PRESTO GEOSYSTEMS

GEOWEB®

CHANNEL PROTECTION SYSTEM

INSTALLATION GUIDELINE

PRESTO GEOSYSTEMS®
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GEOWEB®
CHANNEL PROTECTION SYSTEM INSTALLATION GUIDELINE

NOTE: The following installation techniques and recommendations may require an evaluation by Presto Geosystems to determine applicability of use for individual project requirements.

Site Preparation

- Remove existing vegetation from the slopes and invert.
- Excavate, shape and de-water the proposed channel section.
- Place, compact and shape required earth fill.
- Dig toe-in trenches at the crest and perimeter of the slope as required. Refer to Figure 1.

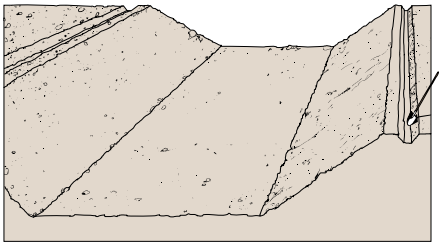


Figure 1 Channel Excavation

Geotextile Separation Layer

- Most non-vegetated channel applications involve a non-woven or woven geotextile separator layer at the sub grade surface. When required, this separation layer is critical to the performance of the channel system. Refer to Figure 2.
- Install geotextile separation layer in accordance with manufacturer's instructions and ensure that minimum overlaps are maintained.
- Ensure geotextile is placed in perimeter toe-in trenches.
- Anchor the edges of the geotextile separation layer in accordance with manufacturer instructions to prevent movement.

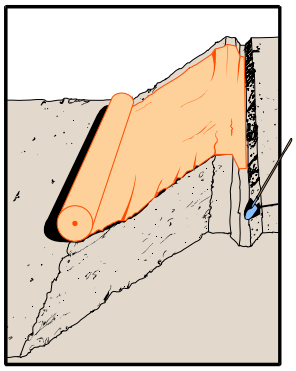


Figure 2 Geotextile Placement

Installation of Geoweb® Sections

- Drive a row of ATRA Stake Anchors along the upper edge of the proposed channel protection area. Space the anchors at pre-determined single cell centers.
- Partially expand the Geoweb® section and place the end cell of the section over its corresponding edge anchor. Ensure the ATRA® Stake Clip arm is placed over the cell wall. Refer to Figure 3.

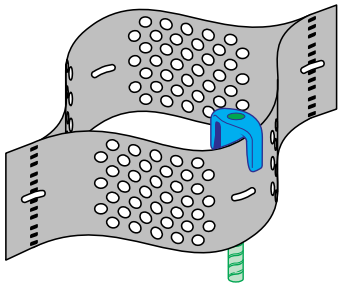


Figure 3 ATRA® Stake Anchor Placement

- Expand the Geoweb® section down the slope to the section's specified length. Refer to Figure 4.
- Hold the fully expanded sections open using one of the following:
  a) ATRA® Stake Anchors, straight stakes or J-Pins (permanent or temporary). Specialized driving tools are available through Presto Geosystems' authorized distributors and representatives to speed driving of ATRA® Stake Anchors. Refer to Figure 5.
  b) Infill several peripheral cells.
- Other acceptable methods may be used.

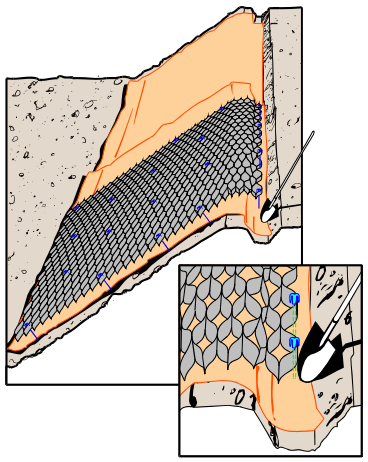


Figure 4 Placement of Geoweb® Section

- Align and interleaf edges of adjoining Geoweb® sections, ensuring that the upper surfaces of adjoining sections are flush.
- Fasten Geoweb® sections together with the ATRA® key connection device. Position the ATRA key through the slots of overlapping sections (side-to-side), or where cells connect (end-to-end), and turn key to "lock" position. Refer to Figure 6.
- When Geoweb sections are connected end-to-end, under-expand a few rows of the adjoining section to allow easy placement of the ATRA keys before fully expanding the connecting section. For easiest placement, insert the key completely through one cell before inserting through the adjoining cell. Adjoining sections should also be fully connected prior to infilling.
- The use of the ATRA key device will reduce construction time significantly and offer cost-savings compared to stapling operations.
- Geoweb sections may also be connected with pneumatic staplers either side-to-side or end-to-end. ATRA key is the recommended connection method.
- The ATRA key connection device and pneumatic staplers and staples are available through Presto Geosystems and their authorized distributors/representatives.

