2016 Interim Changes Related to Concrete Structures, Part 1

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At their 2015 annual meeting, hosted by the New York State Department of Transportation (NYSDOT) in Saratoga Springs, N.Y., in April, the American Association of State Highway and Transportation Officials (AASHTO) Subcommittee on Bridges and Structures (SCOBS) considered and adopted seven agenda items specifically related to concrete structures. Technical Committee T-10, Concrete Design, developed agenda items 4 through 9 and moved them to the subcommittee ballot for consideration in Saratoga Springs. In conjunction with Technical Committee T-5, Loads and Load Distribution, Technical Committee T-10 also developed agenda items 2 and 4 over the past several years and moved them to the subcommittee ballot. The agenda items represent revisions and additions to the 7th edition of the *AASHTO LRFD Bridge Design Specifications*. This column reviews the 2015 concrete-structures agenda items, which are the 2016 Interim Revisions, that have been published and are now available from AASHTO.

Agenda Item 2

Agenda item 2 represents a major revision to the wind-load provisions. It begins by making revisions to the descriptions of the limit-state load combination dealing with wind, and the load factors for wind load, based upon new wind-load provisions applying a 3-sec. wind gust speed with 7% probability of exceedance in 50 years (mean return period of 700 years). Wind load provisions in previous editions of the AASHTO LRFD specifications are based upon fastest-mile wind speed measurements.

The previous provisions allowed the use of a 100-mph fastest mile base wind speed. This wind speed was used for the Strength III limit-state load combination. The Strength V, Service I, and Service IV limit-state load combinations were based upon constant wind speeds. Instead of calculating the wind pressure for the specified constant wind speeds, the 100-mph wind speed is used and the Strength V, Service I, and Service IV limit-state load factors for wind loads on the structure are adjusted to scale the resulting factored wind load to the implied load factor and constant wind speed specified for each load combination.

In the revised provisions, the load factor for wind is 1.0 for all load combinations applied to the wind pressure calculated for the wind speed specified for each limit-state load combination. In addition, Article 3.8 titled "Wind Load: WL and WS" is replaced in its entirety by a new article defining the new wind-load provisions. These provisions provide consistent reliability across different regions and locations unlike those that they replace. Although many typical bridges will not see a change in design due to wind, those structures that fall between the typical range and those needing site-specific considerations will be more reliable through the application of the more robust wind provisions.

Finally, Article 5.14.2 is revised to make all of the load factors for wind during construction of segmentally constructed concrete bridges in Table 5.14.2.3.3-1 equal to 1.0 (to be consistent with the previous discussion). The revision further leaves the specification of the wind speed for the various service limit-state load combinations to the owner, with the only exception being a specification for the minimum wind speed of 70 mph for erection-stability analysis of cantilever construction in lieu of a better estimate by analysis or meteorological records.

Agenda Item 4

Load factors for the Service III limit-state load combination—the check of tensile stress in prestressed components—are addressed in agenda item 4. The calibration of the service limit states for concrete components[1] concluded that typical components designed using the refined estimate of time-dependent losses method, which was incorporated in the specifications in 2005 and includes the use of transformed sections and elastic gains, have a lower reliability index against flexural cracking in prestressed components. This is true when compared against components designed using the prestress loss calculation method specified prior to 2005 based on gross sections and not including elastic gains. For components designed using the currently specified methods for instantaneous prestressing losses and the currently-specified refined estimates of time-dependent losses method, an increase in the load factor for live load from 0.8 to 1.0 is required to maintain the level of reliability against cracking of prestressed concrete components inherent in the system. Agenda item 4 inserts a table into Article 3.4.1 specifying a live-load load factor of 1.0 for prestressed concrete components designed using the refined estimates of time-dependent losses as specified in Article 5.9.5.4 in conjunction with taking advantage of the elastic gain and 0.8 for all other prestressed concrete components. The corresponding appropriate revisions to the *Manual for Bridge Evaluation* were also included in this agenda item.

Agenda Item 5

Agenda item 5 integrates lightweight concrete (LWC) into the entirety of Section 5 in a more consistent and accurate manner based upon the work of Greene and Graybeal[2-4] who presented these changes in greater detail in an article in the Summer 2015 issue of *ASPIRE.*™ A revised definition of LWC is provided to include concrete with lightweight aggregates up to a unit weight of 0.135 kip/ft^3, which is considered the lower limit for normal-weight concrete. Also the terms "sand-lightweight concrete" and "all-lightweight concrete" are removed in the proposed definition to allow other types of LWC mixtures. The concrete density modification factor, which has been in earlier editions of the specifications, is now defined as λ and is introduced to modify various traditional resistance equations, stress limits, and development lengths. Finally, the shear strength reduction factor, ϕ, for LWC has been set equal to the factor for normal-weight concrete.

The remaining concrete agenda items from the 2015 SCOBS meeting, agenda items 6 through 9, will be discussed in a future column.

References

1. Wassef, W. G., et al. 2014. *Calibration of LRFD Concrete Bridge Design Specifications for Serviceability*, NCHRP Web-only Document 201, Transportation Research Board, National Research Council, Washington, DC.
2. Greene, G. G., and B. A. Graybeal. 2013. *Lightweight Concrete: Mechanical Properties*, Report No. FHWA-HRT-13-062, Federal Highway Administration, Washington, DC.
3. Greene, G. G., and B. A. Graybeal. 2014. *Lightweight Concrete: Development of Mild Steel in Tension*, Report No. FHWA-HRT-14-029, Federal Highway Administration, Washington, DC.
4. Greene, G. G., and B. A. Graybeal. 2015. *Lightweight Concrete: Reinforced Concrete and Prestressed Concrete in Shear*, Report No. FHWA-HRT-14-15-022, Federal Highway Administration, Washington, DC.