PRESTO GEOSYSTEMS

GEOWEB®

CHANNEL PROTECTION SYSTEM

INSTALLATION GUIDELINE

PRESTO GEOSYSTEMS
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Table of Contents

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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.

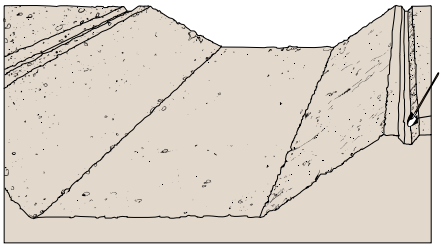


Figure 1 Channel Excavation

Geotextile Separation Layer

- Install the specified geotextile over the channel invert and side slopes. See Figure 2.
- Adequately overlap adjacent sections in a downstream direction.
- Ensure geotextile is placed in perimeter toe-in trenches.
- Pin the edges of the geotextile sections to inhibit movement.

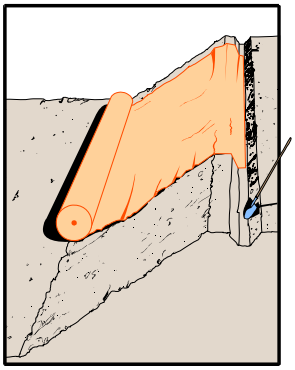


Figure 2 Geotextile Placement

Installation of Geoweb® Sections

- Drive a row of anchor stakes along the upper edge of the proposed slope protection area. Space the stakes at pre-determined single cell centers. See Geoweb® Anchor Spacing Charts for guidance.
- Partially expand the Geoweb® section and place the end cell of the section over its corresponding edge stake. When ATRA® Anchors are used, ensure the ATRA® Clip arm is hooked through the slot hole, or the anchor is placed over the cell wall. See Figure 3.

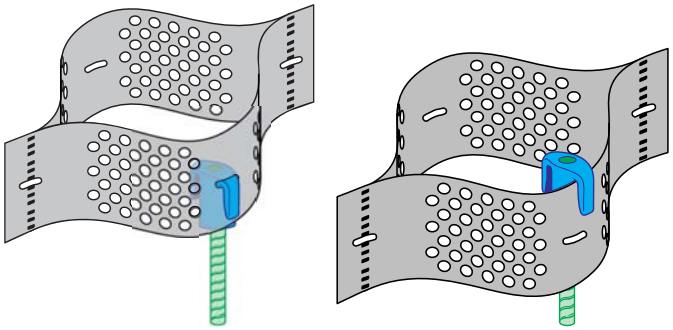


Figure 3 ATRA® Anchor Placement Options

- Expand the Geoweb® section down the channel side slopes to the section's specified length. See Figure 4.

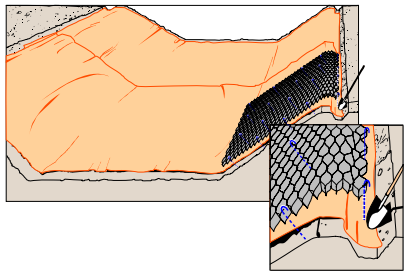


Figure 4 Placement of Geoweb® Section

- Hold the fully expanded sections open using one of the following:
  a) ATRA® 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® anchors. See Figure 5.
  b) Infill several peripheral cells.
  c) Other acceptable methods may also be used.

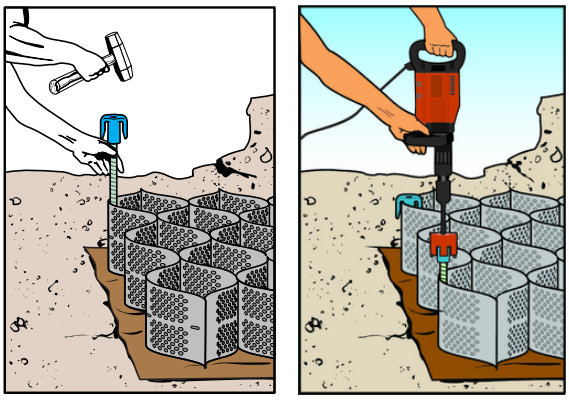


Figure 5 ATRA® Anchor Installation Methods

- 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" in position. See 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 offers cost-savings compared to stapling operations.
- Geoweb sections may also be connected with pneumatic staplers either side-to-side or end-to-end.
- The ATRA key connection device and pneumatic staplers and staples are available through Presto Geosystems and their authorized distributors/representatives.

