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GEOBLOCK®5150

GRASS POROUS PAVEMENT SYSTEM

DESIGN & CONSTRUCTION OVERVIEW

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GEOBLOCK®5150
DESIGN & CONSTRUCTION OVERVIEW

The GEOBLOCK5150 Porous Pavement System

The **GEOBLOCK5150 Porous Pavement System** provides vehicular and pedestrian load support over grass areas while protecting the grass from the harmful effects of the traffic.

The fully developed system has four major components (see Figure 1).

(1) the GEOBLOCK5150 unit,
(2) the *engineered base* for support (if required),
(3) the selected topsoil infill, and
(4) the selected vegetation.

Both the GEOBLOCK5150 unit and the base support soil work together to support the imposed loading. Both the GEOBLOCK5150 unit and the topsoil, as infill and a component of the base, contribute to the vegetation support. A review of the four major components follows.

Other components may include a geosynthetic separation / reinforcement layer, sub-drain components, and topsoil additives, which enhance vegetative growth.

Aggregate-filled systems should utilize the GEOPAVE® Gravel Pavers.

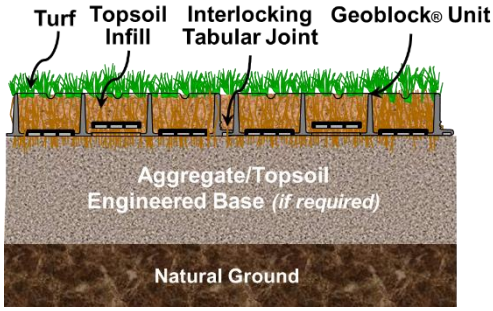


Figure 1 The GEOBLOCK5150 Porous Pavement System Components

DESIGN Considerations

FUNCTION of the GEOBLOCK System Components

Function of the Grass Paver Structure

The GEOBLOCK5150 units have three key purposes:

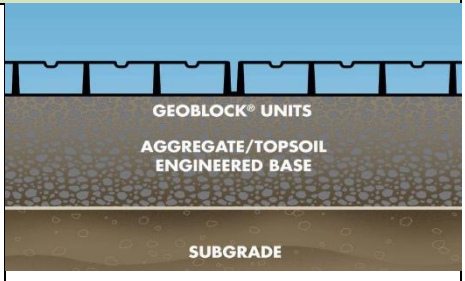
1. to adequately support and dissipate the design loads (up to AASHTO H/HS25 loading).
2. to provide permeability and infiltration of rain water.
3. to provide a healthy environment for the topsoil infill and vegetative cover.

The GEOBLOCK pavers are semi-rigid pavers with interconnected cell walls, and a tabular connection between paver units. This interconnection offers a high load distribution allowing for less supporting base material than many lighter-weight or rolled systems.

Function of the Engineered Base

For a given applied load over an existing sub base soil, both the *engineered base* and the GEOBLOCK5150 unit provide support. The depth of the *engineered base* should be determined using both loading and sub base strength.

The ***engineered base*** consists of an open-graded aggregate and topsoil. The aggregate portion, once compacted, provides structural support for the load and the topsoil portion provides a healthy growing medium for the vegetation.

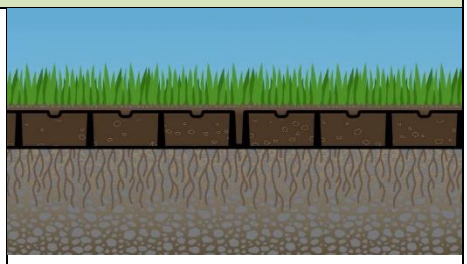


Function of the Topsoil Infill & Vegetation

The topsoil infill placed within the cells of the GEOBLOCK5150 unit provides a nourishing medium for development of a healthy root system for the vegetative cover. The infill determines the permeability and controls the rate of water infiltration within the GEOBLOCK5150 layer, so the topsoil should be a good quality, drainable soil.

If climatic conditions are such where prolonged periods of dryness exist, moisture retention additives within the topsoil may be appropriate.

The completed system should provide a healthy and aesthetically pleasing vegetative cover. Vegetation type should be selected by a qualified agronomist and be resilient enough to withstand anticipated load frequencies. Heat and automotive fluids from excessive traffic can over-stress any vegetative cover resulting in periodic maintenance. In all cases, proper fertilizing, watering, thatch removal, and aeration is a must for healthy vegetation.



OPTIONAL Components

Geosynthetic Layer *(if required)*

Under some conditions, a geosynthetic layer may be a required component between the sub grade and required *engineered base* in the porous pavement system. 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 (Non-Woven Geotextiles) and 3) Drainage / Separation Geosynthetics (Geonets, piping).

Sub-drain Component (if required)

If the GEOBLOCK 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 support capacity.