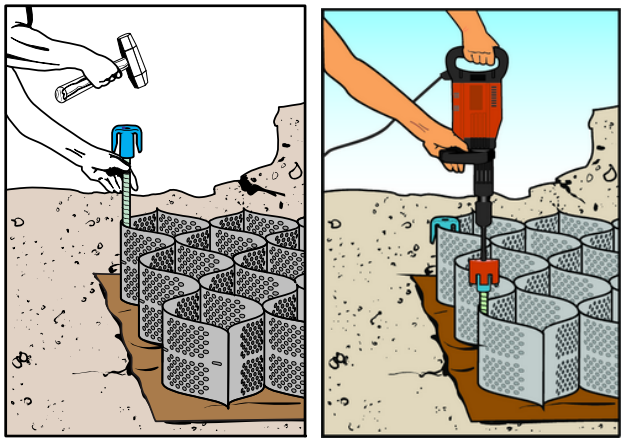


Figure 5 ATRA® Anchor Installation Methods

Figure 6 ATRA® Key Connection Device

Installation of Geoweb® Sections on Curved or Irregular Surfaces

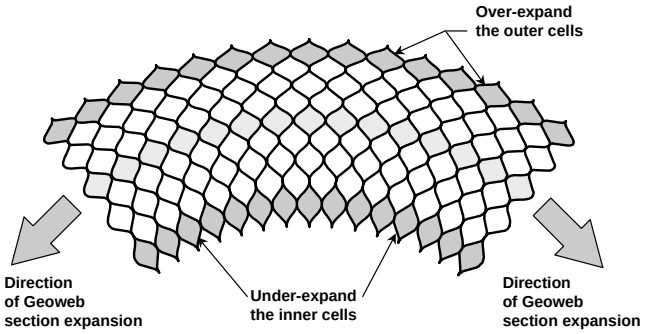


Figure 7 Curved Expansion of Section

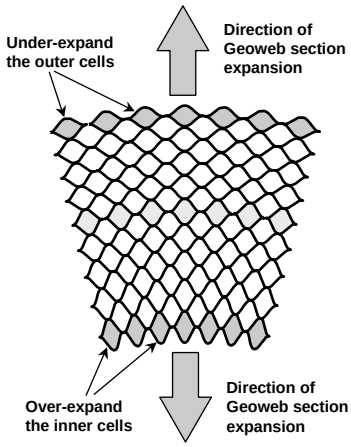
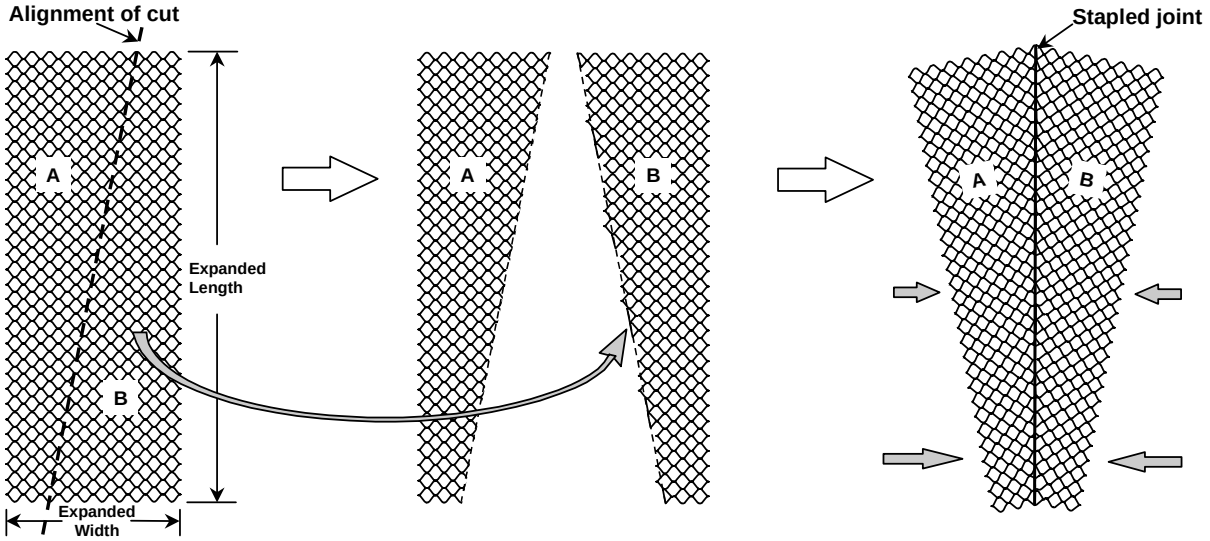


