

Invisible Structures, Inc.

303-233-8383

www.invisiblestructures.com

Gravelpave2 Product Specification (CSI Format)

Notes: This product guide specification is written according to the Construction Specifications Institute (CSI) Format, including *MasterFormat* (1995 Edition), *SectionFormat*, and *PageFormat*, contained in the *CSI Manual of Practice*.

The section must be carefully reviewed and edited by the Engineer to meet the requirements of the project and local building code. Coordinate with other specification sections and the drawings.

Delete all "Specifier Notes" when editing this section.

SECTION 32 12 43 POROUS FLEXIBLE PAVING (Formerly 02795 Porous Paving)

Notes: This section covers Gravelpave2 Porous Pavement System from Invisible Structures. The system provides vehicular and heavy load support over gravel areas while protecting the area from rutting and erosion while remaining porous. The major components of the complete system are the Gravelpave2 units, an engineered base course, anchor pins, and gravel fill material.

Consult Invisible Structures, Inc. for assistance in editing this section for the specific application.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Porous pavement system.

1.2 RELATED SECTIONS

- A. Section [31 20 00 – Earth Moving] [_____ - _____].
- B. Section [33 46 00 – Subdrainage] [_____ - _____].
- C. Section [32 10 00 – Bases, Ballasts, and Paving] [_____ - _____].

Notes: Edit the following list as required for the project. List other sections with work directly related to the porous pavement system.

- D. Section [32 30 00 - Site Improvements] [_____ - _____].
- E. Section [32 90 00 Planting] [_____ - _____].

1.3 REFERENCES

- A. ASTM F 1951-08 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.

- B. ASTM D 638-10 Standard Test Method for Tensile Properties of Plastics
- C. ASTM C 33 Standard Specification for Concrete Aggregates

1.4 SYSTEM DESCRIPTION

- A. The Gravelpave2 porous pavement system provides vehicular and pedestrian load support for gravel areas and reduces erosion and rutting.
- B. Major Components of the Complete System
 - 1. Gravelpave2 units, assembled in rolls.
 - 2. Engineered sand and gravel base course.
 - 3. Anchor pins and washers.
 - 4. Gravel fill aggregate.
 - 5. (Optional) Binder. Consultation suggested with Invisible Structures, Inc.
- C. The Gravelpave2 gravel paving units, gravel fill, and base course work together to support imposed loading.
- D. The Gravelpave2 paving units contain and restrict gravel fill from lateral and vertical movement.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Shop Drawings: Submit design detail showing proper cross-section.
- C. Samples: Submit manufacturer's sample of Gravelpave2 10" x 10" section of Gravelpave2 material.
- D. Installation Instructions: Manufacturer's printed installation instructions. Include methods for maintaining installed products.
- E. Certificates:
 - 1. Manufacturer signed certificate stating the product is made in the USA.
 - 2. Submit Material Certificates for base course and gravel fill materials
 - 3. Product certificates signed by the manufacturer certifying material compliance of polyethylene used to make Gravelpave2 units.
 - 4. ISO Certificate certifying manufacturer's quality management system is currently registered to ISO 9001:2008 quality standards.
- F. LEED Submittals: Provide documentation of how the requirements of Credit will be met:
 - 1. List of proposed materials with recycled content. Indicate post-consumer recycled content and pre-consumer recycled content for each product having recycled content.
 - 2. Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content.
 - 3. Description of Gravelpave2 in stormwater design to limit the disruption of natural hydrology by reducing impervious cover, increasing on-site infiltration, reducing or eliminating pollution from stormwater runoff and eliminating contaminants.
 - 4. Designing elements for Gravelpave2 to limit the disruption and pollution of natural water flows by managing stormwater runoff.
 - 5. Documenting the use of Gravelpave2 to reduce heat islands to minimize the impact on microclimates and human and wildlife habitats.
- G. Substitutions: No material will be considered as an equivalent to the Gravelpave2 unit specified herein unless it meets all areas of this specification without exception. Manufacturers seeking to supply what they represent as equivalent material must submit records, data, independent test results, samples, certifications, and documentation deemed necessary by the Specifier to prove equivalency.
- H. Manufacturer's Material Certification: Product manufacturers shall provide certification of compliance with

all applicable testing procedures and related specifications upon written request. Request for certification shall be submitted by the purchasing agency no later than the date of order placement.

