



Invisible Structures, Inc.

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Grasspave2 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 Grasspave2 Porous Pavement System from Invisible Structures. The system provides vehicular and heavy load support over grass areas while protecting grass roots from harmful effects of traffic.

The major components of the complete system are the Grasspave2 units, an engineered base course, Hydrogrow soil amendment/fertilizer, sand, and grass from seed, hydromulch, or sod.

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] [____ - _____].
- F. Section [32 92 00 – Manufacturers of Turfs and Grasses] [____ - _____].
- G. Section [32 80 00 – Irrigation or Section 32 84 13 – Drip Irrigation] [____ - _____].

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
- D. AASHTO M6 Standard Specification for Fine Aggregate for Hydraulic Cement Concrete

1.4 SYSTEM DESCRIPTION

- A. The Grasspave2 porous pavement system provides vehicular and pedestrian load support for grass areas, while protecting grass roots from harmful effects of traffic.
- B. Major Components of the Complete System
 - 1. Grasspave2 units, assembled in rolls.
 - 2. Engineered sand and gravel base course.
 - 3. Hydrogrow soil amendment and fertilizer, supplied with Grasspave2.
 - 4. Sand fill or USGA greens mix.
 - 5. Selected grass from seed, hydroseeding/hydro-mulching, or sod.
 - 6. Selected topsoil (only for seeded installation).
 - 7. Mulch (needed only for seeded or hydroseeded installations).
- C. The Grasspave2 grass paving units, sand, and base course work together to support imposed loading.
- D. The Grasspave2 grass paving units, Hydrogrow, and sand fill contribute to vegetation support.

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 Grasspave2 10" x 10" section of Grasspave2 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 sand (or USGA mix) fill materials
 - 3. Product certificates signed by the manufacturer certifying material compliance of polyethylene used to make Grasspave2 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 Grasspave2 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 Grasspave2 to limit the disruption and pollution of natural water flows by managing stormwater runoff.
 - 5. Documenting the use of Grasspave2 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 Grasspave2 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 Grasspave2 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 Grasspave2 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 Hydrogrow in a dark and dry location
- D. Handling: Protect materials during handling and installation to prevent damage

1.7 MAINTENANCE SERVICE

Notes: Once healthy turf has been established, the cell wall structure will have minimal visibility when proper turf maintenance practices are followed.

- A. Installer responsible for maintenance of grass plants – water/irrigation, fertilizing, mowing – for one growing season. DO NOT AERATE. See *Grasspave2 Maintenance Guide* from Invisible Structures
- B. System to be maintained by _____, after one growing season.

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 turf 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. Adequately water sod or grass seed to assure germination of seed and growth of root system.
- G. Grass coverage on the sand-filled Grasspave2 rings must be completed within one week: See *Part 3 Execution*.
- H. DO NOT DRIVE, PARK ON, or use Grasspave2 system for two or three mowing cycles until grass root system has matured (about 3 to 4 weeks for sod or 6 to 8 weeks for seeded areas). 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 GRASSPAVE2