Figure 8 Tapered Expansion of Section

Method 1: Geoweb® sections can be readily adapted to cover curved areas by varying the degree of cell expansion across the width of individual sections. Refer to Figure 7.

Method 2: Progressively vary the degree of cell expansion along the length of a section. Refer to Figure 8.

Method 3: Field cut an expanded section to give the required degree of taper. Refer to Figure 9.



Step 1 Cut expanded Geoweb section with utility knife

Step 2 Rotate and re-position trapezoidal section B as shown

Step 3 Abut sections A and B, interleaf the cell walls, and staple together to form tapered section

Figure 9 Field Cutting of Geoweb® Section to Form Taper

Limiting Vertical Curvature of Geoweb® Sections

Table 1: Cell Depth vs. Limiting Radius of Curvature

Geoweb® Cell Depth	Minimum Radius Expansion Direction	Minimum Radius Cross Section Direction
3 in (75 mm)	16 in (400 mm)	24 in (600 mm)
4 in (100 mm)	24 in (600 mm)	40 in (1000 mm)
6 in (150 mm)	36 in (900 mm)	60 in (1500 mm)
8 in (200 mm)	48 in (1200 mm)	80 in (2000 mm)

Preparation of Tendon Geoweb® Sections

- Geoweb® sections are supplied with tendon I-slots. Tendons should be threaded through the appropriate cells that will provide the best distribution of the number of tendons per design.
- Individual tendons are typically precut to allow for efficient installation. Mark the tendons with a black permanent marker per Attachment 1, Tendon Marking Method.
- Feed individual tendons through tendon slots in the collapsed Geoweb® sections prior to section expansion. Refer to Figure 10.

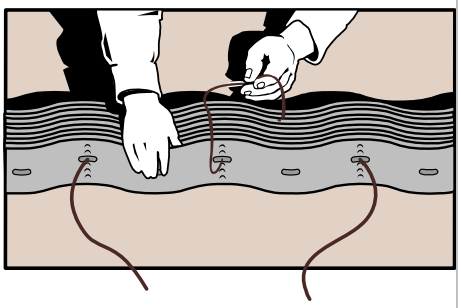


Figure 10 Tendon Insertion

Terminating and Anchoring Tendons

There are two standard methods of terminating tendons at an outer edge of Geoweb® sections.

1. Terminate tendon on ATRA Tendon clip. Refer to Figure 11.
2. Knotted loop - used to attach tendons to a crest or toe anchor. Refer to Figure 12.

The ATRA® Stake Anchor and ATRA® Tendon Clip when used as a restraining device is recommended. Loop the tendon around and under the arms of the ATRA® Stake Clip.

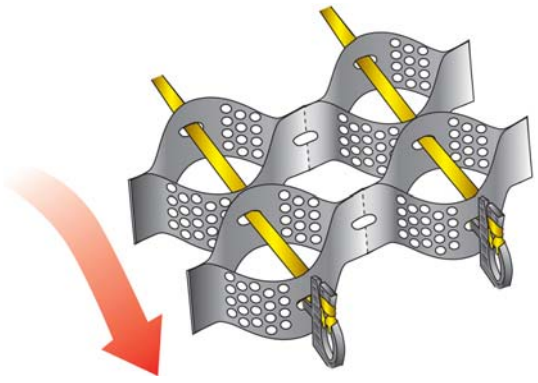


Figure 11 Termination of Integral Tendons

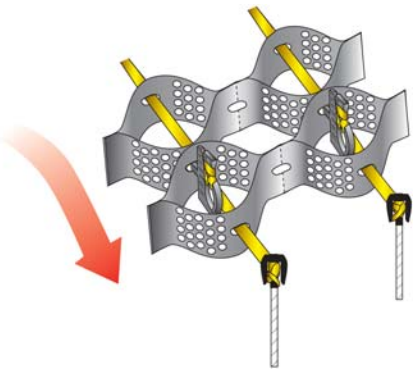


Figure 12 End Anchorage of Tendons

Internal Anchoring

- Drive additional ATRA® Stake Anchors within selected cells of the expanded Geoweb® section at the specified spacing. Refer to Figure 13.
- Ensure the tendon is under the arm of the ATRA® Stake Clip and drive the anchor flush with the base of the cell.
- Final driving of the anchors along a single tendon should progress in sequence from the initial edge anchor (generally at the crest). The trailing length of tendon should remain un-restrained to avoid over-tensioning of the tendon.
- The un-restrained tendon end should be terminated as illustrated above.

