

Grasspave²



New Headquarters

Just immediately south of the new Denver International Airport before you reach Interstate 70 you'll find our Invisible Structures, Inc. corporate headquarters and manufacturing facility off Tower Road in the Majestic Commerce Center.

When you come to Colorado, plan to stop and visit with us, tour our facility, and enjoy the panoramic views of the spectacular Rocky Mountains. We'll make sure you have the latest information on any of our growing list of products, including Grasspave² for grass paving, Gravelpave² for porous gravel paving, Slopetame² for soil stabilization on slopes, Draincore² for subsurface water collection and movement, and Rainstore³ for underground water storage. Promotional rewards are available to designers and contractors who use our products and give us job information.

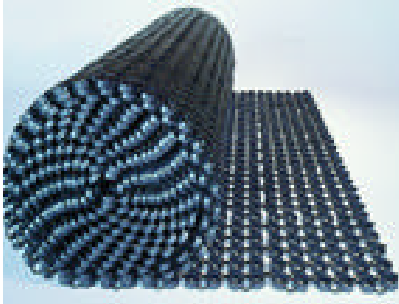
Work With Professionals

Since one of our company's founders is a licensed Landscape Architect, we immediately saw the value of being able to "talk shop" with designers. For our entire corporate history (since 1982) we have focused on hiring sales staff with professional design and contracting experience. You will get straight answers

and current technology solutions to your specific design problems from design professionals with construction experience.

Fast Friendly Service

We realize that you are tight for time in designing a project or in constructing one. We provide instant response with fax-back information, product quotes, installation cost estimates, best shipping routes, access to the internet, high-quality brochures, and our CD-ROM with AutoCAD construction details and graphics.



Grasspave² large rolls for fast installation.

Grasspave² Early Years

In 1982 our first grass paving system was called Ritterings and was composed of 3" PVC

white rings glued onto netting and sold in 4' x 20' mats. It was the start-a-business-in-your-garage approach. In 1988 we began molding 3" black recycled HDPE plastic rings and still glued them onto netting. This roll format made installation very easy for contractors and still is the single most distinguishing feature setting us apart from all modular pavers.

Metric Influence

In 1991 Grassrings² (Grasspave²) was introduced as a half-meter by half-meter square of rigid 2" black recycled HDPE plastic



Cover photo: Koll Center, Irvine, CA — Firelane

Cableland, Denver, CO — Valet parking in the backyard at a city estate.



Biltmore Hotel, Coral Gables, FL — This beautiful grass firelane enhances the lawn areas surrounding the historically restored hotel and is a staging area for events.

rings and integral flexible grid. Living in Australia from 1974 to 1976 gave us the impetus for using metric — the “2” after Grasspave² signifies square meter. In 1993 we changed the name to Grasspave², combining the word grass with the action word “pave.” All of our products have action words — pave, tame, drain, store. We want you to act now and use our products!

Large Roll Sizes

In 1996 a site foreman from Valley Crest Landscaping commented on how he preferred our old 4' x 20' rolls to the meter squares. He claimed that the rolls cut down his installation time considerably and were easier to handle. We took his advice and started pre-assembling the meter squares into several roll sizes which have been extremely popular with both contractors and homeowners.

The rolls interlock with peg/hole connectors. Once fastened together, they will act as one consistent piece. Other pavement reinforcement systems are grooved together and react in a stiff or rigid manner leading to cracking, warping or heaving at the surface.

We use model numbers that coincide with metric measurements. A chart of roll sizes can be found in the centerfold. Model 1010 is one meter wide (3.3') by 10 meters long (32.8'). Model 1020 is 20 meters long. Model 1520 is 1.5 meters wide (4.9'). Model 2020 is two meters wide. Model 2520 is 2.5 meters wide (8.2') by 20 meters long (65.6'). Our largest roll, Model 2550, is available for parking lot projects as shown below. Each roll covers 125 square meters (1,346 sf).

Fast Installation Time

Our rolls can be placed and rolled out in minutes! Rates are approximately 300 square meters (3,000 sf) per person-hour on larger size jobs, and 150-250 m² (1,500-2,500 sf) per person-hour on smaller jobs. The overall installation of base, Hydrogrow, Grasspave² rolls, sand fill, and seed or sod is 100 m² (1,080 sf) in one hour by two workers.

Cutting Rolls

Cutting is done with pruning shears! Shape around all site protrusions including sprinkler heads, control boxes, curbing, bollards, and adjacent hard pavers. Many designers are still using width increments of 4 feet which is right between our one meter (3.3') and our 1.5 meter (4.9'). To solve this, simply cut our 2.5 meter piece down the middle to achieve a 4.1' width. Don't throw odd pieces away because they can be used for small areas. Very little product is wasted!

Free Hydrogrow Mix with Grasspave²

Our turf reinforcement system is unique in that we provide free of charge, a soil amendment called Hydrogrow, which is designed to help grass grow in sand based root zones. We custom blend Hydrogrow, which is a mixture of zeolite, humate, polymer, and porous ceramic. The results are amazing and our Grasspave² areas often look healthier than surrounding turf. By using this special mixture in the sand, porosity will be maintained, turf will be attractive, and aeration will not be necessary.



West Farms Mall, West Hartford, CT — Shopping center parking used for overflow on weekends and during holidays. Tree islands indicate parking rows. This area is plowed in the winter.

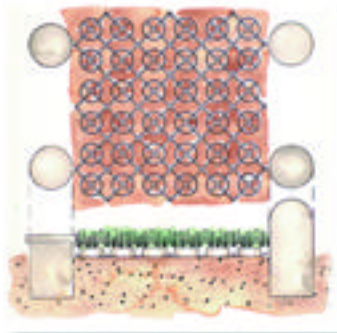


Orange Bowl Stadium, Miami, FL — the city of Miami researched all the grass paving products and found that Grasspave² gave them the best of everything — 100% grass finished appearance, compatibility with asphalt aisles, low staff requirements for unmonitored self-parking, 92% root area for best grass health, good for the environment, and ideal for tailgate parties.

