

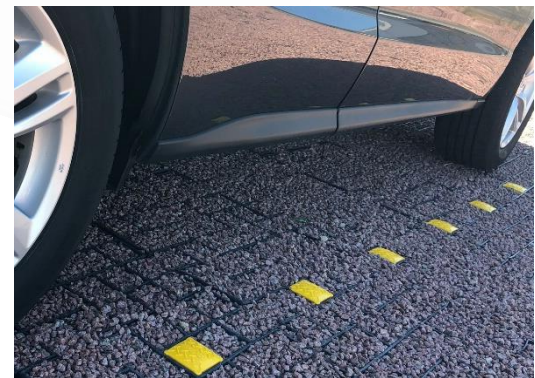
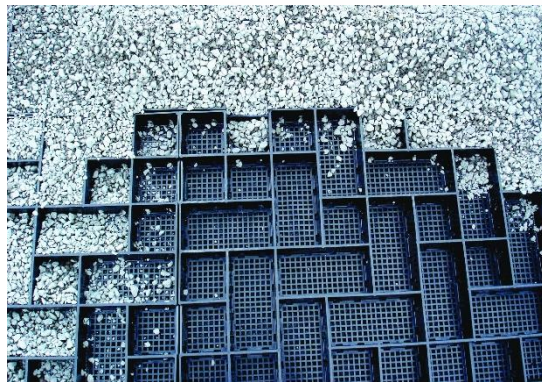


PRESTO GEOSYSTEMS

GEOPAVE®

POROUS PAVEMENT SYSTEM

DESIGN & CONSTRUCTION OVERVIEW



PRESTO GEOSYSTEMS

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The GeoPave® Porous Pavement System Components

The GeoPave Porous Pavement System with open graded aggregate or an aggregate/topsoil engineered infill provides a permeable, stabilized surface for vehicular and pedestrian load support.

The complete system has three major components:

- (1) the GeoPave unit
- (2) if required, open graded aggregate or aggregate/topsoil engineered base
- (3) open graded aggregate or an aggregate/topsoil engineered infill.

Other components may include a geosynthetic separation layer, sub-drain components, and delineation markers.

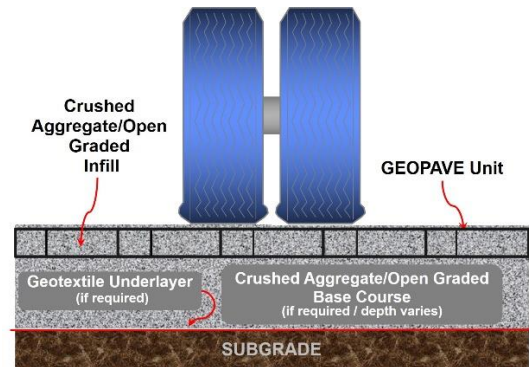


Figure 1 The GeoPave Porous Pavement System

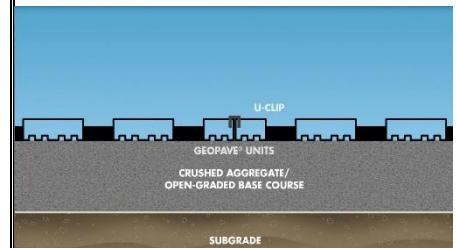
DESIGN Considerations

FUNCTION of the GeoPave System Components

Function of the Paver Structure

The function of the GeoPave unit is to:

- 1) create a structural framework to contain and stabilize open-graded aggregate or an aggregate/topsoil engineered infill that will provide permeability and infiltration of stormwater.
- 2) keep aggregate from migrating through the bottom of the paver units monolithic mesh bottom.
- 3) increase bearing capacity for vehicular (up to AASHTO H/HS-20) or pedestrian loading requirements using open graded aggregate or other structural infill.
- 4) The GeoPave units are semi-rigid pavers with interconnected cell walls. The GeoPave units are connected with strong U-Clip devices. This interconnected cell wall and U-Clip provides high load distribution allowing for less base material than lighter-weight or rolled systems.

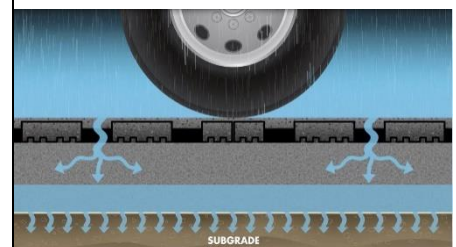


Function of the Base Material

For a given applied load over an existing subgrade, both the base material, *if required*, and GeoPave unit with open graded aggregate or engineered infill provide support. The base depth should be determined using both loading requirements and subgrade strength. Refer to Table 2. The base also performs like an on-site stormwater retention system allowing stormwater to be stored, and infiltrate slowly. The Engineer of Record shall determine the means of edge restraint for the base material such that it is stable during installation and under the expected loads.

For aggregate pavement surfaces, the gradation of the base material and infill are different. Refer to Tables 2 and 3.

For vegetated pavement surfaces, the aggregate particle range recommendation is different for the base material than the infill material. Refer to Table 2.



Function of the Infill

Aggregate Pavement Surface

The recommended infill is an open graded, crushed aggregate with low fine content to provide a highly-permeable system that infiltrates stormwater quickly.



Vegetated Pavement Surface

The completed system provides a healthy and aesthetically pleasing vegetative cover. The aggregate portion of the engineered infill helps to support loads. Chosen vegetation should be resilient enough to withstand anticipated load frequencies. **Vegetated GeoPave pavements are suitable for occasional traffic loads.**





OPTIONAL Components	
Function of the Geosynthetic Layer (if required)	Function of the Sub-drain Component (if required)
Under some conditions, a geosynthetic layer may be required between the sub grade and required base. Generally, the geosynthetic component will serve one or more of the following functions and be one or more of the following materials: 1) tensile reinforcement (woven geotextiles), 2) separation/filtration (woven or non-woven geotextiles) and 3) drainage geosynthetics (Geonets, piping). The geotextile shall be installed in accordance with Manufacturer recommendations. Slit tape woven geotextiles are not recommended.	If the GeoPave units are installed over non-porous soils and an excavation is required such that water could be trapped, sub drainage becomes a required component of the system. Sub-drainage will remove harmful water accumulation that will cause degradation of the in-situ soils resulting in loss of bearing capacity.