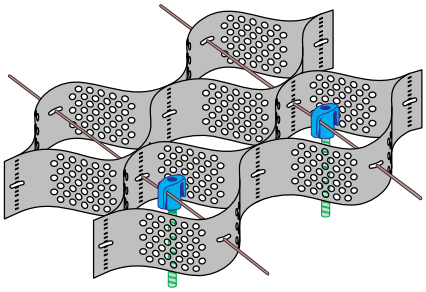


Figure 13 Internal Anchors

Non-Slip Tendon Internal Anchorage

- Geoweb® sections can be effectively supported on steep slopes with an array of internal anchors that are attached to the integral tendon system. Typical internal anchors include:
  a) ATRA® Stake Anchors
  b) J-pins
  c) Steel reinforcing rods
  d) Duckbill® cable anchors
  e) Wooden stakes
- The recommended method of attachment uses the ATRA® Stake Anchor and Moore hitch knot. Refer to Figure 14.

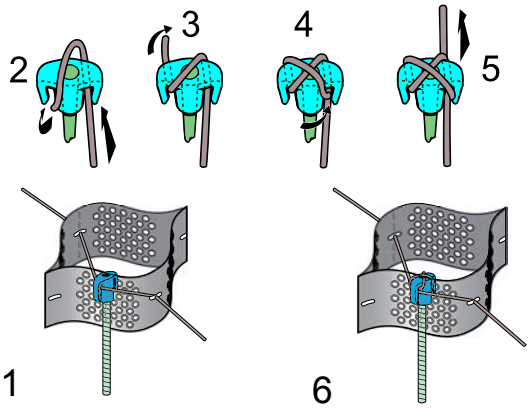


Figure 14 Moore Hitch Non-Slip Connection

Crest Anchorage of Tendon Geoweb® Systems

- Load transfer to crest anchorage is required when a driven anchor array is impractical (e.g. when a geomembrane or impervious material is present). Refer to Figure 15.
- ATRA® Tendon Clips transfer load from the Geoweb sections to the tendons in such cases. Refer to Figure 16.
- Prepare precut tendons in accordance with Preparation of Tendon Geoweb sections on page 4.
- Position the collapsed sections at the crest of the slope.
- Starting from the first tendon location, count the number of cells to the next ATRA Tendon Clip and repeat along that tendon row.

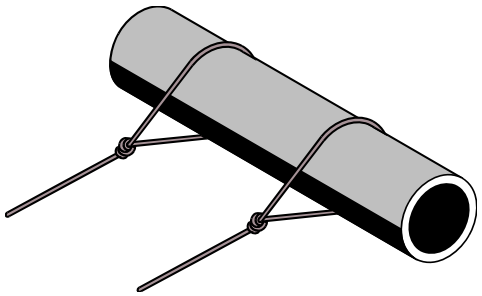


Figure 15 Deadman Crest Anchor

- Repeat this procedure for each additional tendon location.
- With all the ATRA Tendon Clips placed in the section, thread the tendons through the cell wall I-slots in the unexpanded section.
- Locate the corresponding mark on the tendon and position it in front of the cell wall. Hold the tendon and connect to the ATRA Tendon Clip.
- Refer to Attachment 2, ATRA Tendon Clip Installation Method for instructions on installing the ATRA Tendon Clip and tendon tie-off.
- Leave the trailing length of the tendon on the upslope side of the section to allow connection to ATRA Tendon Clip.
- Repeat this procedure for each additional tendon location.
- Place the collapsed section in the anchor trench, secure with temporary stakes or ATRA Stake Anchors and expand down the slope.
- Adjust the section (i.e. a shake or two of the expanded section works well for this) so that the section and tendons are uniformly taut.
- Terminate the bottom of each tendon with an ATRA Tendon Clip.
- Note: Attaching ATRA® Tendon clips at the required spacing can be accomplished while the Geoweb® section is pre-expanded on a flat surface. The section can then be re-collapsed, attached to crest anchorage, and deployed onto the slope. This method facilitates the installation of sections on extremely steep slopes. Refer to Figure 17.

