic, non-conducting and corrosion resistant.
6. Stake length shall be as shown in the Contract Documents.

### C. ATRA® Glass Fiber Reinforced Polymer (GFRP) Anchors

1. ATRA® GFRP Anchors shall be pre-assembled units consisting of the ATRA® Stake 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 glass wrap.
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 in the Contract Documents.

## 2.5 TENDON ANCHORAGE



Specifier Note: If required, select the desired tendon and corresponding break-strength and delete the others. Tendons may be required for additional system hold-down, especially when no anchors are used, such as when the system is over a geomembrane. Kevlar or polypropylene tendons are recommended for concrete infill. Contact Presto Geosystems for assistance.

**A. Tendon Type**

1. Woven Polyester – [TP-67] [TP-93] [TP-225]
  - 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 [1506 lbf (6.70 KN) for TP-67] [2090 lbf (9.30 KN) for TP-93] [5100 lbf (22.5) for TP-225].
2. Woven Kevlar – TK-178
  - a. Material shall be Kevlar® Aramid material woven into a strap.
  - b. Minimum break strength shall be 4000 lbf (17.8 KN).
3. Woven Polypropylene – TPP-55
  - a. Material shall be Polypropylene 3-strand twisted rope.
  - b. Minimum break strength shall be 1250 lbf (5.56 KN).

**B. Types of Tendon Anchorage**

1. Tendons, ATRA® Tendon Clips and ATRA® Anchors.
2. Tendons, ATRA® Tendon Clips and ATRA® Speed Stakes.
3. Tendons, ATRA® Tendon Clips and ATRA® GFRP Anchors.
4. Tendons, ATRA® Tendon Clips and Deadman Pipe Anchorage.
5. Tendons, ATRA® Tendon Clips and Earth Anchors.

## **2.6 INFILL MATERIALS**

Specifier Note: Specify infill material type and delete the others. Coordinate infill materials with associated Soils and Concrete specifications. Engineered infill is typically used to provide structural strength in areas exposed to vehicle loads. Contact Presto Geosystems for assistance.

Infill materials for load support applications should be predominately granular with fines content less than 10%. Soils with greater than 10% fines have low permeability and lose strength when wet. A small fraction of fines (less than 10%) increases stability by binding the soil and reducing the void space. Concrete infill is typically used for low water crossings and boat ramps. Engineered infill is typically used to provide the necessary structural strength for load support in areas where vegetation is desired.

- A. Infill material shall be coarse, drainable sand.
- B. Infill material shall be crushed aggregate with a maximum particle size of 1/3 of the cell wall height. If drainage is desired, limit the fines content to less than 10%.
- C. Infill material shall be concrete with a minimum strength of 3000 psi and air content of 2 to 4% in accordance with ACI and ASTM standards.
- D. Engineered infill shall consist of a topsoil and aggregate mixture for vegetated surfaces.
  1. Engineered infill shall be a mix of topsoil and aggregate having a homogeneous mixture of a clear crushed aggregate having an AASHTO #5 or similar designation blended with pulverized topsoil and

a minimum 30% void space for air and/or water.

2. The mixture shall promote vegetation growth and provide structural support.
3. The aggregate portion shall have a particle range from 0.375 to 1.0 inches (9.5 to 25 mm) with a  $D_{50}$  of 0.5 inches (13 mm) and shall equal 67% of the total volume.
4. The percentage void space of the aggregate portion when compacted shall be at least 30%.
5. The pulverized topsoil portion shall equal 33% of the total volume. The topsoil shall be blended with the aggregate to produce a homogeneous mixture.
6. Once placed, the engineered fill shall be compacted to a 95% Standard Proctor.

- E. Infill material shall be free of any foreign material.
- F. Clays, silts and organics are not acceptable infill material.
- G. Infill material shall be free-flowing and not frozen when placed in the GEOWEB® panels.

## 2.7 ADDITIONAL COMPONENTS

Specifier Note: If required, select the desired additional components and delete the others. A geotextile separation layer is typically recommended for separation between the native soil and infill material. Separation is important to prevent contamination and loss of shear strength of the infill material and to prevent punching or migration of the infill material into the subgrade. The geotextile may also be part of the design to provide additional support. Slit tape woven geotextiles are not recommended for load support applications due to lack of drainage capabilities. High performance woven geotextiles shall be used. Non-woven geotextiles can be used but the designer shall ensure the sub grade does not have high silt content or low plasticity that can lead to clogging.