SPECIFICATION Details:

GeoPave Material Properties & Unit Dimensions

GeoPave units shall be made from materials with physical and chemical characteristics described in Table 1. The manufactured GeoPave unit shall have a minimum deflection without breakage of 1.0 in (25 mm) when units are supported at 40 in (0.50 m) centers at 70°F (21°C). The color shall be uniform throughout all units in any given pallet.

GeoPave units shall have physical dimensions as specified in Table 1 and shown in Figure . GeoPave units shall contain a herringbone-type cell pattern consisting of small and large cells with a mesh bottom and vented side-walls. The monolithic mesh bottom is comprised of a series of square 0.25 in by 0.25 in (6.35 mm by 6.35 mm) openings. The small cells contain 1.0 in (25 mm) high and 0.50 in (12 mm) wide vented cell-wall openings, either 4 or 6 per cell for infill lock-up and lateral drainage between cells. The large cells contain vented cell-wall openings, 12 per cell.

The GeoPave units shall be connected with U-CLIPS side-to-side and end-to-end where the short cell side-walls of adjacent units align. A total of 12 U-Clips are required for each unit. The connection points vary depending on chosen laying pattern (See Laying Patterns). End-to-end or side-to-side warping of the GeoPave unit shall not create a greater opening between adjacent outside walls than 0.25 in (6 mm). The finished GeoPave pavement is a uniformly connected, laterally integrated porous pavement system.

Table 1 SPECIFICATION of the GeoPave® Porous Pavement Unit		
Item	Specification & Details	Paver Unit Details
Material	Up to 100% Recycled Polyethylene ¹	<p>Figure 2 GeoPave Unit Nominal Dimensions</p>
Color	Ranges Dark Shades Gray to Black	
Chemical Resistance	Superior	
Carbon Black for Ultraviolet Light Stabilization	1.5% - 2.0%	
Unit Minimum Crush Strength (Empty) @ 70°F (21°C)	175 psi (1,202 KPa)	
Unit Minimum Crush Strength (Aggregate or Aggregate/Topssoil - Filled) @ 70°F (21°C)	5,160 psi (35,625 KPa) ²	
Flexural Modulus @ 70°F (21°C)	35,000 psi (240,000 kPa)	
Nominal Dimensions (width x length)	20 in x 40 in (0.5 m x 1.0 m) ³	
Nominal Unit Depth	2.0 in (50 mm)	
Nominal Coverage Area	5.38 ft ² (0.5 m ²)	
Cells per Unit	50	<p>Figure 3 GeoPave Cell and Interlocking Offset Tab</p>
Small Cell Size	3.25 in x 3.25 in (83 mm x 83 mm)	
Large Cell Size	3.25 in x 6.5 in (83 mm x 165 mm)	
Top Open Area per Unit	90.5%	
Bottom Open Area per Unit	32.6%	
Bottom Mesh Opening Size	0.25 in x 0.25 in (6.35 mm x 6.35 mm)	
Weight per Unit (nominal)	7.6 lbs (3.4 kg)	
Runoff Coefficient @ 2.5 in/hr (64 mm/hr) Rainfall with Aggregate with Engineered Infill	(0-0.15) (0.10-0.35)	
Units per Pallet	46	



NOTES: 1) The percentage of recycled content may vary depending on availability of recycled materials. 2) Avoid specifications that state material compressive strength only. Material compressive strength, with applied factors of safety must be sufficient to resist compressive and lateral loads. In addition, ultra-high compressive strength adds little value to a porous pavement system. 3) Dimensions and weight are subject to manufacturing tolerances and are influenced by recycled components.

Orientation & Laying Pattern of Units

The Engineer shall specify the laying pattern Offset, Bricklayer or Herringbone in accordance with anticipated traffic type and flow.

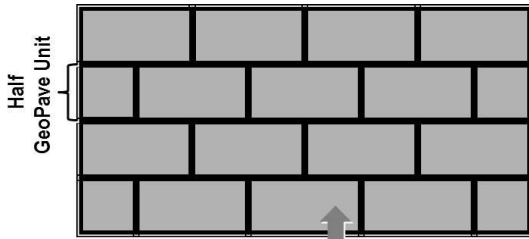
When the application is a narrow access lane, the recommended pattern is the **offset pattern**.



Offset

Figure 4 Offset Laying Pattern

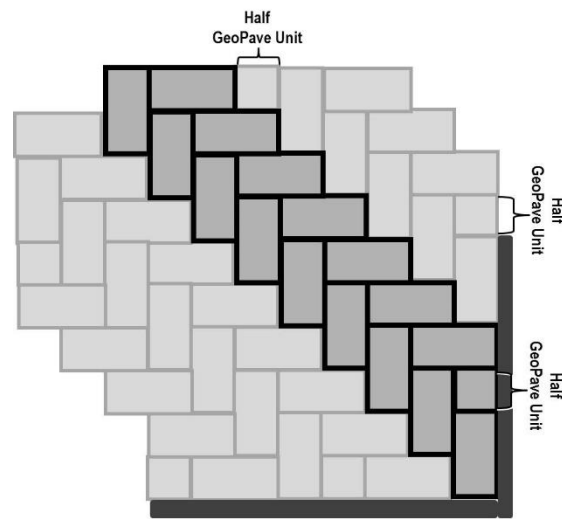
When the application is **one-direction vehicular traffic**, the recommended pattern is the **bricklayer pattern**.



Bricklayer Direction of Traffic

Figure 5 Bricklayer Laying Pattern

When the application is a large area with **multi-directional traffic**, the recommended pattern is the **herringbone pattern**. This pattern reduces straight seams to one and a half block lengths and allows for better disguise of the unit seams.



