

PRODUCT SPECIFICATION CSI FORMAT

Earth Retention System

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This specification utilizes the Construction Specifications Institute (CSI) Format, including MasterFormat (2004 Edition), SectionFormat, and PageFormat, contained in the CSI Manual of Practice. Optional text is indicated by brackets [ ], delete optional text in your final copy. Delete Specifier Notes which precede some sections. Each section must be carefully reviewed by the Engineer to meet the requirements of the project and local building code.

**SECTION 31 32 00**  
**SOIL STABILIZATION SYSTEM**

Specifier Notes: This section covers Cell-Tek Geosynthetics Earth Retention (geocell) Cellular Confinement System. The system is comprised of the following basic components: Verti-Cell™ (geocell), one or more infill materials, geotextiles, geogrids, earth anchoring devices, polymer tendons, geocomposite drainage materials, and surface treatments.

**PART 1 GENERAL**

Specifier Note: Revise any part of the sections below to suit project requirements.

**1.01 SUMMARY**

A. Cellular confinement system utilized for earth retention.

**1.02 RELATED SECTIONS**

A. Section 31 25 00 - Erosion and Sedimentation Control

B. Section 31 24 00 - Embankment

**1.03 REFERENCES**

A. AASHTO M 218 - Steel Sheet, Zinc-Coated (Galvanized) for Corrugated Steel Pipe

B. AASHTO M 288 - Geotextile Specification for Highway Applications

C. ASTM D 1505 - Density of Plastics by the Density-Gradient Technique

D. ASTM D 1693 - Environmental Stress-Cracking of Ethylene Plastics

E. ASTM D 5199 - Measuring Nominal Thickness of Geotextiles and Geomembranes

F. ASTM E 41 - Terminology Relating to Conditioning

#### 1.04 SYSTEM DESCRIPTION

Specifier Note: Edit the following as required for the project.

A. Cellular confinement system involves a three-dimensional geocell material into which specific infill materials are placed. It is composed of a set of recycled polyethylene strips which are ultrasonically welded together at certain intervals, creating seams aligned perpendicular to longitudinal axis of strips. When expanded, this structure creates a flexible, three dimensional matrix of connecting cells.

B. Complete earth retention system includes Verti-Cell™ sections, cell infill materials, [polyester tendons,] [stake anchors,] [geotextiles,] [geocomposite drainage materials,] [geogrids,] and [surface treatments].

#### 1.05 SUBMITTALS

A. Product Data: Submit product data provided by manufacturer.

B. Technical Drawings: Submit manufacturer's technical drawings including section layout, direction of expansion, [tendon locations], and [anchor stake locations].

C. Samples: Submit manufacturer's samples.

1. Geocell sections, including relevant color swatch of front panel
2. [Tendons]
3. [Stake anchors]
4. [Related geosynthetic components supplied under this section]
5. [Geotextile swatch]
6. [Stake anchors]
7. [Specimen of infill materials, if required]

D. Material Certification: Submit certifications of the polyethylene material used to make geocell material.

1. Certification of percentage of HALS provided by manufacturer
2. Certification of polyethylene density (ASTM D1505) and ESCR (ASTM D1693) provided by manufacturer

#### 1.06 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Quality management system certified to ISO 9001:2000.

B. Installation: Choose an installer with a satisfactory record of performance on projects of comparable size, complexity, and quality.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials in manufacturer's original packaging with identification labels clearly intact.

B. Storage:

1. Store materials per manufacturer's instructions.
2. Store materials out of direct sunlight.

C. Handling: Use care when unwrapping, handling, expanding, and infilling grid sections.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURER

A. Cell-Tek Geosynthetics LLC, 2431 Crofton Lane, Suite 9, Crofton, MD 21114  
Toll Free (888) 851-0051. Phone (410) 721-4844. Fax (410) 721-3844.  
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#### 2.02 Cell-Tek Verti-Cell™ CELLULAR CONFINEMENT SYSTEM

Specifier Notes: All measurements are subject to manufacturing tolerances, unless otherwise specified. For wall face panels, specify the desired color.