Additional subbase materials may be required under the GEOWEB® layer to support loading or for additional stormwater storage requirements.

A minimum surface wearing course of 2 inches (50 mm) is typically recommended to prevent trafficking directly on top of the GEOWEB® cell walls. If an asphalt or concrete surface is desired over the GEOWEB®, a minimum one inch (25 mm) separation layer of infill material shall be provided over the GEOWEB® to provide minor consolidation of the surface cover and to prevent contact of the asphalt or concrete with the GEOWEB® cell walls. Contact Presto Geosystems for assistance.

- A. Vegetation
1. Vegetation shall be as specified in the Contract Documents.
- B. Surface Protection
1. Surface protection shall consist of [erosion control blanket] [turf reinforcement mat] as specified in the Contract Documents.
- C. Geotextile
1. The geotextile separation layer 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 LOAD SUPPORT SYSTEMS

- A. Prepare subgrade and install load support system in accordance with Manufacturer's instructions.

Specifier Note: If required, specify the number of days required for the on-site manufacturer's field representative. Delete this section if not required.

- 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 and shape foundation soils as indicated on the drawings.
  2. Ensure foundation soil meets minimum strength requirements through proof rolling or other conventional method, as approved by the Engineer. If unacceptable foundation soils are encountered, excavate and replace with suitable quality material as directed by the Engineer.

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

3. Install geotextile separation layer on prepared surfaces ensuring required overlaps are maintained and outer edges of the geotextile are buried in accordance with the Manufacturer's recommendations.

Specifier Note: Delete this section if additional subbase materials are not required.

- D. Subbase Preparation and Installation
1. Ensure that the subgrade soil meets the minimum strength requirements for installation of the subbase.
  2. Place additional subbase materials to the required depth as specified in the Contract Documents.
  3. Compact to a minimum 95 percent Standard Proctor.

Specifier Note: Delete this section if additional subbase materials in section above is not required.

4. Install geotextile separation layer on top of subbase ensuring required overlaps are maintained and outer edges of the geotextile are buried in accordance with the Manufacturer's recommendations and sub grade CBR.
- E. GEOWEB® Section Placement and Connection
1. Place GEOWEB® sections and verify all sections are expanded uniformly to required dimensions and that outer cells of each section are correctly aligned. Interleaf or overlap edges of adjacent sections. Ensure upper surfaces of adjoining GEOWEB® sections are flush at joint and adjoining cells are fully aligned at the cell wall slot.
  2. Connect the GEOWEB® sections with ATRA® Keys at each interleaf and end-to-end connection. Insert the ATRA® Key through the cell wall slot before inserting through the adjacent cell. Turn the ATRA® Key 90 degrees to lock the panels together.

Specifier Note: Specify anchorage type from Sections F-N below and delete those not required. Choice should coordinate with Sections 2.4 and 2.5.

