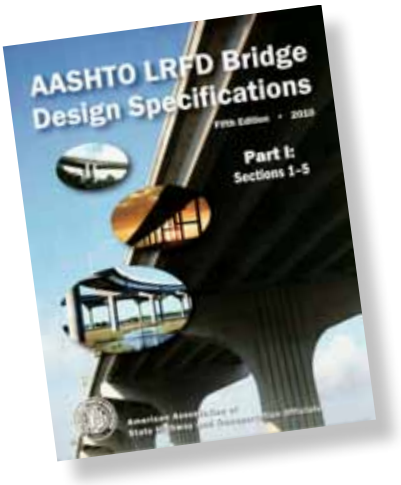
A Question of Application and Interpretation

by Dr. Dennis R. Mertz



The question in the Reader Response on page 6 about the best methodology to calculate the effects of superstructure creep (CR) and shrinkage (SH) on substructure design of a multi-span, continuous concrete bridge structure, raises broader issues regarding the nature of design standards.

The *AASHTO LRFD Bridge Design Specifications* represents minimum requirements and in some cases, such as live-load distribution, acceptable simplifications. At times, the *LRFD Specifications* asks the designer to consider various effects but is not explicit about how. For example, LRFD Article 3.4.1, cited by the reader, states,

"All relevant subsets of the load combinations shall be investigated. For each load combination, every load that is indicated to be taken into account and that is germane to the component being designed, including all significant effects due to distortion, shall be multiplied by the appropriate load factor . . . "

My interpretation of this specification passage, and its intent, is to allow the designer to apply expertise to eliminate effects that are deemed insignificant. As the reader correctly indicates, creep and shrinkage are included in each of the strength and service limit-state load combinations of LRFD Article 3.4.1. A quick look at any of the published design examples developed by various reputable sources, including the newly revised *PCI Bridge Design Manual*, reveals that many of the loads indicated in LRFD Table 3.4.1-1, are not explicitly included in the calculations. The bridge engineers who developed these examples used their expertise and experience to selectively eliminate insignificant effects based upon the type and geometry of the bridge components under investigation.

Similarly, the *LRFD Specifications* does not necessarily tell the designer how to calculate all force effects, especially those principally dependent upon the bridge type and configuration, such as those due to superimposed deformations including creep and shrinkage. This calculation is best left to the judgment of the engineer, who may need to use a global structure response model or a time-step analysis depending on the complexity of the structural system.

In my mind, the specifications are becoming too prescriptive, and thus potentially limiting to experienced designers. The *LRFD Specifications* does not tell how to determine creep and shrinkage effects in complex structures. The bridge designer should have a more intimate knowledge of the behavior of the specific bridge, more than any specification writer can possibly anticipate. I believe it is up to a designer to apply the art and science of bridge design satisfying the minimum requirements represented by the *LRFD Specifications*, but not driven by these specifications. Unfortunately, the *LRFD Specifications* is becoming too much like a cookbook for bridge design and is being used as such. The panel of state bridge engineers who oversaw the development of the first edition of the *LRFD Specifications* dictated that the essence of the specifications should not be that of a textbook but that users of the specifications must bring knowledge of highway bridge design to the specifications. Unfortunately, we seem to be losing this essence.

EDITOR'S NOTE

The topic of pier design for bridges with integral connections between the superstructure and substructure is addressed in the PCI State-of-the-Art of Precast/Prestressed Integral Bridges*, PCI publication No. IB-01-02.*