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Bold Ideas Shaping the Earth

October 2013

Kevin Earley, Director of Commercial Sales
Nicolock Paving Stones
3025 Fairhill Drive
Collegeville, PA 19426

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
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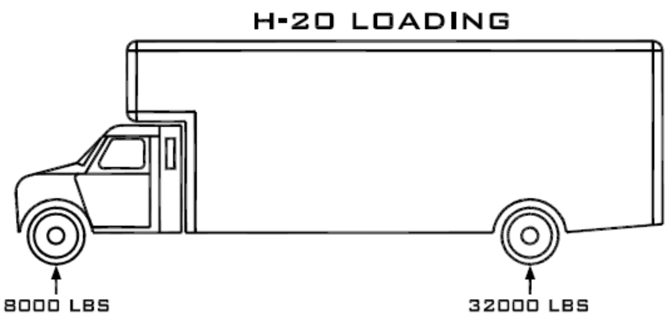
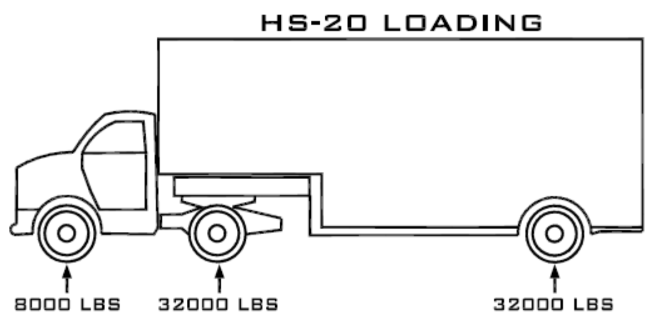
Reference: Nicolock's Eco-Ridge and SF-Rima
Permeable Interlocking Concrete Pavers
Engineering Evaluation
H-20 and HS-20 Traffic Loading

Dear Mr. Earley:

The following calculation demonstrates that the Eco-Ridge and SF-Rima permeable paver system units satisfy the requirements of meeting or exceeding an H-20 or HS-20 loading by comparing the theoretical design loads to the compressive strength on an Eco-Ridge and SF-Rima paver.





<u>Step #1) Determine the maximum wheel load:</u>

W_L = 32,000 lb / 2 (divide by 2 since there are two tires per axle) W_L = 16,000 lb

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

$W_{L\text{-}Dynamic} = W_L \times 1.30$ $W_{L\text{-}Dynamic}$ = 20,800 lb

<u>Step #3) Determine the tire contact area:</u>

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

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

Check dimensions of contact area by confirming that $A_{contact}$ also = 160 in^2

W = (2.5 x L) L= 8 in W = 20 in

$$L = \sqrt{\frac{160}{2.5}} \cdot in$$

$A_{contact}$ = L X W = 8 in x 20 in = 160 in^2 …so the dimensions check.

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

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

Step # 5) Compare paver compressive strength to H-20 or HS-20 loading:

Eco-Ridge & SF Rima are manufactured to ASTM C936standards requiring a minimum compressive strength of 8,000 psi, which is well in excess of any H-20 or HS-20 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 Eco- Ridge & SF-Rima.

The subgrade soil and base preparation are critical to the performance of any permeable interlocking concrete 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. The above calculations demonstrate that Eco- Ridge & SF-Rima are capable of supporting heavy vehicular design loading, but it is up to the design engineer to ensure that an adequate base thickness is specified and that verification of subgrade soil occurs prior to installation of any paver product. All permeable pavement design is site-specific based on actual soil conditions and anticipated vehicular loading patterns and hydrologic objectives

The following notes are considered essential to a successful design and performance of a permeable interlocking concrete pavement:

- The industry standard minimum subbase thickness of 10” is comprised of 4” of AASHTO #57 aggregate and 6” of AASHTO #2 aggregate.
- A 2” thick leveling bed of AASHTO #8 is used to set the Eco-Ridge & SF Rima pavers.
- No free-standing water is observed in the subgrade and the seasonal high water table is at least 2 feet below subgrade elevation.
- Subgrade permeability must meet the minimum design requirements.

If you have any questions about the information contained in this letter, please call me.

Sincerely,

Bart J. Shippee, P.E.
Shippee Engineering, Inc.