



Turfstone is a concrete grid pavement product manufactured by Oldcastle under the Belgard brand in accordance with ASTM C 1319. The product is commonly used to create “green” pathways capable of supporting infrequent vehicular traffic. Turfstone is an acceptable solution for emergency access lanes and occasional fire truck loading if properly designed. Aggregate infill may be suitable in some applications. As a general rule, maximum lifetime ESALs should be limited to 7,500 and applications should be restricted to limited vehicular traffic and only occasional truck traffic.

The project engineer should confirm that Turfstone is appropriate for the application and develop a site-specific pavement cross-section. Construction drawings and design calculations for any concrete grid pavement system should be prepared and stamped by a Professional Engineer registered in the state of the project. The following base thickness suggestions are for general guidelines for typical Turfstone applications.

### Minimum Dense-Graded Aggregate Base Thickness Guidelines for Turfstone

Conditions	Subgrade Soil Types	Residential Loading Driveways, walkways, paths, cart paths, trails	Low Volume Commercial Loading Emergency access, lightly used parking stalls
Stable, firm, dry granular soils (CBR > 10)	GP, GW, GC, SW,	<b>8-inch base</b>	<b>8-inch base</b>
Ground ruts with vehicular traffic (5 < CBR < 10)	SP, SC	<b>10-inch base</b>	<b>12-inch base</b>
Ground is soft, moist, and ruts easily (CBR < 5)	ML, CL, CH	<b>12-inch base</b>	<b>16-inch base</b>

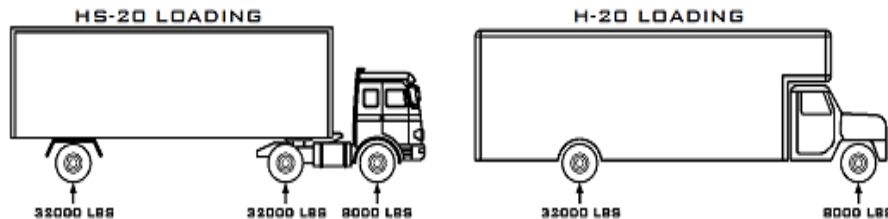
The subgrade soil and base preparation are critical to the performance of any pavement or paver system subjected to vehicular traffic. The subgrade soil and base, in addition to the paver product, must be able to safely transfer the load into the underlying foundation subgrade soil in a stable manner. Turfstone is capable of supporting vehicular loading, but it is up to the design engineer to ensure that an adequate base thickness is specified and verify that suitable subgrade soils are present prior to installation of any pavement product. All pavement design is site-specific and is based on actual soil conditions and anticipated vehicular loading patterns.

The following additional design and installation recommendations are suggested for any Turfstone project:

- Subgrade shall be compacted to 95% of standard Proctor density. Subgrade shall have no free-standing water.
- Base shall be dense-graded aggregate in accordance with local road base criteria and shall be compacted to 98% standard Proctor density. Cement or asphalt treated bases can be used to improve pavement performance. Base material and thickness shall be designed based on site-specific conditions as approved by the project engineer.
- A drainage geotextile chosen in accordance with AASHTO M-288 should be installed to separate the subgrade from the base material and side walls.
- A 1” thick leveling sand bed (with max. 1% passing the 0.080 mm sieve) shall be used to set the Turfstone grid units.
- Infill typically consists of topsoil conforming to ASTM D5268 for most applications. Gravel infill can be used but may not be suitable for all applications. When topsoil and grass are used in the void spaces, irrigation is recommended in most climates to establish and maintain healthy grass cover.
- Slope applications should be limited to 8:1 for vehicular applications.
- An edge restraint for all Turfstone applications is required. Commercial applications should utilize a poured in place concrete curb for containment.

## TRAFFIC LOADING CALCULATION EXAMPLE

The following calculations demonstrate that Turfstone, a permeable lattice grid pavement system used with a turf infill for vegetated applications, satisfies the requirements of meeting or exceeding an H20 or HS20 loading by comparing the theoretical design loads to the compressive strength of Turfstone.