Firelanes

Our long and well established history of providing safe, well constructed firelanes began in 1982 with our first job in Snowmass, Colorado, near Aspen Ski Resort. Since then we have firmly established our expertise in this area with tests having been done by several fire departments, beginning right here in Aurora, Colorado. See the Lab Compression Test Results on Page 7. An Irving, CA, Fire Department test can be seen on Page 11.

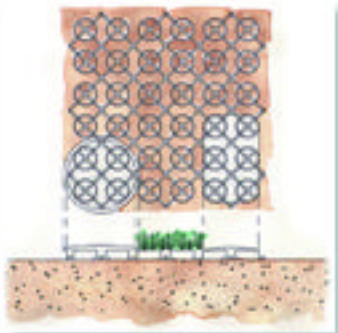
Please note that these details are schematic in nature. Designer shall specify spacing and design of edge treatments. Spacing will vary with turf type, slope, and fire department requirements.



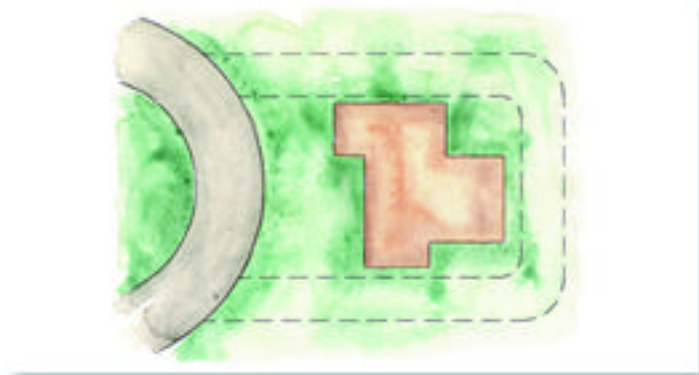
Surface mounted landscape uplight on left with bollard/light fixture on right.



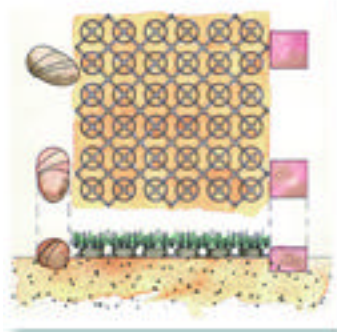
Shrub mass on left and ground covers on right. Note the compacted sandy gravel road base under Grasspave².



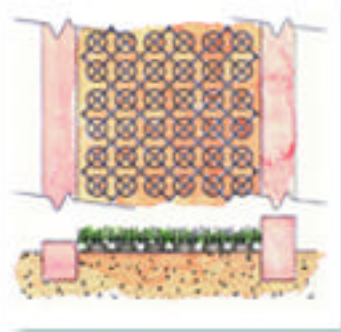
Cart path cap that fits over Grasspave² on left. Strapping tape around rings containing either gravel, non-shrink mortar, or concrete.



Firelane around buildings is delineated with any of these edge treatments.



6"- 8" rounded cobbles on left and precast concrete or brick pavers on right.



Flush concrete curbing shown on left and raised concrete curb on right (height varies).

Visit our web site for updated news on this application of Grasspave². You will also find our CD-ROM disk helpful when designing firelanes. Electronic specifications are included as well as CAD drawings similar to the ones shown here. Strength is required in the base course design to hold up these heavy vehicles. Primarily what would be used under asphalt paving is similar to that required under Grasspave². Design vertical contours in accordance with long axle spacing. Submit your plans to your applicable fire department to obtain approval. We can assist with



In a 1983 test this 100-foot ladder truck was lifted off the grass paving by rear outriggers, and no ruts were caused by either outriggers or tires. The ladder was extended, rotated, and loaded with no depressions in the road surface. All fire fighting vehicles can safely navigate even wet grass.



Denver Tech Center Corporate Client, CO — Curving firelanes around both buildings lends opportunity for private outdoor lounge area for employees who can also enjoy the garden view from their office windows.

Strength When Installed

5,700 pounds per square inch (psi) can be exerted on sand-filled rings without deflection or compromise to safety, when resting upon a base course thick enough and compacted to 95% Proctor. The ring form is the strongest shape for grass paving in that it has no weak corners. Supporting heavy loads with the rings allows us to use less plastic in the product, hence a 92% void area for root development, combined with unbelievable strength! Less plastic means lower cost to you.

120 psi Maximum on Public Highways!

Even empty, Grasspave² will support 2,100 psi (14,470 kPa) — well over the 120 psi highest truck tire pressure allowed on public highways. This is a safety factor of 17 times. When Grasspave² is filled with sand for part of the root zone medium, the strength increases to 5,700 psi (39,273 kPa). The safety factor increases from 17x to 47x. The heavier a vehicle, the more axles and tires it needs to support the load being carried. Grasspave² will meet and exceed all loading criteria.

Vehicle Loading Examples:

Auto tires: 40 psi
Truck tires: 110 psi
DC-10 tires: 250 psi
F-16 tires: 350 psi
Fire truck with outriggers: 81 psi (70,000 lb. truck distributed to four outrigger pads = 17,500 lbs. each with 12" x 18" surface contact with Grasspave²).

All these vehicles are well within our 5,700 psi loading capability. Be sure your base course design is sturdy enough, and our rings will easily do the job under all conditions. Also plan to strengthen concrete sidewalks and curbing that will be mounted by fire trucks.