A. Base Materials:

1. Recycled Polyethylene Colored and Stabilized with HALS:
  - a. Density, ASTM D 1505: 0.9526 g/cm<sup>3</sup> (59.47 pounds per cubic foot)
  - b. Environmental Stress Crack Resistance (ESCR), ASTM D 1693: 3,500 hours
  - c. Available Colors: [Green], [Sand (tan color)], or [Pewter (grey color)]
  - d. Colorants: Non-heavy metal types, homogeneously distributed throughout material
  - e. Ultra-Violet Light Stabilization: Certified 1% HALS (Hindered Amine Light Stabilizer) content by weight, homogeneously distributed throughout material
- B. Strip Properties and Assembly:
  1. Perforated Textured Strip/Cell:
    - a. Strip Sheet Thickness, ASTM D 5199: 1.78 mm, minus 5 percent, plus 10 percent.
    - b. Polyethylene Strips: Textured surface with a multitude of rhomboidal (diamond shape) indentations.
    - c. Polyethylene Strips: Perforated with horizontal rows of 9.5 mm (0.37 inch) diameter holes.
    - d. Perforations Within Each Row: 20 mm (0.79 inch) on-center.
    - e. Horizontal Rows: Staggered and separated 13 mm (0.51 inch) relative to hole centers.
    - f. Edge of Strip to Nearest Edge of Perforation: 7.4 mm (0.29 inch) minimum.
    - g. Centerline of Spot Weld to Nearest Edge of Perforation: 18 mm (0.7 inch) minimum.
  2. Non-Perforated Textured Strip/Cell (FRONT PANEL ONLY)
    - a. Strip Sheet Thickness, ASTM D 5199: 1.78 mm, minus 5 percent, plus 10 percent.
    - b. Polyethylene Strips: Textured surface with a multitude of rhomboidal (diamond shape) indentations.
  3. Weld Spacing:
    - a. Weld spacing for Verti-Cell™ sections: 432 mm plus or minus 2.5 mm (17.0 inches plus or minus 0.10 inch)
- C. Cell Properties:
  1. Individual Cells: Uniform in shape and size when expanded.
  2. Individual Cell Dimensions  
Nominal Dimensions  $\pm$  10%
    - a. Length 315 mm (12.4 inches)
    - b. Width 271 mm (10.7 inches)
    - c. Nominal Area plus or minus 1%: 427 cm<sup>2</sup> (66 square inches)
    - d. Nominal Depth: 150 mm (6 inches)
- D. Cell Seam Strength Tests:
  1. Short-Term Seam Peel-Strength Test:
    - a. Cell Seam Strength: Uniform over full depth of cell.
    - b. Minimum Seam Peel Strength: 2,090 N (472 lbf) for 150 mm (6 inch) depth
  2. Long-Term Seam Peel-Strength Test:
    - a. Conditions: Minimum 7 days in a temperature-controlled environmental chamber that undergoes fluctuation on a 1-hour cycle from room temperature (per ASTM E 41) to 54 degrees C (130 degrees F).
    - b. Testing is conducted on 100 mm (4 inch) cell depth specimens.
    - c. Test Method: Seam shall support a 72.5 kg (160 pound) load for a minimum of 7 days.
- E. Section Type and Size:
  1. Cell Depth: 150 mm (6")
    - a. Section Length: 3.96 m (14 feet)
    - b. Section Width: 0.91 m (3 feet)
    - c. Section Area: 3.60 square meters (42 square feet)

### 2.03 TENDON REQUIREMENTS

Specifier Notes: Specify tendons required to meet design requirements by tendon style for the application. Consult Cell-Tek Geosynthetics for assistance.

#### A. Tendon Style:

1. [TES-1600] [TES-2100] [TES-3000]\*

\*Specifier Note: If engineer has specified break strength other than what is listed please consult Cell-Tek Geosynthetics for the proper tendon style.

a. Material: High-strength, continuous-filament polyester yarns woven into flat webbing

b. Elongation: 9 to 15 percent at break

2. [TPP-2000]

a. Material: Fibrillated polypropylene yarns woven into flat webbing

3. [TKS-Style]

a. Material: Kevlar® Aramid tendon is woven from polyimide yarns into flat webbing

### 2.04 ANCHORING COMPONENTS

Specifier Notes: Specify required anchoring components and delete the others. Choose from options for galvanizing and rod diameter for the steel stakes. Provide data for the wood stakes. Consult Cell-Tek Geosynthetics for assistance.