- I. Product manufacturers shall also have a minimum of 30 years' experience producing products for porous pavement systems.
- J. Manufacturer Quality Certification: ISO Certification certifying manufacturer's quality management system for its Gravelpave2 system is currently registered to ISO 9001:2008 quality standards. Any alternate materials submitted shall provide a certification that their porous pavement system manufacturing process is part of an ISO program and a certification will be required specifically stating that their testing facility is certified and in accordance with ISO.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect Gravelpave2 units/rolls from damage during delivery and store rolls upright, under tarp, to protect from sunlight, when time for delivery to installation exceeds one week.
- C. Store anchor pins and washers in a secure location protected from theft or damage.
- D. Handling: Protect materials during handling and installation to prevent damage.

1.7 MAINTENANCE SERVICE

Notes: Once the gravel fill is in place, the cell wall structure will have minimal visibility when proper care practices are followed.

- A. Installer responsible for maintenance of Gravelpave2 system until site work is complete. See *Gravelpave2 Maintenance Guide* from Invisible Structures.
- B. System to be maintained by _____, after _____ (completion date or other date).

1.8 Project Conditions

- A. Maintain environmental conditions within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Do not begin installation of porous pavements until all hard surface paving adjacent to porous pavement areas, including concrete walks and asphalt paving, is completed.
- C. Install Gravelpave2 units when ambient air temperatures is at least 55 degrees F (13 degrees C).
- D. In cold weather, do not use frozen materials or materials mixed or coated with ice or frost, and do not build on frozen base or wet, saturated or muddy subgrade.
- E. Protect partially completed paving against damage from other construction traffic when work is in progress.
- F. DO NOT DRIVE, PARK ON, or use Gravelpave2 system until system has been properly anchored and fully filled with gravel aggregate fill. Any barricades constructed must still be accessible by emergency and fire equipment during and after installation.

1.9 LIMITED WARRANTY

- A. Invisible Structures, Inc. (ISI) warrants to its purchasers that all products furnished by ISI will be free from defects in material and/or workmanship.
- B. This warranty shall be extended for a period of five (5) years following the date of shipment by ISI.
- C. Providing a written claim is presented to ISI within the warranty period and after inspection by ISI showing the materials have failed under this warranty, all defective materials shall be refurbished under this warranty, at no charge, excluding re-installation costs. This in lieu of all other warranties expressed or implied and is the sole warranty extended by ISI.
- D. Our liability under this warranty is limited to the refurbishing of materials and does not include any

responsibility for incidental, consequential, or other damages of any nature.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Invisible Structures, Inc., which is located at: 3510 Himalaya Rd. Suite 200 ; Aurora, CO 80011; Tel: 303-233-8383; Web: www.invisiblestructures.com.
- B. Substitutions: Not permitted.