Base Strength Is Critical

All grass paving reinforcement structures are designed for two primary functions — transfer loads through the walls of the product to prevent compaction, and provide small cellular confinement areas for optimal growth, stability, and protection of the grass root zone. A rigid base below all grass paving products is required to receive and spread

loads that are transferred through the structure. Some load spreading exists on the bottom of our products, but should not be factored into design calculations. The upper layer of pavement cross-sections, whether asphalt or grass, is appropriately called the “wearing course” and functions to transfer loads to the base course.

Water Runoff Concerns

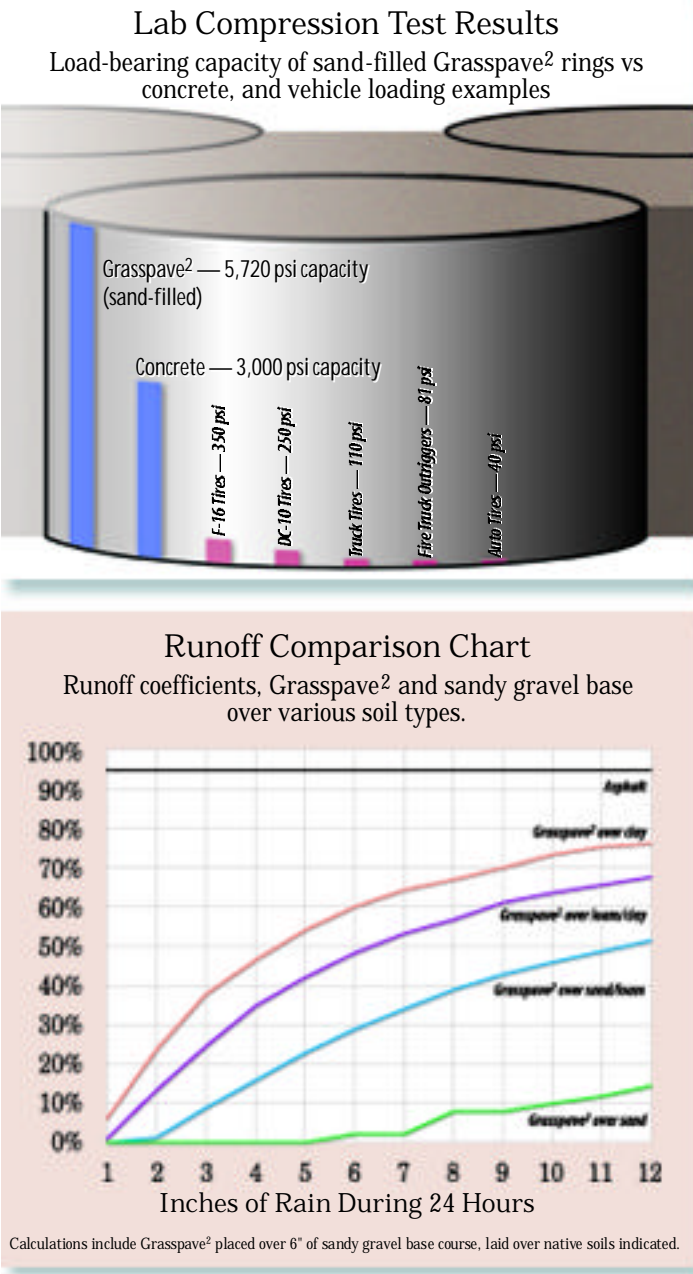
Park on grass! It will be affordable as compared to asphalt and will provide the porosity necessary for storm water collection, which is a major concern in many communities. Detention basins, manholes, and underground piping will not be necessary in most situations. Also many existing trees can be saved, and new trees planted to further assist in reducing runoff. Please refer to our runoff chart for coefficients over various soil types. You'll see that Grasspave² with sand fill can totally absorb up to 5" of rainfall in a 24-hour period and the rates are excellent up to 12"

in a 24-hour period. The runoff for asphalt is 95% for any amount.

Drainage of Base

Be careful not to create a bath tub effect if subsoils are not porous. Install Draincore² underground drainage mats to move water away. Having a sandy gravel base directly beneath Grasspave²

(continued on page 11)



Fillmore Street in Cherry Creek North, Denver, CO — This urban plaza is used for fire truck access as well as event use for the Cherry Creek Arts Festival. A gazebo for music concerts on the north end utilizes the grass area for blanket seating. There have been antique auto displays, polo demonstrations, Susan G. Komen Breast Cancer Art Benefit, and other gatherings which make this Grasspave² installation an active recreation area in the city.

Grasspave2 Installation — Mats can be rolled out in minutes!

600 m² (6,000 sf) per two-person hour! For steps shown below — 100 m² (1,080 sf) per two-person hour!



Excavate for base course as determined by soils and loading requirements. Place and compact sandy gravel which should be a mixture of clean sharp sand and gravel varying in size but not exceeding ¾". To check porosity, use a hose to see that water flows into the base and drains away. Add subsurface drainage as necessary to low spots.



Roll sod with heavy roller to eliminate air pockets and make sure roots are in contact with the sand fill. Water lawn as usual according to climatic requirements.



Apply Hydrogrow mixture that is included free with your order. Hydrogrow is a mixture of polymer and fertilizer designed especially for our Grasspave2 system.



Whether the area has been seeded or sodded, wait to drive on grass until after two mowings, a time which will establish the root system and lock the sod pieces in place. In an emergency such as fire truck access, grass may be driven on immediately after installation.



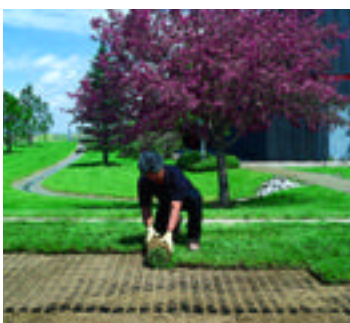
Roll out Grasspave2, aligning the side hole fasteners over the side pegs. The warmth of the sun will relax the plastic so it lays flat. Cut the grid between rings using pruning shears. Utilize small pieces in the same spacing.



