Strength of Grass Paving Structures

Many designers have questioned the strength of grass paving reinforcement structures to determine suitability for specific traffic and load bearing applications, and to compare products made by different manufacturers.

We at Invisible Structures, Inc. would like to assure you about product strength as a design issue, and clarify all of the data contained in various forms of product information.

All Grass Paving Structures are Strong Enough to Support the Heaviest Vehicles allowed on Highways!

This statement is made after analyzing all of the product specifications in this industry and translating the load bearing test data to a common factor.

We at ISI prefer to use pounds per square inch (psi, or kPa for metric), because it is easy to relate to on a personal level, and it relates directly to tire pressure ratings - the amount of pressure applied to a surface by the tire contact area.

How Much Strength is Needed?
Heavy truck tire pressures for vehicles used on public highways is usually a maximum of 120 psi (827 kPa). These vehicles generally carry loads that average less than 5000 lbs (2268 kg) per tire, which means a contact area usually less than 6.5" x 6.5" (16.5 cm x 16.5 cm). Outriggers, found on fire trucks, are also designed to not exceed this pressure.

ISI's Grasspave^2 product has load bearing strength of 2100 psi (14,479 kPa) when empty, which provides a safety factor of nearly 17.5 x. Grasspave^2 has the least amount of structural mass to resist loads compared to any other plastic or concrete grass paver, making it the theoretical "weakest". It is the rigid circular "ring" form which maximizes the weight/load bearing ratio of Grasspave^2.

Grass Paver Strength Compared

Product	psi	psf	US Ton/sf	kPa	M Ton/m2
Standard Truck Tire	*120*	*17,280*	*8.64*	*827*	*0.73*
Grasspave2 (filled)	5,720	823,680	411.84	39,411	34.72
Geoblock (heavy)*	420	60,480	30.24	2,894	2.55
Geoblock (light)*	380	54,720	27.36	2,618	2.31
Grassy Paver*	485	69,840	34.92	3,342	2.94
Grassroad Paver8+*	320	46,080	23.04	2,205	1.94
Turfstone (precast)	3,000	432,000	216.00	20,670	18.21

*Note: mfg data not specific-assumed as unfilled.

Add Strength - Fill Paver
It is very rare that a grass paving structure will be used empty or unfilled. Load bearing strength is increased dramatically when the product is filled with sand for part of the root zone medium. As an example, Grasspave^2 strength increased from 2100 psi to over 5700 psi (39,273 kPa) when filled with sand and ready for seed (or sand based sod). Thus, the design safety factor goes from 17.5x to over 47x.

Base Strength is Critical
All grass paving reinforcement structures are designed for two primary functions -

- transfer loads through the walls of the structure to prevent compaction, and
- provide small cellular confinement areas for optimal growth and protection of the grass root zone.

As with other forms of pavement design, grass (porous) paving must be provided with a rigid base below the structure to receive and spread the loads transferred through the structure. Some measurable load spreading capacity exists on the bottom of all grass paving structures, including the flexible grid of Grasspave^2, but we discount this value to simplify calulations and further increase the safety factor.

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

- load bearing capacity of native sub soil,
- plasticity or impact of moisture,
- frost heave potential,
- traffic frequency and/or duration.

Golf carts and pedestrian traffic may require a thin base course (perhaps nothing over sandy gravel soils) which may amount to 2" to 4" (5 - 10 cm) over very weak soils. Buses, trucks and fire trucks can easily require 8" to 12" (20 - 30 cm) or more depth of base course, and frequently the use of a geotextile below the base to prevent integration with sub soils.

Load Factor Equivalents
Assuming a given tire pressure of 120 psi, the following load factors would be equal:

- 17,280 lbs per square foot
- 8.64 tons per square foot
- 20,000 lbs per axle (4 tires)
- 432% of H10 rear axle load
- 216% of H20 rear axle load

Note: an H20 Design Vehicle is theoretical and does not really exist. The axle load would be illegal on most public highways.

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1600 Jackson Street, Suite 310, Golden, CO 80401
Ph: 800-233-1510 Fax: 800-233-1522
www.invisiblestructures.com