2.2 GRAVELPAVE2

- A. Composition:
 - 1. Manufactured in the USA.
 - 2. High density polyethylene (HDPE): 100 percent recycled materials.
 - 3. Geotextile fabric backing injection molded to the grid system.
 - 4. Color: black, terra cotta, gray, or tan. Custom colors may be available – Contact the manufacturer.
 - 5. Color Uniformity: Uniform color throughout all unit rolls.
 - 6. Carbon Black for ultraviolet light stabilization.
 - 7. Anchor pins and washers, provided by manufacturer with Gravelpave2.
- B. Performance Properties:
 - 1. Maximum Loading Capability: 15,940 psi (2.29 million psf, 109,906 kPa) when filled with gravel.
 - 2. Wheelchair Access testing for ADA Compliance: Passing ASTM F 1951-08.
 - 3. Tensile strength, pull-apart testing: 458 lbf/in from ASTM D638 Modified.
 - 4. System Permeability (Gravelpave2, sand, base course): 2.63 to 38.55 inches of water per hour.
 - 5. Effective Imperviousness (E.I.): 10%.
- C. Dimensions (individual units are assembled and distributed into rolls):
 - 1. Roll area: From 108 sq ft (10 sq m) to 538 sq ft (50 sq m), in 108 sq ft (10 sq m) increments
 - 2. Roll Widths: From 3.3 ft (1 m) to 8.2 ft (2.5 m), in 1.6 ft (0.5 m) increments.
 - 3. Roll Lengths: From 32.8 ft (10m) to 65.6 ft (20 m), in 3.3 ft (1 m) increments.
 - 4. Roll Weights: From 41 lbs (19kg) to 205 lbs (93kg), in 41 lbs (19 kg) increments.
 - 5. Unit Nominal Width by Length: 20 inches by 20 inches (0.5 m by 0.5 m) or 40 inches by 40 inches (1 m by 1 m).
 - 6. Nominal Depth: 1 inch (2.5 cm) – for rolls and individual units.
 - 7. Unit Weight: 19 oz (535 g) or 5 lbs. (2.27 kg).
 - 8. Volume Solid: 8 percent.

2.3 SYSTEM MATERIALS

Notes: All measurements are subject to manufacturing tolerances, unless otherwise specified.

- A. Base Course: Sandy gravel material from local sources commonly used for road base construction (recycled materials such as crushed concrete or crushed asphalt are NOT acceptable).
 - 1. Conforming to the following sieve analysis and requirements:
 - a. 100 percent passing sieve size 1 inch (25 mm).
 - b. 80-100 percent passing sieve size 3/4 inch (19 mm).
 - c. 60-80 percent passing sieve size 3/8 inch (9 mm).
 - d. 40-60 percent passing sieve size #4.
 - e. 25-40 percent passing sieve size #10.
 - f. 5-25 percent passing sieve size #40.

- g. 0-5 percent passing sieve size #200.
- 2. Material may be either "pit run" or "crusher run." Avoid using clay based crusher run/pit run. Crusher run material will generally require coarse, well-draining sand conforming to AASHTO M6 or ASTM C 33 to be added to mixture (20 to 30 percent by volume) to ensure long-term porosity.
- 3. Alternative materials such as crushed shell, limerock, or crushed lava may be used for base course use, provided they are mixed with sharp sand (20 to 30 percent) to ensure long-term porosity, and are brought to proper compaction. Without added sand, crushed shell and limerock set up like concrete and become impervious.
- 4. Alternative size and/or composition of base course materials should be submitted to Invisible Structures, Inc. (Manufacturer) for approval.
- B. Gravel Fill: Obtain clean, washed, fine decorative gravel, must be sharp and angular (not rounded) stone, granite hardness, to fill the 25 mm (1") high rings and spaces between the rings, not to be overfilled more than 1/4" (6 mm). Maximum Size of stone should be: 3/16" to 3/8" (5 mm to 10 mm) and uniform in size - not graded.
- C. Anchors: Typical anchors shall be 8" long nails with "fender" type washers 7 x 30 mm od (5/16" id x 1.25") od, all galvanized metal or similar corrosion resistant coating. Supplied anchors may vary in size and type based on source and availability.
- D. (Optional) Binder: Portland cement, polymer binders, or tree resin binders may be added for additional aggregate stabilization. Contact the manufacturer. ATTENTION: Binders will reduce porosity –and some will even eliminate porosity – in the Gravelpave2 system.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine subgrade and base course installed conditions. Do not start porous paving installation until unsatisfactory conditions are corrected. Check for improperly compacted trenches, debris, and improper gradients.
- B. For fire lane installations: prior to installing base course, obtain approval of local fire authorities of sub-base.

Notes: For Fire lanes and emergency access, It is recommended that Fire Department inspectors be scheduled to inspect installation of Gravelpave2 during preparation of the subbase, installation of the base course, and installation of Gravelpave2 units. Most small projects can accommodate these inspections all on the same day. Verify with Fire Department if certificates of inspection are required.