Figure 6 ATRA® Key Connection Device

Installation of Geoweb® Sections on Curved or Irregular Surfaces

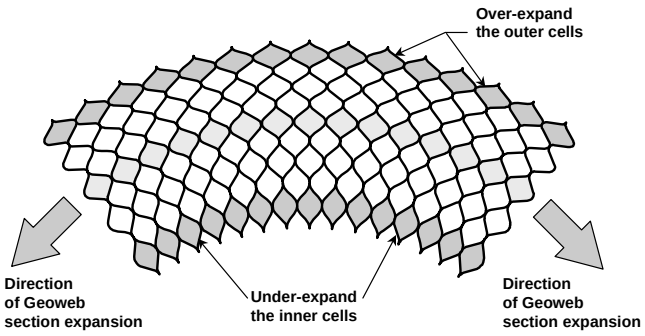


Figure 7 Curved Expansion of Section

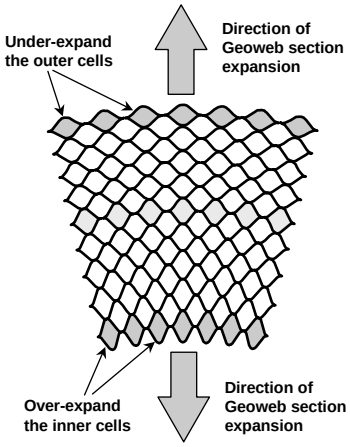
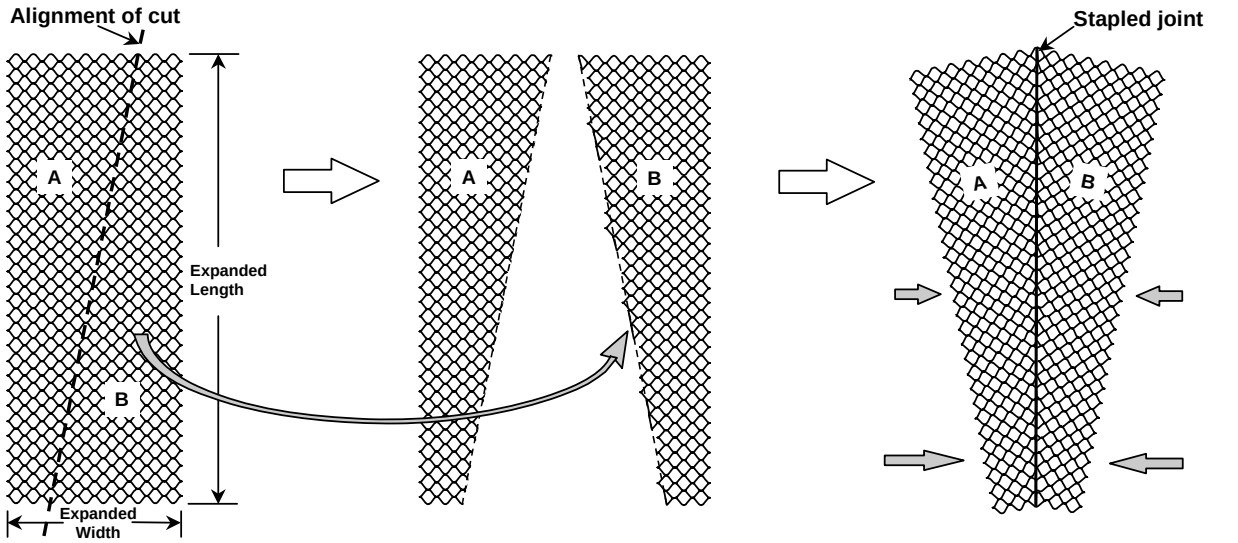


Figure 8 Tapered Expansion of Section

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. See Figure 7.