Herringbone

Figure 6 Herringbone Laying Pattern

Optional Anchoring of Units

If required, the Engineer shall specify anchoring the GeoPave units in-place with 0.5 in (13 mm) #4 rebar to prevent movement of the units. Anchoring may be necessary if the GeoPave units are placed on a slope (5-10%).

Curve or Corner Fit

If necessary, the Engineer shall specify either offsetting the GeoPave units or cutting the GeoPave units to fit around curves or corners. The GeoPave units shall be cut to accommodate existing obstacles, such as manhole covers. Edge restraints shall be specified by the Engineer and are required around both internal and external borders, in order to create closed "cells" that will contain the infill material. The offset or cut units shall be connected in the usual manner.

Base Materials



If necessary for loading requirements, the recommended base shall be aggregate or an engineered aggregate/topsoil mixture, and should be consistent with the chosen infill type. Refer to Table 2 for base material specification. Refer to Table 3 for base depth recommendations.

Infill Materials

The recommended infill shall be an open graded aggregate or an aggregate/topsoil engineered infill for vegetated pavements. Round aggregate is not allowed. Aggregate pavement surfaces are suitable for all types of traffic and frequencies (up to AASHTO H/HS-20 loading). Vegetated pavement surfaces are suitable for occasional use traffic with an engineered infill and base as shown in Table 2.



Table 2 Base and Infill Recommendations

AGGREGATE Pavements		
AGGREGATE Surface	BASE Material	INFILL Material
A 	<p align="center">Open Graded/Crushed Aggregate</p> <p>The <u>base material</u> shall be an open graded crushed aggregate with a particle range from 0.375 in to 1.0 in (10 mm to 25 mm) with a fines content less than 5%.</p> <p>The aggregate shall be compacted to the Engineer's specifications. After compaction, the surface shall be uniform with no protrusions from larger aggregate particles. The edges of the base shall be constrained appropriately.</p>	<p align="center">Open Graded/Crushed Aggregate</p> <p>The <u>infill material</u> shall be an open graded crushed aggregate with a particle range from 0.375 in to 0.5 in (10 mm to 13 mm) and a fines content less than 5%.</p> <p>Round stone should not be used.</p>
	VEGETATED Pavements	
VEGETATED Surface	BASE Material	INFILL Material
B 	<p align="center">Aggregate/Topsoil Mix</p> <p>The aggregate/topsoil engineered <u>base material</u> ensures proper moisture retention and the nutrient component required to maintain healthy vegetative root growth.</p> <p>The aggregate/topsoil engineered base shall consist of a homogenous mixture consisting of 1) an open graded crushed aggregate blended with 2) pulverized topsoil and 3) a void component generally containing air and/or water. This homogenous mixture will promote vegetative growth and provide required structural support. The aggregate portion shall have a particle range from 0.375 in to 1.0 in (10 mm to 25 mm) with a D₅₀ of 0.5 in (13 mm). The percentage void-space of the aggregate portion when compacted shall be at least 30%. The pulverized topsoil shall equal 33% of the total volume and be added and blended to produce a homogenous mixture prior to placement. The mixture shall be compacted to the Engineer's specifications. The edges of the base shall be constrained appropriately.</p>	<p align="center">Aggregate/Topsoil Mix</p> <p>The aggregate/topsoil engineered <u>infill material</u> shall consist of a homogenous mixture consisting of 1) an open graded crushed aggregate with 2) pulverized topsoil and 3) a void component generally containing air and/or water. This homogenous mixture will promote vegetative root growth and provide required structural support. The aggregate portion shall have a particle range from 0.375 in to 0.5 in (10 mm to 13 mm). The percentage void-space of the aggregate portion shall be at least 30%. The pulverized topsoil shall equal 33% of the total volume and be added and blended to produce a homogenous mixture prior to placement.</p> <p>Choice of vegetation shall be determined based upon local climate and proposed use with the aggregate/topsoil mix and a vegetated surface. Infrequent/occasional passes are recommended for vegetated surfaces.</p>
	<p>NOTE: The base and infill materials are different gradations for both Aggregate and Vegetated pavements.</p>	

Under some conditions, a geotextile separation layer may be required between the sub grade and the base material. Care shall be exercised in choosing the proper geotextile to ensure that it does not impede permeability. The geotextile shall be installed in accordance with Manufacturer's recommendations including overlaps.



Design Guideline

Specify base depth based on load description, CBR value and intended pavement surface (aggregate or aggregate/topsoil) based on recommendations in Table 3.

Table 3: Base Depth Recommendations for the GeoPave® Unit
The Engineer shall be responsible for the design and stability of the aggregate base and edges.

LOAD DESCRIPTION ¹	DEPTH OF BASE		DEPTH OF BASE	
	AGGREGATE		ENGINEERED AGGREGATE / TOPSOIL ²	
	CBR 2 – 4	CBR ¹ >4	CBR 2 – 4	CBR ¹ >4
Heavy Fire Truck Access & H/HS-20 loading. Typical 110 psi (758 kPa) maximum tire pressure. Single axle loadings of 32 kips (145 kN), tandem axle loadings of 48 kip (220 kN). Gross vehicle loads of 80,000 lbs (36.3 MT).	6 in (150 mm)	6 in (150 mm)	Not Recommended	Not Recommended
Light Fire Truck Access & H/HS-15 loading. Typical 85 psi (586 kPa) maximum tire pressure. Single axle loadings of 24 kips (110 kN). Gross vehicle loads of 60,000 lb (27.2 MT).	6 in (150 mm)	4 in (100 mm)	Not Recommended	Not Recommended
Utility & Delivery Truck Access & H/HS-10 loading. Typical 60 psi (414 kPa) maximum tire pressure. Single axle loadings of 16 kips (75 kN). Gross vehicle loads of 40,000 lbs (18.1 MT).	4 in (100 mm)	2 in (50 mm)	4 in (100 mm)	2 in (50 mm)
Cars & Pick-up Truck Access. Typical 45 psi (310 kPa) maximum tire pressure. Single axle loadings of 4 kips (18 kN). Gross vehicle loads of 8,000 lbs (3.6 MT).	2 in (50 mm)	None ³	2 in (50 mm)	None ³
Trail Use. Loading for pedestrian, wheelchair, equestrian, bicycle, motorcycle and ATV traffic.	None ³	None ³	None ³	None ³

¹ The GeoPave system can be applied in areas where loading is greater than those listed above. In these situations, call Presto Geosystems or an authorized Presto Geosystems' representative for specific recommendations.

