SECTION 31 32 00

SOIL STABILIZATION, CELLULAR CONFINEMENT SYSTEMS

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\*\* NOTE TO SPECIFIER \*\* Geo Products, LLC; geocells for soil confinement system, slope erosion protection, channel protection, retaining walls and accessories.  
This section is based on the products of Geo Products, LLC, which is located at:12626 N. Houston Rosslyn Rd.Houston, TX 77086Tel: 281-820:5493Fax: 281-820:5499Email: [request info (kroecker@geoproducts.org)](https://arcat.com/rfi?action=email&company=Geo%252BProducts%252C%252BLLC&message=RE%253A%2520Spec%2520Question%2520(02370gpl)%253A%2520&coid=47197&spec=02370gpl&rep=&fax=%2520281-820%253A5499)  
Web: <http://www.geoproducts.org>   
 [ [Click Here](https://arcat.com/company/geo-products-llc-47197) ] for additional information.  
Geo Products specializes in offering a range of high-quality polyethylene products, tailored to your needs.  
Since 1990, Geo Products has manufactured the EnviroGrid geocell, cellular confinement system for soil stabilization, slope and channel erosion control and retaining walls. The honeycomb structure can be filled with various materials and provides a green construction solution. Manufactured by ultrasonically welded high-density polyethylene (HDPE), the geocell is designed for long term use and critical applications. Geomembrane liner fabrication and installation is offered in order to provide a customized product, suited for any specification.  
Geo Products manufacturing plant is located in Houston, Texas USA and is ISO 9001:2015 and CE certified, as well as certified by the Ministry of Transport for the Russian Federation and the Ministry of Public Works in Panama (MOP). In addition, EnviroGrid is an approved material for multiple State Departments of Transportation within the United States. Geo Products sells the products through a global distributor network spanning all 7 continents and over 50 countries.  
Geo Products recognizes that construction generally leaves a significant footprint upon the environment, and therefore seeks to reduce any impact that our EnviroGrid incurs upon the landscape. The limited amount of infill required for EnviroGrid as opposed to conventional construction methods, as well as the lower quality needed, offers not only a much softened blow to the environment but also reduces project engineering, length, and cost. As an industry leader with projects worldwide, Geo Products is committed to providing innovative and cost-effective products in order to supply leading-edge solutions to any soil stabilization problem or liner need. Our goal is to provide superior quality material and specific project design development assistance, backed by over 30 years of experience.

1. GENERAL
   1. SECTION INCLUDES

\*\* NOTE TO SPECIFIER \*\* Delete items below not required for project.

* + 1. Cellular confinement system for soil stabilization. (EnviroGrid EGA 20) (EnviroGrid 30) (EnviroGrid EGA 40)
    2. Cellular confinement system for slope protection. (EnviroGrid EGA 20) (EnviroGrid 30) (EnviroGrid EGA 40)
    3. Cellular confinement system for earth retention. (EnviroGrid EGA 20) (EnviroGrid 30) (EnviroGrid EGA 40)
    4. Cellular confinement system for channel protection. (EnviroGrid EGA 20) (EnviroGrid 30) (EnviroGrid EGA 40)
    5. Cellular confinement system for load support. (EnviroGrid EGA 20) (EnviroGrid 30) (EnviroGrid EGA 40)
  1. RELATED SECTIONS

\*\* NOTE TO SPECIFIER \*\* Delete any sections below not relevant to this project; add others as required.

* + 1. Section 31 20 00 - Earth Moving.
    2. Section 31 23 23.13 - Backfill.
    3. Section 31 35 23 - Slope Protection with Slope Paving.
    4. Section 31 32 13.13 - Asphalt Soil Stabilization.
    5. Section 31 25 00 - Erosion and Sedimentation Controls.
    6. Section 03 30 00 - Cast-in-Place Concrete.
  1. REFERENCES

\*\* NOTE TO SPECIFIER \*\* Delete references from the list below that are not actually required by the text of the edited section.

