Background to the Specifications

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Bridge designs initiated from October 2007 onwards must be in accord with the *AASHTO LRFD Bridge Design Specifications* to qualify for federal matching funds. This is based on an agreement between American Association of State Highway and Transportation Officials (AASHTO) and the Federal Highway Administration (FHWA). The LRFD Specifications was adopted in 1994 by AASHTO as a co-equal alternative to the *Standard Specifications for Highway Bridges.* The 17th and final edition of the *Standard Specifications* was published in 2002.

Since the 1920s, the AASHTO bridge specifications have been developed through the AASHTO Subcommittee on Bridges and Structures (SCOBS). This subcommittee consists of bridge engineers of the various states and other territories and agencies. The subcommittee updates and revises the specifications yearly at their annual meeting based on recommendations from their subcommittees. These meetings result in yearly interim changes to the specifications. These interim changes are published the following year as replacement pages for the loose-leaf bound specifications. Periodically, new editions of the specifications are printed incorporating all of the interim changes since the previous edition. Since the 1920s, 17 editions of the *Standard Specifications* have been issued. For a short time, 1994 through 1999, SCOBS issued yearly interim changes to both the *Standard Specifications* and the *LRFD Specifications*. Since 2000, SCOBS is only maintaining the *LRFD Specifications* through interim changes. The current *LRFD Specifications* is the third edition with Interim editions issued in 2005 and 2006.

In the mid-1980s, SCOBS determined that the *Standard Specifications* was falling behind the times due to advances in the state of practice with which their technical committees, based on volunteer participation from the various departments of transportation (DOT), could not keep pace. Through the National Academies' National Cooperative Highway Research Program, AASHTO initiated project No. 12-33, which resulted in the first edition of the *LRFD Specifications*. A team of over 50 experts including practicing consulting engineers, academics, and DOT personnel, led by the bridge design firm of Modjeski and Masters, Inc., wrote the first draft of the specifications.

The team was charged with developing design specifications that are technically state-of-the-art and easy to apply. At times, these goals were in conflict. The specifications were to include a parallel commentary but not read like a textbook. Finally, and perhaps more importantly, the specifications were to be based on a new probabilistically based design methodology, termed load and resistance factor design (LRFD).

The LRFD methodology appears very similar to the load factor design (LFD) of the *Standard Specifications*, as suggested by the LRFD equation below:

$$\Sigma(\gamma Q) \leq \phi R$$

Where,

γ = load factors

Q = loads

ϕ = resistance factors

R = resistance

Whereas the load and resistance factors of the LFD provisions of the *Standard Specifications* acknowledge uncertainty (for example, with greater load factors associated with loads of greater uncertainty), the factors were chosen rather qualitatively. The load and resistance factors of the *LRFD Specifications* were determined quantitatively using the theory of structural reliability.

The *LRFD Specifications* are not intended to yield bridges with necessarily greater or lesser reliability, but with bridges having a more uniform reliability index. The reliability index is the measure of reliability or safety associated with a probability of failure. The reliability indices represented by the bridges designed by the *Standard Specifications* range from about 1.5 to 4.7. This represents a huge range of probability of failure ranging from 7 in 100 to 3 in 1,000,000. The bridges of the *LRFD Specifications* are more uniformly reliable with a limited range of about 3.3 to 3.8, centered about the target reliability index of 3.5. The probability of failure associated with a reliability index of 3.5 is about 2 in 10,000. Thus, the *LRFD Specifications* yields bridges of much more uniform reliability.

Future columns will highlight the various additions and revisions to the *LRFD Specifications* adopted by AASHTO in 2006 and to be published in 2007.