² With the aggregate/topsoil mix and a vegetative surface, infrequent/occasional passes are recommended. Infrequent/occasional passes are defined as the number of passes over any period of time that causes no lasting damage to the vegetation. This number will be a function of vegetation type and age, climatic conditions, and maintenance practices. This number is not a function of the GeoPave material.

³ A minimum of 2 in (50 mm) of aggregate base should be placed below the GeoPave units as a drainage layer and an infiltration storage area. Greater depth may be required depending upon design rainfall needs and sub base permeability.



Design Considerations for System Structural Integrity

Elements Important to Structural Integrity

<p>The GeoPave unit (or any other similar material) must have five primary characteristics to adequately support loads, and to enable fast and efficient construction as shown below:</p> <ol style="list-style-type: none"> 1) SUITABLE WALL STRENGTH: The wall strength must support wheel loading from the heaviest anticipated vehicles that will travel over the porous pavement system. Vehicular loading will create direct wall compression from tires and equipment outriggers and lateral forces from vehicle braking and acceleration. The wall should resist vertical and lateral deformations when loaded. Caution should be exercised when using systems with thin walls. 2) SUFFICIENT UNIT STIFFNESS: The unit stiffness must allow deflections without unit breakage or separation when subgrade soils yield under loading. When the unit is too flexible, the subgrade support the complete load. When the unit is too rigid, it could break under normal loading in low temperature conditions. Caution should be exercised when using systems that are either too flexible or too rigid. 	<ol style="list-style-type: none"> 3) SUPPORTING BASE if required: The unit support base must have sufficient edge restraints and a large enough area-of-contact with the subgrade so high wheel loads at the top of the unit are reduced sufficiently when transferred to the subgrade. This will provide a system with a greater range of stability. Caution should be exercised when using systems that have little contact area between the porous pavement unit and the subgrade. 4) LARGE OVERALL AREA: A large overall area, in conjunction with the other characteristics, ensures maximum load dissipation. If unit separation should occur and any given unit functions independently, larger unit areas will lower the pressure on the subgrade. Caution should be exercised when using systems that have smaller contact areas. 5) MONOLITHIC MESH BOTTOM: The unit should contain a properly-sized monolithic mesh bottom for encapsulating the aggregate infill and preventing material loss from the bottom of the units when exposed to repeated loading and freeze-thaw cycles. Caution should be exercised when using systems without monolithic mesh bottoms.
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Elements Not Important to Structural Integrity

Avoid specifications that state material compressive strength only. Material compressive strength, with applied factors of safety must be sufficient to resist compressive and lateral load applications. Beyond that, ultra-high material compressive strengths add little to the porous pavement system. Table 1 provides a listing of strength characteristics of the GeoPave porous pavement system. These values provide a balanced system meeting all criteria important to the integrity and performance of a porous pavement system.



Engineer Specification Checklist

The Engineer shall specify the following:

Specification Item	Description
Paver Unit	Specify GeoPave Porous Pavement System
Optional Layers	Specify Geosynthetic Layer or Subdrain Component, if required.
Paver Unit Orientation	Specify Offset, Bricklayer or Herringbone Pattern according to anticipated traffic type & flow.
Paver Unit Connection	Specify the GeoPave units shall be connected with U-CLIPS side-to-side and end-to end where the short cell side-walls of adjacent units align. The connection points vary depending on chosen laying pattern.
Anchorage of Paver Units	Specify anchorage of GeoPave units with rebar if the system will be on a slope or as applicable.
Curve or Corner Fit	Specify offsetting the GeoPave units or cutting the GeoPave units to accommodate corners, curves, existing structures or obstacles.
Pavement Surface	Specify Aggregate Pavement Surface or Vegetated Pavement Surface. Specify the appropriate <u>base</u> and <u>infill</u> materials as recommended in Table 2 .
Vegetation Type	For vegetated pavements, specify Seed or Sod. For Sod: Specify a young sod free from netting material. Specify under filling the units by 1.0 inch (25 mm) to allow root to seat or press the sod within the GeoPave units.
Base Depth	Specify the base depth depending on loading, frequency, and sub grade CBR value and additional stormwater capacity. Refer to base depth recommendation Table 3 .
Delineation	Specify a delineation method such as GeoPave SNAP delineators, in-ground or above-ground curbing, shrubbery, vegetation, or perimeter lighting as needed.
SPECMaker® Specification Development Tool	Presto's SPECMaker® Tool is a quick, easy online resource to make customizable, 3-part GeoPave specifications. Click for the SPECMaker Program