* + 1. American Association of State Highway and Transportation Officials (AASHTO):
       1. AASHTO M 218 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) for Corrugated Steel Pipe.
       2. AASHTO M 288 - Standard Specification for Geotextile Specification for Highway Applications.
    2. ASTM International (ASTM):
       1. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
       2. ASTM D1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
       3. ASTM D1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique.
       4. ASTM D1603 - Standard Test Method for Carbon Black in Olefin Plastics.
       5. ASTM D5199 - Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.
       6. ASTM D5394 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
       7. ASTM D1693 - Environmental Stress Cracking of Ethylene Plastic
       8. ASTM D5596 - Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
       9. ASTM D5721 - Standard Practice for Air-Oven Aging of Polyolefin GeomembranesASTM D5885 - Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry.
       10. ASTM D6693 - Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.
       11. ASTM D7328 - Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus.
    3. Geosynthetic Research Institute (GRI):
       1. GS13 - Standard Guide for Geomembrane-Related Geocell Seam Strength and Its Efficiency With Respect to the Perforated Sheet Strength.
       2. GS14 - Standard Test Method for Average Wall Thickness of a Geomembrane-Related Geocell by Indirect Measurement.
    4. International Organization for Standardization (ISO):
       1. ISO 9001 - Certification for Quality.
    5. US Army Corps of Engineers (USACE):
       1. Technical Report GL-86, Appendix A.
  1. SUBMITTALS
     1. Submit under provisions of Section 01 30 00 - Administrative Requirements.
     2. Product Data:
        1. Manufacturer's data sheets on each product to be used.
        2. Preparation instructions and recommendations.
        3. Storage and handling requirements and recommendations.
        4. Typical installation methods.
     3. Shop Drawings: Including but not limited to details of materials, construction dimensions, section layout, cell depth, system components and relationship with adjacent construction.
     4. Verification Samples: Two representative units of each type.
     5. Manufacturer's Certificate of Compliance: Indicate geocells comply with specified requirements including, but not limited to, minimum seam strengths.
     6. Manufacturer's Certificate of Analysis: Containing the following test results for the project-specific cellular confinement material to ensure compliance:
        1. Base resin lot numbers.
        2. Resin density per ASTM D1505.
        3. Production lot numbers.
        4. Material thickness per ASTM D5199.
        5. Sheet thickness per GRI-GS14.
        6. Short term seam peel strength per USACE Technical Report GL-86, Appendix A.
        7. Carbon black percentage.
     7. Quality Assurance Certification: Submit manufacturer's ISO 9001 and CE quality assurance certifications.
     8. If required, provide calculations for the recommended anchor system, tendon system or anchor trenches.
        1. Include design conditions, slope stability calculations, and friction angles. Provide the number of stakes, stake length, attachment device, and spacing.
        2. Include design conditions, slope stability calculations, calculated factors of safety, friction angles. Provide the number of tendons, tendon type, load transfer device, and spacing.
        3. Provide the pipe type and diameter, or the minimum anchor pullout strength, and calculations for the recommended crest anchorage system.
  2. QUALITY ASSURANCE
     1. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum 20 years documented experience producing cellular confinement systems.
        1. Raw Material Sourcing: The cellular confinement system material must be manufactured with raw materials produced in the USA.
        2. Quality Management System: The manufacturer's quality management system shall be certified and in accordance with ISO 9001 and CE certification.
        3. Alternate materials submitted must provide a certification that the 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.
        4. An ISO certification for the substitute material will not be acceptable unless it is proven it pertains specifically to the geocell manufacturing operations.
        5. In addition, submit a certification for alternate materials showing that the cellular confinement material meets product specifications per CE Declaration of Performance.
     2. Manufacturer's Field Representative Qualifications: Manufacturer shall provide a qualified field representative experienced in cellular confinement system installation.
     3. Installer Qualifications: Company experienced in cellular confinement system installation with minimum 5 years documented experience with projects of similar scope and complexity or company has been trained by Geo Products or a Geo products distributor.
     4. Source Limitations: Each type of product from a single manufacturing source to ensure uniformity.

