SECTION 32 32 23

SEGMENTAL MODULAR AND VEGETATED RETAINING WALLS

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\*\* NOTE TO SPECIFIER \*\* Geo Products, LLC; EnviroWall is a polymer modular retaining wall and slope system designed as planting containers providing two functions - structural wall or slope facing and plant growth.
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(02830gpl)%253A%2520&coid=47197&spec=02830gpl&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; EnviroGrid Geocell, EnviroGuard Liner and EnviroWall Living Retaining Wall System. Since 1990, Geo Products has manufactured the EnviroGrid geocell, cellular confinement system for soil stabilization, slope and channel erosion control and retaining walls. The HDPE geocell is designed for long term use and critical applications. Geo Products also offers EnviroGuard geomembrane liner that is custom fabricated and installed, suited for any specification. Geo Products sells the products through a global distributor network spanning all 7 continents and over 50 countries.
The EnviroWall living retaining wall system is comprised of individual 15 inch (381 mm) wide by 6 inch (152 mm) high by 13 inch (330 mm) deep modules, each having removable side walls and an open cell bottom that creates a trough for the insertion of a gardening sock. Modules allow mechanical connection to reinforcement, accept system accessories and are comprised of a hollow face wall, two side wall receptors and a rigid bottom wall, thus creating a large, accurate fill receiving trough which is open and unbounded at the rear. The modules are segmented facing units designed as planting containers that provide a structural wall or slope face able to support vegetation. EnviroWall Retaining Wall System is designed to be installed in accordance with these specifications and the installation manual. Following the lines and grades designated on the drawings/plans, work shall include foundation, drainage, compaction, gardening sock or infill material, reinforcement, optional irrigation components, approved plants and related system accessories per specification.
Geo Products manufacturing plant is located in Houston, Texas USA and is ISO 9001:2015 and CE certified. 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 erosion control 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. Segmental modular and vegetated retaining walls.
	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. ASTM International (ASTM):
			1. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort; 12 400 ft-lb per cu ft (600 kN-m per cu m).
			2. ASTM D4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus.
			3. ASTM D4595 - Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
			4. ASTM D5262 - Standard Test Method for Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics.
			5. ASTM D5397 - Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.
			6. ASTM D6637 - Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method.
		2. United States Environmental Protection Agency (USEPA):
			1. USEPA CFR 503 - Standards for the Use or Disposal of Sewage Sludge.
		3. The United States Composting Council (USCC):
			1. Test Methods for the Examination of Composting and Compost
				1. USCC TMECC 04.11B.
				2. USCC TMECC 02.02B.
	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. Manufacturer certifications.
			3. Preparation instructions and recommendations.
			4. Storage and handling requirements and recommendations.
			5. Typical installation methods.

\*\* NOTE TO SPECIFIER \*\* Delete if not applicable to product type.

* + 1. Verification Samples: Two representative units of each type, size, pattern and color.
		2. Shop Drawings: Include details of materials, construction and finish. Include relationship with adjacent construction.
			1. Retaining wall design calculations, including global stability analysis and drawings are to be stamped by a registered Professional Engineer licensed in the state of the project.
		3. Planting and Irrigation Plan: Plant list with elevation views, approved suppliers, seasonal requirements for planting, fertilization, plant coverage targets, methods of measurement, erosion control plans addressing site runoff during and after construction, maintenance agreements.
		4. Sustainable Compliance: All information pertaining to categories, points and documentation.
	1. QUALITY ASSURANCE
		1. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum five years documented experience.
		2. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.
		3. Source Limitations: Provide 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 and visual appearance.
			2. If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
			3. Retain mock-up during construction as a 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 Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, critical path items and approvals.
	2. DELIVERY, STORAGE, AND HANDLING
		1. Contractor shall check the materials upon delivery to assure the proper materials have been received.
		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. Damaged materials shall not be used in the project (ASTM C 1372).
		4. Exposed faces of modules are to be free of cracks, stains and other imperfections and additional materials are to be free of defects.
	3. 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.
	4. WARRANTY
		1. Manufacturer's standard limited warranty unless indicated otherwise.
			1. Living Wall Systems: No warranty is provided for the living wall system in terms of vegetation this will be provided by the landscaper, Therefore, a warranty on the modules themselves is provided by the Manufacturer.
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(02830gpl)%253A%2520&coid=47197&spec=02830gpl&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. SEGMENTAL MODULAR AND VEGETATED RETAINING WALLS
		1. Performance and Design Requirements:
			1. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort; 12 400 ft-lb per cu ft (600 kN-m per cu m).
			2. Geosynthetic Reinforcement:
				1. ASTM D4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus.
				2. ASTM D4595 - Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
				3. ASTM D5262 - Standard Test Method for Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics.
				4. ASTM D5397 - Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.
				5. ASTM D6637 - Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method.
			3. Blended Media as Plantable Unit Infill:
				1. USEPA CFR 503.
				2. USCC TMECC 04.11B.
				3. USCC TMECC 02.02B.
			4. Included in the Work: Following the lines and grades designated on the drawings.
				1. Foundation.
				2. Drainage.
				3. Compaction.
				4. Plantable Unit Infill: Filter sock material.
				5. Reinforcement.
				6. Irrigation components; optional.
				7. Approved plants.
				8. Related system accessories per specification.
			5. Retaining Wall Systems: Design to be planted and grown over.
				1. Planting Pockets: Large enough to accommodate multiple plugs.
				2. Reinforcement Design:

Reinforced with a woven coated polymer strap reinforcement.

