Construction Specifications
Channel Protection

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work covered by this section includes the furnishing of all labor, materials, equipment and incidentals for construction and installation of the Geocellular Confinement System as shown on the Construction Drawings and described by the Contract Specifications.

B. Use of the Geocellular Confinement System to mechanically restrain the near surface zone of steep slopes which could otherwise slide due to self-weight or applied tractive loads. Applications include surface protection of steep reinforced-soil slopes, vegetated slope covers and protective covers on geomembrane slope installations.

C. Products and materials which form the system include: The cellular confinement sections, select infill materials, woven & nonwoven geotextiles, drainage composites, surface treatments, integral tendons, straight stake rebar anchors, galvanized staples.

1.02 RELATED WORK

A. Section [ ] - Earthwork, Subgrade preparation.

B. Section [ ] - Subsurface Drainage. Install drainage materials, as required, in areas where in-situ soils have poor permeability.

1.03 REFERENCES

A. AASHTO Specification M-288-00, ASTM D-1557 and relevant CSI (Construction Specifications Institute) Spec Data Documentation.

B. American Society for Testing and Materials (ASTM).

C. International Organization For Standardization (ISO).

D. Manufacturer's Technical Notes and Design and Installation Guidelines.

1.04 QUALITY ASSURANCE AND CERTIFICATION

A. Soil Stabilization Products Company, Inc. shall provide certification of compliance to all applicable testing procedures and related specifications upon written request. Request for certification shall be submitted no later than the date of order placement.

B. Soil Stabilization Products Company, Inc. shall have earned a certificate of registration, which demonstrates that its Total Quality Management system (TQM) for its Geocellular Confinement System is currently registered to the ISO 9002 quality standards (or latest ISO standard). The scope of the ISO 9002 registration shall be for the entire Geocellular Confinement System product manufacturing process from incoming raw materials (resin) to finished product. Earned registration shall be verifiable by providing a copy of the current continuous registration certificate upon the customers written request.

C. Material Substitutions: No material will be considered as an equivalent to the geocell materials specified herein unless it meets all areas of this specification without exception. Manufacturers seeking to supply what they represent as equivalent material must submit records, data, independent testing results, samples, certifications, and documentation deemed necessary by the Engineer to prove equivalency. The Engineer shall approve or disapprove other manufacturers materials within 60 days after all submitted information is studied and tested.

1.05 SYSTEM DESCRIPTION

A. Geocellular Confinement System consists of geocell material into which specific infill material may be placed. The Geocellular Confinement System section is an assembly of high-density polyethylene sheet strips,

connected by a series of ultrasonic welded seams. When expanded, the interconnected strips form the walls of a flexible, three-dimensional, honeycomb like, cellular structure.

B. The Geocellular Confinement System is produced in a range of cell depths. Standard cell depths are: 75 mm (3 in.), 100 mm (4 in.), 150 mm (6 in.) & 200 mm (8 in.)

1.06 SUBMITTALS

A. Submit shop drawings.

B. Submit product data, drawings and samples.

C. Soil Stabilization Products Company, Inc. shall provide a Manufacturer Qualified Representative (MQR) on site at the start of construction to provide the installing contractor and Project Engineer with technical support and information regarding installation of the Geocellular Confinement System. The MQR shall document a minimum of 5 years experience assisting with the installation of Geocellular Confinement Systems.

Submit qualifications of MQR. Request for qualifications of the MQR shall be submitted by the purchasing agency to Soil Stabilization Products Company, Inc. or the manufacturer's representative no later than the date of order placement. MQR's submittal shall include a written certification verifying that the MQR has completed a minimum of one manufacturer-sponsored technical training course of minimum duration of 20 hours in the design principles and installation practices of Geocellular Confinement Systems. The certificate submitted must show the name of the qualifying MQR, give the date and location where the training occurred and be signed by an authorized representative of Soil Stabilization Products Company, Inc. (the manufacturer). Availability of MQR personnel shall be subject to scheduling, fees for travel and per diem expenses.