- F. Anchorage with ATRA® Anchors

1. Position collapsed sections at the crest of the slope.
  2. If required, excavate the anchor trench at the top of the slope to the depth as shown on the Contract Documents.
  3. Drive ATRA® anchors at the crest of the slope to secure the sections in place and allow expansion of the sections into position.
  4. After the sections are expanded as desired, drive ATRA® Anchors so the arm of the ATRA® Stake Clip engages with the top of the cell wall.
  5. Anchorage pattern and stake length shall be as indicated on the Contract Documents.
  6. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.
- G. Anchorage with ATRA® Speed Stakes
1. Position collapsed sections into place and partially drive ATRA® Speed Stakes in the outer edge cells and expand sections into place. Partially drive ATRA® Speed Stakes in the perimeter cells to keep sections fully expanded.
  2. With sections fully expanded, drive ATRA® Speed Stakes so the arm of the ATRA® Speed Stake is through the internal slots in the cell wall and anchors do not protrude over the top of the cell wall.
  3. Anchorage pattern and stake length shall be as indicated on the Contract Documents.
- H. Anchorage with ATRA® GFRP Anchors
1. Position collapsed sections into place and partially drive ATRA® GFRP Anchors in the outer edge cells and expand sections into place. Partially drive ATRA® GFRP Anchors in the perimeter cells to keep sections fully expanded.
  2. With sections fully expanded, drive ATRA® GFRP Anchors so the arm of the ATRA® GFRP Anchor is through the internal slots in the cell wall and anchors do not protrude over the top of the cell wall.
  3. Anchorage pattern and stake length shall be as indicated on the Contract Documents.
- I. Anchorage with Tendons, ATRA® Tendon Clips and Buried at Crest  
Preferred Method – Top of Slope Installation
1. Excavate the anchor trench at the top of the slope to the depth as shown on the Contract Documents.
  2. Position the collapsed sections at the crest of the slope.
  3. Measure and cut the tendon run lengths for each tendon location.
  4. Mark the tendons with a black permanent marker per the ATRA® Tendon Clip Location Chart.
  5. Starting from the first cell, count the number of cells to the next ATRA® Tendon Clip location and repeat along that cell row.
  6. Repeat this procedure for each additional cell row tendon/ATRA® Tendon Clip run.
  7. With all the ATRA® Tendon Clips placed in the section, thread the tendons through the cell wall I-slots in the unexpanded section.
  8. Locate the corresponding mark on the tendon and position it in front of the cell wall. Hold the tendon and connect to the ATRA Tendon Clip. Refer to the Slope Installation Manual for ATRA® Tendon Clip tie-off instructions.
  9. Leave the trailing length of the tendon on the upslope side of the section to allow connection to ATRA® Tendon Clip.
  10. Repeat this process on each cell row tendon/ATRA® Tendon Clip run.

11. Place the collapsed section in the anchor trench, secure with temporary stakes or ATRA® Anchors and expand down the slope.
12. Adjust the section (i.e. a shake or two of the expanded section works well for this) so that the section and tendons are uniformly taut.
13. Terminate the bottom of the tendons with ATRA® Tendon Clips.
14. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.

**Alternate Method – On Slope Installation**

1. Excavate the anchor trench at the top of the slope to the depth as shown on the Contract Documents.
2. Position collapsed sections at the crest of the slope.
3. Feed precut lengths of specified tendon material through the I-slots in cell walls before expanding individual sections into position. Number of tendons per section shall be per the Contract Documents. Leave the trailing length of the tendon on the upslope side of the section to allow for connection of the ATRA® Tendon Clips.
4. Place the collapsed section in the anchor trench, secure with temporary stakes or ATRA® Anchors and expand down the slope.
5. Install the ATRA® Tendon Clips at the locations indicated on the Contract Documents.
6. Hold the tendon and connect to each ATRA® Tendon Clip. Refer to the Slope Installation Manual for ATRA® Tendon Clip tie-off instructions.
7. Adjust the section (i.e. a shake or two of the expanded section works well for this) so that the section and tendons are uniformly taut.
8. Terminate the bottom of the tendons with ATRA® Tendon Clips.
9. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.

**J. Anchorage with Tendons, ATRA® Tendon Clips and ATRA® Anchors**

**Preferred Method – Top of Slope Installation**

1. Excavate the anchor trench at the top of the slope to the depth as shown on the Contract Documents.
2. Position the collapsed sections at the crest of the slope.
3. Measure and cut the tendon run lengths for each tendon location.
4. Mark the tendons with a black permanent marker per the ATRA® Tendon Clip Location Chart.
5. Thread the tendons through the unexpanded section.
6. Starting from the first cell, count the number of cells to the next ATRA® Tendon Clip location and repeat along that cell row.
7. Repeat this procedure for each additional cell row tendon/ATRA® Tendon Clip run.
8. With all the ATRA® Tendon Clips placed in the section, thread the tendons through the cell wall I-slots in the unexpanded section.
9. Locate the corresponding mark on the Tendon and position it in front of the cell wall. Hold the tendon and connect to the ATRA® Tendon Clip. Refer to the Slope Installation Manual for ATRA® Tendon Clip tie-off instructions.
10. Repeat this process on each cell row tendon/ATRA® Tendon Clip run.
11. Place the collapsed section in the anchor trench, drive ATRA® Anchors in the first row of cells so the arm of the anchor engages with the top of the cell wall and expand down the slope. Number of

anchors shall be per the Contract Documents.