Use a regular lawn mower for maintenance. There are no paver edges protruding the surface that would damage mowers. Do not aerate!



Fill rings with clean sharp concrete sand using large rakes and brooms so that the top of the rings show when done.



Lay turf over the rings. On warm days, wet the sand first to lower sand temperature and provide moisture for grass roots. Seeding and hydromulching is also an accepted vegetating method at this stage. A dusting of topsoil may be beneficial in the case of seeding and hydromulching.



Large rolls save installation dollars — it's the fastest grass paving system! Rolls apply to Grasspave2, Gravelpave2, Draincore2 and Slopetame2. Custom roll sizes available by request.

Invisible Structures — Standard Product Roll Sizes										
Model	Width		Length		Diameter		Area		Weight	
	m	ft	m	ft	m	ft	m ²	ft ²	kg	lbs
1010	1	3.3	10	32.8	0.5	1.7	10	108	19	41
1020	1	3.3	20	65.6	0.8	2.7	20	215	37	82
1050	1	3.3	50	164	1.2	4	50	538	93	205
1520	1.5	4.9	20	65.6	0.8	2.7	30	323	56	123
1550*	1.5	4.9	50	164	1.2	4	75	807	139	308
2020	2	6.6	20	65.6	0.8	2.7	40	430	75	164
2050*	2	6.6	50	164	1.2	4	100	1,076	186	410
2520	2.5	8.2	20	65.6	0.8	2.7	50	538	93	205
2550*	2.5	8.2	50	164	1.2	4	125	1,346	233	513

*Roll sizes marked with asterisks should be installed by lifting machines only. All other rolls can be installed manually (2 people advised). Rolls apply to Grasspave², Gravelpave², Draincore², and Slopetame². Custom roll sizes available by request.



(continued from page 7)
provides for good drainage at the surface and makes the firelane or parking area not only safer but more durable. Do a site inspection when the base is installed to ensure the depths are accurate and drainage is effective.

Base Course Design

Calculating the depth and composition of materials for the base course incorporates the same design criteria as for other pavements:

- load bearing capacity of native (or fill) subsoil
- plasticity or impact of moisture on strength and longevity
- frost heave potential
- traffic load, frequency and/or duration.

Sample Base Course Depths

Please consult with a soils engineer for site-specific base requirements. Generally, the depth that is used under asphalt will be the requirement under Grasspave². Golf carts and pedestrian traffic may require nothing over sandy gravel soils, and just 2" to 4" (5-10 cm) over very weak soils. Cars usually need 4" to 8" (10-20 cm). Buses, trucks, and fire trucks can easily require 8" to 12" (20-30 cm) or more. The use of geotextiles, though not required, below the base will prevent integration with subsoils and is strongly advised in areas of clay or silt soils and frost heave.

Filling Grasspave² with Topsoil Is Unwise

Remember that we are building a roadway with grass as the surface. Maintaining porosity for air and water movement is very important. When organic, clay or silt particles are in the rings, compaction can take place within the small cells, defeating the structure, and restricting access by air and water to roots. Growing grass in sand over a sandy gravel road base is more difficult to get established, but horticulturally and structurally it works! If ruts should appear in a finished installation, topsoil has been used either under the rings or within the rings, contrary to our installation instructions.

Seeding Grasspave² Is Popular

In California and other temperate climate zones many of our installations are seeded. Waiting for a period of two mowings will

ensure that the root system is well established. Seeding allows total customization of plant selection and eliminates possible contamination of the root zone from clay based or high peat content sod, both problems with high use areas.

92% Root Area and 100% Grass Coverage

Our installations are hard to find because they are invisible! With so little plastic near the crown of the grass, the blades of grass are not smashed by product. Root development is not interrupted from spreading laterally. The rings are strong and rigid, keeping grass root systems protected from harm. The roots grow directly downward and deeply into the sandy gravel base course. Grasspave² by Invisible Structures is, by far, the best possible "living" paving surface designed by a landscape architect.



Dupont Center, Irvine, CA — Fire department testing of Grasspave² with sand-filled rings to determine stability of outriggers when ladder was extended. Below: Firelane shown years later. Grass enhanced the landscaping and softened the appearance of this building.



Grasspave² Uniqueness

- Large rolls for fast installation — 10 to 125 m²
- 92% root area for best grass growth
- Strong rigid rings that conform to undulating terrain with flexible grid between rings
- 100% recycled post-consumer plastic
- Hydrogrow — polymer, fertilizer, soil amendment provided free
- Rolls can be cut and shaped with pruning shears

CSI Grants Specification Number

02795 Porous Paving — Recognition by CSI has helped establish legitimacy to the porous (grass and gravel) paving industries.

Now we can all agree on 02795! As designers expand their use and acceptance of porous paving, the industry will grow.

Creativity With Hard Surface Pavers

Ideas include: Combine Grasspave² with flush paths, pads or markers of concrete in a firelane for pedestrian traffic, design elements or delineation; use brick pathways through the grass; fill the rings with other plant materials such as daisies and ground covers; lay strips of concrete to define parking areas, especially handicapped parking; checkerboards of grass and pavers or other patterns to be enjoyed from high-rise offices; design of company logos in the parking lots or firelanes with polymer-bound colored stone; narrow residential streets with guest parking on grass shoulders.

Handicapped Parking and Ramps

Because our system creates firm support in the grass, it is very acceptable as a wheelchair access surface. Pulling a suitcase with wheels across marble floors is much easier than pulling it across carpeting. Likewise, wheeling across concrete will be easier than a Grasspave² grass surface by about the same amount. Care should be taken to adhere to our specifications and either use the seeding method or sand-based sod to attain a smoother profile. Less coarse grass mixtures will also increase the smoothness, as will maintaining a short blade cut.