D. Soil Stabilization Products Company, Inc. shall have earned a certificate of registration, which demonstrates that its quality-management system for its Geocellular Confinement System is currently registered to the ISO 9002 quality standards. The scope of the ISO 9002 registration shall be for the entire Geocellular Confinement System product manufacturing process from incoming raw materials (resin) to finished product. Earned registration shall be verifiable by providing a copy of the current continuous registration certificate upon the customer's written request. Under the scope of the ISO quality standard, Soil Stabilization Products Company, Inc. shall compile, keep record of, and provide for each customer order or production lot, actual and certified values for the following:

1. Resin Lot Number
2. Resin Density
3. Carbon Black content (where applicable)
4. High Pressure Oxidation Induction Time (HPOIT) (where applicable)
5. Sheet Thickness
6. Short-term Seam Peel Strength
7. Long-term Seam Peel Strength
    i. 7-day hot box method
8. 10,000 hour hang strength test

PART 2 PRODUCTS

2.01 MANUFACTURER and AVAILABILITY

A. SSP Geocell is supplied by Soil Stabilization Products Co., Inc., PO Box 2779, Merced, CA 95344. Phone: (800) 523-9992.

2.02 CELLULAR CONFINEMENT SYSTEM

A. Polyethylene Composition and System Properties

2.02 CELLULAR CONFINEMENT SYSTEM

A. Polyethylene Composition and System Properties

PROPERTY Value & Test Method

1) Resin Density	0.935 - 0.960 g/cm² (58.4-60.2 lb/ft²) per ASTM D 1505. Performed by Resin manufacturer. Results are verified on Certificate of Analysis that accompanies each lot number of resin received.
2) Carbon Black Content	1.5 - 2.0% by weight through the addition of a carrier with a certified carbon black content. Tested during manufacturing every 15,800 ft² of 203 mm (8.0 in) cell depth, every 20,000 ft² of 150 mm (6.0 in) cell depth, every 31,600 ft² of 102 mm (4.0 in) cell depth and every 40,000 ft² of 75 mm (3.0 in) cell depth.
3) Sheet Thickness	1.27 mm (50 mil) -5% + 10% per ASTM D 5199. Tested during manufacturing every 2,900 ft² of 203 mm (8.0 in) cell depth, every 3,800 ft² of 150 mm (6.0 in) cell depth, every 5,800 ft² of 102 mm (4.0 in) cell depth and every 7,600 ft² of 75 mm (3.0 in) cell depth.
4) Resin ESCR	Minimum 3000 hours per ASTM D374. Performed by Resin manufacturer. ESCR = Environmental Stress Crack Resistance
5) Short-Term Seam Peel Strength	See Appendix A.
6) Long-Term Seam Peel Strength	See Appendix B.
7) 10,000 hour hang strength	The manufacturer shall provide data showing that the high-density polyethylene resin used to produce the geocell sections has been tested using an appropriate number of seam samples and varying loads to generate data indicating that the seam peel strength shall support a loading of at least 52 kg (115 lbf) for a minimum of 10,000 hours without failure.

B. Surface Treatment

Performance: The peak friction angle between the surface of the perforated, textured plastic and a #40 silica sand at 100% relative density shall be no less than 85% of the peak friction angle of the silica sand in isolation when tested by the direct shear method per ASTM D 5321. The quantity of perforations shall remove 22.1% ± 0.5% of the cell wall area.

Material: The surface texturing shall be a multitude of rhomboidal (diamond shape) indentations. The rhomboidal indentations shall have a surface density of 22 - 31 per cm² (140 - 200 per in²). The thickness of the textured sheet shall be 1.52 mm ±0.15 mm (60 mil ± 6 mil) determined per ASTM D5199. The perforations shall be horizontal rows of 10 mm (0.391 in) diameter holes. Perforations within each row shall be 19 mm (0.75 in) on-center. Horizontal rows shall be staggered and separated 12 mm (0.50 in) relative to the hole centers. The edge of strip to the nearest edge of perforation shall be 8 mm (0.312 in) minimum and the centerline of the weld to the nearest edge of perforation shall be 18 mm (0.7 in) minimum.

C. **Assembly**

Standard Cellular Confinement System sections are fabricated using strips of sheet polyethylene each having a length of 3.61 m (142 in) and a width equal to the cell depth. The polyethylene strips shall be connected using uniformly-spaced, full-depth ultrasonic spot-welds. Welds shall be off-set and aligned perpendicular to the longitudinal axis of the strips. Weld spacing shall be 356 mm ± 2.5 mm (14 in. ± 0.10 in). The ultrasonic weld melt-pool width shall not exceed 25 mm (1.0 in).

Cellular confinement sections shall be made from high density polyethylene plastic. The polyethylene shall have properties per paragraph A above.