\*\* NOTE TO SPECIFIER \*\* Include mock-up if the project size or quality warrant the expense. The following is one example of how a mock-up on might be specified. When deciding on the extent of the mock-up, consider all the major different types of work on the project.

* + 1. Mock-Up: Construct a mock-up with actual materials in sufficient time for Architect's review and to not delay construction progress. Locate mock-up as acceptable to Architect and provide temporary foundations and support.
       1. Intent of mock-up is to demonstrate quality of workmanship.
       2. If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
       3. Retain mock-up during construction as standard for comparison with completed work.
       4. Do not alter or remove mock-up until work is completed or removal is authorized.
  1. PRE-INSTALLATION CONFERENCE
     1. Convene a conference approximately two weeks before scheduled commencement of the Work. Attendees shall include Contractor, Engineer, installer, manufacturer's representative and trades involved. Agenda shall include schedule, responsibilities, critical path items and approvals.
  2. DELIVERY, STORAGE, AND HANDLING

\*\* NOTE TO SPECIFIER \*\* Material shall be shipped flat, unfolded, on 12 ft (3658 mm) pallets to ensure proper expansion upon arrival to jobsite. 4 ft (1219 mm) pallets may be substituted if approved by Engineer.

* + 1. Deliver materials to site in manufacturer's original, unopened pallets and packaging, with labels clearly identifying product name and manufacturer.
    2. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
    3. Protect from damage due to weather, excessive temperature, and construction operations.
  1. PROJECT CONDITIONS
     1. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.
     2. If ambient conditions are not met at the time of delivery, manufacturer reserves the right to void the warranty.
  2. WARRANTY

\*\* NOTE TO SPECIFIER \*\* See manufacturer's literature for full details and conditions of 10 year limited warranty. This warranty is intended for commercial use only and is not in effect for the consumer as defined in the Magnuson-Moss Warranty Act.

* + 1. Manufacturer's Standard Limited Warranty: Against defects in materials and workmanship at the time of manufacture for a period of 10 years of normal use and service.

1. PRODUCTS
   1. MANUFACTURERS
      1. Acceptable Manufacturer: Geo Products, LLC, which is located at:12626 N. Houston Rosslyn Rd.Houston, TX 77086Tel: 281-820:5493Fax: 281-820:5499Email: [request info (kroecker@geoproducts.org)](https://arcat.com/rfi?action=email&company=Geo%252BProducts%252C%252BLLC&message=RE%253A%2520Spec%2520Question%2520(02370gpl)%253A%2520&coid=47197&spec=02370gpl&rep=&fax=%2520281-820%253A5499);Web: <http://www.geoproducts.org>

\*\* NOTE TO SPECIFIER \*\* Delete one of the following two paragraphs; coordinate with requirements of Division 1 section on product options and substitutions.

* + 1. Substitutions: Not permitted.
    2. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.
  1. CELLULAR CONFINEMENT SYSTEM

\*\* NOTE TO SPECIFIER \*\* Delete basis of design paragraphs and options not required.

* + 1. Basis of Design: EnviroGrid EGA 20 as manufactured by Geo Products, LLC.

\*\* NOTE TO SPECIFIER \*\* Delete application options not required.

* + - 1. Application: Cellular confinement system for slope protection.
      2. Application: Cellular confinement system for earth retention.
      3. Application: Cellular confinement system for channel protection.
      4. Application: Cellular confinement system for load support.
      5. Application: Cellular confinement system for soil stabilization
      6. Application: As indicated on Drawings.

\*\* NOTE TO SPECIFIER \*\* Delete cell depth options not required.

