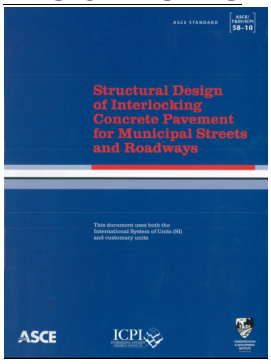
STRUCTURAL DESIGN OF ROADS FOR FIRE TRUCKS
(Last Updated December 23, 2013)

A common question posed by design professionals is the ability of pavers to withstand fire truck loading. This is due to the extremely high axle weights that they exert; in fact, certain states (California for example) have created fire truck exemptions whereby the maximum allowable weight of a fire truck can exceed the Department of Transportation allowable weight restrictions.

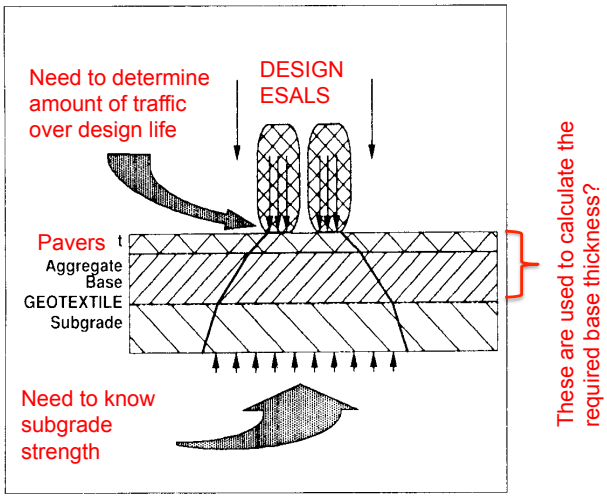
In terms of structural design for roadways, there are three loading conditions that need to be considered for fire trucks, namely:

1. The design ESALs applied to the pavement system.
2. The fire truck wheel and axle loads.
3. Point loads that occur when the stabilizer outriggers are in place.

DESIGN ESALS



Interlocking concrete pavers have been proven to provide a durable and effective pavement system, but, as with any pavement, proper design, construction and maintenance procedures are required. The adjacent document was created by the ASCE/T&DI Structural Design of Interlocking Concrete Pavement Standards Committee to provide guidelines for developing appropriate pavement structures for various traffic and subgrade conditions.

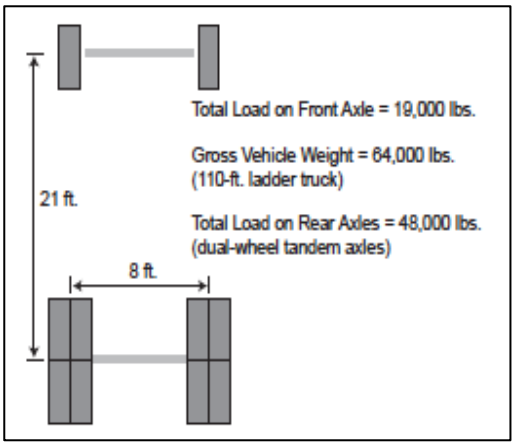


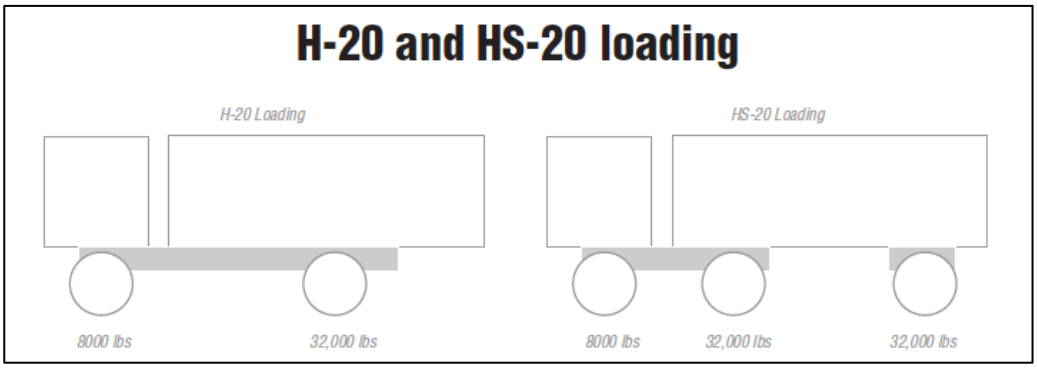
This standard guideline was developed based on the *1993 AASHTO Guide for Design of Pavement Structures*, which calculates the thickness of a road cross section required to withstand the applied loads for the given lifespan based on the native soils bearing capacity. ESALs (Equivalent Single Axle Loads) express the equivalent damage created by each type of vehicle as compared to an 18,000-pound axle load. Passenger cars have a Vehicle Load Factor (VLF) of 0.0004 (it would take 2,500 cars to create the same damage as one ESAL) while full fire trucks range from 0.21 to 6.87.

Although it is evident by the VLFs that fire trucks can exert high ESALs on the pavement surface, it is important to note that roads are designed around hundreds of thousands, if not millions of ESALS, so the impact of the occasional fire truck is actually marginal.

WHEEL & AXLE LOADS

Designers use H-20 or HS-20 from AASHTO (shown below), or specific axle configurations (shown adjacent), to express the extreme load effect created by heavy vehicles such as transports, buses and fire trucks. These in turn are used to calculate the moment (bending) and shear acting on a bridge or other suspended segment as the vehicle passes over it. For example, the lid of a concrete vault would need to be able to support the specified loading to make sure the fire truck did not collapse the lid and fall into the vault itself.





Paver systems include a fully supportive base, and are in no way suspended over an opening into which they can collapse; therefore, the application of H-20 or HS-20 loading is not required.

POINT LOADS

In terms of being able to withstand the surface pressure exerted by the truck tires, the heaviest gross axle weight (GAW) for a fire truck that the author could find was 24,000 pounds on a single steering axle; assuming standard tires are used (even though Super Single tires are required) the maximum weight on each of the wheels is 12,000 pounds (24,000 pounds/2 wheels). Using a conservative contact area on the bottom of the wheel of 8 inches square, then the pressure exerted by each front wheel is 187.5 psi (12,000 pounds/64 square inches). Any concrete paver offered under the Belgard line is made in accordance with ASTM C936, which calls for an average compressive strength of 8.000 psi with no individual unit being less than 7,200 psi. So, simply put, the pavers are on average 40 times stronger in compression than required to withstand the surface pressure that would be exerted under these extreme conditions.

When the stabilizer outriggers are in place, a point load of as much as 45,000 pounds can be applied to the pavement surface. Although significant, when distributed over an “unfactored” stabilizer plate surface area of 0.97 square feet (area of 10x14 inches), this equates to a surface pressure of 322 psi, which again is well within the compressive strength capabilities of paver. As a final thought, should one or more pavers become damaged, these individual units can be removed and replaced without compromising the structural integrity of the system (instruction manual available upon request).