SPECIFICATION Details

Material Properties & Unit Dimensions

GEOBLOCK5150 units shall be made from materials with physical and chemical characteristics described in Table 1. The manufactured GEOBLOCK5150 units shall have a minimum deflection without breakage of 1.0 in (25 mm) when units are supported at 1.64 ft (0.50 m) centers at 70°F (21°C). The color shall be uniform through all units in any given pallet.

GEOBLOCK5150 units shall have physical dimensions as specified in Table 1 and shown in Figure 2. GEOBLOCK5150 units shall have an interlocking offset tab system on all edges as detailed in both Figures 2 and 3. End-to-end or side-to-side warpage of the GEOBLOCK5150 units shall not be greater than 0.25 in (6 mm).

Table 1 SPECIFICATION of the GEOBLOCK®5150 Porous Pavement Unit

Item	Specification & Details
Material	Up to 97% Recycled Polyethylene *
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)	420 psi (2,900 KPa)
Unit Minimum Crush Strength (Sand-Filled) @ 70°F (21°C)	7,058 psi (48,734 KPa)
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)
Nominal Unit Depth	2.0 in (50 mm)
Nominal Coverage Area	5.3 ft² (0.5 m²)
Cells per Unit	72
Cell Size	3.1 in x 3.2 in (79 mm x 81 mm)
Top Open Area per Unit	87%
Bottom Open Area per Unit	41%
Weight per Unit (nominal)	9 lb (4.1 kg)
Runoff Coefficient @ 2.5 in/hr (64 mm/hr) Rainfall	0.15
Units per Pallet	50

* The percentage of recycled content may vary depending on availability of recycled materials.

- Dimensions and weight are subject to manufacturing tolerances and are influenced by recycled components.
- End-to-end or side-to-side warp of the GEOBLOCK5150 unit shall not be greater than 0.5 in (6 mm).
- 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.

Paver Unit Details

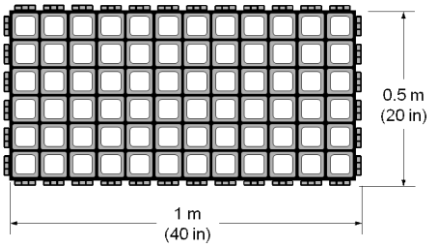


Figure 2 GEOBLOCK5150 Unit Nominal Dimensions

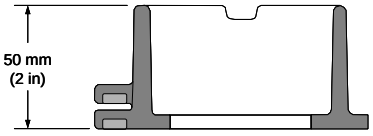


Figure 3 GEOBLOCK5150 Cell and Interlocking Offset Tab

Engineered BASE Material

The recommended ***'engineered base'*** is a homogenous mixture consisting of 1) a clear stone / crushed aggregate having an AASHTO #5 or similar designation 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. See *Function of the Engineered Base* for details.

The aggregate portion shall have a particle range from 0.375 in to 1.0 in (9.5 mm to 25 mm) with a D_{50} of 0.5 in (13 mm). The percentage void-space of the aggregate portion when compacted shall be at least 30%. The pulverized topsoil portion shall equal 33% +/- of the total volume and be added and blended to produce a homogenous mixture prior to placement. Once placed, the mixture shall be compacted to 95% Standard Proctor Density.

Under some conditions, a geotextile separation layer may be required between the natural ground and the engineered base.

Table 2 BASE Recommendations for GEOBLOCK®5150

Load Description[1]	***Depth of Engineered Base***	
	CBR[2] 2 – 4[3]	***CBR[2] > 4[3]***
Heavy Fire Truck Access & H/HS25 loading. Typical 110 psi (758 kPa) maximum tire pressure. Single axle loadings of 40 kips (178 kN), tandem axle loadings of 48 kip (220 kN). Gross vehicle loads of 90,000 lbs (40.1 MT). Infrequent passes[4].	6 in (150 mm)	4 in (100 mm)
Light Fire Truck Access & H/HS15 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). Infrequent passes[4].	4 in (100 mm)	2 in (50 mm)
Utility & Delivery Truck Access & H/HS10 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). Infrequent passes[4].	2 in (50 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). Infrequent passes[4].	None	None
Trail Use. Loading for pedestrian, wheelchair, equestrian, bicycle, motorcycle, and ATV traffic.	None	None

[1] The GEOBLOCK5150 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] CBR is the abbreviation for California Bearing Ratio. Methods for determining CBR vary from more sophisticated laboratory methods to simple field identification methods that use hand manipulation of the soil. Presto does not recommend one method over the other; however, the user must have a high degree of confidence in the results produced by the chosen method.

[3] If other-than-CBR soil strength values exist, use available correlation charts to relate the value to CBR.

[4] Infrequent 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 GEOBLOCK5150 material.

Topsoil Infill

The topsoil should be a good quality, drainable soil and not be compacted within the units as infill determines the permeability and controls the rate of water infiltration within the paver system.

If weather conditions are such where prolonged periods of dryness exist, watering or moisture retention additives within the topsoil may be appropriate.