Porous Paving vs. Asphalt

Currently asphalt is substituted for Grasspave² when the construction budget is cut. If comparisons are made product to product, asphalt is cheaper. However, when projects are large and the initial engineering of the site is begun with porous grass paving as the first choice, savings will be realized with reducing or eliminating storm water collection systems, detention basin areas, modifying grading requirements, and saving on maintenance resurfacing.

Avoid Thin-Wall Web Systems

Several companies market an accordion-shaped cellular confinement system for use as a porous pavement alternative. These structures were developed for the military to stabilize native soils sufficiently to allow for short term access by military vehicles. The cells use a thin flexible wall to confine soils or aggregate, but are not able to effectively transfer loads vertically. The product price is attractive, but the cells are too large to prevent compaction forces, and disturbance of the upper root zone is inevitable, causing loss of turf.

Environmental Pressures

The pendulum has swung away from heightened concern over the environment, but it will soon swing back. In our immediate future there will be further willingness to improve water quality and clean air — both of which are benefits offered by Grasspave². The installed system biodegrades engine oils, filters silt and other

suspended particles, traps air-borne dust, produces oxygen, and allows for trees in parking lots while cooling the ambient air temperatures. Our "constructed" world needs to be more agreeable to the human body.

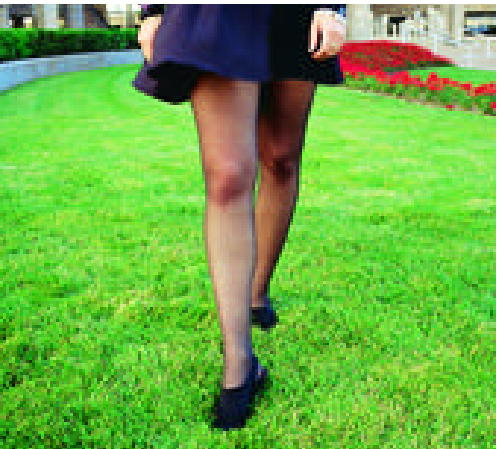
"Urban parking lots are pollutant hot spots," says U.S. Forest Service pilot-study director Gregory McPherson in a recent article in National Wildlife. "Rising from the cars is an invisible cloud of

evaporating gasoline, which releases polluting hydrocarbons into the atmosphere. The hotter the cars, the faster the fuel evaporates."

Three USFS scientists report that "peak summer air temperatures can be 4-8 degrees cooler in lots that are well-shaded compared to those with no shade." They are also doing a pilot study of the effects of shade on gasoline evaporation from cars parked on asphalt. "Of the total hydrocarbons emitted into the atmosphere due to human activity, motor vehicles contribute about 30%, and parked cars supply almost 20% of the hydrocarbons that come from vehicles." (Grasspave² allows more trees in parking areas — double cooling with grass and trees.)



Exclusive Private Residence, CO — Four-car garage courtyard with privacy walls, open on one side to the spectacular view. Area doubles for recreation/entertainment use. Below: High heels on grass — Grasspave² provides a firm grass surface, protected from pedestrian wear, thus eliminating cow paths.



Environmental Benefits

Grasspave² offers the following environmental benefits per 100 m² (1,080 sf) of coverage:

- 410 lbs of recycled plastic consumed and kept out of landfills
- 6,710 gallons of rain water kept on site for every 10" of rainfall
- 22 adults supplied with oxygen for one year from turf (carbon dioxide gas converted)
- 1.7 tons of air conditioning effect annually from turf.

Maintenance

Irrigation is required in dry climates for wearing grass. Any popular pop-up system can be used. Simply cut out rings to reveal the irrigation head. The use of Hydrogrow soil polymer quickly puts the Grasspave² installation on the same irrigation cycle as surrounding turf. Be careful not to over water as this will encourage shallow root development.

Fertilize once a year with an NPK slow release fertilizer that contains trace elements. There are many brands on the market. Do not aerate! You'll end up with product damage. When installed using sand in the rings, there will not be a compaction problem. Be careful not to use clay based sods in pedestrian or vehicular traffic areas — use sandy soil sod, or seed and mulch. There seems to be no problem with sod selection for fire lanes. Sodding a site will allow driving that same day if necessary.

Snow Removal

Our clients have solved this by attaching skids to their plows. Fire departments require snow removal usually with storms dropping over 3". Consult with your local fire department for their guidelines.

Shipping

We use three methods: UPS, Common Carrier, and Truck/Rail. Your quote will list the designated carrier that is best for your size order. Model 1010 rolls go UPS in quantities less than 1,200 sf. Common Carrier is used for Models 1020, 1520, 2020, 2520 and larger. For orders of 3,000 m² (32,280 sf) or more we utilize Truck/Rail transportation — Model 2520 (2.5 meters high to maximize inside trailer dimensions).



Detroit Grand Prix, Bell Isle, MI — Team race cars, pedestrians, buses, and 80,000-lb. transporter trucks use the area every June for the week-long event. Vehicles won't get stuck in the mud.

Order Terms

Since your schedule is tight, we usually stock inventory so that we can ship product to your site on the same day as financial arrangements are made. Discounts are given for pre-payment of your order — Mastercard, Visa, American Express, wire transfer, Federal Express a check — are all available. We also offer 30 day terms to those clients with approved credit. In rare instances, terms beyond 30 days are available.

Quantities larger than 200 m² (2,000 sf) should be reserved in advance through purchase orders. The more advance notice we have, the better we can meet your schedule.