- C. Start of installation constitutes acceptance of existing conditions and responsibility for satisfactory performance. If existing conditions are found unsatisfactory, contact Architect for resolution.

3.2 PREPARATION

Notes: Ensure that subbase materials are structurally adequate to receive designed base course, wearing course, and designed loads. Generally, excavation into undisturbed normal strength soils will require no additional modification. Fill soils and otherwise structurally weak soils may require modifications, such as geotextiles, geogrids, and/or compaction (not to exceed 90%). Ensure that grading and soil porosity of the subbase will provide adequate subsurface drainage

- A. Subgrade Preparation:
 - 1. Prepare subgrade as specified in Section 32 10 00. Verify subgrade in accordance with porous paving system manufacturer's instructions.
 - 2. Proper subgrade preparation will enable the Gravelpave2 rolls/units to connect properly and remain level and stationary after installation.
 - 3. Excavate area allowing for unit thickness, the engineered base depth (where required), and 0.5 inch (1.25 cm) for 0.25 inch (6mm) gravel overfill and slight recession to contain gravel.
 - 4. Provide adequate drainage from excavated area if area has potential to collect water, when

working with in-place soils that have poor permeability.

5. Ensure in-place soil is relatively dry and free from standing water.
6. Uniformly grade base.
7. Level and clear base of large objects, such as rocks and pieces of wood.

B. Base Preparation:

1. Install Base as specified in Section 32 10 00. Verify engineered base (if required) is installed in accordance with porous paving system manufacturer's instructions.
2. Coordinate base installation and preparation with subdrains specified in Section 33 46 00.
3. If required, place a geotextile separation layer between the natural ground and the 'engineered base'.
4. If required, install the specified sub-drain and outlet according to construction drawings.
5. Place engineered base in lifts not to exceed 6 inches (150 mm), compacting each lift separately to 95 percent Modified Proctor.
6. Leave 1 inch (2.5 cm) of depth below final grade for porous paver unit and sand fill and 0.5 inch (1.25 cm) for overfill of gravel aggregate.

Notes: Delete requirement for on-site manufacturer's field representative if not required

3.3 ON-SITE MANUFACTURER'S FIELD REPRESENTATIVE

- A. A qualified Manufacturer's field representative shall be available for a pre-construction meeting via phone or in person and will provide installation videos, design details, installation instructions, and the technical specifications.
- B. The time for on-site observation shall be indicated in the Contract Documents and included in the base bid price.

3.4 GRAVELPAVE2 INSTALLATION

- A. Install the Gravelpave2 units by placing units with rings facing up/fabric below, and using small male/female connectors provided along each edge to maintain proper spacing and interlock the units. Cutting can be performed with pruning shears and knife, or portable power saw. Units shall be anchored to the base course, using anchors described above, as required to secure units in place from movement by traffic, at an average rate of 6 pins per square meter (high speed, heavy vehicles, fast turning movement will require additional anchors). Tops of rings shall be flush with the surface of adjacent hard surfaced pavements.
- B. Smooth the fabric overlaps from one roll or unit to the adjacent unit. Take care to make sure there are no gaps in the fabric exposing base course.
- C. Install gravel into rings after the units are anchored by "backdumping" directly from a dump truck, or from buckets mounted on tractors, with a minimum depth of 6", then exit the site by driving forward over rings already filled. Sharp turning of vehicles on bare rings must be avoided. The gravel is then spread laterally from the pile using power brooms, blades, flat bottomed shovels and/or wide "asphalt rakes" to fill the rings. A stiff bristled broom should be used for final "finishing". The gravel should be "compacted", if necessary, by using a vibrating plate or small roller, with the finish grade no less than the top of rings and no more than 6 mm (0.25") above top of rings.
- D. (Optional) If a binder for fill stone is desired (due to traffic speed, concentrated water flow, or other reason), use one of the following methods:
 1. Portland cement: Mixed dry at 10% by weight with fill stone,. Place into rings after thoroughly wetting the base, then lightly mist the surface after fill and compaction. Then, cover with a water resistant tarp, or plastic sheeting material for a minimum period of 3 days, or until the mixture has bonded.
 2. Polymer Resin Binder or Tree Resin Binder: Please contact Invisible Structures, Inc. and Resin Manufacturer for installation.

