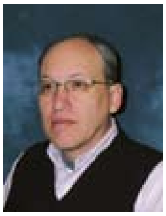
Slab-on-Beam Bridge
Live Load Distribution Factors



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The slab-on-beam bridge live load distribution factors of the AASHTO *LRFD Bridge Design Specifications* were originally developed by Imbsen & Associates Inc., through National Cooperative Highway Research Program (NCHRP) Project 12-26, *Distribution of Wheel Loads on Highway Bridges*. Originally, this project resulted in an AASHTO guide specification (which is now out-of-print) for use with the AASHTO *Standard Specifications for Highway Bridges*. Subsequently, the original developers adapted the distribution factors for inclusion in the *LRFD Specifications*. The major differences between the factors in the guide specifications and those of the *LRFD Specifications* are twofold. Each set of factors reflects the different multiple-presence factors of the two bridge specifications. Second, the *LRFD Specifications* deals with vehicle or lane loads while the *Standard Specifications* deals with wheel loads. By itself, this difference in the treatment of loads would result in a difference of a factor of two.

An examination of the live load distribution factors for slab-on-beam bridges demonstrates the enhanced sophistication of the LRFD distribution factors in comparison with the original factors of the *Standard Specifications*. The multiple-lane, live load distribution factor, g, of the *Standard Specifications* for the interior beam of a slab-on-beam bridge is:

$g = \frac{S}{5.5}$ in terms of wheel loads, or:

$g = \frac{S}{11}$ in terms of vehicle or lane loads of the *LRFD Specifications*,

where S equals the girder spacing.

These factors are used for both moment and shear, and are very simple and easy to apply, yet they have been demonstrated to be conservative in some cases while unconservative in others.

The LRFD multiple-lane distribution factor for moment of an interior girder of a slab-on-beam bridge, from LRFD Table 4.6.2.2.2b-1 is:

$$g = 0.075 + \left(\frac{S}{9.5}\right)^{0.6}\left(\frac{S}{L}\right)^{0.2}\left(\frac{K_g}{12Lt_s^3}\right)^{0.1}$$

in terms of vehicle or lane loads,

where S equals the girder spacing, L equals the span length, K_g represents the longitudinal stiffness, and t_s equals the slab thickness.

A different distribution factor equation is used for shear.

Obviously, the LRFD distribution-factor equation is more complicated, yet each term of the equation reflects more accuracy in determining live load distribution. The first term of the product, $(S/9.5)^{0.6}$ represents the traditional distribution factor illustrating the strong dependency on girder spacing. The next term of the product, $(S/L)^{0.2}$ reflects the aspect ratio of the girder spacing divided by length of the bridge. The wider the spacing relative to the bridge length, the less distribution of load or the higher the distribution factor. The final term of the product represents the longitudinal stiffness of the bridge divided by its transverse stiffness. The stiffer the bridge is in the longitudinal direction relative to its stiffness in the transverse direction, again the less distribution of load or the higher the distribution factor. Clearly, the more complex live load distribution equations provide opportunities to capture load-distribution effects beyond those of the traditional simple equations.

The presentation of live load distribution factors in LRFD Article 4.6.2.2 is based upon several tables. Table 4.6.2.2.1-1 summarizes the various bridge and girder types for which live load distribution is defined in the specifications. Subsequent tables are keyed to the types included in this table. Tables 4.6.2.2.2b-1 and 4.6.2.2.2d-1 specify live load distribution factors for moment of interior and exterior girders, respectively. Reduction factors based upon skew angle are given for distribution factors for moment in Table 4.6.2.2.2e-1. Tables 4.6.2.2.3a-1 and 4.6.2.2.3b-1 specify live load distribution factors for shear of interior and exterior girders, respectively. Finally, correction factors for load distribution factors for support shear of the obtuse corner are given in Table 4.6.2.2.3c-1.