#### A. Steel J-Pin Stakes:

1. Material: Mild steel or reinforced steel rod

2. [Galvanizing: AASHTO M 218]

3. Return: Minimum-radius, 180-degree return at one end

4. Rod Diameter: [10 mm (0.375 inch)] [13 mm (0.50 inch)] [16 mm (0.625 inch)] [19 mm (0.75 inch)]

5. Stake Length: As indicated on the drawings

#### B. Straight Steel Stakes:

1. Material: Mild steel or reinforcing steel rod

2. [Galvanizing: AASHTO M 218]

3. Rod Diameter: [10 mm (0.375 inch)] [13 mm (0.50 inch)] [16 mm (0.625 inch)] [19 mm (0.75 inch)]

4. Stake Length: As indicated on the drawings

#### C. Wood Stakes:

1. Wood Type: \_\_\_\_\_, free of knots that may diminish strength

2. Cross Section: \_\_\_\_\_ by \_\_\_\_\_

3. Length: \_\_\_\_\_

### 2.05 RELATED GEOSYNTHETIC COMPONENTS

Specifier Notes: Specify related geosynthetic components required for the application. Consult Cell-Tek Geosynthetics for assistance in determining requirements.

A. Geotextiles: AASHTO M 288.

B. Geocomposite Drainage Materials:

C. Geogrid and Geotextile Sheet Reinforcement:

### 2.06 CELL INFILL MATERIALS

Specifier Notes: Specify cell infill materials based on nature and size of design loads. Specify combinations of infill types to meet required range of performance requirements. Consult Cell-Tek Geosynthetics for assistance in determining requirements.

A. Cell infill materials include one or a combination of the following:

1. Sand

2. Gravel and crushed rock or stone with a maximum particle size of 50 mm (2 inches) in retaining walls or multi-layer retention structures

3. Clays, silts, and organic soils are not acceptable infill material for internal cells for retaining walls or multi-layer retention structures.

4. For multi-layer retention structures, infill exposed outer cells with soil that supports vegetative cover.

## 2.07 SURFACE TREATMENTS

Specifier Note: Specify surface treatments of infilled geocell system.

A. Surface treatment includes one or a combination of the following:

1. Vegetation
2. Degradable revegetative blankets
3. Turf reinforcement mats
4. Sprayed emulsions and binders
5. Surface grouts

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Evaluate site conditions. Notify the Engineer and refrain from excavation until site conditions have been corrected.

B. Evaluate the layout of the project as indicated on the drawings. Notify the Engineer and do not proceed until the layout of the project matches the drawings.

### 3.02 INSTALLATION OF EARTH RETENTION SYSTEMS

A. Prepare subgrade and install according to manufacturer's instructions.

B. Subgrade Preparation:

1. Excavate and shape foundation soils as required to footing grades, elevations, and dimensions as indicated on the drawings or as directed by the Engineer.

2. Confirm foundation soil meets minimum strength requirements through proof rolling or other conventional method and is examined by the Engineer. If unacceptable foundation soils are encountered, excavate affected areas and replace these areas with suitable quality material as directed by the Engineer.

3. Install geotextile underlayer, confirming required overlaps are maintained and outer edges of geotextile are buried a minimum of 150 mm (6 inches).

C. Base and Footing Installation:

1. Place and shape granular base materials, complete with non-woven geotextile encapsulation if required. Compact to a minimum of 95 percent Standard Proctor Dry Density (SPDD).

2. Expand specified Verti-Cell™ sections into specified position on prepared base and temporarily anchor at corners and edges.

3. Overfill cells with selected granular infill. Maximum particle size of granular material shall not exceed 50 mm (2 inches). Level surface approximately 50 mm (2 inches) above cell walls.

4. Compact fill in cells to a minimum of 95 percent SPDD.

5. Place and compact fill to a minimum of 95 percent SPDD along each side of footing.

6. Remove excess infill so that infill materials are level with top of cells.

D. Drainage System Installation:

1. Install perforated subdrain pipe wrapped with nonwoven geotextile or backfill with clear stone adjacent to footing as indicated on the drawings. Be sure that a minimum longitudinal gradient of 1 percent is maintained. Connect subdrain pipes to specified outlets with T-connectors. Wrap outlet pipes which pass through footing or wall front panel with geotextile to preserve cell infill materials. Connect outlet pipes to site drainage system if present. Confirm that emission at outlet will not create localized erosion. Compact fill surrounding drainage system.