D. Geocell Dimensions and Weights

1. Individual cells of the standard Geocell section shall be uniform in shape and size when expanded. The nominal cell dimension, in expanded configuration, shall measure 8.6" (218 mm) in length (in the direction of expansion) with 0.25" (6 mm) tolerance and 10.5" (267 mm) in width. Expanded section size is 8.7' (2.65 m) x 24.25' (7.39 m).

   a. Cell Area: 47.9 in (309 cm) cell expanded (nominal area)

   b. Product Code: GC 20V61034P

   c. Cell depth: 6.0" (150 mm)

   d. Section weight: 85.21 lb (38.65 kg)

   e. Section width 8.7 ft (2.65 m)

   f. Section length 24.25 ft (7.39 m)

2.03 ANCHORING COMPONENTS

A. Integral High-Tenacity Polymer Tendons
Where required in project plans and specifications, Geocellular Confinement System sections shall be supplied with a series of aligned holes, pre-formed in the cell walls, to accommodate insertion of polymer tendons throughout their length.

B. Standard tendons shall be manufactured from bright, high-tenacity, industrial-continuous-filament polyester yarn woven into a braided strap. Elongation shall be 9-15% at break. The maximum and minimum dimensions of the tendon shall be given in addition to its minimum break strength. The tendon reference name and ultimate break strength shall be per the following:

Product:	Min. Break strength	Infill Type Notes
TP-31	700 lbs	May not be used with Concrete Infills
TPP-44	990 lbs	May not be used with Concrete Infills
TP-67	1506 lbs	May not be used with Concrete Infills
TK-89	2000 lbs	May be used with Concrete Infills
TP-93	2090 lbs	May be used with Concrete Infills
TK-133	3000 lbs	May be used with Concrete Infills

C. Straight Stake Anchors
Standard #4 steel construction rebar, diameter of 12.7 mm (½"). Project plans and specifications may call for alternate anchor types depending upon design requirements (e.g., GFRP anchors which may be specified for critical applications and severe service environments).

2.04 RELATED GEOSYNTHETIC COMPONENTS

A. Geotextiles
Geotextile materials shall meet appropriate durability, long-term strength, and soil interaction requirements. In the absence of local design and selection standards, the recommendations given in AASHTO M 288-00 shall be followed.

B. Geo-composite Drainage Systems
Geo-composite drainage systems, including geotextile wrapped perforated pipes and sheet drainage cores, may be incorporated as sub-drains and interceptor drains. Product selection and application shall be determined by the design engineer.

C. Geogrid and Geotextile Sheet Reinforcement
Sheet reinforcement materials shall meet appropriate durability, long-term strength, and soil interaction requirements. In the absence of local design and selection standards, the recommendations given in AASHTO M 288-00 shall be followed.

2.05 CELL INFILL MATERIALS

A. Selection of infill materials is based on several factors including: geometry of structure, the nature, magnitude and duration of anticipated hydraulic and mechanical stresses, and local climatic conditions. Combination of infill types can be specified and placed in various zones with the Geocellular Confinement System to meet a range of performance requirements.

B. Standard infill materials include:

1. Screened topsoil or sand

2. Gravel or crushed rock with a maximum particle size of 3" (75 mm).

3. Concrete and soil-cement mixes.

2.06 SURFACE TREATMENTS

1. Degradable re-vegetation blankets.
2. Sprayed emulsions and binders.
3. Concrete and soil-cement mixes.
4. Grass seed or vegetation

PART 3 INSTALLATION

3.01 EXAMINATION

A. Verify that site conditions are as indicated on Construction Drawings. Examine subgrade (native soil) conditions to ensure soil is structurally adequate to support slope cover materials. Do not start infill placement until unsatisfactory conditions are corrected. Check for insufficient compaction, slumping areas, improper gradients, debris, and improper drainage.

B. Verify that all materials required for the work and delivered to site comply with contract specifications. Contact the project engineer for resolution of unsatisfactory conditions. Installation of materials constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 SITE and SUBGRADE PREPARATION

A. Following bulk excavation and fill placement operations, shape and compact the subgrade surfaces to the profiles, lines and grades shown on the Construction Drawings.

B. Remove unstable subgrade soils and replace with approved compacted fill.

C. Install the specified geotextile under layer on the prepared surfaces, ensuring that required overlaps are maintained and that the outer edges of the geotextile are buried at least 150mm (6") below grade to prevent uncontrolled flow of surface runoff below the geotextile.