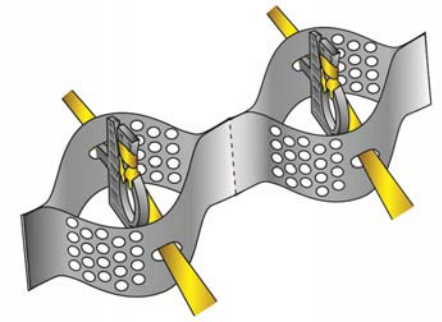


Figure 16 ATRA® Tendon Clips

Figure 17 Threading Tendon and Attaching ATRA Tendon Clips

Placement of Infill

- Infilling of Geoweb® sections can begin when anchoring work is complete.
- A range of equipment types can be used as illustrated in Figure 18 – Figure 22.
  - Hydraulic Excavator (Backhoe)
  - Front-end Loader
  - Conveyor
  - Crane-mounted skip
  - Mixer Chute
- Limit drop-height of infill material to 3 ft (1 m) maximum.
- Infill from the crest of the slope to the toe.
- Controlled overfilling of cells is required to allow for consolidation and compaction of the infill.
- Ensure that infill will be flush with the upper surface of the cells at the completion of the installation.

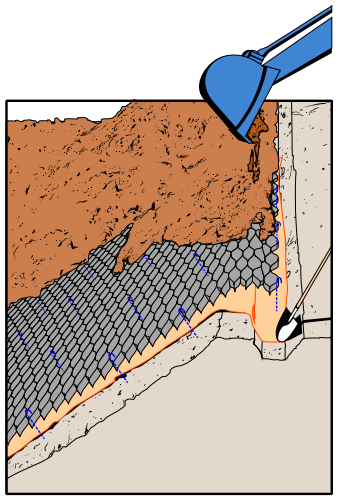


Figure 18 Excavator

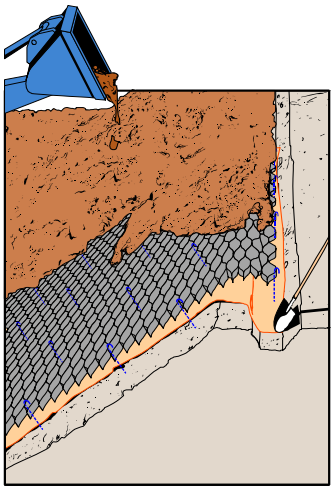


Figure 19 Loader

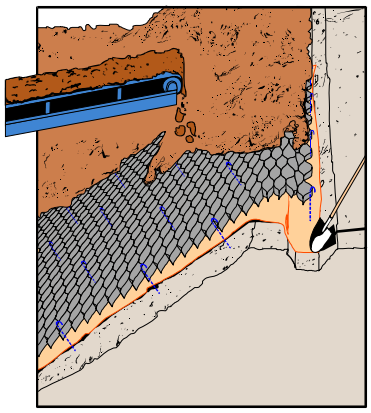


Figure 20 Mobile Conveyor

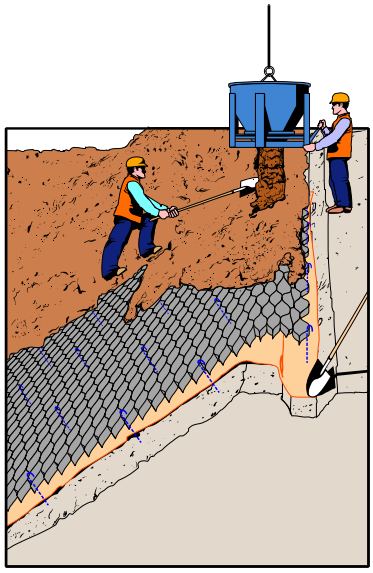


Figure 21 Skip

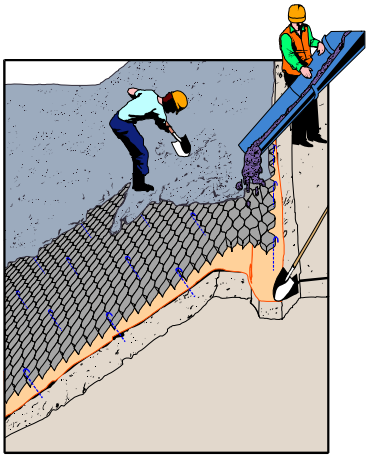


Figure 22 Chute

Dimensions and Weights of Palletized Geoweb® Sections

Geoweb® sections are normally tri-folded and palletized for shipment to the site. Table 2 provides typical pallet dimensions and weights for a range of section and cell sizes.