* + - 1. Cell Depth: 3 inches (75 mm).
      2. Cell Depth: 4 inches (100 mm).
      3. Cell Depth: 6 inches (150 mm).
      4. Cell Depth: 8 inches (200 mm).
      5. Cell Depth: As scheduled and indicated on Drawings.
      6. Color: Black.
      7. Nominal Expanded Cell Size: 10.2 inches (259 mm) wide, 8.8 inches (224 mm) long.
      8. Nominal Expanded Cell Area: 44.8 square inches (289 sq cm).
      9. Nominal Expanded Section: 8.4 ft (2.56 m) wide, 21.4 feet (6.52 m) long.
      10. Cells per Section: 10 cells wide, 29 cells long.
      11. Nominal Expanded Section Area: 180 square ft (16.7 sq m).
      12. Weld Spacing: 14.0 inches plus or minus 0.12 inch (355 mm plus or minus 3 mm).
    1. Basis of Design: EnviroGrid EGA 30 as manufactured by Geo Products, LLC.

\*\* NOTE TO SPECIFIER \*\* Delete application options not required.

* + - 1. Application: Cellular confinement system for slope protection.
      2. Application: Cellular confinement system for earth retention.
      3. Application: Cellular confinement system for channel protection.
      4. Application: Cellular confinement system for load support.
      5. Application: Cellular confinement system for soil stabilization
      6. Application: As indicated on Drawings.

\*\* NOTE TO SPECIFIER \*\* Delete cell depth options not required.

* + - 1. Cell Depth: 3 inches (75 mm).
      2. Cell Depth: 4 inches (100 mm).
      3. Cell Depth: 6 inches (150 mm).
      4. Cell Depth: 8 inches (200 mm).
      5. Cell Depth: As scheduled and indicated on Drawings.
      6. Color: Black.
      7. Nominal Expanded Cell Size: 12.6 inches (320 mm) wide, 11.3 inches (287 mm) long.
      8. Nominal Expanded Cell Area: 71.3 square inches (460 sq cm).
      9. Nominal Expanded Section: 8.4 ft (2.56 m) wide, (27.4 ft (8.35 m) long.
      10. Cells per Section: 8 cells wide by 29 cells long.
      11. Nominal Expanded Section Area: 230 square ft (21.4 sq m).
      12. Weld Spacing: 17.5 inches plus or minus 0.12 inch (446 mm plus or minus 3 mm).
    1. Basis of Design: EnviroGrid EGA 40 as manufactured by Geo Products, LLC.

\*\* NOTE TO SPECIFIER \*\* Delete application options not required.

* + - 1. Application: Cellular confinement system for slope protection.
      2. Application: Cellular confinement system for earth retention.
      3. Application: Cellular confinement system for channel protection.
      4. Application: Cellular confinement system for load support.
      5. Application: Cellular confinement system for soil stabilization
      6. Application: As indicated on Drawings.

\*\* NOTE TO SPECIFIER \*\* Delete cell depth options not required.