### Step #1) Determine the maximum wheel load:

$W_L = 32,000 \text{ lb} / 2$  (divide by 2 since there are two tires per axle)

$$W_L = 16,000 \text{ lb}$$

### Step #2) Increase the load by 30% to account for dynamic forces associated with moving vehicles:

$W_{L-Dynamic} = W_L \times 1.30$

$$W_{L-Dynamic} = 20,800 \text{ lb}$$

### Step #3) Determine the tire contact area:

FHWA has defined an acceptable default tire contact area as a rectangle with an area of  $0.01W_L$  (in<sup>2</sup>) with a length-to-width ratio of 1:2.5.

$$A_{contact} = 0.01 W_L$$

$$A_{contact} = 0.01 \times (16,000 \text{ lb}) = 160 \text{ in}^2$$

Check dimensions of contact area by confirming that  $A_{contact}$  also = 160 in<sup>2</sup>

$$L = \sqrt{\frac{160}{2.5}} \cdot \text{in} \quad W = (2.5 \times L) \quad L = 8 \text{ in} \quad W = 20 \text{ in}$$

$$A_{contact} = L \times W = 8 \text{ in} \times 20 \text{ in} = 160 \text{ in}^2 \quad \dots \text{ checks.}$$

### Step #4) Determine the stress exerted per tire in the dynamic load:

$$\sigma_{tire} = \frac{W_{L-dynamic}}{A_{contact}} \quad 20,800 \text{ lb} / 160 \text{ in}^2 \quad \sigma_{tire} = 130 \frac{\text{lb}}{\text{in}^2}$$

### Step # 5 ) Compare Turfstone strength to H20 or HS20 loading:

Turfstone is manufactured to ASTM C1319 standards requiring a minimum compressive strength of 5,000 psi, which is well in excess of any H20 or HS20 theoretical loading scenarios. As illustrated above, the maximum theoretical tire pressure exerted is 130 psi, so stresses are effectively transferred to the base and subgrade using Turfstone. This significant factor of safety makes Turfstone a viable solution for a flexible grass pavement system.



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## MATERIAL PRODUCT DATA SHEET

### Product Name

Narrow Modular Paver by Stepstone®

### Manufacturer

Stepstone, Inc.  
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Gardena, CA 90248

Phone 310-327-7474  
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Toll free 1-800-572-9029

### Product Description

Stepstone has produced high quality precast concrete for over 40 years. Narrow Modular Pavers by Stepstone® are precast concrete pavers that come in five standard sizes. Narrow Modular Pavers by Stepstone® are designed to be used for both commercial and residential applications.

### Composition & Materials

Narrow Modular Pavers by Stepstone® are hand-made, wet-cast from 5000 PSI hard rock concrete using Type III cement.

### Sizes

Narrow Modular Pavers by Stepstone® are available in 2-7/8"x 8-7/8"x 4", 2-7/8"x 11-7/8"x 4", 2-7/8"x 17-7/8"x 4", 2-7/8"x 23-7/8"x 4", 5-7/8" x 11-7/8"x 4", 5-7/8" x 17-7/8"x 4, 5-7/8" x 23-7/8"x 4, 2-7/8"x 17-7/8"x 1" (vertical set tile veneer only), and 2-7/8"x 17-7/8"x 2-1/2" (tile: mortar set only).

### Finishes

Narrow Modular Pavers by Stepstone® available finishes include: Custom aggregates, light, medium, or heavy sandblast

### Colors

Narrow Modular Pavers by Stepstone® are available in 12 standard colors: Adobe, Agave, Almond, Brick Red, Cafe Brown, Caramel, French Gray, Granada White, Iceberg Green, Kona, Pebble, and Porcelain; custom colors are available upon request.

### Technical Data

APPLICABLE STANDARDS: American Society for Testing & Materials (ASTM)

ASTM C33 - *Standard Specification for Concrete Aggregates*

ASTM C39 - *Concrete Compressive Strength*

ASTM C150 - *Standard Specification for Portland Cement*

ASTM C642 - *Water Absorption, Density, Voids in Hardened Concrete*

ASTM C666 - *Rapid Freeze/Thaw Resistance of Concrete*

ASTM C979 - *Pigments for Integrally Colored Concrete*

ASTM C1028 - *Coefficient of Friction*

### Physical /Chemical Properties

Narrow Modular Pavers by Stepstone® weight varies by thickness: 4" thickness is 48 PSF; 2½" thickness is 28 PSF; 1" thickness is 12 PSF. Water absorption not more than 6.0 % average, not more than 7.0 % for any individual unit for standard colors. Unit length, width and height are not more than +/-1/8" from standard dimensions. No unit will differ more than +/-1/8" from the approved samples. Test reports are available upon request. Concrete is non-combustible.

*Please contact Stepstone, Inc. for further information*

November 2018