12. Adjust the section (i.e. a shake or two of the expanded section works well for this) so that the section and tendons are uniformly taut.
13. After the sections are expanded, drive ATRA® Anchors so the arm of the anchor engages with the top of the cell wall.
14. Anchorage pattern and stake length shall be as indicated on the Contract Documents.
15. Terminate the bottom of the tendons with ATRA® Tendon Clips.
16. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.

**Alternate Method – On Slope Installation**

1. Excavate the anchor trench at the top of the slope to the depth as shown on the Contract Documents.
2. Position collapsed sections at the crest of the slope.
3. Feed precut lengths of specified tendon material through the I-slots in the cell walls before expanding individual sections into position. Number of tendons per section shall be per the Contract Documents. Leave the trailing length of the tendon on the upslope side of the section to allow for connection of the ATRA® Tendon Clips.
4. Place the collapsed section in the anchor trench, drive ATRA® Anchors in the first row of cells so the arm of the anchor engages with the top of the cell wall and expand down the slope.
5. Install the ATRA® Tendon Clips at the locations indicated on the Contract Documents.
6. Hold the tendon and connect to each ATRA® Tendon Clip. Refer to the Slope Installation Manual for ATRA Tendon Clip tie-off instructions.
7. Adjust the section (i.e. a shake or two of the expanded section works well for this) so that the section and tendons are uniformly taut.
8. After the sections are expanded as desired, drive ATRA® Anchors so the arm of the anchor engages with the top of the cell wall.
9. Anchorage pattern and stake length shall be as indicated on the Contract Documents.
10. Terminate the bottom of the tendons as required.
11. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.

**K. Anchorage with Tendons, ATRA® Tendon Clips and ATRA® Speed Stakes**

**Preferred Method – Top of Slope Installation**

1. Excavate the anchor trench at the top of the slope to the depth as shown on the Contract Documents.
2. Position the collapsed sections at the crest of the slope.
3. Measure and cut the tendon run lengths for each tendon location.
4. Mark the tendons with a black permanent marker per the ATRA® Tendon Clip Location Chart.
5. Thread the tendons through the unexpanded section.
6. Starting from the first cell, count the number of cells to the next ATRA® Tendon Clip location and repeat along that cell row.
7. Repeat this procedure for each additional cell row tendon/ATRA® Tendon Clip run.
8. With all the ATRA® Tendon Clips placed in the section, thread the tendons through the cell wall I-slots in the unexpanded section.
9. Locate the corresponding mark on the Tendon and position it in front of the cell wall. Hold the



tendon and connect to the ATRA® Tendon Clip. Refer to the Slope Installation Manual for ATRA® Tendon Clip tie-off instructions.

10. Repeat this process on each cell row tendon/ATRA® Tendon Clip run.
11. Place the collapsed section in the anchor trench, drive ATRA® Speed Stakes in the first row of cells so the arm of the anchor engages with the top of the cell wall and expand down the slope. Number of anchors shall be per the Contract Documents.
12. Adjust the section (i.e. a shake or two of the expanded section works well for this) so that the section and tendons are uniformly taut.
13. After the sections are expanded, drive ATRA® Speed Stake so the arm of the stake engages with the top of the cell wall.
14. Anchorage pattern and stake length shall be as indicated on the Contract Documents.
15. Terminate the bottom of the tendons with ATRA® Tendon Clips.
16. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.

#### Alternate Method – On Slope Installation

1. Excavate the anchor trench at the top of the slope to the depth as shown on the Contract Documents.
2. Position collapsed sections at the crest of the slope.
3. Feed precut lengths of specified tendon material through the I-slots in the cell walls before expanding individual sections into position. Number of tendons per section shall be per the Contract Documents. Leave the trailing length of the tendon on the upslope side of the section to allow for connection of the ATRA® Tendon Clips.
4. Place the collapsed section in the anchor trench, drive ATRA® Anchors in the first row of cells so the arm of the anchor engages with the top of the cell wall and expand down the slope.
5. Install the ATRA® Tendon Clips at the locations indicated on the Contract Documents.
6. Hold the tendon and connect to each ATRA® Tendon Clip. Refer to the Slope Installation Manual for ATRA® Tendon Clip tie-off instructions.
7. Adjust the section (i.e. a shake or two of the expanded section works well for this) so that the section and tendons are uniformly taut.
8. After the sections are expanded as desired, drive ATRA® Speed Stake so the arm of the stake engages with the top of the cell wall.
9. Anchorage pattern and stake length shall be as indicated on the Contract Documents.
10. Terminate the bottom of the tendons as required.
11. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.