Modules to include a true mechanical connection through the modules themselves creating high connection values regardless of wall height or fill.

There is to be no need for additional pins, rods, pipes, or other means of attachment.

* + 1. Basis of Design: Envirowall Living Retaining Wall System as manufactured by Geo Products LLC. A polymer modular retaining wall and slope system comprised of individual modules. The modules are segmented facing units designed as planting containers providing two functions; a structural wall or slope facing with plant growth.
			1. Live Retaining Wall Modules: EnviroWall: 15 x 6 x 13 inch (381 x 152 x 330 mm). Injection molded polypropylene with additives for UV stabilization, impact resistance and color. Molded with no sidewalls and open bottom, creating a trough for growth media.
				1. Weight: 2.5 lbs (1.13 kg).
				2. UV Stabilization: 7 years minimum.
				3. Color: As determined by the Architect from manufacturer's range.
				4. Facilitate mechanical connection to reinforcement and system accessory parts.
				5. Face Wall: Hollow.

\*\* NOTE TO SPECIFIER \*\* Sidewalls are used when turning tight radiuses or when using loose Growing Media. The rails broaden the bearing surface which is needed when stacking radii that shifts bearing points away from posts at rear of module face.

* + - * 1. Sidewalls: Polypropylene accessories that insert into receptors in modules.

\*\* NOTE TO SPECIFIER \*\* Delete Strap Reinforcement if reinforcement is not required.

* + - 1. Strap Reinforcement: Rolls of inextensible structural straps, composed of high tenacity polyester yarns placed in tension, then co-extruded with polyethylene to form a polymeric strap.
				1. Widths: Varying widths between 2 to 4 inch (50 to 100 mm).
			2. Growth Media: Specified to match the planting list for the region of use, in order to facilitate successful grow-out and long-term coverage of the completed wall or slope system.
			3. Packaging: Bulk.
			4. Packaging: Precise packaging for placement within each module.
1. EXECUTION
	1. EXAMINATION
		1. Do not begin installation until substrates have been properly constructed and prepared.
		2. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.
	2. PREPARATION
		1. Clean surfaces thoroughly prior to installation.
		2. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
	3. INSTALLATION
		1. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.
			1. Excavation: Excavate to lines and grades shown on construction drawings.
				1. Use care when excavating to prevent disturbance of the base beyond the lines shown. Follow all local, state, and federal laws regarding earthwork.
			2. Leveling Pad: Excavate foundation soil as required for leveling pad to the depths and locations shown on the plan sheet or as directed by the design engineer.
				1. Exposed Foundation Soil: To be observed by the on-site soils engineer prior to construction. Verify the exposed material is suitable for the net design bearing pressure and that excavation base is free of loose soil, non-compacted fill, water, or frozen material.
				2. Undercut any Unsuitable Soil. Fill undercut areas with crushed limestone and compacted to 95 percent of material's standard Proctor maximum dry density.
				3. Construct crushed rock leveling pad to lines and grades on the plans.

Top compacted levelling pad with 2 to 3 inches (51 to 76 mm) of sand to facilitate levelling of individual modules.

* + - 1. Base Course: Install first course of modules on leveling pad.
				1. Modules must be level side-to-side and front-to-back.
				2. Place modules 9 inches (mm) apart in accordance with diagrams to yield a 24 inch (610 mm) center-on-center spacing for straight run sections.
				3. Base pad itself should be leveled such that modules placed on it are level once pressed into the sand topping.

Modules shall not be pounded with a hammer or mallet as a means of leveling.

* + - * 1. Fill below grade units and spaces between units, with free draining granular infill to a level even with the tops of the side rails in accordance with manufactures installation guidelines. See website for the most up to date information.
			1. Unit Installation: Each module straddles two modules on the course below creating a checkerboard pattern of planting pockets.
				1. Pull the units forward into contact with the rear face of the lower module to establish a 70 degree wall batter.
				2. On Any Given Unit" Lift, always fill the entire course of modules with a 2 ft (610 mm) plantable unit infill or filter sock material before placing mass backfill.
				3. On Reinforced Courses: Care must be taken to ensure straps are flat, without wrinkles and lay horizontal to the connection elevation at the rear of the module.
				4. Backfill and compact behind the modules to the cut embankment or ends of the straps and continue construction in sequence per site specific design and plans.
				5. Each Course of Modules: Must be stacked and completely backfilled before the next course is placed.

No stacking of multiple courses before filling shall be allowed.