3.03 PLACEMENT AND ANCHORING OR TENDONED CELLULAR CONFINEMENT SECTIONS

A. Feed pre-cut lengths of tendon material through the aligned holes in the cell walls of the cellular confinement sections prior to expanding individual sections into position. Anchor the tendons and cellular confinement sections at the crest and expand down the slope surface.

B. Where intermediate anchoring of the slope surface is not permitted due to the presence of an underlying geomembrane, attach restraining tendon anchor pins to the tendons at pre-determined intervals, to achieve the necessary load transfer.

C. Anchor the tendoned cellular confinement sections with rows of rebar stakes in the prescribed pattern, as identified in construction drawings, throughout the slope surface in situations. At each anchor location, form a loop in the tendon, insert a stake, and drive into the subgrade. See project plans and specifications for knot or loop pattern requirements.

D. Inter-leaf or butt-joint adjacent sections of cellular confinement sections, as detailed in manufacturer's technical documentation of Standard Connections Between Cellular Confinement Sections, according to which side-wall profiles abut. In all cases, ensure that the upper surfaces of adjoining cellular confinement sections are flush at the joint, and that sections are fully stapled.

3.04 PLACEMENT OF INFILL

A. Place fill in the expanded cells with suitable materials handling equipment such as a backhoe, excavator, grade all, font-end loader, dozer, conveyor, or crane-mounted skip. Limit drop height to a maximum of 0.9 m (3 ft). On steep slopes, potential displacement of the Geocellular Confinement System can be avoided by infilling from the crest to the toe. Requirement for overfilling and compaction of infill is dependent on the type and consistency of material and the cell depth:

B. Overfill screened topsoil between 25 mm – 50 mm (1in. - 2in.) and lightly tamp or roll to leave the soil flush with top edge of the cell walls.

C. Overfill loose granular materials approximately 25 mm (1 in.) and compact with a plate tamper or drum roller. Remove loose surface material.

D. Manually compact and screed the surface of poured concrete infill and ensure that the finished surface is flush with the top edge of the cell.

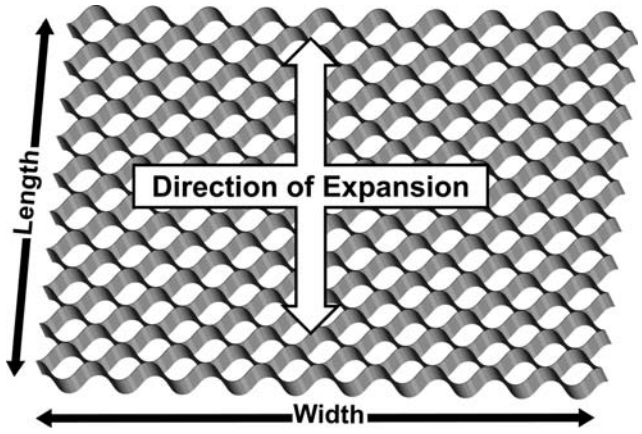
3.05 SURFACE TREATMENTS

Carry out application of surface treatments immediately following placement of infill in accordance with project plans and specifications.

3.06 FINISHING PROCEDURES

Apply specified surface treatments following placement of infill in accordance with project plans and specifications.

3.07 STANDARD SECTION TABLE



Cellular Confinement System section length and width shall be as indicated in Figure 1. Sections shall have expanded dimensions per Table 1.

Note: All measurements are subject to manufacturing tolerances unless otherwise noted.

Table 1 Section Dimensions

Minimum Expansion		Maximum Expansion		Nominal Area
Length	Width	Length	Width	
24.8 ft	9.2 ft	30.0 ft	7.6 ft	230 ft^2

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PO Box 2779, Merced, CA 95344-0779
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E-mail: info@sspco.com Website: http://www.sspco.com

Appendix A

Short-Term Seam Strength Test Procedure

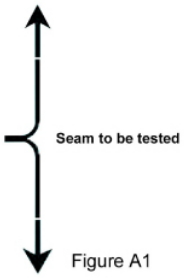

Figure A1

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.

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 300 mm (12 in) 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:

• 2840 N (640 lbf) for the 200 mm (8 in) depth cell

• 2130 N (480 lbf) for the 150 mm (6 in) depth cell

• 1420 N (320 lbf) for the 100 mm (4 in) depth cell

• 1060 N (240 lbf) for the 75 mm (3 in) 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.