#### L. Anchorage with Tendons, ATRA® Tendon Clips and ATRA® GFRP Anchors

##### Preferred Method – Top of Slope Installation

1. Excavate the anchor trench at the top of the slope to the depth as shown on the Contract Documents.
2. Position the collapsed sections at the crest of the slope.
3. Measure and cut the tendon run lengths for each tendon location.
4. Mark the tendons with a black permanent marker per the ATRA® Tendon Clip Location Chart.
5. Thread the tendons through the unexpanded section.
6. Starting from the first cell, count the number of cells to the next ATRA® Tendon Clip location and

repeat along that cell row.

7. Repeat this procedure for each additional cell row tendon/ATRA® Tendon Clip run.
8. With all the ATRA® Tendon Clips placed in the section, thread the tendons through the cell wall I-slots in the unexpanded section.
9. Locate the corresponding mark on the Tendon and position it in front of the cell wall. Hold the tendon and connect to the ATRA® Tendon Clip. Refer to the Slope Installation Manual for ATRA® Tendon Clip tie-off instructions.
10. Repeat this process on each cell row tendon/ATRA® Tendon Clip run.
11. Place the collapsed section in the anchor trench, drive ATRA® GFRP Anchors in the first row of cells so the arm of the anchor engages with the top of the cell wall and expand down the slope. Number of anchors shall be per the Contract Documents.
12. Adjust the section (i.e. a shake or two of the expanded section works well for this) so that the section and tendons are uniformly taut.
13. After the sections are expanded, drive ATRA® GFRP Anchors so the arm of the stake engages with the top of the cell wall.
14. Anchorage pattern and stake length shall be as indicated on the Contract Documents.
15. Terminate the bottom of the tendons with ATRA® Tendon Clips.
16. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.

#### Alternate Method – On Slope Installation

1. Excavate the anchor trench at the top of the slope to the depth as shown on the Contract Documents.
2. Position collapsed sections at the crest of the slope.
3. Feed precut lengths of specified tendon material through the I-slots in the cell walls before expanding individual sections into position. Number of tendons per section shall be per the Contract Documents. Leave the trailing length of the tendon on the upslope side of the section to allow for connection of the ATRA® Tendon Clips.
4. Place the collapsed section in the anchor trench, drive ATRA® GFRP Anchors in the first row of cells so the arm of the anchor engages with the top of the cell wall and expand down the slope.
5. Install the ATRA® Tendon Clips at the locations indicated on the Contract Documents.
6. Hold the tendon and connect to each ATRA® Tendon Clip. Refer to the Slope Installation Manual for ATRA® Tendon Clip tie-off instructions.
7. Adjust the section (i.e. a shake or two of the expanded section works well for this) so that the section and tendons are uniformly taut.
8. After the sections are expanded as desired, drive ATRA® GFRP Anchors so the arm of the stake engages with the top of the cell wall.
9. Anchorage pattern and stake length shall be as indicated on the Contract Documents.
10. Terminate the bottom of the tendons as required.
11. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.