Installation Difficulties

Should you perceive a problem with a Grasspave² installation, please call us immediately so that we can consult with you to resolve the issues and give you professional guidance.

Thank You Customers

Through your creativity and loyal support we continue to enjoy our relationships with you. We appreciate your faith and commitment to us, and look forward to a long and lasting friendship. Good luck with your wonderful projects. Let's hear from you more often.

Vicki and Bill Bohnhoff and the families of Invisible Structures

TECHNICAL SPECIFICATION
SECTION 02795 — Porous Paving

PART 1 — GENERAL

1.01 General Provisions

A. The Conditions of the Contract and all Sections of Division 1 are hereby made a part of this Section.

1.02 Description of Work

A. Work Included:

- 1. Provide and install sandy gravel roadbase as per Geotechnical Engineer's recommendations and/or as shown on drawings, to provide adequate support for project design loads. See 2.02 Materials.
- 2. Provide Grasspave² Paving System products including Grasspave² units, Hydrogrow soil conditioner, and installation per the manufacturer's instructions furnished under this section.

3. Provide and install clean sharp sand to fill the Grasspave² units, when needed.

4. Provide and install grass by using sod or hydroseeding.

B. Related Work:

- 1. Subgrade preparation under Section 02200 Earthwork.
- 2. Subsurface drainage materials — Section 02710 Subsurface Drainage, when needed
- 3. Irrigation installation — Section 02810 Irrigation, when needed.

1.03 Quality Assurance

A. Follow Section 01340 requirements.

B. Installation: Performed only by skilled work people with satisfactory record of performance on landscaping or paving projects of comparable size and quality.



Fillmore Street during festival. Grass firelane used for seating.

1.04 Submittals

- A. Submit manufacturer's product data and installation instructions.
- B. Submit a 10" x 10" section of Grasspave² material for review. Reviewed and accepted samples will be returned to the contractor.
- C. Submit material certificates for base course and sand fill materials.

1.05 Delivery, Storage, and Handling

A. Protect Grasspave² units from damage during delivery and store under tarp when time from delivery to installation exceeds one week. Keep Hydrogrow in a dark and dry location.

1.06 Project Conditions

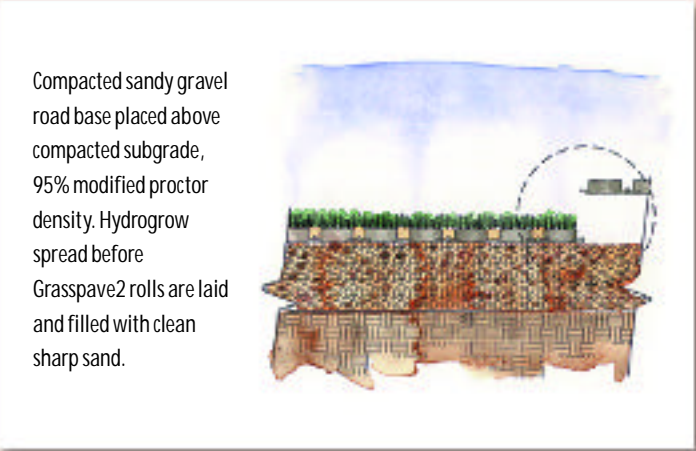
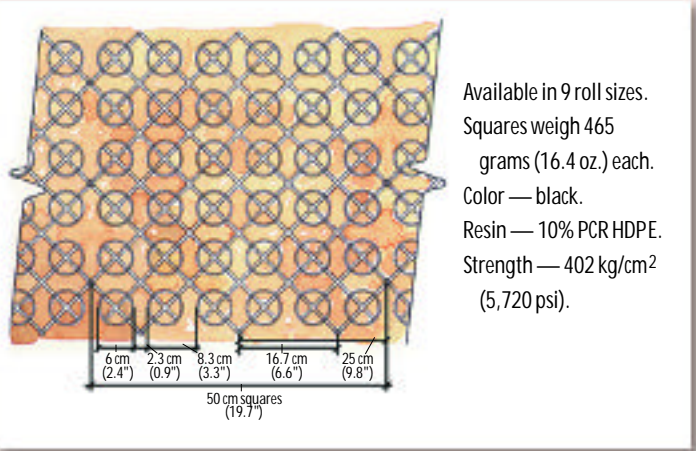
A. Review installation procedures and coordinate Grasspave² work with other work affected. Generally, Grasspave² is installed at the same time as project grass installation, nearly the last site construction activity.

B. All hard surface paving adjacent to Grasspave² areas, including concrete walks and asphalt paving, must be completed prior to installation of Grasspave².

C. Cold weather:

- 1. Do not use frozen materials or materials mixed or coated with ice or frost.
- 2. Do not build on frozen work or wet, saturated or muddy subgrade.
- 3. Grasspave² is best placed when ambient air temperatures exceed 55° F.

D. Protect partially completed paving against damage from other construction traffic when work is in progress, and until grass root system has matured (from 3 to 8 weeks). Any barrier



grades constructed must still be accessible by emergency and fire equipment during and after installation.

E. Protect adjacent work and surfaces from damage during Grasspave² installation.

PART 2 — PRODUCTS

- 2.01 Availability
- A. Manufacturer: (Grasspave², Hydrogrow) Invisible Structures, Inc., 20100 East 35th Drive, Aurora, Colorado 80011-8160. Call from USA and Canada 800-233-1510 toll free, International 303-373-1234, Fax 303-373-1223.
- B. Local Sales Representative: (Contact Manufacturer)

- 2.02 Materials
- A. Base Course: Sandy gravel material from local sources commonly used for road base construction, passing the following sieve analysis.