3.7 PROTECTION

- A. Prohibit traffic on the Gravelpave2 system until installation is completed. Any traffic on the unfilled or un-anchored Gravelpave2 system is a safety risk and subject to irreparable damage to the product.

3.8 FIELD QUALITY CONTROL

- A. Remove and replace segments of Gravelpave2 units where three or more adjacent rings are broken or damaged, reinstalling as specified, so no evidence of replacement is apparent.
- B. Perform cleaning during the installation of work and upon completion of the work. Remove all excess materials, debris, and equipment from site. Repair any damage to adjacent materials and surfaces resulting from installation of this work.

3.9 MAINTENANCE

- A. Keep area free of and remove organic material such as soil runoff, tree leaves, fruit, and other vegetation debris.
- B. Broom or rake gravel smooth to no more than 6mm (0.25") above the rings.
- C. Refill areas with gravel aggregate where walls of the rings are more than 3mm (0.125") exposed.
- D. When snow removal is required, keep a metal edged plow blade a minimum of 17mm (0.75") above the gravel surface during plowing operations to avoid causing damage to the Gravelpave2 units, or
 - 1. Use a plow blade with a flexible rubber edge, or
 - 2. Use a plow blade with skids on the lower outside corners set so the plow blade does not come in contact with the units.

END OF SECTION



BASE COURSE MATERIAL RECOMMENDATION

Sandy Gravel material from local sources commonly used for road base construction, passing sieve analysis:

Sieve % Passing

1"	100
¾"	80 - 100
3/8"	60 - 80
#4	40 - 60
#10	25 - 40
#40	5 - 25
#200	0 - 5

Acceptable alternate base: AASHTO #57 stone mixed with clean, sharp sand (ASTM C- 33) at a rate of 70% stone to 30% sand for full depth of base.

Make sure to avoid using materials such as recycled asphalt, limestone and decomposed granite, as they will cause problems with the porosity and/or pH levels.