- A. Composition:
 - 1. Manufactured in the USA.
 - 2. High density polyethylene (HDPE): 100 percent recycled materials.
 - 3. Color: black
 - 4. Color Uniformity: Uniform color throughout all units rolls.
 - 5. Carbon Black for ultraviolet light stabilization.
 - 6. Hydrogrow soil amendment and fertilizer, provided by manufacturer with Grasspave2.
- B. Performance Properties:
 - 1. Maximum Loading Capability: 15,940 psi (2.29 million psf, 109,906 kPa) when filled with sand.
 - 2. Wheelchair Access testing for ADA Compliance: Passing ASTM F 1951-08.
 - 3. Wheelchair Access testing for ADA Compliance: Passing Rotational Penetrometer testing.
 - 4. Tensile strength, pull-apart testing: 458 lbf/in from ASTM D638 Modified.
 - 5. System Permeability (Grasspave2, sand, base course): 2.63 to 38.55 inches of water per hour.
 - 6. 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: 18 oz (510 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. 90-100 percent passing sieve size 3/4 inch (19 mm).
 - c. 70-80 percent passing sieve size 3/8 inch (9 mm).
 - d. 55-70 percent passing sieve size #4.
 - e. 45-55 percent passing sieve size #10.
 - f. 25-35 percent passing sieve size #40.
 - g. 3-8 percent passing sieve size #200.
 2. Provide a base course material nearly neutral in pH (range from 6.5 to 7.2) to provide adequate root zone development for turf.
 3. 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.
 4. 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.
 5. Alternative size and/or composition of base course materials should be submitted to Invisible Structures, Inc. (Manufacturer) for approval.
- B. Sand Fill for Rings and Spaces Between Rings: Clean sharp sand (washed concrete sand). Choose one of the following:
1. Coarse, well-draining sand, such as washed concrete sand conforming to AASHTO M6 or ASTM C-33.
 2. United States Golf Association (USGA) greens, section - sand mix "The Root Zone Mixture."
- C. Turf Conditioner:
1. Hydrogrow a proprietary soil amendment manufactured by Invisible Structures, Inc. and provided with Grasspave2.
 2. NO SUBSTITUTIONS.

Notes: Use grass species resistant to wear by traffic generally a Blue/Rye/Fescue mix used for athletic fields in northern climates, and Zoysia, Fescue, or Bermuda types in southern climates. Check with local sod and seed suppliers for preferred mixtures. Dedicated fire lanes can use same grass species used on surrounding turf. Parking applications require greatest wear-resistant species possible, generally available only by seed or hydroseeding/hydro-mulching.

D. Grass – Choose either sod or seed:

1. Sod: [_____]. Use 13 mm (0.5") thick (soil thickness) rolled sod from a reputable local grower. Species should be wear resistant, free from disease, and in excellent condition. Sod shall be grown in sand or sandy loam soils only. Sod grown in soils of clay, silt, or high organic materials such as peat, will not be accepted.
2. Seed: [_____]. Use seed materials, of the preferred species for local environmental and projected traffic conditions, from certified sources. Seed shall be provided in containers clearly labeled to show seed name, lot number, net weight, % weed seed content, and guaranteed % of purity and germination. Pure Live Seed types and amount shall be as shown on plans.
 - a. Mulch – needed only for hydroseeding: Wood or paper cellulose commercial mulch materials compatible with hydroseeding operations. Mulch depth according to mulch

manufacturers' recommendation. DO NOT use mulch of straw, pine needles, etc., because of their low moisture holding capacity.

- b. Topsoil – needed only for seeding, recommended for hydroseeding: Obtain specified topsoil for a light “dusting” (no more than ½” or 13mm) above rings filled with sand for seeding germination.

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 for turf paving, obtain approval of local fire authorities of sub-base.
- 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 Grasspave2 rolls/units to connect properly and remain

Notes: For Fire lanes and emergency access, It is recommended that Fire Department inspectors be scheduled to inspect installation of Grasspave2 during preparation of the subbase, installation of the base course, and installation of Grasspave2 units. Most small projects can accommodate these inspections all on the same day. Verify with Fire Department if certificates of inspection are required.

- 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 depth of sod root zone or topsoil germination area (when applicable).
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. Coordinate base installation and preparation with irrigation and drip irrigation lines specified in Section 32 80 00 and 32 84 13, respectively.
 6. Place engineered base in lifts not to exceed 6 inches (150 mm), compacting each lift separately to

95 percent Modified Proctor.

7. 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 depth of sod root zone or topsoil germination area (when applicable).

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 HYDROGROW INSTALLATION

- A. Spread all Hydrogrow mix provided (spreader rate = 4.53 kg per 100 m² (10 lbs per 1076 ft²) evenly over the surface of the base course with a hand-held, or wheeled, rotary spreader.
- B. The Hydrogrow mix should be placed immediately before installing the Grasspave2.