#### M. Anchorage with Tendons, ATRA® Tendon Clips and Pipe Deadman Anchorage

##### Preferred Method – Top of Slope Installation

1. Excavate the anchor trench at the top of the slope to the depth as shown on the Contract Documents.

2. Install pipe Deadman in anchor trench. Pipe type, diameter and thickness shall be as shown on the Contract Documents.
3. Position the collapsed sections at the crest of the slope.
4. Measure and cut the tendon run lengths for each tendon location allowing extra length to connect to deadman anchor.
5. Mark the tendons with a black permanent marker per the ATRA® Tendon Clip Location Chart.
6. Thread the tendons through the unexpanded section.
7. Starting from the first cell, count the number of cells to the next ATRA® Tendon Clip location and repeat along that cell row.
8. Repeat this procedure for each additional cell row tendon/ATRA® Tendon Clip run.
9. With all the ATRA® Tendon Clips placed in the section, thread the tendons through the cell wall I-slots in the unexpanded section.
10. Locate the corresponding mark on the Tendon and position it in front of the cell wall. Hold the tendon and connect to the ATRA® Tendon Clip. Refer to the Slope Installation Manual for ATRA® Tendon Clip tie-off instructions.
11. Repeat this process on each cell row tendon/ATRA® Tendon Clip run.
12. Place the collapsed section in the anchor trench, connect tendons to the deadman anchor and expand down the slope.
13. Adjust the section (i.e. a shake or two of the expanded section works well for this) so that the section and tendons are uniformly taut.
14. Terminate the bottom of the tendons with ATRA® Tendon Clips.
15. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.

**Alternate Method – On Slope Installation**

1. Excavate the anchor trench at the top of the slope to the depth as shown on the Contract Documents.
2. Install pipe Deadman in anchor trench. Pipe type, diameter and thickness shall be as shown on the Contract Documents.
3. Position collapsed sections at the crest of the slope.
4. Feed precut lengths of specified tendon material through the I-slots in cell walls before expanding individual sections into position. Number of tendons per section shall be per the Contract Documents. Leave the trailing length of the tendon on the upslope side of the section to allow for connection to deadman anchor.
5. Place the collapsed section in the anchor trench, connect tendon to deadman anchor and expand down the slope.
6. Install the ATRA® Tendon Clips at the locations indicated on the Contract Documents.
7. Hold the tendon and connect to each ATRA® Tendon Clip. Refer to the Slope Installation Manual for ATRA® Tendon Clip tie-off instructions.
8. Adjust the section (i.e. a shake or two of the expanded section works well for this) so that the section and tendons are uniformly taut.
9. Terminate the bottom of the tendons with ATRA® Tendon Clips.
10. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.

**N. Anchorage with Tendons, ATRA® Tendon Clips and Earth Anchors**

**Preferred Method – Top of Slope Installation**

1. Excavate the anchor trench at the top of the slope to the depth as shown on the Contract Documents.
2. Position the collapsed sections at the crest of the slope.
3. Measure and cut the tendon run lengths for each tendon location allowing extra length to connect to earth anchor.
4. Mark the tendons with a black permanent marker per the ATRA® Tendon Clip Location Chart.
5. Thread the tendons through the unexpanded section.
6. Starting from the first cell, count the number of cells to the next ATRA® Tendon Clip location and repeat along that cell row.
7. Repeat this procedure for each additional cell row tendon/ATRA® Tendon Clip run.
8. With all the ATRA® Tendon Clips placed in the section, thread the tendons through the I-slots in the unexpanded section.
9. Locate the corresponding mark on the Tendon and position it in front of the cell wall. Hold the tendon and connect to the ATRA® Tendon Clip. Refer to the Slope Installation Manual for ATRA® Tendon Clip tie-off instructions.
10. Repeat this process on each cell row tendon/ATRA® Tendon Clip run.
11. Install earth anchors in accordance with Manufacturer's recommendations and instructions. Earth anchor type and strength shall be as shown on the Contract Documents.
12. Place the collapsed section in the anchor trench, secure tendons to earth anchors and expand down the slope.
13. Adjust the section (i.e. a shake or two of the expanded section works well for this) so that the section and tendons are uniformly taut.
14. Terminate the bottom of the tendons with ATRA® Tendon Clips.
15. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.

**Alternate Method – On Slope Installation**

1. Excavate the anchor trench at the top of the slope to the depth as shown on the Contract Documents.
2. Position collapsed sections at the crest of the slope.
3. Feed precut lengths of specified tendon material through the I-slots in the cell walls before expanding individual sections into position. Number of tendons per section shall be per the Contract Documents. Leave the trailing length of the tendon on the upslope side of the section to allow for connection of the ATRA® Tendon Clips.
4. Install earth anchors in accordance with Manufacturer's recommendations and instructions. Earth anchor type and strength shall be as shown on the Contract Documents.
5. Place the collapsed section in the anchor trench, secure tendons to earth anchors, and expand down the slope.
6. Install the ATRA® Tendon Clips at the locations indicated on the Contract Documents.
7. Hold the tendon and attach to the ATRA® Tendon Clips. Refer to the Slope Installation Manual for ATRA® Tendon Clip tie-off instructions.
8. Adjust the section (i.e. a shake or two of the expanded section works well for this) so that the section and tendons are uniformly taut.
9. Terminate the bottom of the tendons with ATRA® Tendon Clips.