* + - 1. Cell Depth: 3 inches (75 mm).
      2. Cell Depth: 4 inches (100 mm).
      3. Cell Depth: 6 inches (150 mm).
      4. Cell Depth: 8 inches (200 mm).
      5. Cell Depth: As scheduled and indicated on Drawings.
      6. Color: Black.
      7. Nominal Expanded Cell Size: 20 inches (508 mm) wide, 18.7 inches (475 mm) long.
      8. Nominal Expanded Cell Area: 187 square inches (1206 sq cm).
      9. Nominal Expanded Section: 8.4 ft (2.56 m) wide by 45 ft (13.72 m) long.
      10. Cells per Section: 5 cells wide, 29 cells long.
      11. Nominal Expanded Section Area: 378 square ft (35.14 sq m).
      12. Weld Spacing: 28.0 inches plus or minus 0.12 inch (711 mm plus or minus 3 mm).
    1. Material Properties: Virgin, non-thermally degraded, high-density polyethylene (HDPE); no post-consumer resins (PCR) of any type are added to the formulation.
       1. Polymer Density, ASTM D1505: 58.4 - 60.2 lbs per cu ft (0.935 - 0.965 grams per cu cm).
       2. Environmental Stress Crack Resistance, ASTM D5394: Greater than 400 hours.
       3. Environmental Stress Crack Resistance, ASTM D1693: 6000 hours.
       4. Minimum Carbon Black Content, ASTM D1603: 1.5 percent by weight.
       5. Carbon Black Dispersion, ASTM D5596.
       6. Nominal Sheet Thickness by Weight, GRI-GS14: 50 mils (1.25 mm) plus or minus 10 percent.
       7. Nominal Sheet Thickness, Smooth Sheet, ASTM D5199: 50 mils (1.25 mm) plus 10 percent, minus 5 percent.
       8. Nominal Sheet Thickness, Textured Sheet, ASTM D5199: 60 mils (1.50 mm) plus 10 percent, minus 5 percent.
       9. Seam Efficiency, Perforated Strip, GRI-GS13: 100 percent.
       10. Resistance to Oxidative Degradation (HPOIT), ASTM D5885: Over 400 minutes.
       11. UV Resistance, ASTM D7238: Over 50 percent HPOIT retained after 1500 hours.
       12. Polyethylene Strips:
           1. Indentations: Textured with rhomboidal (diamond shape) indentations.
           2. Surface Density of Indentations: 140 to 200 per in2 (22 to 31 per sq cm).
    2. Geocell Strain / Stress Properties:
       1. Geocell Strain-Stress: Provide manufacturer's large-scale field-testing data to verify 50 percent reduction in stress on base layer interface using poorly graded stone infill material. Test at 10,000 vertical cycles on minimum 49 cell test section at 80 psi (552 kPa). Lab testing is unacceptable.
          1. EV Ratio: Initial load modulus EV1 and reload modulus EV2 ratio to be less than 2.7.
          2. Static Load Test:

Initial Load: 70 psi (483 kPa).

Second Load: 100 psi (689 kPa).

Hold reload for three minutes.

* + 1. Cell Walls: Perforated.
       1. Perforations:
          1. For Cell Depths of 3 inches (75 mm) and 6 inches (150 mm): 15 to 17 percent of cell wall area is removed.
          2. For Cell Depths of 4 inches (100 mm) and 8 inches (200 mm): 11 to 13 percent of cell wall area is removed.
       2. Horizontal Rows: 0.4 inch (10 mm) diameter holes, 0.65 inch (16.6 mm) on center.
       3. Pattern: Staggered horizontal rows, hole centers separated 0.33 inch (8.3 mm).
       4. Edge of Cell Wall to Nearest Edge of Perforations: 0.31 inch (7.93 mm).
       5. Centerline of Weld to Nearest Edge of Perforations: 1.1 inches (27.9 mm) minimum.
       6. Slotting: Standard in the center of the non-perforated areas and at the center of each weld; 0.45 x 1.9 inches (11.4 mm x 48.3 mm).
    2. Seams:
       1. Minimum Seam Strength:
          1. Reports providing written certification of test results in compliance with minimum design requirements.
          2. Materials submitted with average or typical values will not be accepted.
       2. Seam Peel Strength: USACE Technical Report GL-86-19, Appendix A.

\*\* NOTE TO SPECIFIER \*\* Delete cell depth options not required.

* + - * 1. For 3 inches (75 mm) Cell Depth: 240 lb (1065 N).
        2. For 4 inches (100 mm) Cell Depth: 320 lb (1420 N).
        3. For 6 inches (150 mm) Cell Depth: 480 lb (2130 N).
        4. For 8 inches (200 mm) Cell Depth: 640 lb (2840 N).
      1. Seam Hang Strength: For 4 inch (102 mm) welded joints.
         1. Supports load of 160 lb (72.5 kg) for 30 days minimum.
         2. Supports load of 160 lb (72.5 kg) for 7 days minimum while undergoing temperature change from 74 degrees F (23 degrees C) to 130 degrees F (54 degrees C) on 1 hour cycle.
  1. INSTALLATION COMPONENTS

\*\* NOTE TO SPECIFIER \*\* Delete components not required.