Design Considerations for System Structural Integrity

Elements Important to Structural Integrity

The GEOBLOCK5150 unit (or any other similar paver system) must have five primary characteristics to adequately support load as shown below:

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 as well as lateral forces from vehicle breaking 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 subbase soils yield under loading. When the unit is too flexible, the base soils 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.

3) **SIGNIFICANT JOINT STRENGTH:** The strength of the joint must transfer load from unit to unit while staying engaged under normal deflections. Some deflection should be expected due to the physical characteristics of plastics and soils. High joint shear-strength causes greater load dissipation resulting in lower pressure on the base and subbase soils. If the joint has inadequate shear-strength, load support will occur through each unit causing the unit to act independently.

   Caution should be exercised when using systems that have little or no physical material in the joint.

4) **SUPPORTING BASE:** The unit support base must have a large enough area-of-contact with the base soil so high wheel loads at the top of the unit are reduced sufficiently when transferred to the base soil. 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 base soil.

5) **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 base and subgrade soils.

   Caution should be exercised when using systems that have smaller contact areas.

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 application. Beyond that, ultra-high material compressive strengths add little to the porous pavement system. Table 3 provides a listing of strength characteristics of the GEOBLOCK5150 porous pavement system. These values provide a balanced system meeting all criteria important to the integrity and performance of a porous pavement system.

Table 3 STRENGTH Characteristics of the GEOBLOCK5150 Unit

Test	Value
Wall Compressive Strength (simulated tire area loaded) Test Procedure - Circular plate, 6.5 in (165 mm) diameter, loaded to failure	420 psi (2,900 kPa)
Wall Compressive Strength (full GEOBLOCK5150 unit loaded) Test Procedure - Full single unit loaded to failure via flat plate	138,240 lbf (615 kN)
Equivalent Elastic Stiffness Test Procedure - Simply supported GEOBLOCK5150 unit loaded to 1 in (25 mm) deflection	48,000 lb-in² (140 N-m²)
Joint Shear Strength Test Procedure - Direct shear of tongue-and-groove using special apparatus (See **NOTE**)	20,000 lbf (89.0 kN)
NOTE: All tests were conducted by Bathurst, Jarrett and Associates Inc. at the Royal Military College in Kingston, Ontario, Canada on the wall of a different GEOBLOCK5150 unit with an equivalent wall.	