% Passing	Sieve Size
100	3/4"
85	3/8"
60	#4
30	#40
< 3	#200

1. Sources of the material can include either "pit run" or "crusher run." Crusher run material will generally require sharp sand to be added to mixture (20 to 30% by volume) to ensure long term porosity.
2. Selected materials should be nearly neutral in pH (range from 6.5 to 7.2) to provide adequate root zone development for turf.

3. Alternative materials such as crushed shell, limerock, and/or crushed lava may be considered for base course use, provided they are mixed with sharp sand (20-30%), and brought to proper compaction. (Crushed shell and limerock alone can set up like concrete without sand added.)

- B. Hydrogrow Conditioner: A dry synthetic crystal made of polyacrylimide (<0.1%) polymer. This polymer is non-toxic and neutral in pH, and will absorb 150 to 350 times its weight in water from most tap sources. Hydrogrow is a non-ionic form of polymer which allows absorption of fertilizers and other minerals without degradation. Alternative polymers of ionic, or anionic, forms will not be allowed to be substituted.

- C. Grasspave² Grass Paving Units: Lightweight injection-molded plastic units 0.5 x 0.5 x 0.025m (20" x 2" x 1" high, 2.7 ft² each) with hollow rings rising from a strong open grid allowing maximum grass root penetration and development. The

plastic shall be 100% post-consumer recycled plastic resins, predominately HDPE, with minimum 3% carbon black concentrate added for UV protection.

Loading capability is equal to 402 kg/cm² (5,700 psi) when filled with sand, over an appropriate depth of roadbase. Standard color is black. Unit weight = 510 g (18 oz.), volume = 8% solid. Units will be shipped in pre-assembled rolls from 1 meter (40") to 2.5 meters (8.2') wide. Contact Manufacturer for size options.

- D. Sand: Obtain clean sharp sand (washed concrete sand) to fill the 25 mm (1") high rings and spaces between the rings when seeding or using 13 mm (0.5") thick sod (soil thickness).

- E. Grass: Use species resistant to wear by traffic generally a



Denver Tech Center site functions well in snowy weather.

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 firelanes can use same grass species used on surrounding turf. Parking applications require greatest wear-resistant species possible, generally available only by seed or sprigging. Choose one of the following paragraphs to suit project requirements.)

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, or supplied from a recognized "Washed Sod" process. 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.
- F. Mulch: (Needed only for seeding.) Shall be of wood or paper cellulose types of commercial mulch materials often used in conjunction with hydroseeding operations. Mulches of straw, pine needles, etc. will not be acceptable because of their low moisture holding capacity.

- G. Fertilizer: A commercial "starter" fertilizer, with Guaranteed Analysis of 17-23-6, or as recommended by local grass supplier, for rapid germination and root development.

- H. Firelane Signage & Delineation: Firelanes must be identified regarding their entrance and physical location with the placement of signs, gates, curbs, bollards, etc. Specific signage wording and other details must be coordinated with and approved by local fire authorities.

- I. Grasspave² Sign: A sign to identify the presence of Grasspave² paving, stating that special maintenance is required,

with the manufacturer's phone number, and made of durable materials for outdoor exposure shall be provided and installed.

PART 3 — EXECUTION

- 3.01 Inspection
- (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.)

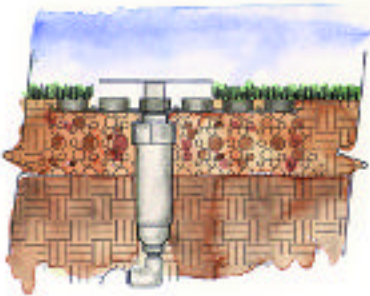
- A. Examine subgrade and base course installed conditions. Do not start Grasspave² installation until unsatisfactory conditions are corrected. Check for porosity of subsoils, existence of subsurface drainage (if needed), improperly compacted trenches, debris, and improper gradients.

- B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance. If existing conditions are found unsatisfactory, contact project manager for resolution.

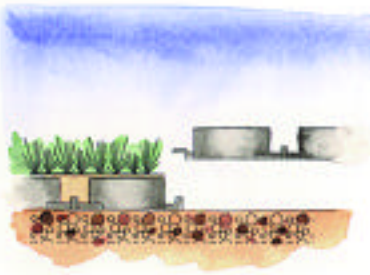
- 3.02 Preparation
- (Ensure that subbase materials are structurally adequate to receive designed base course, wearing course, and designed loads. Ensure that grading and soil porosity of the subbase will provide adequate subsurface drainage.)

- A. Place base course material over prepared subbase to grades shown on plans, in lifts not to exceed 150 mm (6"), compacting each lift separately to 95% Modified Proctor. Leave 25 mm (1") for Grasspave² unit and sand/sod fill to Final Grade.

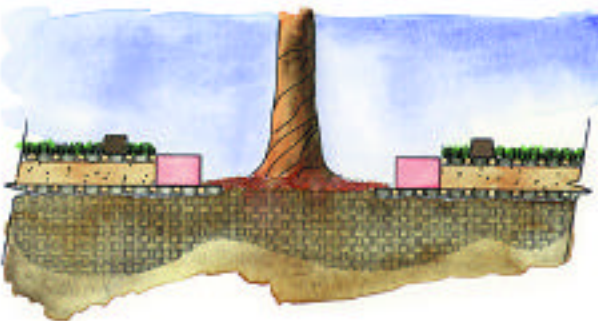
- B. Spread all Hydrogrow mix provided (spreader rate = 4.5 kg per 100 m² (10 lbs per 1,000 sf) evenly over the surface of the base course with a handheld or wheeled rotary spreader. The Hydrogrow mix should be placed immediately before installing



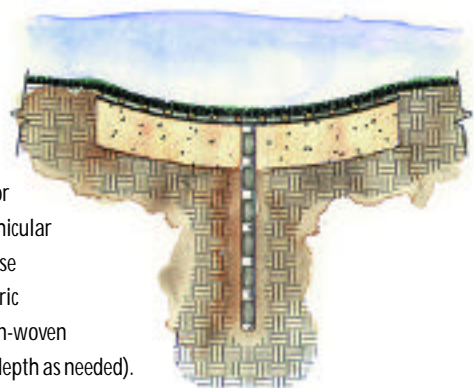
Irrigation Head Installation
Excavate compacted sub-grade as required to permit placement of irrigation pipes. Fill in and compact road base around irrigation riser. Cut and remove Grasspave² rings and grid to accommodate irrigation head.