* + 1. Panel Connection Components:
       1. Basis of Design: EnviroLock as supplied by Geo Products, LLC.
       2. Description: Injection molded, high-strength, UV stabilized, Nylon part used to connect geocell panels together at each fin and end to end connections.
       3. Connection Type: Mechanical across the full depth of the cell.
       4. Minimum Break Strength: 310 lb (140 kg).
       5. Color: Black, UV resistant.
    2. Anchoring Components:
       1. Basis of Design: EnviroClip as supplied by Geo Products, LLC.
          1. Materials: Galvanized steel conforming to ASTM A123.
          2. Dimensions: 2.56 inches (66 mm) wide, 1.57 inches (40 mm) tall.
       2. Twist Anchors: As manufactured by Geo Products, LLC.
          1. Materials: Galvanized steel conforming to ASTM A123.
          2. Fabrication:

Twist anchor head and installation chuck are fabricated in a way such that it allows the twist anchor to be installed to full depth without damaging the EnvioClip.

The Twist Anchor are fabricated in a way such that no washer is needed to be added to spread the load and secure the EnrioClip.

* + - * 1. Testing: The twist anchor must have supporting 3rd party testing available that provides pullout resistance in 3 separate soil types (clay, loam, sand).

\*\* NOTE TO SPECIFIER \*\* Select from the 4 options listed below based on soil type. TL-TA2, 12 inches (300 mm) is not available with EGA20 system. Delete twist anchor type options not required.

* + - * 1. Twist Anchor Type: TL-TA1, 8 inches (200 mm).
        2. Twist Anchor Type: TL-TA1, 12 inches (300 mm).
        3. Twist Anchor Type: TL-TA2, 8 inches (200 mm).
        4. Twist Anchor Type: TL-TA2, 12 inches (300 mm).
        5. Twist Anchor Type: As scheduled and indicated on Drawings.
      1. Steel Reinforcing Bars:

\*\* NOTE TO SPECIFIER \*\* Delete material options not required.

* + - * 1. Material: Uncoated steel.
        2. Material: Galvanized steel.
        3. Material: Epoxy coated steel.
        4. Material: As scheduled and indicated on Drawings.

\*\* NOTE TO SPECIFIER \*\* Delete material options not required.

* + - * 1. Diameter: 0.375 inch (10 mm).
        2. Diameter: 0.500 inch (12 mm).
        3. Diameter: 0.625 inch (16 mm).
        4. Diameter: 0.75 inch (20 mm).
        5. Diameter: As scheduled and indicated on Drawings.
        6. Length: As scheduled and indicated on the Drawings.

\*\* NOTE TO SPECIFIER \*\* Delete hook options not required.

* + - * 1. Hook: 180-degree bend.
        2. Hook: 45-degree bend.
        3. Hook: As scheduled and indicated on the Drawings.
      1. Fiberglass Reinforced Polymer (FRP) Reinforcing Bars:

\*\* NOTE TO SPECIFIER \*\* Delete diameter options not required.

* + - * 1. Diameter: 0.500 inch (12 mm).
        2. Diameter: As indicated on the Drawings.
        3. Length: As scheduled and indicated on the Drawings.
        4. Hook: As scheduled and indicated on the Drawings.
        5. Tensile Strength: 100 kpsi (689475 kPa).
      1. Straight Stakes: Support and anchor geocells.

\*\* NOTE TO SPECIFIER \*\* Delete material options not required.

* + - * 1. Material: Steel reinforcing bars, uncoated.
        2. Material: Steel reinforcing bars, galvanized.
        3. Material: Steel reinforcing bars, epoxy coated.
        4. Material: Wood.
        5. Material: As scheduled and indicated on Drawings.
        6. Diameter: As scheduled and indicated on the Drawings.
        7. Length: As scheduled and indicated on the Drawings.
    1. Tendon Anchorages:

\*\* NOTE TO SPECIFIER \*\* Delete option for woven polyester anchorages if not required.

* + - 1. Anchorage Materials: Woven polyester; high tenacity, industrial continuous filament, polyester yarn woven into a braided strap.
         1. Elongation: 9 to 15 percent at break.

\*\* NOTE TO SPECIFIER \*\* Delete woven polyester anchorage options not required.