3.5 GRASSPAVE2 INSTALLATION

- A. Install the Grasspave2 units by placing units with rings facing up, and using snap-fit connectors, pegs and holes, provided to maintain proper spacing and interlock the units. Units can be easily shaped with pruning shears or knife. Units placed on curves, slopes, and high traffic areas shall be anchored to the base course, using 40d common nails with fender washer, as required to secure units in place. Tops of rings shall be between 6 mm to 13 mm (0.25" to 0.5") below the surface of adjacent hard-surface pavements.
- B. Install sand in rings as they are laid in sections by "back-dumping" directly from a dump truck, or from buckets mounted on tractors, which then exit the site by driving over rings already filled with sand. The sand is then spread laterally from the pile using flat bottomed shovels and/or wide "asphalt rakes" to fill the rings. A stiff bristled broom should be used for final "finishing" of the sand. The sand must be "compacted" by using water from hose, irrigation heads, or rainfall, with the finish grade no less than the top of rings and no more than 6 mm (0.25") above top of rings.

3.6 INSTALLATION OF GRASS

- A. Grass coverage on the sand-filled rings must be completed within one week. Sand must be re-installed and leveled and Grasspave2 checked for integrity if rings become exposed due to wind, rain, traffic, or other factors. (Choose one paragraph below to meet grass installation method desired.)

Notes: Choose one paragraph below to match grass installation method

1. Preferred method: Hydroseeding/hydro-mulching - A combination of water, seed and fertilizer are homogeneously mixed in a purpose-built, truck-mounted tank. The seed mixture is sprayed onto the site at rates shown on plans and per hydroseeding manufacturer's recommendations. Coverage must be uniform and complete. Following germination of the seed, areas lacking germination larger than 20 cm x 20 cm (8" x 8") must be reseeded immediately. Seeded areas must be fertilized and kept moist during development of the turf plants.). DO NOT DRIVE ON SYSTEM: Hydroseeded/hydro-mulch areas must be protected from any traffic, other than emergency vehicles, for a period of 6 to 8 weeks, or until the root system has penetrated and established well below the Grasspave2 units.
2. Install thin sod directly over sand filled rings, filled no higher than the top of the rings. Sod strips should be placed with very tight joints. Sodded areas must be fertilized and kept moist during root

establishment (minimum of 3 weeks). DO NOT DRIVE ON SYSTEM: Sodded areas must be protected from any traffic, other than emergency vehicles, for a period of 3 to 4 weeks, or until the root system has penetrated and established well below the Grasspave2 units.

3. Install grass seed at rates per grass type. A light "dusting" of commercial topsoil mix, not to exceed 1/2" (25 mm) will be placed above the rings and seed mix to aid germination rates. Seeded areas must be fertilized and kept moist during development of the turf plants.). DO NOT DRIVE ON SYSTEM: Seeded areas must be protected from any traffic, other than emergency vehicles, for a period of 6 to 8 weeks, or until the root system has penetrated and established well below the Grasspave2 units.
- B. Adequately water sod or grass seed to assure germination of seed and growth of root system.

3.7 PROTECTION

Notes: Choose one paragraph below to match grass installation method.

- A. Seeded areas must be protected from any traffic, other than emergency vehicles, for a period of 4 to 8 weeks, or until the grass is mature to handle traffic.
- B. Sodded areas must be protected from any traffic, other than emergency vehicles, for a period of 3 to 4 weeks, or until the root system has penetrated below the Grasspave2 units.

3.8 FIELD QUALITY CONTROL

- A. Remove and replace segments of Grasspave2 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. Maintain grass in accordance with manufacturer's instructions and as specified in Section 32 92 00 Manufacturers of Turfs and Grasses.
- B. Lawn Care: Normal turf care procedures should be followed, including de-thatching.
- C. DO NOT AERATE. Aerator will damage the Grasspave2 units. Aeration is not necessary in a sand root zone.
- D. When snow removal is required, keep a metal edged plow blade a minimum of 3/4 inch (17 mm) above the surface during plowing operations to avoid causing damage to the Grasspave2 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