Table 2: V-Series Geoweb® Shipping Dimensions and Weights

Cell Depth	*Pallet Dimensions*	*Minimum Weight*	*Maximum Weight*
3 in (75 mm)	42 in x 42 in (1070 mm x 1070 mm)	860 lb (390 kg)	1,560 lb (710 kg)
4 in (100 mm)	42 in x 42 in (1070 mm x 1070 mm)	880 lb (400 kg)	1,600 lb (730 kg)
6 in (150 mm)	42 in x 42 in (1070 mm x 1070 mm)	800 lb (360 kg)	1,450 lb (660 kg)
8 in (200 mm)	42 in x 42 in (1070 mm x 1070 mm)	880 lb (400 kg)	1,600 lb (730 kg)

Infill Volumes

Table 3: Infill Volumes for Geoweb® Sections

Cell Depth	**3 in (75 mm)**	**4 in (100 mm)**	**6 in (150 mm)**	**8 in (200 mm)**
Volume (m^3 / 100 m^2 of area)	7.5 m^3	10.0 m^3	15 m^3	20.0 m^3
Volume (yd^3 / 100 yd^2 of area)	8.3 yd^3	11.1 yd^3	16.7 yd^3	22.2 yd^3

Tools and Equipment

Installation efficiency is greatly improved by the appropriate choice of construction equipment and tools. The following guidelines apply to most Geoweb® system applications. Non-standard tools and equipment may provide additional benefits in some situations.

Table 4: Standard Construction Tools for Installation of the Geoweb® System

Geoweb® Components	**Power Tools**	**Concrete Finishing**	**Surveying Equipment**
ATRA® Stake Clips/Anchors ATRA® Tendon Clips	Heavy-duty drill	Bull floats	Surveyor's auto-level
ATRA® Key Connection Device	Circular saw	Hand floats	Tripod and rod
Hand Tools	Percussion hammer	Steel trowels	Laser beacons
Shovels and spades	Stanley-Bostitch stapler	Poker vibrators	Audio target receiver
Rakes and screed bars	SB103020 wire staples	Tamping rods	Survey stakes
Sledge hammers	Gas generator		Markers + spray cans
Crowbars	Air compressor		String-lines + spirit level
Utility knives	Electric Impact Hammer ATRA® Anchor Driving Tool and Gad.		
Spikes, nails + lumber			
Templates			

Excavation and Materials Handling Equipment

Conventional excavators, front-end loaders, mini-excavators and skid-steer loaders, equipped with smooth-edged buckets, are normally employed for the installation of Geoweb® systems. Infilling of Geoweb® sections can also be carried out with conveyors, chutes and skips. As a rule, the overall rate of installation relates directly to the speed and efficiency of infill placement and compaction.

Compaction Equipment

Compaction of slope surfaces prior to installation of the Geoweb® system is normally carried out with: 1) vibratory plate compactor attachments for backhoes, 2) a mobile winch assembly at the slope crest to support a roller or plate compactor, or 3) manual tamping. Slope pre-compaction is primarily intended to minimize sloughing of loose surface topsoil or aggregate fill materials.

Limited Warranty

Presto Geosystems warrants each Geoweb® section which it ships to be free from defects in materials and workmanship at the time of manufacture. Presto's exclusive liability under this warranty or otherwise will be to furnish without charge to Presto's customer at the original f.o.b. point a replacement for any section which proves to be defective under normal use and service during the 10-year period which begins on the date of shipment by Presto. Presto reserves the right to inspect any allegedly defective section in order to verify the defect and ascertain its cause.

This warranty does not cover defects attributable to causes or occurrences beyond Presto's control and unrelated to the manufacturing process, including, but not limited to, abuse, misuse, mishandling, neglect, improper storage, improper installation, improper alteration or improper application.

PRESTO MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, WRITTEN OR ORAL, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OR MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE, IN CONNECTION WITH THE GEOWEB® SYSTEM. IN NO EVENT SHALL PRESTO BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR THE BREACH OF ANY EXPRESS OR IMPLIED WARRANTY OR FOR ANY OTHER REASON, INCLUDING NEGLIGENCE, IN CONNECTION WITH THE GEOWEB® SYSTEM.