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



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

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

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
75 mm (3 in)	400 mm (16 in)	600 mm (24 in)
100 mm (4 in)	600 mm (24 in)	1000 mm (40 in)
150 mm (6 in)	900 mm (36 in)	1500 mm (60 in)
200 mm (8 in)	1200 mm (48 in)	2000 mm (80 in)

Preparation of Tendoned Geoweb® Sections

- Geoweb® sections are supplied with tendon 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 cut to a total length equal to:

  1.15 x expanded Geoweb® section length
  + 1.0 m (3 ft) to allow for loops, etc. and
  + 0.15 m (6 in) for each ATRA Clip used per Figure 16 Moore Hitch Non-Slip Connection.
- Feed individual tendons through tendon slots in the collapsed Geoweb® sections prior to section expansion. See Figure 10.

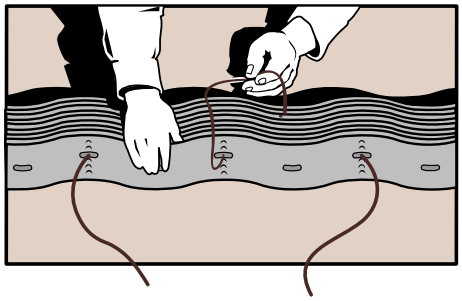


Figure 10 Tendon Insertion

Special Tendon Insertion Methods:

- Use a short length of 2.5 mm (12 gauge) wire with an elongated loop at one end as a threading needle to pull the leading end of the tendon through the Geoweb® section. See Figure 11.

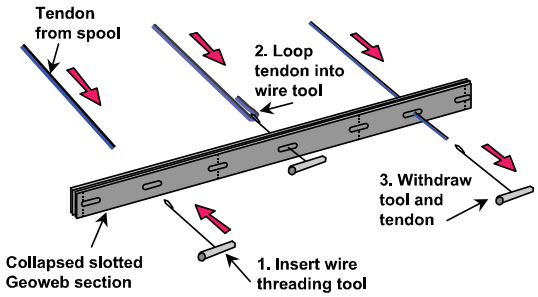


Figure 11 Threading Tendons

- Insert a short length of thin-wall metal tubing as a smooth guide for the tendon. Once the tendon has been fed through the collapsed Geoweb® section, the tube is removed. See Figure 12.

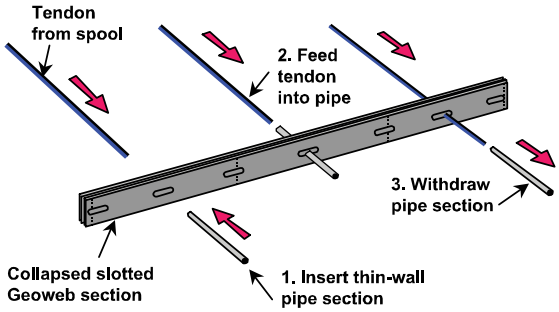


Figure 12 Use of Guide Tubes

Terminating and Anchoring Tendons

There are two standard methods of terminating tendons at an outer edge of Geoweb® sections. See Figure 13 and Figure 14.