* + - * 1. Woven Polyester Anchorages:

Type: PT2200 as supplied by Geo Products, LLC.

Minimum Break Strength: 2200 lbf (9.34 kN).

* + - * 1. Woven Polyester Anchorages:

Type: PT3285 as supplied by Geo Products, LLC.

Minimum Break Strength: 3285 lbf (14.6 kN).

* + - * 1. Woven Polyester Anchorages:

Type: PT5100 as supplied by Geo Products, LLC.

Minimum Break Strength: 5100 lbf (23.2 kN).

* + - * 1. Woven Polyester Anchorages:

Type: PT7700 as supplied by Geo Products, LLC.

Minimum Break Strength: 7700 lbf (35 kN).

* + - * 1. Woven Polyester Anchorages:

Type: PT11000 as supplied by Geo Products, LLC.

Minimum Break Strength: 11000 lbf (50 kN).

* + - * 1. Woven Polyester Anchorages:

Type: PT16500 as supplied by Geo Products, LLC.

Minimum Break Strength: 16500 lbf (75 kN).

* + - * 1. Woven Polyester Anchorages: Types as scheduled and indicated on Drawings.

\*\* NOTE TO SPECIFIER \*\* Delete option for woven Kevlar/Aramid anchorages if not required.

* + - 1. Anchorage Materials: Woven Kevlar/Aramid material woven into a strap.

\*\* NOTE TO SPECIFIER \*\* Delete woven Kevlar/Aramid anchorage options not required.

* + - * 1. Woven Kevlar/Aramid Anchorages:

Type: AT2500 as supplied by Geo Products, LLC.

Minimum Break Strength: 2500 lbf (11.1 kN).

* + - * 1. Woven Kevlar/Aramid Anchorages:

Type: AT2500 as supplied by Geo Products, LLC.

Minimum Break Strength: 3000 lbf (13.3 kN).

* + - * 1. Woven Kevlar/Aramid Anchorages:

Type: AT2500 as supplied by Geo Products, LLC.

Minimum Break Strength: 4000 lbf (17.8 kN).

* + - * 1. Woven Kevlar/Aramid Anchorages: Types as scheduled and indicated on Drawings.

\*\* NOTE TO SPECIFIER \*\* Delete option for woven polypropylene anchorages if not required.

* + - 1. Anchorage Materials: Woven polypropylene 3-strand twisted rope.
         1. Woven Polypropylene Anchorages: PPT2200 as supplied by Geo Products, LLC.
         2. Minimum Break Strength: 2200 lbf (9.34 kN).
  1. INFILL MATERIAL
     1. Cell Infill Materials: General.
        1. Infill material shall be free of any foreign material.
        2. Clays, silts and organic materials are not acceptable infill material.
        3. Infill material shall be free-flowing and not frozen when placed in the geocell sections.

\*\* NOTE TO SPECIFIER \*\* Cellular confinement systems allow the use of various types of infill materials for unique and aesthetic applications. Consult Geo Products for additional information. Modify the lines below as required to specify the required infill material. Delete cell infill material options not required.

* + 1. Cell Infill Materials: Sand.
    2. Cell Infill Material: Topsoil shall have an SCS texture of loam, sandy loam or silty loam. Topsoil shall be neither excessively acidic nor alkaline.
    3. Cell Infill Materials: Crushed aggregate with a maximum particle size of 1/3 depth of the cell with a fine content less than 10 percent.
    4. Cell Infill Materials: Concrete with a minimum strength of 3000 psi (20648 kPa) and air content of 2 to 4 percent in accordance with ACI and ASTM standards.
    5. Cell Infill Materials: Engineered fill consisting of topsoil and aggregate mixture for vegetated surfaces. Once placed, the engineered fill shall be compacted to a 95 percent Standard Proctor.
       1. Engineered infill composed of a mix of topsoil and aggregate having a homogeneous mixture of a clear crushed aggregate having an AASHTO No. 5 or similar designation blended with pulverized topsoil and a minimum 30 percent void space. The mixture will promote vegetation growth and provide structural support for air and/or water.
       2. Particle Size Range for Aggregate Portion: 0.375 to 1.0 inches (9.5 to 25 mm) with a D50 of 0.5 inches (13 mm).
       3. Percentage Void Space of Aggregate Portion: At least 30 percent when compacted
       4. Pulverized Topsoil Portion: 25 percent of the total volume.
       5. Topsoil: Blended with the aggregate to produce a homogeneous mixture.
    6. Cell Infill Materials: As scheduled and indicated on Drawings