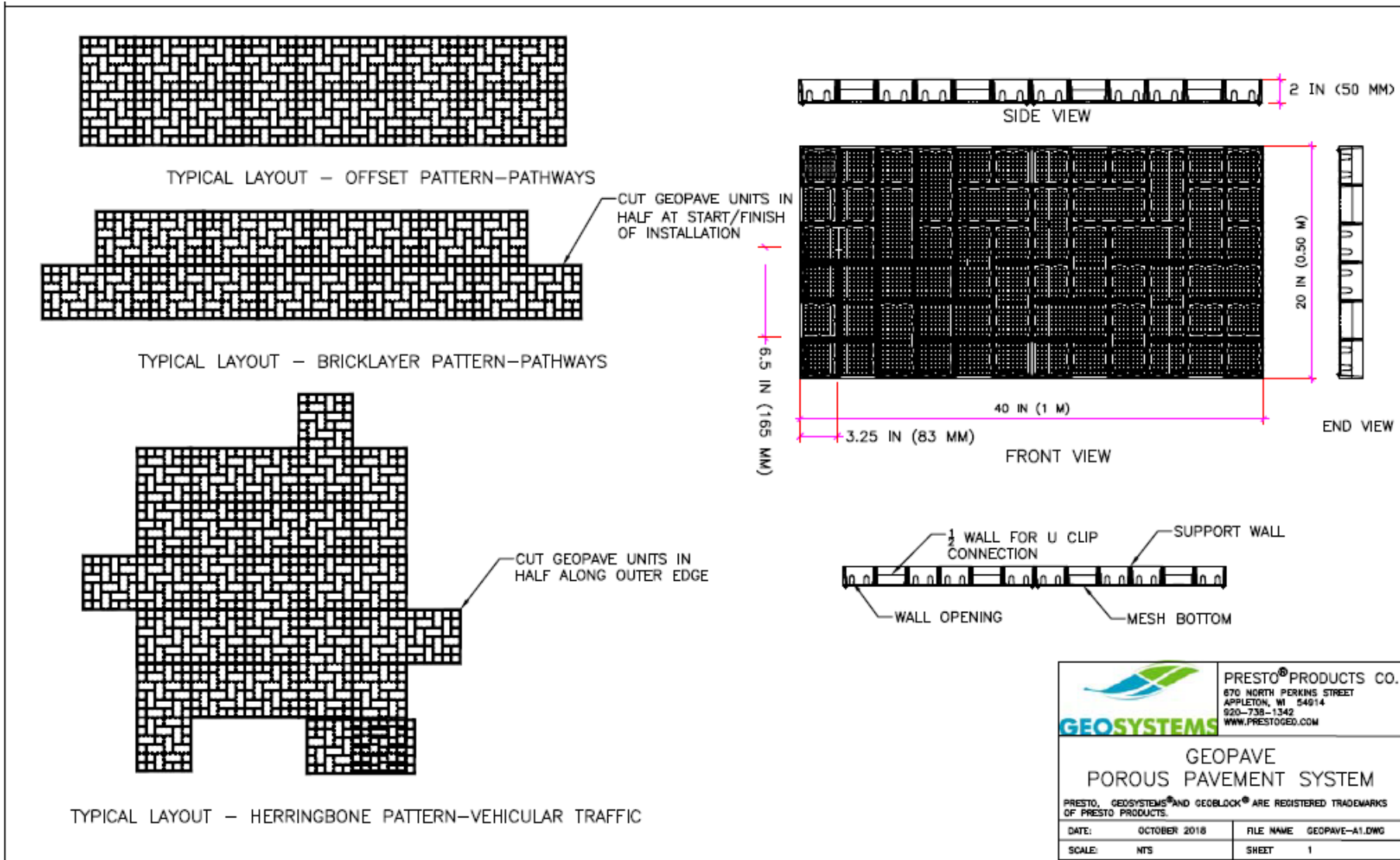


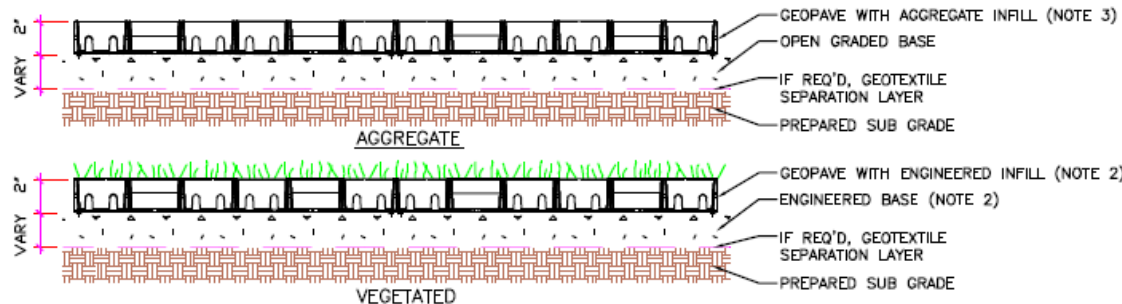
Figure 7 GeoPave System Dimensions and Layout



DESIGN GUIDELINES – BASE DEPTH					GEOPAVE MATERIAL SPECIFICATION	
LOAD DESCRIPTION	AGGREGATE SURFACE		VEGETATED SURFACE		MATERIAL	UP TO 97% RECYCLED POLYETHYLENE
	CBR 2 – 4%	CBR > 4%	CBR 2 – 4%	CBR 2 – 4%	COLOR	RANGES DARK SHADES GRAY TO BLACK
Heavy Fire Truck Access & H/HS-20 loading. Typical 110 psi (758 kPa) tire pressure. Single axle loadings of 32 kips (145 kN), tandem axle loadings of 48 kips (220 kN). Gross vehicle weight of 80,000 lbs (36.3 MT). Infrequent passes.	6 IN(150 MM)	6 IN(150 MM)	NOT RECOMMENDED	NOT RECOMMENDED	CHEMICAL RESISTANCE	SUPERIOR
Light Fire Truck Access & H/HS-15 loading. Typical 85 psi (586 kPa) tire pressure. Single axle loadings of 24 kips (110 kN). Gross vehicle loads of 60,000 lbs (27.2 MT). Infrequent passes.	6 IN(150 MM)	4 IN(100 MM)	NOT RECOMMENDED	NOT RECOMMENDED	CARBON BLACK FOR UV STABILIZATION, %	1.5 TO 2.0%
					UNIT MIN CRUSH STRENGTH – EMPTY @ 70F (21C)	175 PSI (1,202 KPa)
Utility & Delivery Truck Access & H/HS-10 loading. Typical 60 psi (414 kPa) tire pressure. Single axle loadings of 16 kips (75 kN). Gross vehicle loads of 40,000 lbs (18.1 MT). Infrequent passes.	4 IN(100 MM)	2 IN(50 MM)	4 IN(100 MM)	2 IN(50 MM)	UNIT MIN CRUSH STRENGTH – FILLED @ 70F (21C)	5,160 PSI (35,625KPa)
					FLEXURAL MODULUS @ 70F (21C)	35,000 PSI (240,000 KPa)
Cars & Pick-up Truck Access. Typical 45 psi (310 kPa) tire pressure. Single axle loadings of 4 kips (18 kN). Gross vehicle loads of 8,000 lbs (3.6 MT). Infrequent passes.	2 IN(50 MM)	NONE	2 IN(50 MM)	NONE	NOMINAL DIMENSIONS – WIDTH X LENGTH	20 X 40 IN (0.5 X 1.0 M)
					NOMINAL UNIT DEPTH	2.0 IN (50 MM)
Trail Use. Loading for pedestrian, wheelchair, equestrian, bicycle, motorcycle and ATV traffic.	NONE	NONE	NONE	NONE	NOMINAL AREA	5.38 SQFT (0.5 SQMTR)
					CELLS PER UNIT	50
					SMALL CELL SIZE	3.25 X 3.25 IN (83 X 83 MM)
					LARGE CELL SIZE	3.25 X 6.5 IN (83 X 165 MM)
					TOP OPEN AREA PER UNIT	90.5%
					BOTTOM OPEN AREA PER UNIT	32.6%
					BOTTOM MESH OPENING SIZE	0.25 X 0.25 IN (6.35 X 6.35 MM)
					NOMINAL WEIGHT PER UNIT	7.6 LBS (3.4 KG)
					RUNOFF COEFFICIENT @ 2.5 IN/HR (64 MM)	0 – 0.15 0.10 – 0.35
					RAINFALL WITH AGGREGATE WITH ENGINEERED INFILL	
					UNITS PER PALLET	46

Notes:

1. This evaluation is based on the use of GeoPave manufactured by Presto Products Co. All rights reserved. Any use of this evaluation for any rigid porous paver product other than that manufactured by Presto is strictly prohibited and makes this evaluation invalid.
2. Engineered base and infill shall be per Presto guidelines consisting of 3/4 crushed aggregate and 1/4 topsoil mix. Aggregate (0.375" to 1") with a D50 of 0.5" and provide 30% void space when compacted.
3. Aggregate infill shall be 0.375 to 0.5 inch (10 to 13 mm) open graded crushed aggregate with fine content less than 5% to allow for free drainage.
4. A minimum 2 inch (50 mm) of aggregate should be placed below the units to act as drainage layer and infiltration area. The Engineer of Record shall be responsible for the design and stability of the open graded base course.
5. If required, provide non-woven geotextile separation layer and install in accordance with Manufacturer recommendations including overlaps based on sub grade CBR.
6. Connect GeoPave panels with the U-CLIP connection device at all half wall locations, and driven completely so that adjacent sections have horizontally level profiles.
7. Refer to the GeoPave Design and Construction Overview for a complete description of the design and construction methods.



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GEOPAVE
POROUS PAVEMENT SYSTEM

PRESTO, GEOSYSTEMS® AND GEOBLOCK® ARE REGISTERED TRADEMARKS OF PRESTO PRODUCTS.

DATE:	OCTOBER 2018	FILE NAME:	GEOPAVE-B1.DWG
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Figure 8 GeoPave System Material Properties and Usage Guideline



INSTALLATION Procedures

Prepare the Subgrade

Excavate the area, allowing for the GeoPave unit thickness and the base depth (where base material is required).

- When working with a subgrade that has poor permeability, provide adequate drainage from the excavated area if there is the potential to collect water.
- The subgrade should be relatively dry and free from any standing water.

Finish-grade the surface of the subgrade specifically when the GeoPave unit is to be installed without additional base material. Level and clear the area of large objects such as rocks, pieces of wood, etc. to enable the GeoPave units to connect properly and remain stationary after installation.

The sub grade shall be compacted to the Engineer’s specifications. Caution should be exercised to ensure that the porous sub base not be over compacted such that porosity is hindered.

Install Optional Components (if specified)

Geotextile Layer (if specified)

If required and/or specified by the project engineer, the geosynthetic layer shall be rolled out over the prepared subgrade along the alignment in the direction of traffic. The geosynthetic shall be pulled taut to ensure that there are no folds. The geotextile shall be installed in accordance with Manufacturer recommendations, including overlaps.

Sub-Drainage Component (if specified)

If required and/or specified by the project engineer, install the specified geonet, sub-drain and outlet piping according to construction drawings. Ensure that a proper slope is maintained throughout the drainage system and that the outlet is free from any obstructions preventing free drainage.

Prepare the Base

If required, install the specified base material over the prepared sub grade, compact to the Engineer of Record’s specifications and fine grade as appropriate. Refer to Table 2 for a description of aggregate and engineered bases.

The base shall be compacted to the Engineer’s specifications. The edges of the base must be constrained to prevent movement. Base depth shall be per Engineer’s specification. The Engineer shall be responsible for the design and stability of the open graded base course. Reference Table 3 Base Depth Recommendations.

Install GeoPave Units

Orientation & Laying Pattern of Units

Place the GeoPave units with the mesh bottom to the ground using the specified laying pattern shown below (Offset, Bricklayer and Herringbone).

OFFSET PATTERN:

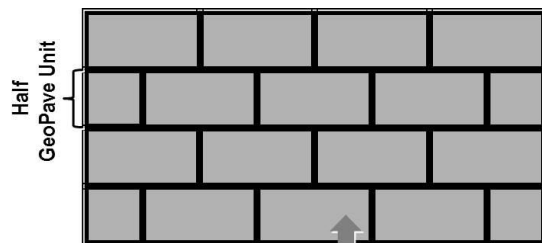
When the application is a **narrow access lane**, stagger the units to produce the offset pattern.



Offset

BRICKLAYER PATTERN:

When the application is a **one-direction vehicular driveway**, follow the bricklayer pattern.



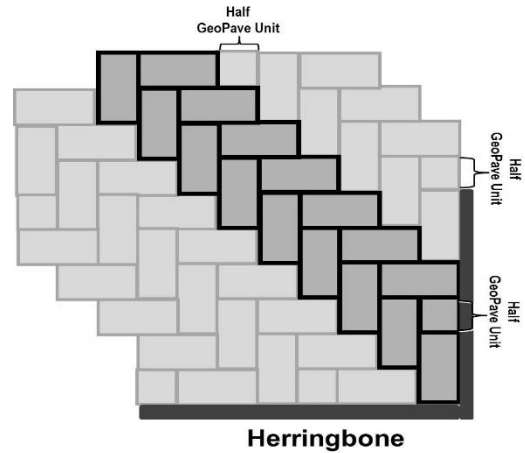
Bricklayer Direction of Traffic



HERRINGBONE PATTERN:

When the application is a **large area with multi-directional traffic**, stagger the units to produce the herringbone pattern. This pattern reduces straight seams to one and a half block lengths and allows for better disguise of the unit seams.

The staggered pattern is developed by using **half GeoPave units** made by field cutting a full unit and placing the units as illustrated. Cut the units with a hand or power saw to custom fit both contours and/or around obstructions. These final seam patterns assure maximum load transfer and support.



Position GeoPave Units

If applicable, ensure that all adjacent hard-surfaced paving work around the perimeter is completed before installing the GeoPave units.

Place the first row of GeoPave units against a stationary edge when available. Units should be placed such that corners and seams do not protrude above the desired surface elevation. Abut adjoining units to form the desired laying pattern.

Fully installed GeoPave units should be at or below the existing elevation

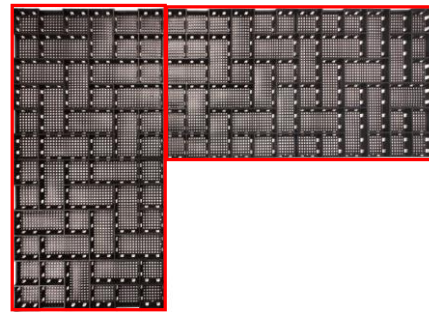


Figure 9 Joining GeoPave Units

Fit GeoPave Units to Corners and Curves

If applicable, the GeoPave units can be field cut with a saw to fit around corners and curves. Edge restraints are required to create a closed “cell” that can be infilled.

If cutting the units is not desired, the units can be offset such that the GeoPave coverage approximates the corner or curve feature. Edge restraints are required.

GeoPave units can be cut to fit around existing structures, such as manhole covers. Connect the cut GeoPave units as usual.



Connect Units with U-Clips

Secure adjoining GeoPave units together using the U-CLIP connection device. A total of 12 U-Clips are required for each unit. Refer to Figure 10. U-CLIPS shall be set in place by hammer at all the half-wall locations and driven completely so that adjacent sections have horizontally level profiles.

Caution should be exercised to assure that no material is trapped between adjacent sections prior to the placement of U-CLIPS.



Figure 10 The U-Clip Connection Device



Optional Anchoring of Units

If specified, secure the GeoPave units with stakes, rebar or earth anchors to prevent movement of the units. Refer to Figure 11. Anchoring may be necessary if the GeoPave units are placed on a slope (5-10%).

The anchors can be driven through the cell-wall vent holes either in the middle of the GeoPave units or along the perimeter as required.

Anchoring units in-place should occur after installation of all the units within the defined area.

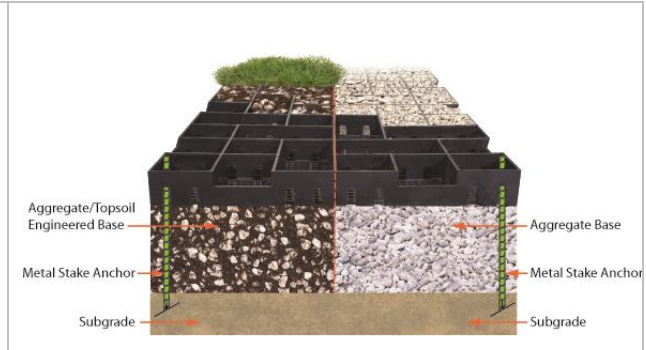


Figure 11 Optional Stake Anchoring

Optional SNAP Delineators

If specified, install GeoPave SNAP Delineators as required in the units to indicate parking lines. Refer to Figure 12.

The delineators are snapped in to GeoPave units, and are held in place with tabs that match vents in the GeoPave cells. Delineators may be placed in the square or rectangle cells. Place the delineators as frequently as required to meet visual and local agency requirements.

SNAP Delineators should be placed after installation of the units and before installation of the infill material.



Figure 12 Optional SNAP Delineators

Infill the GeoPave Units

Infill the GeoPave units with the specified material for the intended application. Refer to Table 2. Infilling should take place immediately after the units are installed to minimize movement of the units.

Infill shall be placed with each successive pile of aggregate or aggregate/topsoil mixture to be placed at the edge of previously filled GeoPave units and spread with a skid steer, small tractor or small loader. Spread the infill material uniformly over the units. Hand raking should be performed to assure that the infill is at the top of the cell walls.

Aggregate Systems

If aggregate infill, overfill the cells to allow for settlement of the infill. The overfill height will be determined by the size of the infill material.

Vegetated Systems - Seed or Sod

If aggregate/topsoil engineered mixture, rake infill flush with the top of the cell walls. Once the aggregate/topsoil engineered mixture is evenly spread in the GeoPave units, either grass seed (preferred) or sod may be applied. If using sod, the GeoPave units should be underfilled by 1.0 inch (25 mm) to allow room to seat or press the sod within the GeoPave units.

