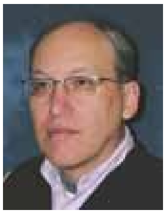
The HL-93 Live Load Model
Dynamic Load Allowance



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Dynamic load allowance is the increment added to the static load to yield force effects assumed equivalent to a dynamic load. Engineers analyze highway bridges by statically placing vehicle or uniform lane loads onto the bridge or its members. To account for the dynamic nature of the moving traffic, the static loads are incremented by an additional percentage in lieu of a true, more complicated dynamic analysis. In the case of the *AASHTO LRFD Bridge Design Specifications*, for the most part the dynamic load allowance for the HL-93 live-load model is specified in Article 3.6.2, as a constant value of 33% for superstructures at the strength or service limit states. In previous AASHTO specifications, the dynamic load allowance was termed "impact," and in the *LRFD Specifications*, dynamic load allowance is abbreviated as IM.

Research conducted during the development of the *LRFD Specifications* suggested that a constant dynamic load allowance of approximately 25% should be applied to vehicular loads. An explanation of the specified value of 33% is in order.

Recall from the previous articles that the HL-93 live load consists of a design truck or design tandem and a design lane load. The dynamic load allowance is only applied to the vehicles of the HL-93 live-load model—the design truck or the design tandem—not the design lane load. Thus, the static axle loads of the design truck or the design tandem are, in effect, multiplied by 1.33 to yield dynamic force effects.

The fact that the design lane load does not get incremented for dynamic effects acknowledges that when a bridge is more fully loaded as in the case of the design lane load, the various vehicle axle loads that the design lane load represents, tend to dampen each other.

From the discussion in the Fall 2009 issue of *ASPIRE*,™ the design lane load is predominate for long-span bridges with the design vehicles becoming more and more insignificant with increasing span length. In this case, the dynamic load allowance has little or no effect.

For medium-span bridges, the design truck is the governing vehicle and it is on this vehicle that the design lane load is superimposed. In this case, the design lane load, as a part of the notional load, amplifies the effects of the 72-kip design truck to super-legal magnitudes, but dynamic load allowance is only applied to the design-truck loads. To account for this, the observed dynamic load allowance of 25% of vehicle loads was increased to the specified value of 33%. This "adjusts" for the fact that the dynamic load allowance is not applied to the design lane load in medium-span bridges yet the design lane load is used to amplify the 72-kip truck to a more realistic truck weight for design. Thus, a dynamic load allowance of 33% works for the HL-93 live-load model since it is a notional load. For actual trucks as opposed to a notional load, a value of 25% is more appropriate for dynamic load allowance.

Finally, short-span bridges are governed by the axle loads of the design tandem with the design lane load applied to loaded lengths so short as to become insignificant with shorter and shorter span lengths. Axle loads are typically more variable or uncertain than complete vehicles. The specified dynamic load allowance of 33% as opposed to the observed value of 25% was deemed appropriate for these span lengths to provide some additional reliability to the more uncertain axle loads.