Pioneering Stormwater Solutions

www.invisiblestructures.com
303.233.8383



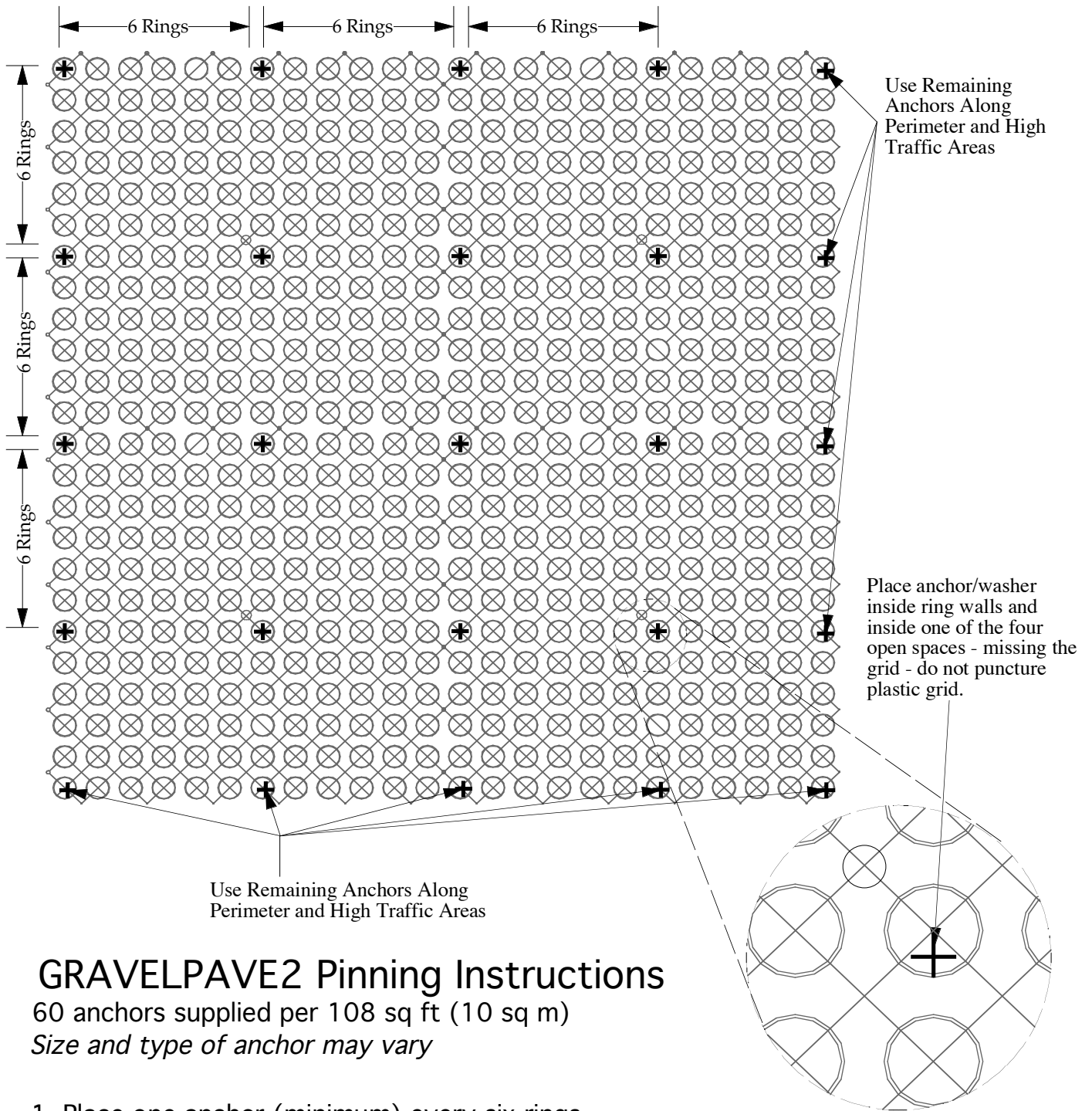
Base Course Depth Recommendations **GRASSPAVE²** and **GRAVELPAVE²**

Invisible Structures, Inc.
303-233-8383
www.invisiblestructures.com

	Normal Traffic		Occasional Passes		Infrequent Passes	
	CBR 2-4	CBR >4	CBR 2-4	CBR >4	CBR 2-4	CBR >4
Heavy Fire Truck & H-20 Loading Max 110 psi 80000 lb	14 in	12-14 in	12-14 in	12 in	12 in	10-12 in
Light Fire Truck & H-15 Loading Typical 85 psi 60,000 lb	12 in	10-12 in	10 in	8-10 in	8-10 in	8 in
Utility & Delivery Truck & H-10 Loading Typical 60 psi 40,000 lb	8-10 in	8 in	8-10 in	6-8 in	6-8 in	6 in
Cars & Pick-Up Truck Access Typical 45 psi 8,000 lb	6-8 in	6 in	6 in	4-6 in	4-6 in	2-4 in
Trail Use and Cart Paths <1,000 lb	6 in	4-6 in	2-4 in	0-2 in	None	None

*** THESE DEPTH RECOMMENDATIONS SHOULD BE VERIFIED BY THE PROJECT ENGINEER AND LOCAL AUTHORITIES**





GRAVELPAVE2 Pinning Instructions

60 anchors supplied per 108 sq ft (10 sq m)

Size and type of anchor may vary

1. Place one anchor (minimum) every six rings
2. Place anchor inside rings, in one of the four open spaces (do not puncture grid).
3. Place remaining anchors around perimeter of site and in high traffic areas

NOT TO SCALE

GRAVELPAVE2 PINNING INSTRUCTIONS