ATTACHMENT 1: TENDON MARKING METHOD

ATRA® Tendon Clip Preassembly Layout Guide

To pre-assemble ATRA tendon clips to tendons with the Geoweb® slope or channel protection system:

1. Determine Total Tendon Length using imperial or metric charts below.
2. Add to that length the tendon required to secure the system to anchor pipe, anchor stakes, helical anchors, etc., and use the "Distance between marks" charts to mark off the location for each ATRA tendon clip to be located.
3. After threading the tendon through the still collapsed Geoweb sections, align the first mark with the top cell and assure it remains properly located as the tendon is tied to the ATRA tendon clip.
4. Move to the next recipient cell (as per project design) and align the next mark with the cell and continue the process.
5. The bottom cell should receive its last clip AFTER expanding the Geoweb system down the slope.

Distance between marks
INCHES

Number of Cells between ATRA Tendon Clips	Cell Size 20V	30V	40V
1	15.8	18.3	25.7
2	24.6	29.6	44.4
3	33.4	40.9	63.1
4	42.2	52.2	81.8
5	51.0	63.5	100.5
6	59.8	74.8	119.2
7	68.6	86.1	137.9
8	77.4	97.4	156.6
9	86.2	108.7	175.3
10	95.0	120.0	194.0

Distance between marks
CENTIMETERS

Number of Cells between ATRA Tendon Clips	Cell Size 20V	30V	40V
1	40.1	46.5	65.3
2	62.5	75.2	112.8
3	84.8	103.9	160.3
4	107.2	132.6	207.8
5	129.5	161.3	255.3
6	151.9	190.0	302.8
7	174.2	218.7	350.3
8	196.6	247.4	397.8
9	218.9	276.1	445.3
10	241.3	304.8	492.8

Total Tendon Length
(Does not include length at top of slope for anchorage)
20V Cell Size Section
Section Length (feet)

Number of Cells between ATRA Tendon Clips for Each Row	18	21	25	29	34
1	25.5	29.6	35.2	40.7	47.6
2	20.0	23.5	27.8	32.1	37.2
3	18.1	21.1	25.4	29.1	34.1
4	17.5	20.5	24.2	27.8	32.3
5	16.9	19.8	22.9	26.6	31.1
6	16.3	19.2	22.9	26.0	30.5
7	16.3	18.6	22.3	26.0	29.9
8	16.3	18.6	22.3	25.4	29.9
9	15.7	18.6	21.7	25.4	29.2
10	15.7	18.6	21.7	24.8	29.2

Total Tendon Length
(Does not include length at top of slope for anchorage)
30V Cell Size Section
Section Length (feet)

Number of Cells between ATRA Tendon Clips for Each Row	18	21	25	29	34
1	29.4	34.2	40.6	47.0	55.1
2	23.9	28.1	33.3	38.5	44.6
3	22.1	25.7	30.8	35.4	41.6
4	21.5	25.1	29.6	34.2	39.7
5	20.9	24.4	28.4	33.0	38.5
6	20.2	23.8	28.4	32.3	37.9
7	20.2	23.2	27.8	32.3	37.3
8	20.2	23.2	27.8	31.7	37.3
9	19.6	23.2	27.2	31.7	36.7
10	19.6	23.2	27.2	31.1	36.7

Total Tendon Length
(Does not include length at top of slope for anchorage)
40V Cell Size Section
Section Length (feet)

Number of Cells between ATRA Tendon Clips for Each Row	18	21	25	29	34
1	41.1	47.8	56.8	65.8	77.1
2	35.6	41.7	49.5	57.3	66.7
3	33.7	39.3	47.0	54.2	63.6
4	33.1	38.6	45.8	53.0	61.8
5	32.5	38.0	44.6	51.7	60.5
6	31.9	37.4	44.6	51.1	59.9
7	31.9	36.8	44.0	51.1	59.3
8	31.9	36.8	44.0	50.5	59.3
9	31.3	36.8	43.4	50.5	58.7
10	31.3	36.8	43.4	49.9	58.7

Total Tendon Length
(Does not include length at top of slope for anchorage)
20V Cell Size Section
Section Length (meters)