Follow good seeding, fertilizing, and water procedures for turf establishing based on regional practices.

Delineation

In addition to the GeoPave SNAP delineator, other delineation may be desired to create visibility and can include the following: delineation markers, in-ground or above ground curbing, shrubbery, vegetation, perimeter lighting, or other suitable systems.

With vegetated systems, once healthy turf has been established and good turf maintenance practices are followed, the GeoPave cell wall will have minimal visibility.



Maintenance

Aggregate Surface Wear Course

When the surface is aggregate, it should be inspected from time to time to identify signs of slight cell infill loss. If cell infill loss occurs, additional aggregate material should be added.

Vegetated Surface

When the surface is vegetated, lawn care should follow normal watering, fertilizing and mowing procedures. Vegetated surfaces are intended for infrequent or occasional traffic with a maximum H-10 loading. The pavement should be monitored to ensure traffic frequency and loading does not exceed the pavement design.

Snow Removal

If required, snow removal should be performed using one of the following basic procedures:

- Keep a metal edged plow blade a minimum of 1.0 in (25 mm) above the surface during plowing operations, or
- Use a plow blade with a flexible rubber edge, or
- Use a plow blade with skids on the lower outside corners so that the plow blade does not come in direct contact with the units.

When deeper ground freeze occurs, the system functions as a typical hard pavement surface. If a sharp metal plow-blade comes in direct contact with the surface during plowing, any portion of the GeoPave system that protrudes above the normal surface level could be damaged or removed by the blade. NOTE: Damage can occur to the surface if plowing abuse is prevalent.



Estimating Time and Cost of Installation

Typical Crew Size and Responsibilities

2	to set the GeoPave units in place.	NOTE: Adding or subtracting one or two people to the crew may result in a cost-effective productivity increase depending on local work habits.
2	to spread and level the specified infill.	
1	Equipment operator for the front-end loader.	

Equipment Needed and Purpose

- Saws, U-clips (may be purchased from Presto’s distributors/representatives) and anchors (if required) – all or some of these are used for cutting and securing the GeoPave units as required per the plans or as needed during construction.
- A small tractor/backhoe or loader for infilling of the GeoPave units.
- Rakes and shovels for final leveling of the infill material.

Typical Construction Sequences and Times

Productivity is a variable and the ranges below are typical. Select an installation rate through personal experience or after discussion of project details with Presto or one of its qualified distributors or representatives. The estimates below do not include base preparation.

1.	Place the GeoPave units on the prepared base and install connecting U-clips.	35-45 units/man-hr
2.	Fill the in-place GeoPave units using a small loader or backhoe to evenly distribute the specified infill.	100 - 120 units/man-hr
3.	Level the infill using rakes and shovels. If aggregate, overfill the top of the cell walls 0.5 in (13 mm). If aggregate/topsoil mixture, rake flush with the top of the cell walls.	75 - 100 units/man-hr
4.	If applicable, spread selected grass seed and water.	150 – 180 units/man-hr

NOTE: The above sequences can be in progress at the same time if workspace is adequate.

Table 2 Approximate Quantities of Infill Material Required for GeoPave Unit

Depth of unit	Volume of Aggregate Required per unit	Volume of Aggregate Required per 1000 ft ² (100 m ²)
2 in (50 mm)	0.0293 yd ³ (0.0224 m ³)	5.447 yd ³ (4.48 m ³)

General Notes

1. The tractor/backhoe loader must be sized so it can distribute the fill material per time/productivity requirements.
2. Experience shows that the above installation rates would be considered typical rates of installation.
3. As is with all construction operations, placement of material stockpiles, crew productivity, jobsite conditions, special installation requirements such as cutting and custom fitting of the GeoPave units, etc. significantly affect overall productivity, therefore actual results may be different than the estimates above.



Total Time and Materials Required

Area of installation = length x width of site				
(_____) ft (m) long	x	(_____) ft (m) wide	=	(_____)ft ² (m ²) Area
GeoPave units required = ft ² (m ²) (Area ÷ 5.38 ft ² (0.50 m ²)/unit [the GeoPave unit is 20 in x 40 in (0.50 m x 1.00 m) nominal]				
(_____) ft ² (m ²) Area	÷	5.38 ft ² (0.50 m ²)/unit	=	(_____) units
Man-hr required for installation of GeoPave units = GeoPave units ÷ 40 units/man-hr				
(_____) units	÷	40 units/man-hr	=	(_____) man-hr
Infill material quantities = GeoPave units x yd ³ (m ³)/unit (see Table 2)				
(_____) units	x	(_____) yd ³ (m ³)/unit	=	(_____) yd ³ (m ³)
Man-hr required for placing infill = GeoPave units ÷ 110 units/man-hr				
(_____) units	÷	110 units/man-hr	=	(_____) man-hr
Man-hr required for leveling of infill = GeoPave units ÷ 85 units/man-hr				
(_____) units	÷	85 units/man-hr	=	(_____) man-hr

Total Cost of Time and Materials

GeoPave unit cost	\$_____/unit	x	_____ units	=	\$ _____
Cost of Infill	\$_____/yd ³ (m ³)	x	_____ yd ³ (m ³)	=	\$ _____
Cost of Labor	\$_____/man-hr	x	_____ man-hr	=	\$ _____
Cost of Equip. Operator	\$_____/man-hr	x	_____ man-hr	=	\$ _____
Cost of Front-end Loader	\$_____/hr	x	_____ hr	=	\$ _____
NOTE: Does not include base material or preparation	APPROXIMATE TOTAL COST			=	\$ _____



Limited Warranty

Presto Geosystems warrants each GeoPave® unit 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 unit 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 unit 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 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 GeoPave® 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 GeoPave system. Contact Presto Products Company, Ph: 800-548-3424; 920-738-1328 or Email: info@prestogeo.com.

Disclaimer

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Project specifications take precedence over all manufacturers' recommendations.

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