1. Double-loop knot with stop washer – normally used at the toe of the slope.

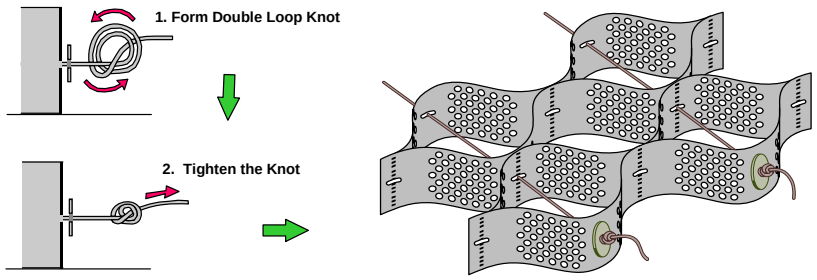


Figure 13 Termination of Integral Tendons

2. Knotted loop - used to attach tendons to a crest or toe anchor.

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

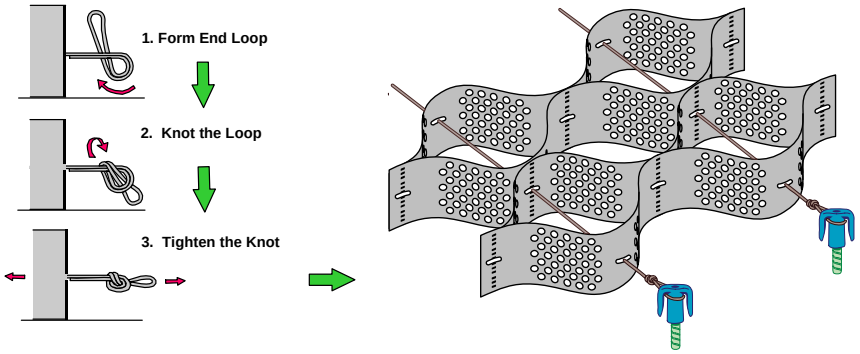


Figure 14 End Anchorage of Tendons

Internal Anchoring

- Drive additional ATRA® Anchors within selected cells of the expanded Geoweb® section at the specified spacing. See Figure 15.
- Ensure the tendon is under the arm of the ATRA® 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.

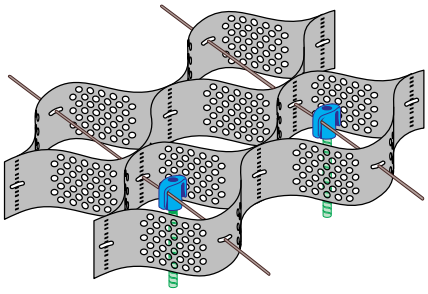


Figure 15 Internal Anchors

Non-Slip Tendoned 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® Anchors
  b) J-pins
  c) Steel reinforcing rods
  d) Duckbill® cable anchors
  e) Wooden stakes
- The recommended method of attachment uses the ATRA® Anchor and a mooring hitch Presto Geosystems refers to as the "Moore Hitch". See Figure 16.

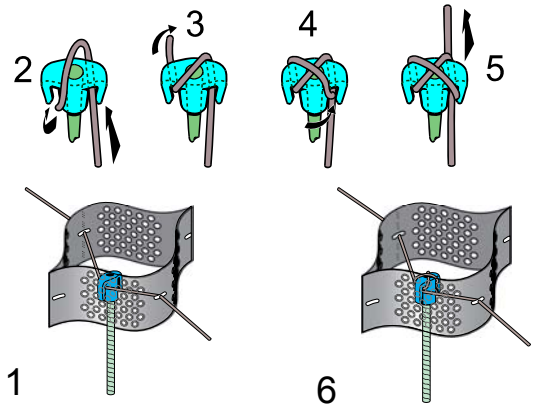


Figure 16 Moore Hitch Non-Slip Connection

Crest Anchorage of Tendoned 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). See Figure 17.
- ATRA® restraining clips transfer load from the Geoweb sections to the tendons in such cases. See Figure 18.
- With tendons inserted, expand the Geoweb® section into position and attach the ATRA® Clips at pre-determined cell spacing.
- Attachment of ATRA® restraining clips can progress in either an up-slope or down-slope direction.
- Pre-anchor the end of the tendon from which the ATRA® Clip attachment commences.
- Remove all internal slack from tendons as the ATRA® Clips are attached.
- Precut tendons must be long enough to allow for attachment knots at each clip. Refer to recommendation on page 4.

➔ Attaching ATRA® restraining 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. **NOTE**: Use a small electrical tie to secure the ATRA® Clip to the tendon before collapsing the Geoweb section. This will prevent the clip from falling off the tendon.

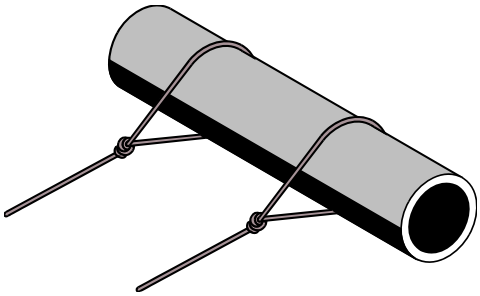


Figure 17 Deadman Crest Anchor

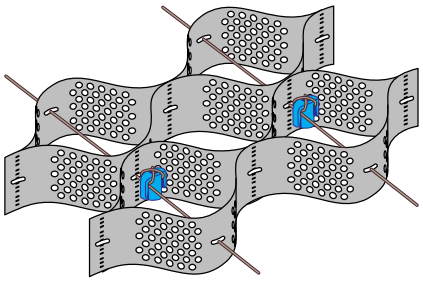


Figure 18 ATRA® Restraint Clips

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 19 – Figure 23.
  - Hydraulic Excavator (Backhoe)
  - Front-end Loader
  - Conveyor
  - Crane-mounted skip
  - Mixer Chute
- Limit drop-height of infill material to 1 m (3 ft) 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.