Closeup of Grasspave² peg and hole attachment placed above compacted sandy gravel base course. Sand and root mass to fill Grasspave². Top of grass root mass 6 mm (.25") above top of ring.



Porous parking with Grasspave² to save existing trees — construct using minimal fill over existing grade leaving tree roots undisturbed. Root zone diameter equals 12" per 1" trunk caliper. Mulch around trunk with stone or wood chips.



Grasspave² swale with French drain for drainage in vehicular traffic areas. Use Draincore² fabric wrapped in non-woven geotextile (to depth as needed).

the Grasspave² units to assure that the polymer does not become wet and expanded when installing the units.

3.03 Installation of Grasspave² Units

A. Install the Grasspave² units by placing units with rings facing up, and using 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 and slopes shall be anchored to the base course, using ISI Anchors, or 16d Common nails with fender washer, as required to secure units in place. Tops of rings shall be flush with the surface of adjacent hard-surface pavements.

B. Install sand in rings by “backdumping” 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.

3.04 Installation of Grass

(Choose one paragraph below to meet grass installation method desired.)

A. Install grass seed and mulch over sand-filled rings with commercial hydroseeding equipment, at rates shown on plans and per 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 mulched, fertilized and kept moist during development of the turf plants (6 to 8 weeks).

B. Install thin sod (or “washed 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 fer-

tilized and kept moist during root establishment (minimum of 3 weeks). 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 grass well below the Grasspave² units.

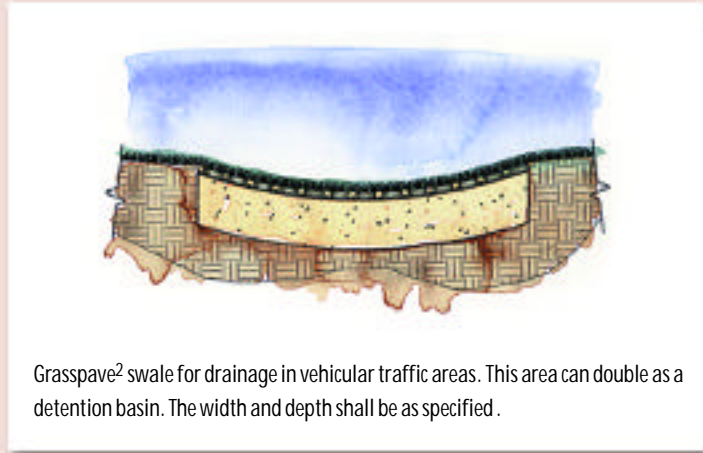
C. Install thick (25 to 35 mm) sod over bare rings, using t i g h t joints between sod strips. Vibrate the sod into rings with roller or plate, with sod in a moist condition, until the bottom of sod touches base of paver (usually 3 to 4 passes with vibration). Protect from traffic for minimum period of 1 week.

3.05 Cleaning

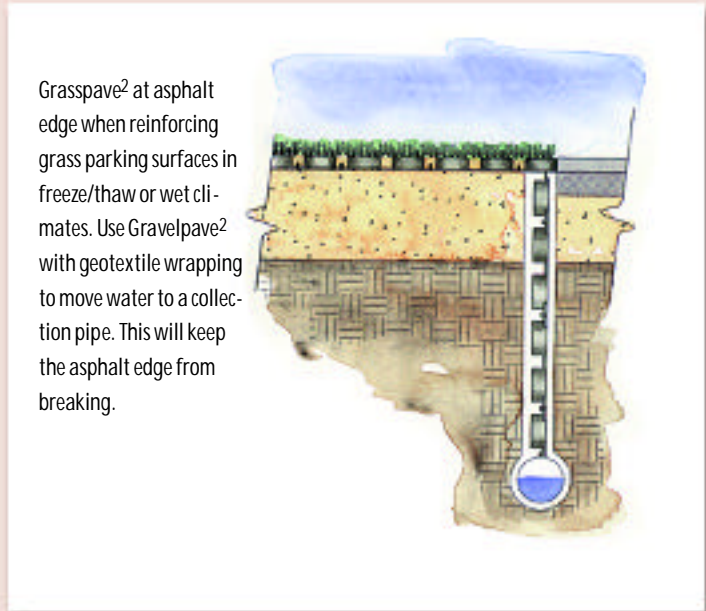
A. Remove and replace segments of Grasspave² units where three or more adjacent rings are broken or damaged, reinstalling as specified, so no evidence of replacement is apparent.

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.

If you have any questions regarding this specification, please call Invisible Structures, Inc. 1-800-233-1510, overseas call 303-373-1234.



Grasspave² swale for drainage in vehicular traffic areas. This area can double as a detention basin. The width and depth shall be as specified .



Grasspave² at asphalt edge when reinforcing grass parking surfaces in freeze/thaw or wet climates. Use Gravelpave² with geotextile wrapping to move water to a collection pipe. This will keep the asphalt edge from breaking.



Tustin Ranch Homes, Tustin, CA — Pedestrian concrete walkways cut across this fire-lane which encircles the ranch homes. The grass firelane helps maintain an upscale appearance while still providing safe secondary access by fire trucks.

Invisible Structures, Inc. family of other products for site improvement.



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