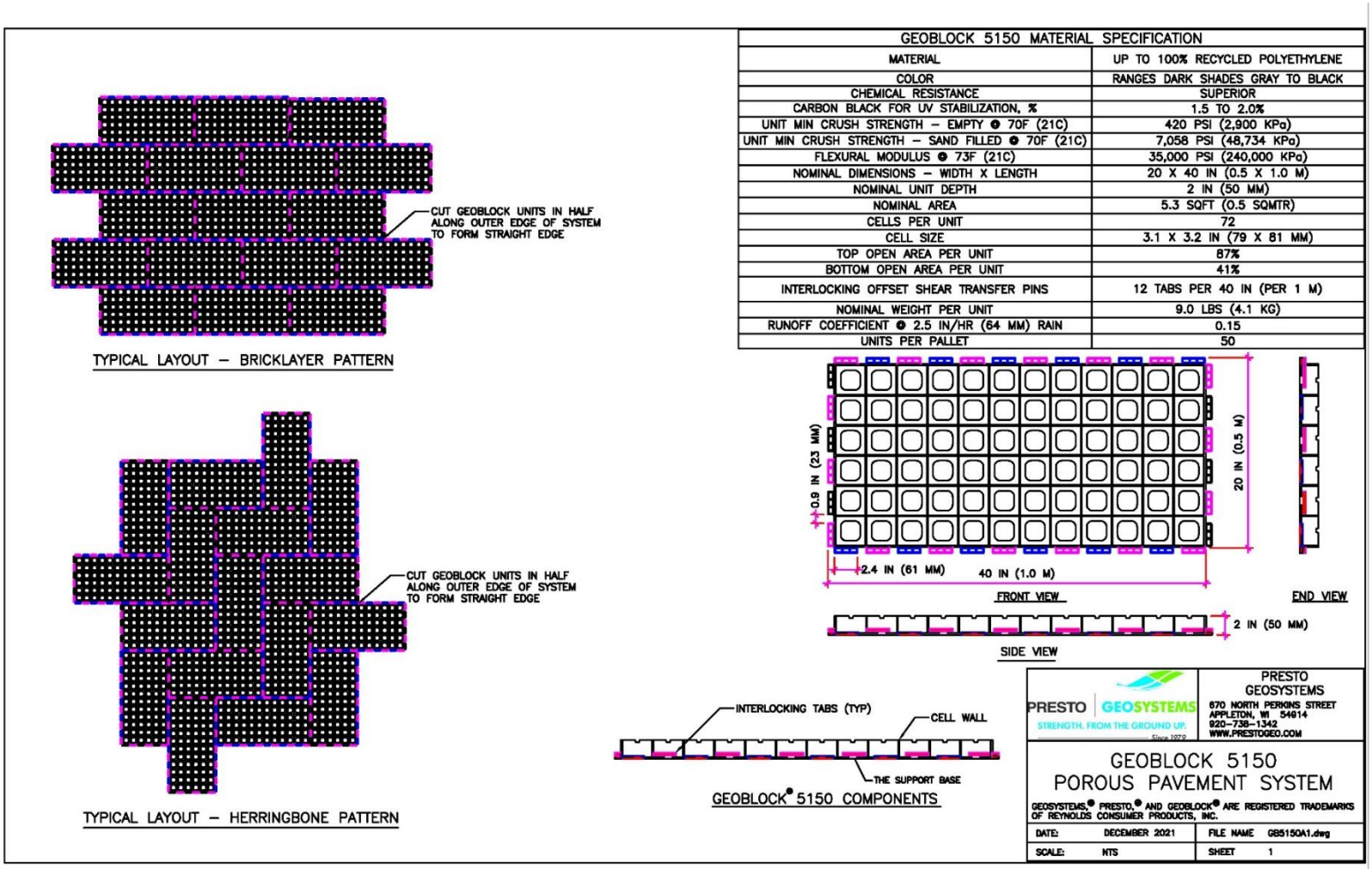
Elements Important to the Vegetation

The GEOBLOCK5150 unit provides an environment for maintaining healthy vegetative cover by preventing loads from excessively damaging the vegetative cover through compaction of the topsoil layer. The wall system has the strength and spacing needed to support any tire loading from influencing the topsoil layer. The open area in the bottom of the GEOBLOCK5150 unit allows water and nutrients to pass through the soil layers. The GEOBLOCK5150 unit alone will not ensure healthy vegetation. Vegetation must grow in un-compacted soil and receive adequate water and nutrients to remain healthy.

Engineer Specification Checklist

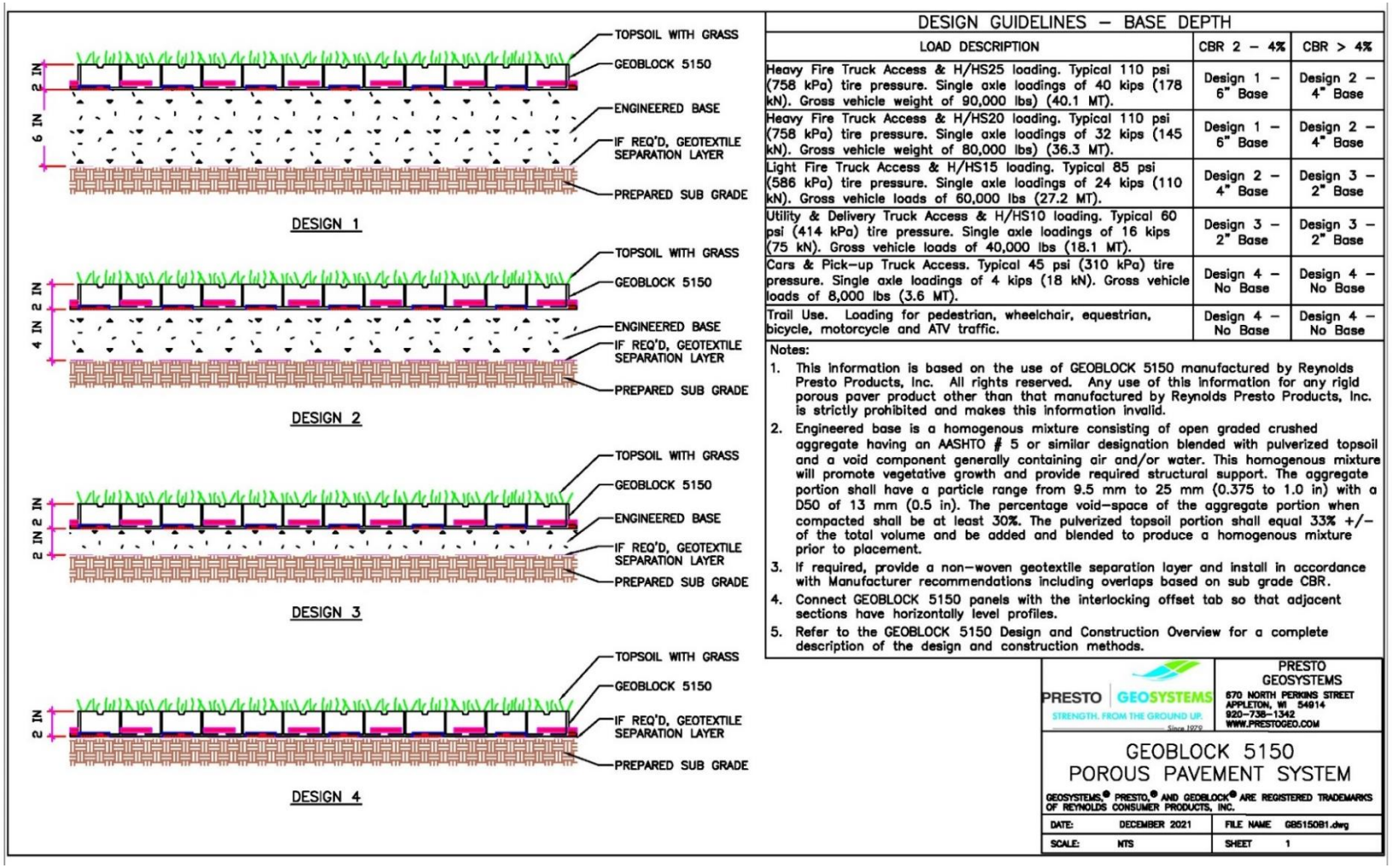
The Engineer shall specify the following:

Specification Item	Description
Paver Unit	Specify GEOBLOCK5150 Porous Pavement System
Optional Layers	Specify Geosynthetic Layer or Subdrain Component if required
Paver Unit Orientation	Specify Bricklayer or Herringbone Pattern depending on traffic type & flow.
Connection & Anchorage of Paver Units	Specify connection of paver units with thread-forming tapping screws through the interlocking tabs on the perimeter units. If required for slope applications, specify anchoring with stakes through the perimeter units.
Engineered Base Material	Specify: The recommended ***'engineered base'*** is a homogenous mixture consisting of 1) a clear stone / crushed aggregate having an AASHTO # 5 or similar designation 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. See *Function of the Engineered Base* for details. The aggregate portion shall have a particle range from 0.375 in to 1.0 in (9.5 mm to 25 mm) with a D_{50} of 0.5 in (13 mm). The percentage void-space of the aggregate portion when compacted shall be at least 30%. The pulverized topsoil portion shall equal 33% +/- of the total volume and be added and blended to produce a homogenous mixture prior to placement. Once placed, the mixture shall be compacted to 95% Standard Proctor Density.
Engineered Base Depth	Specify None, 2 in, 4 in, 6 in or greater depending on loading, frequency and subgrade CBR value.
Infill	Specify: The topsoil should be a good quality, drainable soil and not be compacted within the unit as the infill determines the permeability and controls the rate of water infiltration within the porous pavement system. If climatic conditions are such where prolonged periods of dryness exist, moisture retention additives within the topsoil may be appropriate.
Vegetation	Specify Seed or Sod. For both, specify sweeping out the infill to create a meniscus layer within the cells and to follow water and fertilizing procedures for turf establishment and regional practices. For Sod: Specify a young sod free from netting material.
Delineation	Specify a delineation method such as in-ground or above-ground curbing, shrubbery, perimeter lighting, or delineation markers.
SPECMaker® Specification Development Tool	Presto's SPECMaker Tool is a quick, easy online resource to make customizable, 3-part GEOBLOCK specifications. Click for the SPECMaker Program



GEOBLOCK 5150 MATERIAL SPECIFICATION	
MATERIAL	UP TO 100% RECYCLED POLYETHYLENE
COLOR	RANGES DARK SHADES GRAY TO BLACK
CHEMICAL RESISTANCE	SUPERIOR
CARBON BLACK FOR UV STABILIZATION, %	1.5 TO 2.0%
UNIT MIN CRUSH STRENGTH – EMPTY @ 70F (21C)	420 PSI (2,900 KPa)
UNIT MIN CRUSH STRENGTH – SAND FILLED @ 70F (21C)	7,058 PSI (48,734 KPa)
FLEXURAL MODULUS @ 73F (21C)	35,000 PSI (240,000 KPa)
NOMINAL DIMENSIONS – WIDTH X LENGTH	20 X 40 IN (0.5 X 1.0 M)
NOMINAL UNIT DEPTH	2 IN (50 MM)
NOMINAL AREA	5.3 SQFT (0.5 SQMTR)
CELLS PER UNIT	72
CELL SIZE	3.1 X 3.2 IN (79 X 81 MM)
TOP OPEN AREA PER UNIT	87%
BOTTOM OPEN AREA PER UNIT	41%
INTERLOCKING OFFSET SHEAR TRANSFER PINS	12 TABS PER 40 IN (PER 1 M)
NOMINAL WEIGHT PER UNIT	9.0 LBS (4.1 KG)
RUNOFF COEFFICIENT @ 2.5 IN/HR (64 MM) RAIN	0.15
UNITS PER PALLET	50