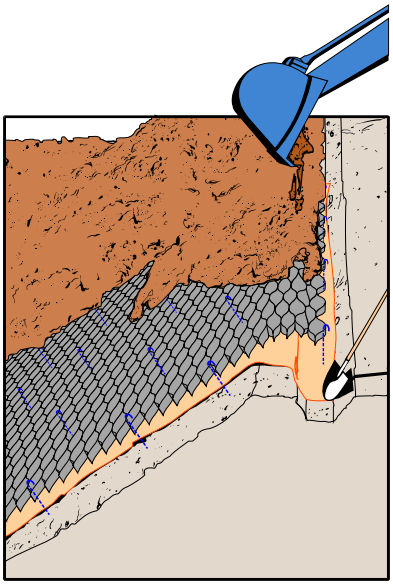


Figure 19 Excavator

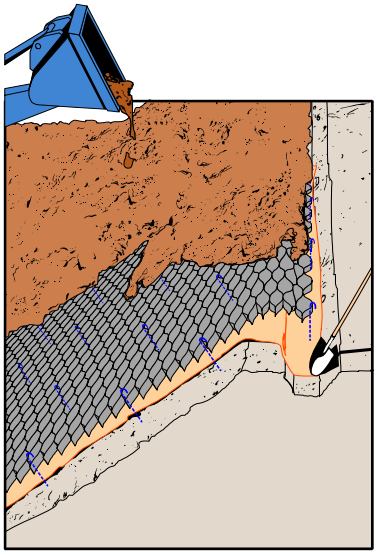


Figure 20 Loader

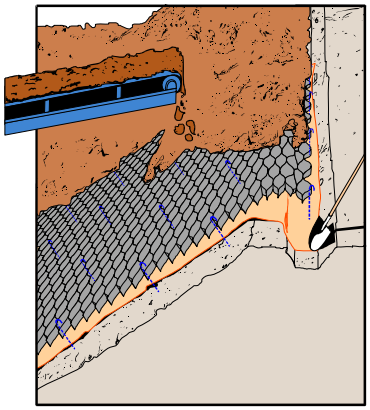


Figure 21 Mobile Conveyor

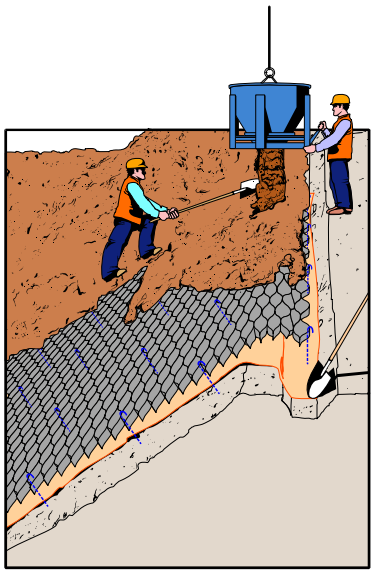


Figure 22 Skip

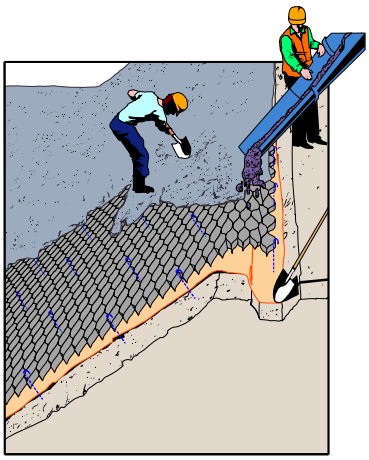


Figure 23 Chute

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

Infill Volumes

Table 3: Infill Volumes for Geoweb® Sections

Cell Depth	**75 mm (3 in)**	**100 mm (4 in)**	**150 mm (6 in)**	**200 mm (8 in)**
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® Clips/Anchors	Heavy-duty drill	Bull floats	Surveyor's auto-level
ATRA® 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.