2. Place geotextile, if specified, over base and extend up face of excavation and pin in position. Maintain 0.3 m (12 inch) overlaps between sections of geotextile. Where geocomposite drainage materials are

specified, ensure each sheet or strip is continuous and fully encapsulated with geotextile and unrestricted outlet is provided.

#### E. Installation of Gravity Structure and Flexible Fascia System:

1. Expand Verti-Cell™ sections. Confirm each section is expanded uniformly using bent rebar expander tools, J-pins, or other suitable anchors positioned inside selected outer cells. Confirm they are correctly aligned. Interleaf or overlap edges of adjacent sections in each layer, joining the grid sections per the manufacturer's installation instructions. Anchor securely.

2. Overfill cells with granular infill and level surface approximately 50 mm (2 inches) above cell walls.

3. Compact cell infill and backfill materials to a minimum of 95 percent SPDD. Remove excess infill so that infill is level with top of cells. Limit amount of compaction within 1 m (3 feet) of Verti-Cell™ sections by using walk-behind compaction equipment. Ensure compaction activity is not laterally displacing Verti-Cell™ sections.

4. Subsequent Verti-Cell™ layers must be set back to produce required front face slope and side-to-side alignment to prevent loss of infill materials. Place select backfill material during infilling of Verti-Cell™ sections. Place backfill material behind Verti-Cell™ sections in maximum lifts of 250 mm (10 inches).

5. Fill and compact subsequent layers as specified.

6. Installation of freestanding Verti-Cell™ structures and vertical walls may require strips of non-woven geotextile along outer edge of infilled Verti-Cell™ section before adding the next layer.

7. If particular infill materials are specified for exposed face cells of Verti-Cell™ sections, check with the Engineer regarding filling procedures prior to execution. These may include, but are not limited to:

a. Temporarily cover outer cells to prevent spillage of other infills from entering those cells. Infill outer cells at the completion of each layer.

b. Partial spillage of internal infill material into outer cells may be acceptable depending on tolerance of special outer cell infill material. Final work on outer cells can be done separately after several Verti-Cell™ section layers are installed.

#### F. Installation of Reinforcement and Backfill:

1. Install geosynthetic reinforcement, (geogrid or geotextile), between Verti-Cell™ sections and extend horizontally into compacted backfill zone.

2. Place precut sections of reinforcement at specified elevations dimensioned and oriented as indicated on the drawings. Place reinforcement horizontally, with high-strength axis perpendicular to wall face at elevation indicated on the drawings or as directed by the Engineer. Extend outer edges of reinforcement to within 150 mm (6 inches) of front face of in-place Verti-Cell™ sections.

3. Place and infill next Verti-Cell™ layer as specified in paragraph E. "Installation of Gravity Structure and Flexible Fascia System" listed above.

4. Manually tighten reinforcement layer by pulling it away from the rear of Verti-Cell™ sections so it is taut. If necessary, pin reinforcement to eliminate loose folds during placement of backfill over reinforcement. Lay reinforcement layer flat when pulled back perpendicular to rear of Verti-Cell™ section.

5. Refrain from operating tracked equipment directly on top of reinforcement layer until a minimum thickness of 150 mm (6 inches) of backfill has been placed over reinforcement layer. Rubber-tired equipment may travel on top of reinforcement at slow speeds. Use caution and avoid sudden stops and sharp turns.

6. Place backfill within reinforced zone in approximate lifts of 250 mm (10 inches) and compact to a minimum of 95 percent SPDD. Excessive displacement of reinforcement should not occur during fill placement. Place backfill near Verti-Cell™ section and spread toward rear of reinforced soil zone. Shape and compact backfill level with Verti-Cell™ section before placing subsequent layers of reinforcement.

7. Place and compact retained soils, for fill situations, behind reinforced soil zone in approximate lifts of 250 mm (10 inches) and compact to a minimum of 95 percent SPDD.