Figure 4 GEOBLOCK5150 System Material Specification and Layout



DESIGN GUIDELINES – BASE DEPTH

LOAD DESCRIPTION	CBR 2 – 4%	CBR > 4%
Heavy Fire Truck Access & H/HS25 loading. Typical 110 psi (758 kPa) tire pressure. Single axle loadings of 40 kips (178 kN). Gross vehicle weight of 90,000 lbs) (40.1 MT).	Design 1 – 6" Base	Design 2 – 4" Base
Heavy Fire Truck Access & H/HS20 loading. Typical 110 psi (758 kPa) tire pressure. Single axle loadings of 32 kips (145 kN). Gross vehicle weight of 80,000 lbs) (36.3 MT).	Design 1 – 6" Base	Design 2 – 4" Base
Light Fire Truck Access & H/HS15 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).	Design 2 – 4" Base	Design 3 – 2" Base
Utility & Delivery Truck Access & H/HS10 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).	Design 3 – 2" Base	Design 3 – 2" Base
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).	Design 4 – No Base	Design 4 – No Base
Trail Use. Loading for pedestrian, wheelchair, equestrian, bicycle, motorcycle and ATV traffic.	Design 4 – No Base	Design 4 – No Base

Notes:

1. This information is based on the use of GEOBLOCK 5150 manufactured by Reynolds Presto Products, Inc. All rights reserved. Any use of this information for any rigid porous paver product other than that manufactured by Reynolds Presto Products, Inc. is strictly prohibited and makes this information invalid.
2. Engineered base is a homogenous mixture consisting of open graded crushed aggregate having an AASHTO # 5 or similar designation blended with pulverized topsoil and 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 9.5 mm to 25 mm (0.375 to 1.0 in) with a D50 of 13 mm (0.5 in). The percentage void-space of the aggregate portion when compacted shall be at least 30%. The pulverized topsoil portion shall equal 33% +/- of the total volume and be added and blended to produce a homogenous mixture prior to placement.
3. If required, provide a non-woven geotextile separation layer and install in accordance with Manufacturer recommendations including overlaps based on sub grade CBR.
4. Connect GEOBLOCK 5150 panels with the interlocking offset tab so that adjacent sections have horizontally level profiles.
5. Refer to the GEOBLOCK 5150 Design and Construction Overview for a complete description of the design and construction methods.

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GEOBLOCK 5150
POROUS PAVEMENT SYSTEM

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Figure 5 GEOBLOCK5150 System Usage Guideline

INSTALLATION Procedures

Prepare the Subgrade

Excavate the area, allowing for the GEOBLOCK5150 unit thickness and the *engineered base* depth (where the *engineered base* is required).

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

Finish-grade the surface of the sub grade specifically when the GEOBLOCK5150 unit is to be installed without an *engineered base*.

Level and clear the area of large objects such as rocks, pieces of wood, etc. to enable the GEOBLOCK5150 units to interlock properly and remain stationary after installation.

Install Optional Components (if specified)

Geosynthetic Separation 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 and be installed in accordance with Manufacturer's recommendations including overlaps.

Sub-Drainage Component (if specified)

If required and/or specified by the project engineer, install the specified sub-drain and outlet 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 Engineered Base

The strength of the Porous Pavement System is determined, in part, by the support required by a stable *engineered base*. The health of the vegetation, however, requires that the *engineered base* be loose to facilitate root penetration. These two requirements seem to be in direct conflict – but they are not. **Use the recommended Engineered Base Material as specified.**

Spread the specified *engineered base* material over the prepared base and compact to 95% Standard Proctor Density. Install the *engineered base* depth as specified or refer to the *Engineered Base Recommendation Table*.

NOTE: Typical compaction densities and testing do not apply to the *engineered base* since only the aggregate portion of the *engineered base* is compacted. The topsoil portion will remain relatively un-compacted when the mixture is properly placed. Therefore, conventional compaction testing and resulting densities will produce values that are not meaningful.

Install GEOBLOCK5150 Units

Orientation & Laying Pattern of Units

Place the GEOBLOCK5150 units with the square hole to the ground.

BRICKLAYER PATTERN:

When the application is a **one-direction access lane,** stagger the units to produce the **bricklayer pattern**. The pattern is positioned such that the long direction of the unit is perpendicular to the primary direction of traffic. See Figure 6.

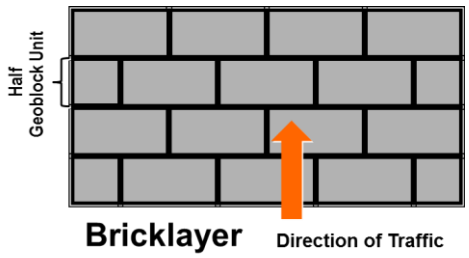

Figure 6 Bricklayer Laying Pattern

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. See Figure 7.

The staggered pattern is developed by using half GEOBLOCK5150 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.

Other laying patterns are generally not recommended.