* + - * 1. Radius Walls: May require smaller or larger spacing between units to maintain the running bond.

When off-bond; upper module not evenly straddling lower module, addition of the Side Rail accessory supports may be installed in order to ensure peak performance of the system.

* + - * 1. Drain Pipes: Install as specified and run to daylight at low points and/or periodically along wall alignment as shown on plans.
			1. Reinforcement: When required, reinforce with a woven and coated polymer strap reinforcement.
				1. Once modules of a reinforced course have been placed on the wall column, insert the tag end of the Strap Reinforcement from the top, inside the trough, through the connection aperture in the bottom of each module and pull through to the mid-point of its total length, prior to filling the module.
				2. The Strap Reinforcement may now be pulled evenly into the backfill zone for each connected module on the course, at the elevations shown on the plans.

In order to prevent vertical forces on the straps and tails of modules, care must be taken to ensure that straps lay horizontal at the same elevation as the top surface of the connection aperture inside of trough.

Terminal ends of the strap should be at the same distance from the module and spread apart no more than the center-to-center width of the modules, which is 24 inches (610 mm).

Strap Reinforcement placed outside a plus or minus 4 inches (100 mm) zone of the placement design elevation will not be accepted.

In sequence, fill modules with plantable unit infill or filter sock material.

Mass backfill shall be placed and/or pushed in a rearward direction, starting from the modules moving toward the rear of the fill zone.

Construction equipment other than rubber-tired or rubber-tracked shall not be operated directly on the Strap Reinforcement.

\*\* NOTE TO SPECIFIER \*\* EnviroWall installation manual must be consulted prior to installation and any deviations from methods shown must be approved by the wall design engineer prior to construction. . (Go to the EnviroWall website page for views and details).

* + - 1. Backfill Zone Material: Placed in maximum 12 inch (305 mm) lifts and compacted to at least 95 percent of the material's maximum dry density as determined by the standard Proctor method.
				1. No compaction equipment other than vibratory plates may be operated within 3 feet of the rear of the modules.
				2. Place, spread and compact backfill in such a manner that minimizes wrinkles and movement of the reinforcement.
				3. Field Density Testing: Conduct by a qualified soils technician. Verify the minimum degree of compaction is being obtained.
				4. The finished grade above the structure should include a drain swale and must be sloped in such a manner to drain all water away from the wall unless it has been specifically designed to accept site runoff water.

\*\* NOTE TO SPECIFIER \*\* Always consult with the owner and/or their representatives early in the project to determine all responsible parties with regard to plants, quantity, design, maintenance and feeding.

* + - 1. Planting:
				1. Once complete, the finished system face should be brushed off to dislodge any over-filling of the pockets which would quickly slough off on its own.

This is not needed when filter sock material is utilized.

* + - * 1. Planting Live Plugs Instead of Seeding: Planting must start from the top course and continue down the face of the wall until every pocket is filled with at least one plant to yield a minimum coverage of 1 plant per sf of exposed face area.

The planting pocket is designed large and the fill volume is high, so each pocket can accommodate multiple plugs.

Live Plants: Center in the "sun receiving" area of the pocket; not under the upper module.

As an alternative, filter sock material can be internally seeded or pockets can be hand seeded after installation.

Water plants in accordance with the project plans.

Maintenance of plant material should be required for first year in order to ensure proper grow-in.

Walls to be low to no maintenance thereafter.

\*\* NOTE TO SPECIFIER \*\* Delete irrigation paragraph if not required.

* + - 1. Irrigation: Modules allow flat drip tape or 1/4 inch (6 mm) drip irrigation tubing to be placed in the filter sock or running from module to module through the side rails in order to run a continuous water line.
			2. Maintenance:
				1. The modules themselves do not require maintenance.
				2. Maintenance and care of vegetated portions of the wall system is required at least until the vegetation is established.

The initial and continuing maintenance required will depend on the plantable unit infill, type of vegetation, local weather conditions and exposure.

The Manufacturer may, at its discretion, provide maintenance review visits for the purpose of documenting the progress and condition of the completed system.

At such regular visits within the first 24 months from completion, reports will be generated and shared with stakeholders as a tool to facilitate successful grow-out.

Any provisions, by and for, the project owner in addition to those listed above, such as percent plant coverage by calendar date, shall be placed in a separate document and included with the plans and specifications of the project prior to bidding and selection of installer.

* 1. FIELD QUALITY CONTROL
		1. Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.

\*\* NOTE TO SPECIFIER \*\* Include if manufacturer provides field quality control with onsite personnel for instruction or supervision of product installation, application, erection or construction. Delete if not required.

* + 1. Manufacturer's Services: Coordinate manufacturer's services in accordance with appropriate sections in Division 01.
			1. Technical Support: The Manufacturer's staff is available for specification assistance and jobsite review of various installation stages. The Manufacturer should be contacted at least 14 days prior to the start of construction if technical representatives are needed during the installation process.
	1. CLEANING AND PROTECTION
		1. Clean products in accordance with the manufacturers recommendations.
		2. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION