

PRESTO | GEOSYSTEMS®

STRENGTH. FROM THE GROUND UP.

Since 1979

# GEOWEB®

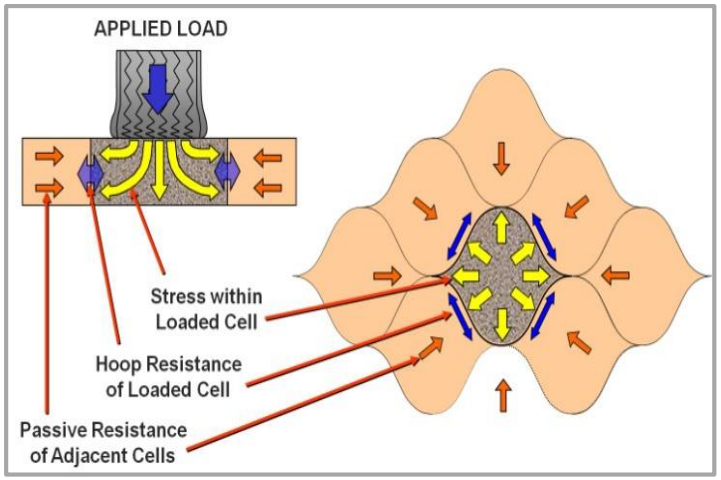
## SOIL STABILIZATION SYSTEM

History & Material Details

# GEOWEB Geocells

## History, Presto Geosystems Innovation:
## Geocells vs. Geosynthetics

- Presto Products collaborated with the US Army Corps of Engineers in the late 1970's to develop quickly deployable roadways for military vehicle beach access.
- **Presto's Gary Bach** conceived of the use of HDPE for the first Geocell (GEOWEB®) and designed the first ultrasonic welder to meet the high seam peel strength demands of load support applications.
- Presto introduced **"cellular confinement"** to the civil engineering community in 1984.
- **"Geocells"** are a three-dimensional geosynthetic that confine a depth of infill material.
- Confinement in cellular network **strengthens the load bearing capacity of cohesionless granular material** and provides an "apparent cohesion" to granular materials.






# GEOWEB Geocells

## Material Composition

- GEOWEB material is manufactured from quality, 100% virgin high density polyethylene (HDPE), a proven material for over 40 years. **All virgin HDPE is NOT equal and there are many blends.**
- 1.5-2.0% carbon black is added for Ultra-Violet (UV) stabilization.
- **HALS (Hindered-Amide Light Stabilizers)** is added to colored wall fascia sections for UV stabilization.





# GEOWEB Geocells

## Material Composition

- The **cell wall thickness** for textured GEOWEB is 57-66 mil.
- The cell wall thickness for **GEOWEB Alpha** is slightly thinner than GEOWEB (51-60 mil). This makes it more flexible (less stiff)
  - **advantageous in cold temperatures.**
  - less advantageous in high temperatures.





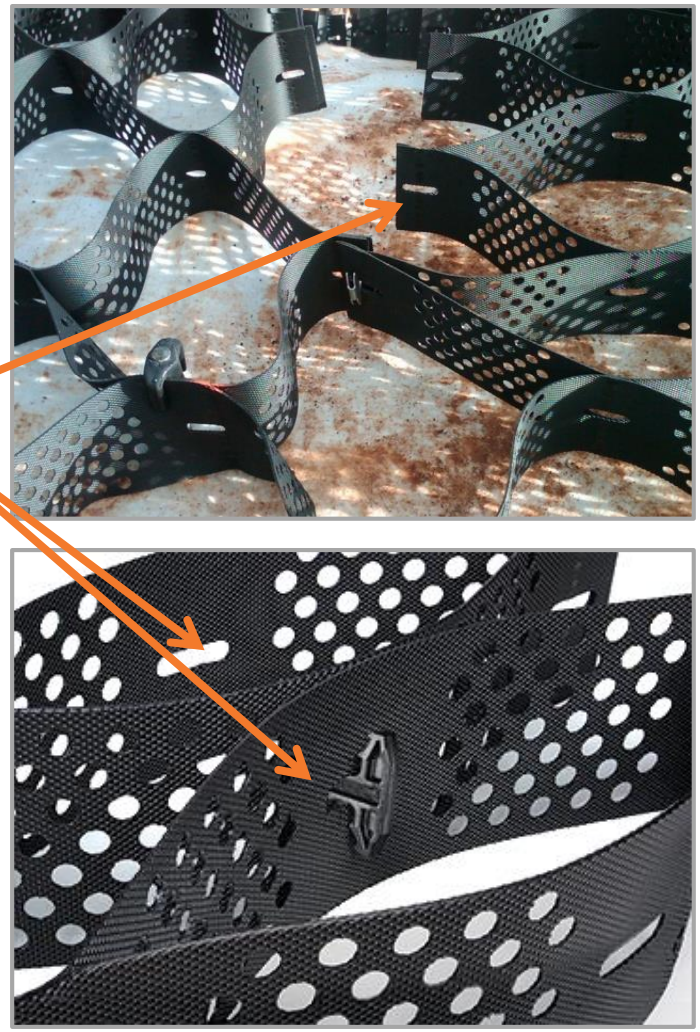


# GEOWEB Geocells

## Material Composition

- Typical GEOWEB and GEOWEB Alpha cell wall type is **textured and perforated** with advantageous **I-slot holes** for ATRA® keys and tendons.

- **I-slots** are located mid-cell to allow GEOWEB sections to be joined with ATRA Keys without staples.



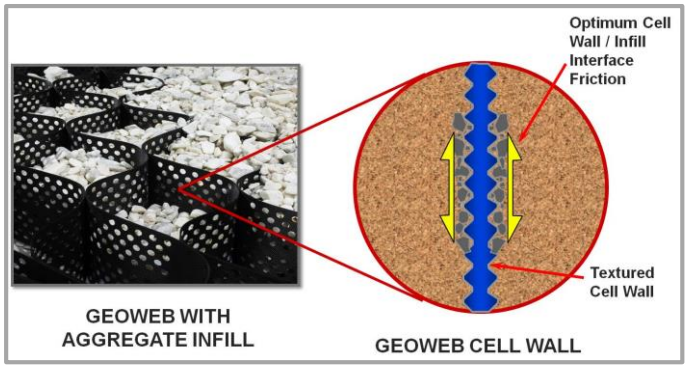
# GEOWEB Geocells

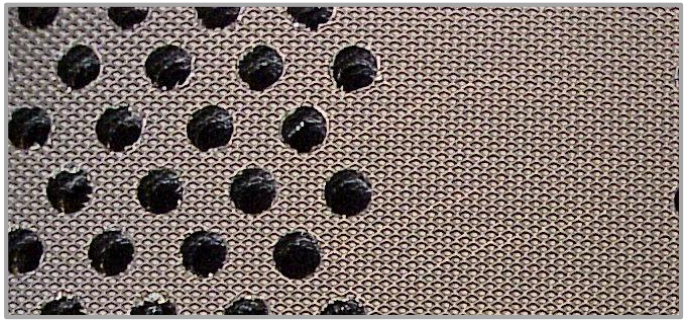
## Cell Wall Textured Surface & Perforations:

**Texture and perforations** in the GEOWEB cell wall are not just for appearance. They are related but not identical in purpose.

### Texture cell walls:

- Increase **frictional interlock** between cell wall and infill material and increase the load bearing performance.
- Our rhomboidal pattern is designed to **optimize friction with most typical sand or aggregate infill** choices.
- All textures do not perform equally.



# GEOWEB Geocells

## Perforations:

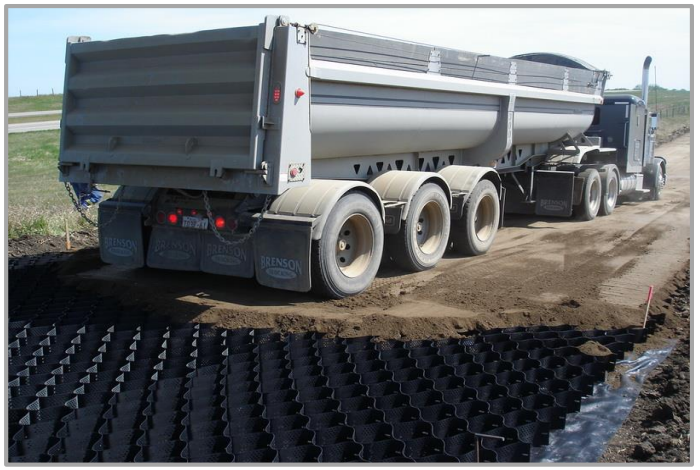
- **increase frictional interlock** between infill and cell wall
- facilitate **lateral drainage of water**
- allow **cell to cell drainage** beneath pavements
- allow **concrete to flow through cell walls**
- provide **resistance to upward displacement** caused by freeze/thaw cycles

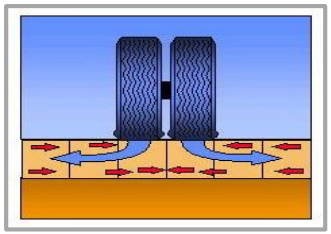


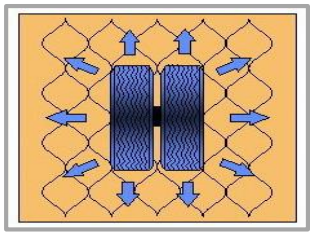
# Benefits of the GEOWEB System & How it Works

The GEOWEB structure is a network of interconnected cells. This structure confines soils and gives strength to soils that would otherwise be unstable either on an embankment or under vehicle loading.

- Confinement of soils reduces lateral movement
- Confinement **reduces required depth of base material by 50%-85%.**
- Confinement of a given material creates a support system equal up to **1.5-2.5 times the depth of the same infill without the GEOWEB.**
- Confinement allows slopes to be steeper than when unconfined.
- The structure with confined infill provides protection to geomembranes.







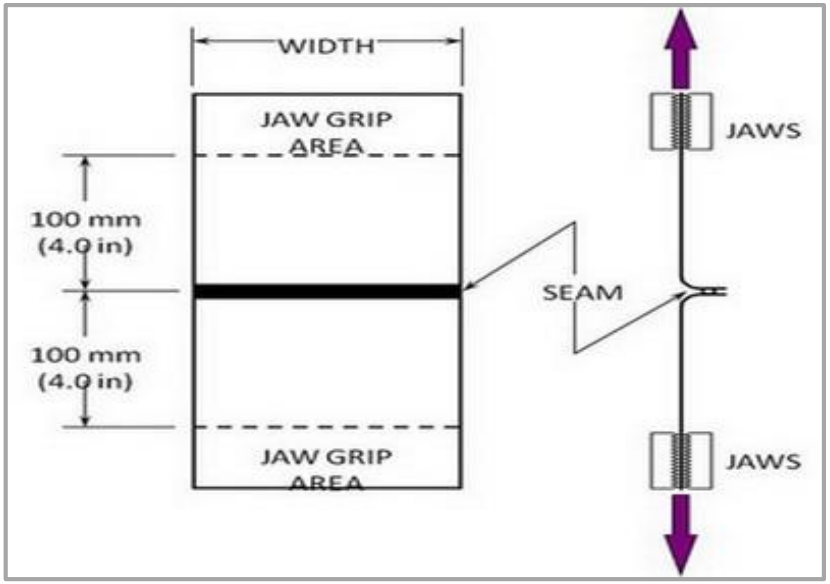




# Material Nomenclature & Seam Strength:

## Seam Strength: Minimum vs. Average

- The seam strength for the GEOWEB material is listed as a **minimum** seam strength.
- Some manufacturers still use **average** seam strengths based on old USACE specifications benchmark, which allows their material to conform to lower minimums.
- This is an important difference between GEOWEB Geocells and many competitors.
- Presto Geosystems project evaluations (preliminary designs) are copyrighted and can NEVER be used by our competitors due to lower seam strengths.





# APPLICATIONS & CELL SIZE

3 Cell Sizes, 4 Key Applications

# 4 Key Application Areas

## The Four Main Applications of the GEOWEB System:

- Slope & Shoreline Protection
- Channel Protection
- Load Support
- Retaining Walls

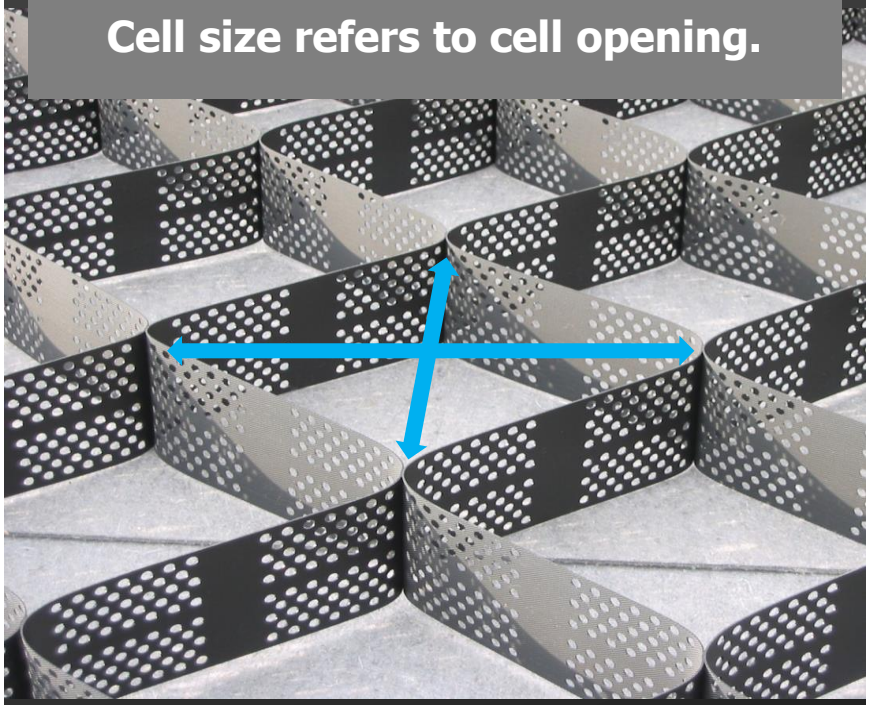
Within each category are numerous sub-applications.

For instance, Load Support applications include the following: haul & access roadways, base support under paved surfaces, road shoulders, railroad sub-ballast stabilization, port & intermodal facilities, and trails.







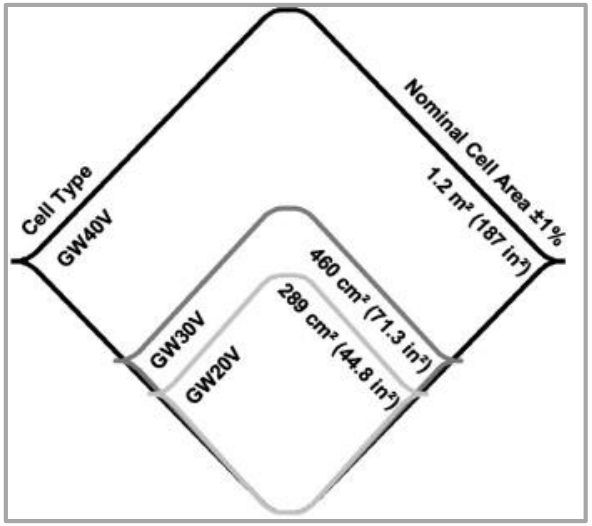



# GEOWEB Details

## Typical Cell Sizes

**The GEOWEB system is a unique product that solves problems in many different applications.**

- **Cell Size** refers to **Size of the Cell Opening.**
- While some general application guidelines for cell type follow, these are not meant to be limiting.
- Numerous project variables can affect the recommendation for cell size and must be determined by a trained designer.
- Presto Geosystems offers free project evaluation services to assist customers.




**3 Sizes**

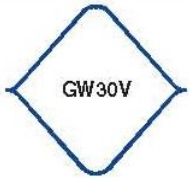
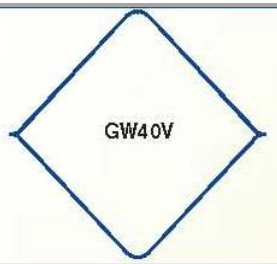
20V, 30V, 40V

# GEOWEB Details

## Typical Cell Sizes

**Three cell sizes (cell openings) are available to meet all applications**

- **GW20V** refers to the **small cell size**
- **GW30V** refers to the **mid-cell size**
- **GW40V** refers to the **large cell size**, is 4 times the area of the GW20V

| Relative Size[1] |   |   | |   |
|---|---|---|---|---|
| **Name** | **GW20V (small cell)** | **GW30V (mid cell)** For all other Applications | For Earth Retention[4] | **GW40V (large cell)** |
| Nominal Length x Width[2] | 8.8 x 10.2 in (224 x 259 mm) | 11.3 x 12.6 in (287 x 320 mm) | 10.5 x 13.0 in (267 x 330 mm) | 18.7 x 20.0 in (475 x 508 mm) |
| Nominal Area[3] | 44.8 $in^2$ (289 $cm^2$) | 71.3 $in^2$ (460 $cm^2$) | 68.3 $in^2$ (440 $cm^2$) | 187.0 $in^2$ (1206 $cm^2$) |
| Cells per $yd^2$ ($m^2$) | 28.9 (34.6) | 18.2 (21.7) | NA | 6.9 (8.3) |
| Nominal Depths | 3 in (75 mm), 4 in (100 mm), 6 in (150 mm), and 8 in (200 mm) for all cells | | | |

# Typical Cell Sizes & Applications:

## GW20V (Small Cell):

- steep slopes 1H:1V or greater
- heavy load support surface stabilization- especially with small-wheeled vehicles
- challenging channel applications





# Typical Cell Sizes & Applications:

## GW30V (Mid Cell):

- concrete infilled channels
- common for slopes up to 1H:1V
- surface stabilization and base stabilization
- **standard cell size for retaining wall sections**







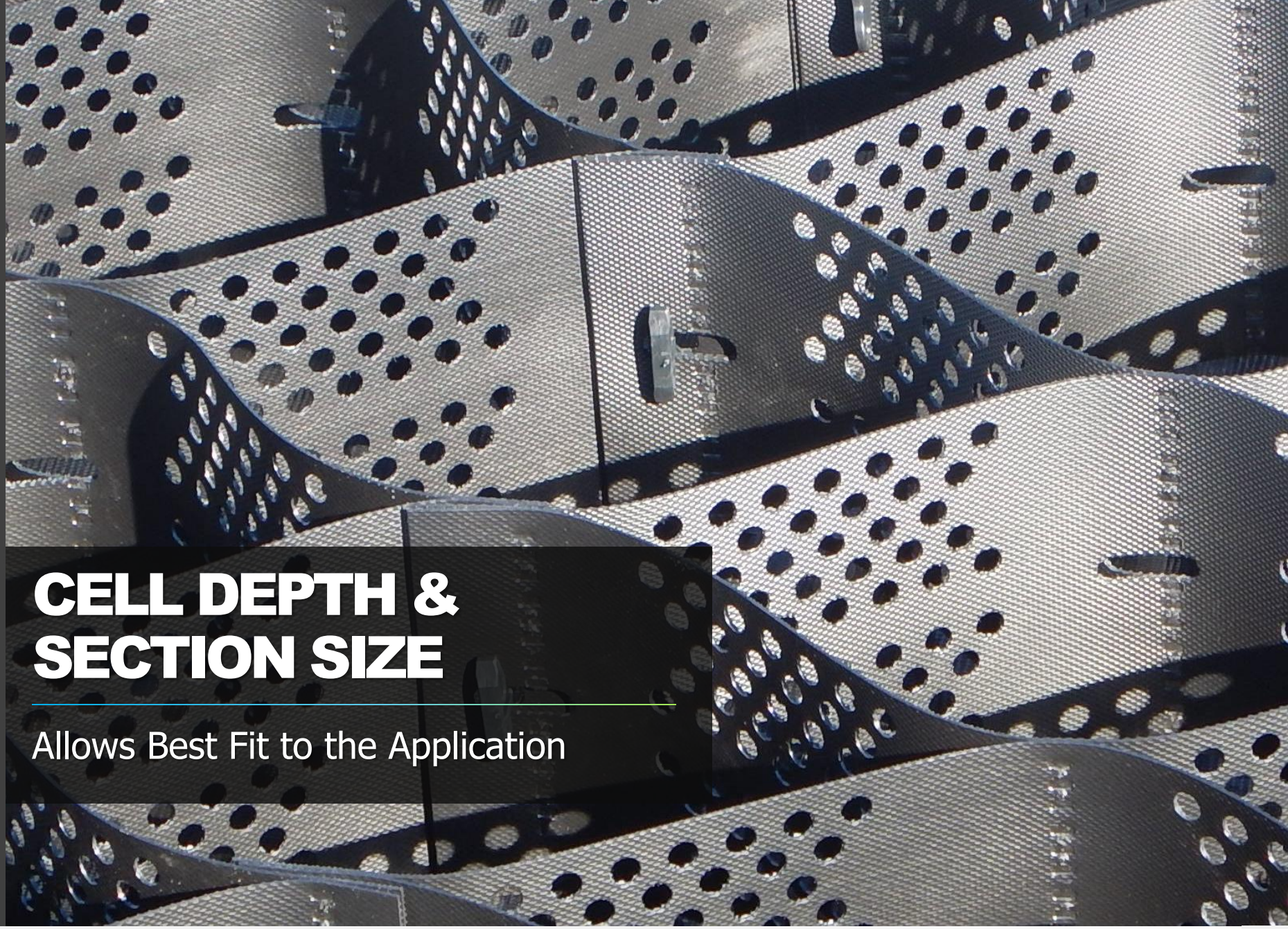
# Typical Cell Sizes & Applications:

## GW40V (Large Cell):

- Mild slopes 3H:1V or less
- Concrete infilled mild slopes & channels







# CELL DEPTH & SECTION SIZE

Allows Best Fit to the Application

# CELL DEPTH by Application:

**GEOWEB sections are available in the following Cell Depths:**
3 in, 4 in, 6 in, 8 in, and 12 in (75mm, 100mm, 150mm, 200mm, 300mm).

## Typical Applications per Cell Depth:

- **3 inch (75 mm):** vegetated slopes, geomembrane covers, concrete slopes/channels
- **4 inch (100 mm):** most common for vegetated slopes, aggregate & concrete channels, light-duty load support (golf cart paths, car traffic)
- **6 inch (150 mm):** load support for loads with moderate subgrade, retaining walls (GW30V6)
- **8 inch (200 mm):** load support for extreme loads and/or with very poor subgrades
- **12 inch (300 mm):** shorelines, channels with large aggregate infill



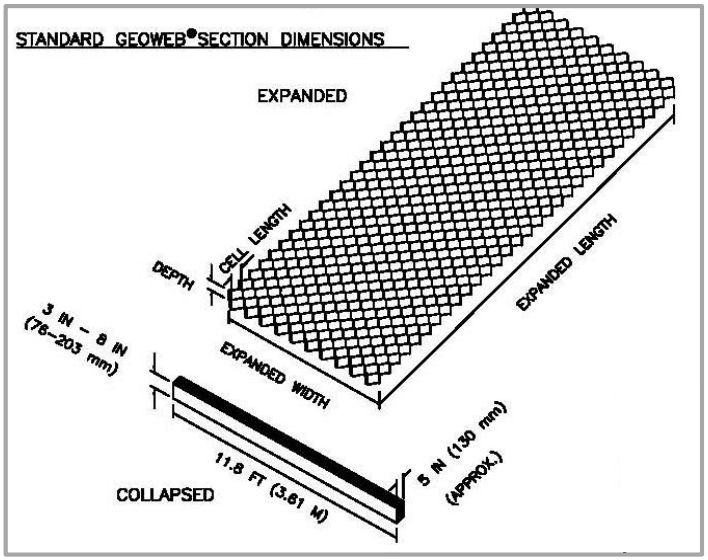




# Section Sizes

## Section Lengths:
## 5 GEOWEB Section Lengths are Available

- Section length is measured by number of **cells long**
- Section lengths are **18, 21, 25, 29, and 34** cells long
- Each GEOWEB section has an expanded length range (varies from 12 – 58 feet depending on cell size & number of cells long)
- **5 section lengths allow best fit to project requirements**
- Sections are collapsed, bundled when shipped
- 29 and 34 cell are the most commonly inventoried section lengths





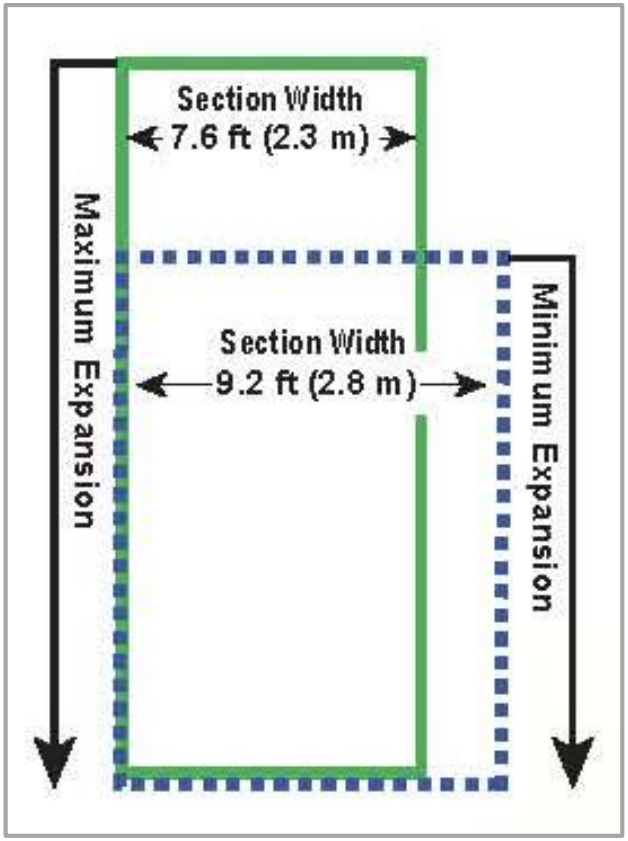



# Section Sizes

## Section Expansion:

Expansion of the GEOWEB section length is "variable" like an accordion, not fixed.

- **Maximum section expansion yields minimum section width.** Conversely, minimum section expansion yields maximum section width.
- While there is no reason why sections may not be expanded beyond the maximum or minimum shown below, **optimum area coverage is found by expansion within these limits.**
- **Nominal area** is an approximation of the area found when a section is expanded between the maximum and the minimum shown below.
- For everyday calculations, sections are considered **8.5 ft (2.6 m) wide** when expanded to **nominal area**.



# Section Sizes

## Section Width:

The number of **cells wide is always fixed** and is determined by cell size. Since collapsed sections are always 12 feet wide, the spacing of the welds (which determines cell size) lead to a fixed number of cells wide.

**All GEOWEB panels when expanded to nominal width are 8.5 ft.**

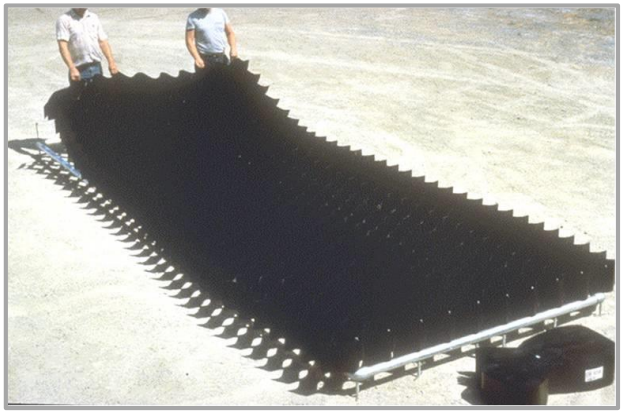
- **GW20V:** 10 cells wide
- **GW30V:** 8 cells wide (wall sections are fixed, not nominal)
- **GW40V:** 5 cells wide

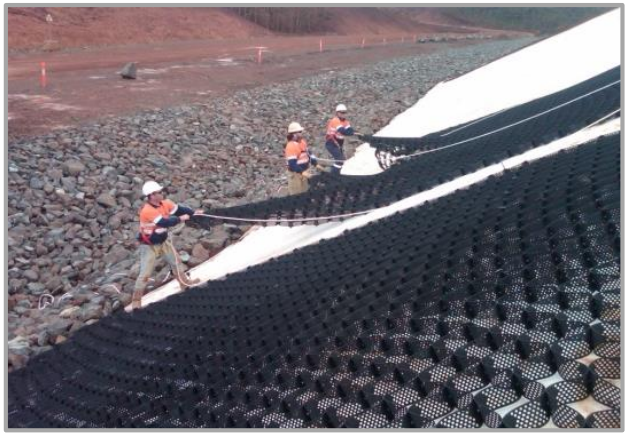
**Note: A GW20V6 and a GW30V6 of the same cell length:**

- Are identical when collapsed
- Are different when expanded (GW30V6 covers more area)

## READ THIS PAGE AGAIN.

**NOTE that the total weight of a 20V, 30V, and 40V of the same cell length are nearly equal. But with more welds, the 20V expands to the least coverage size.**







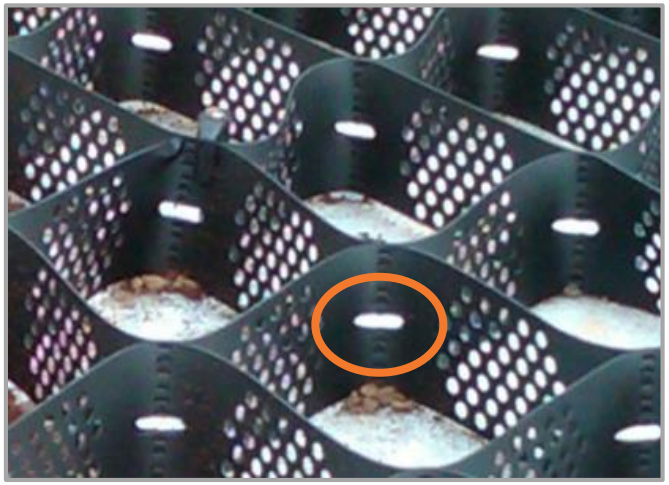
# INTEGRAL SYSTEM COMPONENTS

## Built for Strength & Speed

# Integral Cell Wall I-Slots

**I-slots** are manufactured slots in the GEOWEB cell walls. They also contribute in ways identical to perforations, but are primarily designed for allowing:

- **ATRA® Key** connections (1)
- **Tendons** to pass (2)
- **ATRA® Tendon Clips** to engage – load transfer device (3)



1



2



3



# Integral Components & Purpose

**ATRA® Keys:**

- save contractors time and money.
  **(make sure your contractor knows this!)**
- connect GEOWEB sections quickly & efficiently.
- **install three times faster and are three times stronger than stapling**
- provide **corrosion-resistant permanent** connection.

**Presto is the ONLY manufacturer with this time/cost saving device.** Competitors do not have ATRA keys, so it is important to have them specified by your customers.









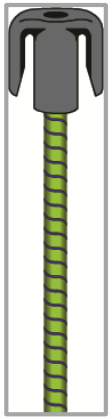
ATRA Keys only require one man per connection vs. two for stapling operations so installers work independently.

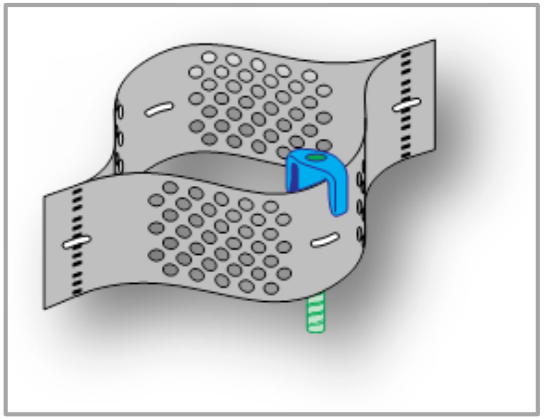
# Anchorage Component

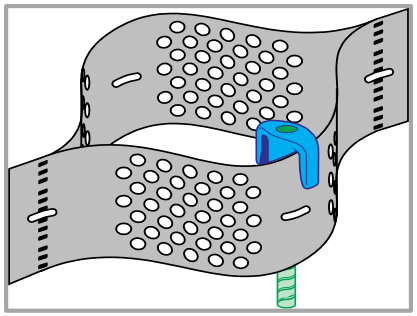
## ATRA® Anchors

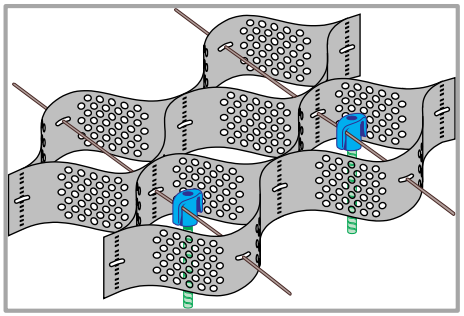
- are **easier to drive than J-hooks** because the impact is aligned with the stake.
- are designed so the lipped arm of the **ATRA Stake Clip head provides a more secure connection** with the GEOWEB cell wall than J-hooks.
- allow use of an **ATRA Driver**, a tool that drives anchors quickly and efficiently.
- with tendons, **resist sliding and/or uplift forces.** Used for internal and crest anchoring. (bottom photos)

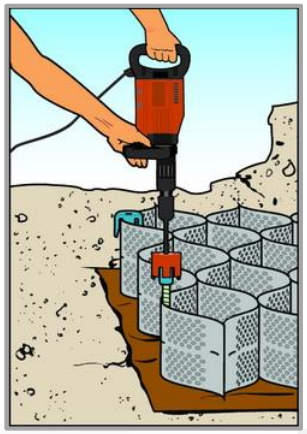
## ATRA Stake Clip on a stake = ATRA Anchor











# Anchorage Component

## ATRA GFRP Anchors

Optional Glass Fiber-Reinforced Polymer anchor (ATRA GFRP) is coated with coarse silica sand.

ATRA GFRP Anchors are **resistant to corrosion.**

These anchors are advantageous in corrosive environments that will degrade steel rebar.

**ATRA GFRP Anchors are sold preassembled** in the following sizes:

- **18 inch** (457 mm)
- **24 inch** (610 mm)
- **30 inch** (762 mm)



# Anchorage Component

## ATRA Speed Stakes

Are one-piece molded polymer anchors engineered for optimal performance and installation speed while providing resistance to corrosive environments.

- Barbs and engineered stake shape adds increased level of holding force.

**ATRA Speed Stake Equivalence:**

- 16 inch ≥ 18 inch rebar/GFRP Anchor
- 20 inch ≥ 24 inch rebar/GFRP Anchor

** GFRP: Glass fiber-reinforced polymer*



- Specially engineered polymer blend material for highest strength and durability.
- Corrosion-resistant, non-metallic anchors suitable for use in acidic soils, saltwater applications or where extended design-life is required.
- Flat polymeric head eliminates tire punctures on load support applications where permanent anchors are required (vs. rebar solutions).

# ATRA Drivers

Electric system for driving ATRA anchors.

- The electric ATRA driving system consists of a Hilti vibratory hammer driving tool and a special **steel GAD** that fits the head of the ATRA anchor.
- Saves contractors time and money; **drives anchors 10+ times faster than hand hammering.**
- Eliminates worker fatigue, workman compensation claims.





Hand hammering ATRA Anchors is not as efficient as using an ATRA Driver.

# Anchorage Component

**Tendons:**

- along with **ATRA Tendon Clips** transfer load from the GEOWEB section and weight of the infill to the tendon.
- are commonly used over geomembranes, and more frequently with heavier infill materials such as aggregate or concrete.
- **are available in seven standard tendon types,** ranging from 700 lbs (3.11 kN) to 5100 lbs (22.7 kN) break strength
  - Break strength and number of tendons per section is a function of the evaluation/design.
  - Tendons are either **woven polyester, woven polypropylene or Kevlar®.**





# Anchorage Component

**ATRA® Tendon Clips (ATC):**

- are Presto's **load transfer device** to transfer slope gravity forces from the GEOWEB cell wall to the tendon.
- **stay fully engaged** with the tendon and GEOWEB cell wall. The ATC is "locked" through the cell wall, ensuring that it will bear against the cell wall and remain there.
- are a stronger load transfer device, **reducing by half the number of load transfer clips needed.**
- **make preassembly easier and faster** to complete at the top of the slope, or on flat ground.









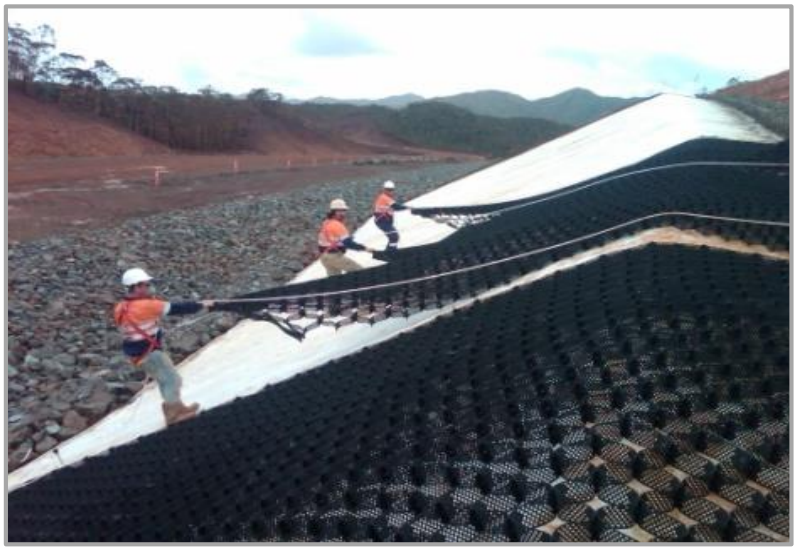
# COMPLIMENTARY

Products, Testing, Research

# Complimentary Products

The total solution of a project may consist of the GEOWEB system in conjunction with the following geosynthetics:

- **Geomembranes:** GEOWEB installed over a geomembrane provides a cover protection system (geotextile layers included).
- **Geotextiles:** Woven and/or non-woven geotextiles are provided as an underlayment to the GEOWEB system for load support, channels and separation between the retained and backfill soils for retaining walls.
- **Geogrids:** Used as reinforcement layer in retaining walls.







# Complimentary Products

The total solution of a project may consist of the GEOWEB system in conjunction with the following erosion control products:

- **Turf Reinforcement Mats (TRMs):** Installed over the GEOWEB system on embankments to resist higher velocities (top photo).



- **Erosion Control Blankets (ECBs):** Installed over the GEOWEB system on embankments to protect the loss of seed and topsoil prior to vegetation (bottom photo).



# Material Testing

**Important Terms:**

**Seam Strength, Long-Term Peel Test**

- Testing is continuous and performed every two hours.
- GEOWEB material is manufactured in an **ISO 9001:2015 and CE certified** facility.
- Tensile tests are performed on GEOWEB material to assure that ALL Genuine GEOWEB sections shipped meet seam peal minimums.
- Resin testing and certification of origin are performed and verified.
- Annual monitoring of extended field monitoring tests are performed.

**Seam Peel Strength**

At regular intervals, GEOWEB is tested by pulling the seam to failure.

- **Short-term hydraulic test** as shown.
- **Long-term peel tests** are also performed in a specialized hot box with climatic changes at prescribed intervals.



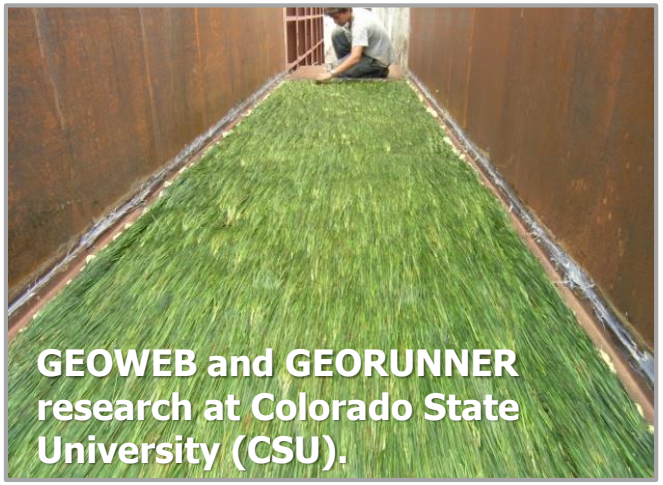


# Research

Many tests at research facilities have been performed over the last 40 years. Results of those tests led to:

- Product improvements and manufacturing improvements
- Modeling tools
- New applications

**Presto's testing/research continues to pursue new applications, products and markets.**



**GEOWEB and GEORUNNER research at Colorado State University (CSU).**

ATRA Key GEOWEB section connection



GEOWEB slopes/shoreline with TRMs



GEOWEB channels with aggregate infill

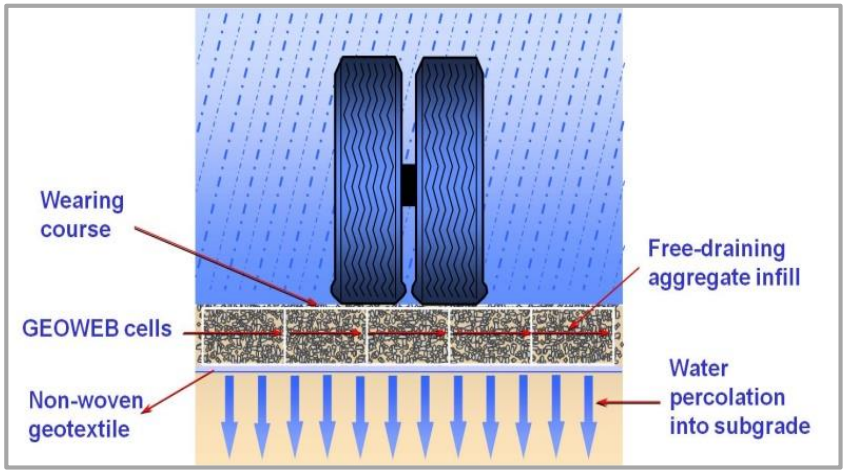


# Green Aspects

With permeable infill, the GEOWEB system is a natural **Low Impact Development (LID) / Best Management Practice (BMP)** solution to stormwater challenges.

- Reduces stormwater runoff
- Allows managing stormwater on-site
- Cooler surface reduces heat island effect

The GEOWEB system confines the **open-graded base course (OGBC)** and prevents shoving and rutting that would occur with OGBC or other poorly-graded aggregates that are ideal for permeability.








# SELLING POINTS

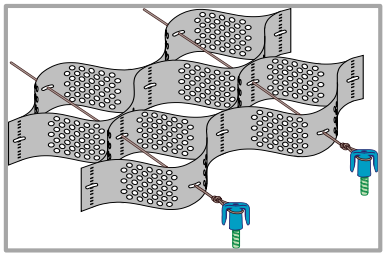
## Competitive Advantages & Differentiators

# Selling Points: Competitive Advantages & Differentiators

**One size doesn't fit all. GEOWEB material offers:**

- **3 cell sizes, 5 cell depths, 5 section lengths**
- **2 product lines** (GEOWEB, GEOWEB Alpha) to best suit project requirements.
- Presto Geosystems is the **original inventor of geocell technology** with **40+ years history** behind our product.
- Material is manufactured from **high quality, high density polyethylene;** others manufactured from lower quality/cost liner or recycled materials.
- **Geosystems offers a complete "system"** that includes time and cost-savings components like ATRA Keys, ATRA Wall Keys, ATRA Anchors, ATRA Tendon Clips and ATRA Drivers that **our competitors do not offer.**







# Selling Points: Competitive Advantages & Differentiators

## Project Evaluations & Construction Services

**Design Support:**

- Presto Geosystems offers **free project evaluations** to determine recommended materials.
- Our **SPECMaker® Specification Tool** allows engineers to create customized, CSI-formatted specs fast and easy.

**Construction Support:**

- **Site support** is available.
- Presto Geosystems or their distributors/ representatives who are "certified field representatives" qualified in installation can provide contractor training, installation oversight.





# Selling Points: Competitive Advantages & Differentiators

**GEOWEB Load Support System:**

- Confined infill significantly **minimizes surface rutting.**
- Confinement reduces aggregate cross-section by **50-85%;** saves aggregate resources and reduces aggregate material hauling and excavation costs by **50% or more.**



- In **surface stabilization**, (i.e., access roads/haul roads) confinement **prevents infill movement, minimizes rolling resistance from heavy vehicles** (saving fuel costs and wear on tires).
- With open-graded base course (OGBC) infill, **creates a permeable pavement** that reduces stormwater runoff; acts as an on-site stormwater detention basin capturing and storing rainwater in the pavement's depth.



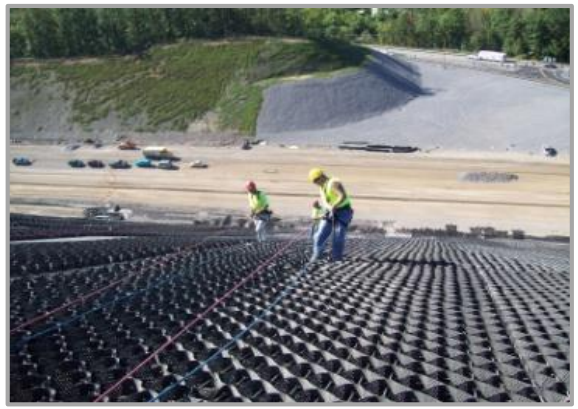
# Selling Points: Competitive Advantages & Differentiators

## GEOWEB Slope & Shoreline Protection System:

- Stabilizes the **upper soil layer**; solves challenging soil stability problems beyond limits of Turf Reinforcement Mats (TRMs) or Erosion Control Blankets (ECBs).
- Works together with ECBs, TRMs to **double performance in flow conditions.**
- Confinement allows slopes to be **constructed steeper than when material is unconfined,** reducing land space and expanding buildable lot space.
- **Integrating tendons allows for additional stability.** Also used when stake anchoring is not possible-over a geomembrane or hard rock surface.







# Selling Points: Competitive Advantages & Differentiators

**GEOWEB Channel Protection System:**

**With Topsoil/Vegetation and TRMs**

- can withstand velocities to 30 ft./sec.

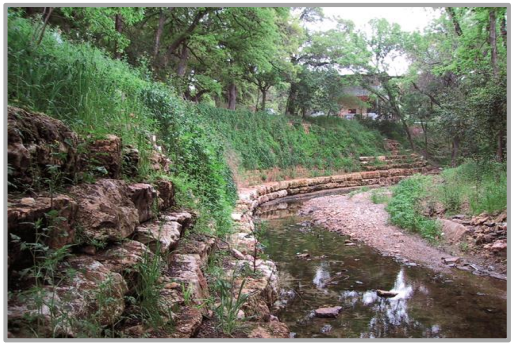
**With Stacked Configuration and Topsoil/Vegetation**

- creates a green wall that can withstand intermittent, flows for short durations (high volume with concrete).

**With Aggregate Infill**

- can significantly reduce rip rap particle size; **reducing D50 by 2 to 10 times,** lowering cost on fill material.
- may allow use of on-site rock, reducing cost and transportation of more expensive infill material.
- **is less expensive than gabions**







# Selling Points: Competitive Advantages & Differentiators

## GEOWEB Channel Protection System:

**With Concrete Infill**

- Is significantly **less expensive than articulating concrete block (ACB) systems.**
- Requires no other formwork.
- Is easy to work within complex concrete geometries.
- Controlled cell wall "cracking" prevents formation of large cracks typical of poured concrete.
- No rebar needed compared to poured in place concrete.
- Allows for reduction in concrete depth (typically 3" with the GEOWEB system compared to 5-6" for reinforced concrete.







# Selling Points: Competitive Advantages & Differentiators

**GEOWEB Retaining Wall System:**

- Offers an aesthetic, **vegetated "green" wall structure** that blends with the environment.
- Open fascia allows variable vegetation/plantings as desired by the client or to accommodate the environment.
- Living walls **reduce stormwater runoff** and **reduce environmental impact** by capturing rainwater through the front open fascia as water sheet flows over the face of the wall.
- **Conforms better to differential settlement** than modular block systems in soft soil environments which crack and fail under settling conditions.







# Selling Points: Competitive Advantages & Differentiators

**GEOWEB Retaining Wall System:**

- Is **less expensive** and **faster to construct** than modular block systems.
- **For space constraints, gravity walls** can be constructed without geogrid reinforcement.
- **The wall flexibility** allows them to withstand earthquakes better than modular block systems.
- **Light-weight wall sections** are **easy to transport** to difficult-to-access sites.
- Retains moisture, beneficial in arid climates.









PRESTO | GEOSYSTEMS®

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Since 1979

# CONGRATULATIONS!

## Course Completed

## GEOWEB®

### SOIL STABILIZATION SYSTEM