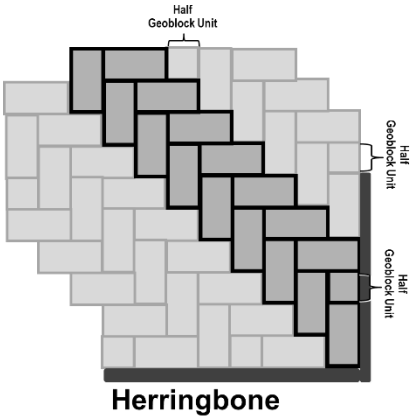

Figure 7 Herringbone Laying Pattern

Position the Units

If applicable, ensure that all adjacent hard surface paving work is completed before installing GEOBLOCK units.

Place the first row of GEOBLOCK5150 units against a stationary edge when available. If the units are placed between two perpendicular or near-perpendicular stationary edges (i.e. two parallel concrete curbs) allow for potential thermal expansion of the GEOBLOCK5150 units by keeping the units away from the stationary edge. The separation distance can be calculated using the reference value given in the section titled ***Thermal Expansion***.

Slide the units together so that the interlocking tab joint is fully engaged as illustrated in Figure 8. Units should be placed such that corners and seams do not protrude above the desired surface elevation. Anchor perimeter units as described below.

Figure 8 The Interlocking Tab Joint

Anchoring Units

The GEOBLOCK5150 units can be fixed in-place to prevent the units from shifting during installation with optional wood or metal stakes through the perimeter units, and/or, by placing thread-forming tapping screws (i.e. 1-1.5 in deck screws) through the perimeter interlocking tabs.

Anchoring may be necessary if 1) trafficking / turning of heavier construction vehicles cause movement of the units during the installation process or 2) large temperature changes occur during the installation process. Figure 9 illustrates some of the anchoring possibilities. In both cases, fixing the units in-place should occur after installation of all the units within the defined area.

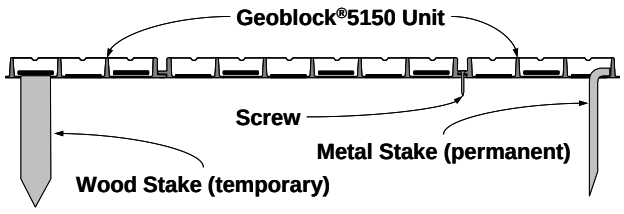

Figure 9 Anchoring Possibilities

Thermal Expansion

The GEOBLOCK5150 polyethylene stabilized with carbon black has a relatively high rate of thermal conductivity and thermal expansion. The rate of thermal expansion is approximately 1.7% per 100 ºF (55 ºC). Based on the temperature of the GEOBLOCK5150 unit exposed to full sunlight for several hours, a temperature gain of 60-70 ºF (33-38 ºC) is typical. As a result, a compensation of 1.375 in (34 mm) could be applied for each 10 ft (3 m) increment of length. When the installation day(s) is optional, install the GEOBLOCK5150 units on cooler cloudy days as opposed to hot sunny days.

Note that joint separation occurring from large temperature fluctuations is normal. Rejoining of the GEOBLOCK5150 units should be considered normal construction practice. Once infilled, thermal expansion is minimized. Once the root system is fully developed, the vegetation provides all necessary anchoring of the system.

Infill the GEOBLOCK5150 Unit

Infill the GEOBLOCK5150 units with a suitable topsoil. The topsoil should be a good quality, drainable soil and not be compacted within the GEOBLOCK5150 unit. Use spreading methods that will leave the cell infill un-compacted.

Vigorously broom or rotary sweep the infilled surface to remove the top portion of topsoil infill from the GEOBLOCK cells so it has a meniscus appearance as shown in Figure 10. Final topsoil placement should be slightly below the level of the GEOBLOCK5150 cell wall.

Overfilling the cells is not recommended since vehicular loading will cause undesirable compaction of the topsoil.

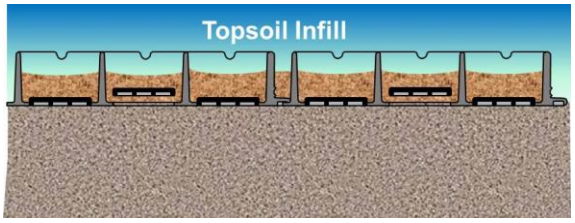

Figure 10. Sweep out topsoil infill

Apply Vegetation and Finishing Procedures

Seeding

Follow seeding, fertilizing, and watering procedures for turf establishment based on regional practices. An increase in watering frequency may be necessary when free-draining base materials are used. Use of a free draining base is generally not recommended.

Sod Application

Sod can be used for areas where immediate use is desired. Young sod that is free from netting materials is recommended. Mature sod with a more developed root system and sod with netting may be difficult to press/cut into the GEOBLOCK5150 cells.

When sod is used:

- Aggressively sweep out the topsoil from the GEOBLOCK5150 unit to allow room to seat the sod. **Enough topsoil must be removed so that the crown of the sod is recessed slightly below the top of the cell after pressing the sod in place**. If too much topsoil is removed, the bottom of the sod will not make contact with the topsoil after it is pressed into the cell. Avoid removing too much topsoil.
- Place the sod per normal practices.
- Press the sod into the partially emptied cells using a roller or other suitable equipment.
- Use recommended watering procedures to ensure healthy sod growth.