10. Fill the anchorage trench with the specified material and compact as required by the Contract Documents.

Specifier Note: Specify infill type from sections O-R below and delete those not required. Choice should coordinate with Section 2.6.

**O. Sand Infill Placement**

1. Place the specified aggregate infill with suitable material handling equipment.
2. Infill material shall be free-flowing and not frozen when placed in the GEOWEB® sections.
3. Overfill cells with aggregate infill material. Limit the drop height of infill material to avoid damage or displacement of the cell wall.
4. Level surface approximately 2 inches (50 mm) above cell walls. Maintain a 2-inch wear surface over the GEOWEB® sections to prevent damage to the cell walls.
5. Compact infill to a minimum of 95 percent Standard Proctor.
6. Shape compacted surface to required elevation as indicated on the drawings.

**P. Crushed Aggregate Infill Placement**

1. Place the specified aggregate infill with suitable material handling equipment.
2. Infill material shall be free-flowing and not frozen when placed in the GEOWEB® sections.
3. Overfill cells with aggregate infill material. Limit the drop height of infill material to avoid damage or displacement of the cell wall.
4. Level surface approximately 2 inches (50 mm) above cell walls. Maintain a 2-inch wear surface over the GEOWEB® sections to prevent damage to the cell walls.
5. Compact infill to a minimum of 95 percent Standard Proctor.
6. Shape compacted surface to required elevation as indicated on the drawings.

**Q. Concrete Infill Placement**

1. Concrete shall be placed, finished and cured in accordance with the Contract Documents.
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 avoid distortion 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. Adjust the slump in the field to allow installation.
6. The concrete shall be thoroughly compacted by means of an approved vibrator, with the period of vibration being not less than 2 seconds or more than 5 seconds at any one point.
7. Finish the concrete flush with the top of the GEOWEB® cell walls.
8. Apply specified finish.

**R. Engineered Infill Placement**

1. Place the specified engineered infill with suitable material handling equipment.
2. Infill material shall be free-flowing and not frozen when placed in the GEOWEB® sections.

3. Overfill cells with engineered infill material. Limit the drop height of infill material to avoid damage or displacement of the cell wall.
4. Level surface approximately 2 inches (50 mm) above cell walls. Maintain a 2-inch wear surface over the GEOWEB® sections to prevent damage to the cell walls.
5. Compact infill to a minimum of 95 percent Standard Proctor.
6. Shape compacted surface to required elevation as indicated on the drawings.

Specifier Note: Delete if a Base Stabilization Wearing Surface is not required.

**S. Base Stabilization Wearing Surface**

1. Ensure a minimum 2 in (50 mm) overfill is placed and compacted over the GEOWEB® sections prior to placing the wearing surface.
2. The wearing surface shall be as specified in the Contract Documents.

Specifier Note: Delete if a vegetated surface is not required. Vegetation surface wearing course is typically associated with Engineered Infill.

**T. Surface Treatment**

1. Surface protection shall be installed immediately after placement of the infill material and secured per the Manufacturer's instructions.
2. Vegetation shall be placed and protected as specified in the Contract Documents.
3. Install vegetation immediately after the engineered infill is placed.

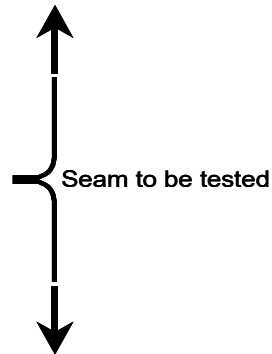


## Appendix A

### 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.

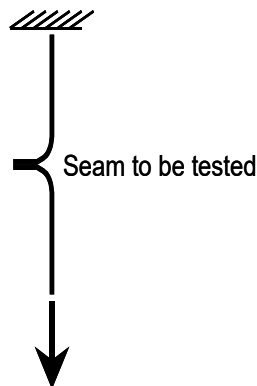


Figure B1

#### 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**