Number of Cells between ATRA Tendon Clips for Each Row	18	21	25	29	34
1	7.77	9.04	10.72	12.41	14.51
2	6.09	7.17	8.48	9.79	11.34
3	5.53	6.42	7.73	8.86	10.41
4	5.34	6.24	7.36	8.49	9.85
5	5.16	6.05	6.99	8.11	9.47
6	4.97	5.86	6.99	7.93	9.29
7	4.97	5.68	6.80	7.93	9.10
8	4.97	5.68	6.80	7.74	9.10
9	4.78	5.68	6.61	7.74	8.91
10	4.78	5.68	6.61	7.55	8.91

Total Tendon Length
(Does not include length at top of slope for anchorage)
30V Cell Size Section
Section Length (meters)

Number of Cells between ATRA Tendon Clips for Each Row	18	21	25	29	34
1	8.97	10.44	12.39	14.34	16.78
2	7.29	8.57	10.15	11.73	13.61
3	6.73	7.82	9.40	10.79	12.67
4	6.54	7.64	9.03	10.42	12.11
5	6.36	7.45	8.65	10.05	11.74
6	6.17	7.26	8.65	9.86	11.55
7	6.17	7.08	8.47	9.86	11.37
8	6.17	7.08	8.47	9.67	11.37
9	5.98	7.08	8.28	9.67	11.18
10	5.98	7.08	8.28	9.49	11.18

Total Tendon Length
(Does not include length at top of slope for anchorage)
40V Cell Size Section
Section Length (meters)

Number of Cells between ATRA Tendon Clips for Each Row	18	21	25	29	34
1	12.52	14.58	17.32	20.06	23.49
2	10.84	12.71	15.08	17.45	20.32
3	10.28	11.97	14.34	16.52	19.38
4	10.10	11.78	13.96	16.14	18.82
5	9.91	11.59	13.59	15.77	18.45
6	9.72	11.41	13.59	15.58	18.26
7	9.72	11.22	13.40	15.58	18.08
8	9.72	11.22	13.40	15.40	18.08
9	9.54	11.22	13.21	15.40	17.89
10	9.54	11.22	13.21	15.21	17.89

Example shown as highlighted above: GW30V40825PT section is 25 cells in length. ATRA Tendon Clips to be placed every FOUR cells along the tendon beginning with cell to be located at top of slope.

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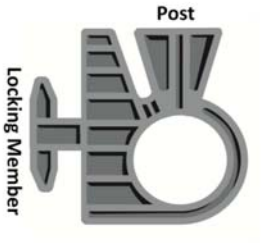
ATTACHMENT 2: ATRA® TENDON CLIP INSTALLATION METHOD



ATRA® Tendon Clip

LOAD TRANSFER DEVICE

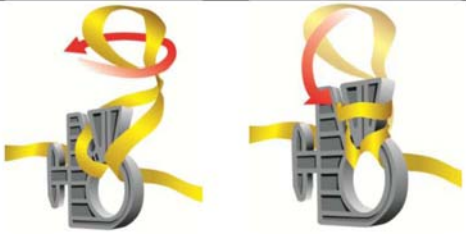
ATRA Tendon Clips are load transfer devices to transfer slope gravity forces from the GEOWEB® cell wall to the tendon. The device engages securely with the GEOWEB cell wall, allowing hands-free connection while securing the tendon. ATRA Tendon Clips can be preassembled at the top of the slope on flat ground improving safety and efficiency.

5 EASY INSTALLATION STEPS...

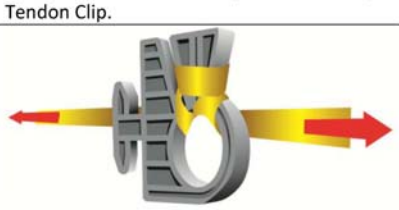
STEP 1: Locate the cells where the ATRA Tendon Clips will be installed. Insert the locking member of the ATRA Tendon Clip through the slot in the GEOWEB cell wall. Turn the clip 90 degrees to lock.

STEP 2: Pull a few inches of the tendon through the circular opening in the ATRA Tendon clip.

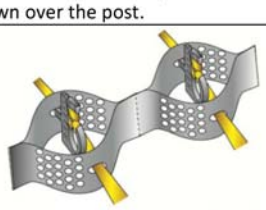
STEP 3: Pull the tendon up and over the post of the ATRA Tendon Clip.



STEP 4. Twist the tendon to form a loop. Fold the tendon loop back down over the post.



STEP 5: Pull the tendon so the slack is eliminated and it is tightly secured to the clip.



COMPLETED. ATRA Tendon Clip load transfer connection.

Use the QR Code to view our ATRA Tendon Clip videos.

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