Delineation

Once healthy turf has been established and good turf maintenance practices are followed, the GEOBLOCK5150 cell wall structure will have minimal visibility.

Delineation may be desirable to create greater visibility and can include the following: in-ground or above-ground curbing, shrubbery, vegetation, perimeter lighting, or delineation markers, or other suitable systems.

Maintenance

Lawn Care

Normal turf care procedures should be followed, including de-thatching and aerating. Some equipment may slightly scar or cut the GEOBLOCK5150 wall structure during some operations but will not affect overall structural integrity of the system.

Snow Removal

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

- Keep a metal edged plow blade a minimum of 1 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 porous pavement system.

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 GEOBLOCK5150 system that protrudes above the normal surface level could be removed by the blade. **NOTE**: Damage can occur to the grass and topsoil if plowing abuse is prevalent.

Estimate Time and Cost of Installation

Typical Crew Size and Responsibilities

2	People to set the GEOBLOCK5150 units in place.
2	People to spread and level the topsoil infill.
1	Equipment operator for the front-end loader.

NOTE: Adding or subtracting one or two people to the crew may result in a cost-effective productivity increase depending on local work habits.

Equipment Needed and Purpose

- Saws, screwdrivers, hammers, stakes, screws – all of some of these for cutting and securing the GEOBLOCK5150 units as required per the plans or as needed during construction.
- A small front-end loader for infilling of the GEOBLOCK5150 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.

1.	Place the GEOBLOCK5150 units on the prepared base.	75 - 100 units/man-hr
2.	Fill the in-place GEOBLOCK5150 units using the small loader to evenly distribute the topsoil infill.	100 - 120 units/man-hr
3.	Level the infill using rakes and shovels so that the topsoil is flush with the top of the cell wall.	75 - 100 units/man-hr
4.	Spread selected grass seed and water.	150 - 180 units/man-hr
NOTE: The above four sequences can be in progress at the same time if workspace is adequate.		

Table 4 Approximate Quantities of Infill Material Required for GEOBLOCK5150 Unit

Depth of unit	Volume of Topsoil Required per unit	Volume of Topsoil Required per 100 m^2 (1000 ft^2)
2 in (50 mm)	0.0327 yd^3 (0.025 m^3)	6.08 yd^3 (5.00 m^3)
NOTE: The above quantities are based only on the 2 in (50 mm) cell depth GEOBLOCK5150 unit.		

General Notes

1. The front-end 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 GEOBLOCK5150 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	=	**(_____) ft² (m²) Area**
GEOBLOCK5150 Units Required = m² (ft²) Area ÷ 0.50 m² (5.3 ft²)/unit [the GEOBLOCK5150 unit is 0.50 m x 1.00 m (20 in x 40 in) nominal]				
(_____) ft² (m²) Area	÷	5.3 ft² (0.50 m²)/unit	=	**(_____) units**
Man-Hr Required for Installation of GEOBLOCK5150 Units = GEOBLOCK5150 units ÷ 100 units/man-hr				
(_____) units	÷	100 units/man-hr	=	**(_____) man-hr**
Infill Material Quantities = GEOBLOCK5150 units x m³ (yd³)/unit (see Table 4)				
(_____) units	x	(_____) yd³ (m³)/unit	=	**(_____) yd³ (m³)**
Man-Hr Required for Placing Infill = GEOBLOCK5150 units ÷ 120 units/man-hr				
(_____) units	÷	120 units/man-hr	=	**(_____) man-hr**
Man-Hr Required for Leveling of Infill = GEOBLOCK5150 units ÷ 100 units/man-hr				
(_____) units	÷	100 units/man-hr	=	**(_____) man-hr**
Man-Hr Required for Seeding = GEOBLOCK5150 units ÷ 180 units/man-hr				
(_____) units	÷	180 units/man-hr	=	**(_____) man-hr**

Total Cost of Time and Materials

GEOBLOCK5150 unit cost	$_____/unit	x	_____units	=	**$** _____
Cost of Infill	$_____/yd³ (m³)	x	_____yd³ (m³)	=	**$** _____
Cost of Labor	$_____/man-hr	x	_____man-hr	=	**$** _____
Cost of Equip. Operator	$_____/man-hr	x	_____man-hr	=	**$** _____
Cost of Front-end Loader	$_____/hr	x	_____hr	=	**$** _____
		APPROXIMATE TOTAL COST			**$** _____

NOTE: The above estimate does not include time and materials associated with initial base preparation. The cost of this item would be similar to other pavement systems regardless of type.

Limited Warranty

Presto Geosystems warrants each GEOBLOCK5150 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 GEOBLOCK5150 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 GEOBLOCK5150 system. Contact Presto Geosystems, phone 800-548-3424; 920-738-1328 or email: info@prestogeo.com.

Disclaimer

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