\*\* NOTE TO SPECIFIER \*\* Delete the entire article below if nonwoven geotextiles are not required by the Engineer approved design.

* 1. ADDITIONAL GEOSYNTHETIC COMPONENTS
     1. Nonwoven Geotextiles: As specified in Division 31.
     2. Geomembrane Layers: As specified in the appropriate subdrainage sections as specified in the appropriate sections in Division 02 (33).
     3. Surface Protection: Consisting of erosion control blankets as specified in appropriate sections in Division 02 (31).
     4. Surface Protection: Consisting of turf reinforcement geosynthetic mats as specified in the appropriate sections in Division 02 (31).
     5. Turf Protection: Surface protection of hydroseed as specified in the appropriate sections in Division 02 (32).

1. EXECUTION
   1. EXAMINATION AND PREPARATION

\*\* NOTE TO SPECIFIER \*\* Many variables affect the preparation, installation, and performance of cellular confinement systems (geocells), including slope grade, subsurface stability, infill material, rainfall, artificial watering, hydraulic characteristics of the ground water flow, and subbase anchoring quality. Due to the large number of factors, it is difficult to apply exact parameters to individual applications without depending on engineering, design, and environmental inputs of on-site professionals.

* + 1. Examine and prepare areas to receive geocells using the methods recommended by the manufacturer for achieving best result for the project conditions.
       1. Prepare site by removing vegetative cover, debris, and unacceptable soils from area where geocells will be installed.
       2. Replace removed soils with acceptable materials.
       3. Complete earthwork, including toe-in trenches when required for slope or channel lining applications, as specified in Division 31.
    2. Do not proceed with preparation or installation until unacceptable conditions have been corrected have been prepared using the methods recommended by the manufacturer and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.
    3. If preparation is the responsibility of another installer, notify Engineer and Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
  1. INSTALLATION

\*\* NOTE TO SPECIFIER \*\* Contact Geo Products for application-specific installation instructions.

* + 1. Install geocells in accordance with manufacturer's instructions, approved submittals and in proper relationship with adjacent construction at locations indicated on the Drawings.

\*\* NOTE TO SPECIFIER \*\* Delete option below if nonwoven geotextiles are not required by the design.

* + - 1. Install nonwoven geotextiles as specified in Division 31.
      2. Install geocells in accordance with manufacturer's instructions at locations indicated on the drawings.
      3. Anchor geocell sections as necessary to resist sliding due to gravitational forces and sheet flow.
      4. Ensure top edges of adjoining cell walls are flush with each other and in proper alignment.
      5. Deliver infill material to geocells from top of slope or channel to bottom in accordance with manufacturer's instructions.
      6. Limit drop height of infill material to a maximum of 3 feet (1 m) to prevent damage to geocells.

\*\* NOTE TO SPECIFIER \*\* Delete two options below when using all infill materials, except concrete.

* + - 1. Overfill expanded geocell sections by 1 to 2 inches (25 to 50 mm) to allow for settling and compaction, when using granular infill materials.
      2. Compact granular infill materials to top of geocells to a minimum of 95 percent SPDD.

\*\* NOTE TO SPECIFIER \*\* Delete option below when using concrete as the infill material.

* + - 1. Manually rake and machine finish concrete infill material.
  1. CLEANING AND PROTECTION
     1. Clean and protect products in accordance with the manufacturer's recommendations.
     2. Repair or replace damaged products before work is covered, and before Substantial Completion.

END OF SECTION