Recently Approved Changes to the Ninth Edition *AASHTO LRFD Bridge Design Specifications*

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The 2023 meeting of the American Association of State Highway and Transportation Officials (AASHTO) Committee on Bridges and Structures took place May 22–25 in Kansas City, Mo. During that meeting, seven working agenda items that impact Section 5, Concrete Structures, and Section 10, Foundations, of the *AASHTO LRFD Bridge Design Specifications*[1] were prepared by AASHTO Technical Committee T-10 and were approved by the Committee on Bridges and Structures (COBS). These agenda items were developed within the last year and follow the working agenda items that were approved in previous years for the forthcoming 10th edition of the AASHTO LRFD specifications.[2] They are T-10's last batch of changes for this edition, which is expected to be published in early 2024. This article summarizes the seven recently approved working agenda items. These items will be discussed in detail in upcoming issues of *ASPIRE*®.

High-Strength Steel in Concrete Bridges (Working Agenda Item 168, COBS Agenda Item 31)

The 2012 interim revisions to the AASHTO LRFD specifications permitted the use of high-strength reinforcing bars with a minimum yield strength of 100 ksi in nonseismic regions. High-strength reinforcing bars could be used for structures in nonseismic zones and, with some limitations, in moderate- to high-seismic zones. Article 20.2.1.3 in the American Concrete Institute's *Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19)*[3] specifies additional requirements for ASTM A615[4] Grades 40, 60, 80, and 100 reinforcing bar and ASTM A706[5] Grades 60, 80, and 100 reinforcing bar. The requirements include the ratio of actual tensile strength to actual yield strength and elongations for use in designing reinforced concrete components. Some states have been using high-strength reinforcing bars, especially ASTM A706 Grade 80, in structural components, including capacity-protected components such as drilled shafts and cap beams. A large amount of material test data for ASTM A615 Grade 80 and Grade 100 and ASTM A1035[6] Grade 100 reinforcing bars has become available during the last decade. These data show that steel rolling mills have been manufacturing high-strength bars that meet the requirements of the material specifications.

This update allows the use of high-strength steel in a broader range of concrete bridge applications, which can result in cost savings while improving constructability. More specifically, the use of higher-strength steel could reduce component cross sections and reinforcement quantities, leading to savings in materials, shipping, and labor. Reducing reinforcement quantities will also reduce congestion problems, leading to better-quality concrete construction.

Reinforcement Detailing and Bar Cutoffs (Working Agenda Item 208, COBS Agenda Item 32)

Reinforcement termination and continuation requirements of the AASHTO LRFD specifications are summarized for better clarity through two new figures that will be added to the commentary for Article 5.10.8.1.2. One figure summarizes general flexural reinforcement termination requirements; the other summarizes negative-moment reinforcement termination requirements.

Clarifications for the Design of Segmental Concrete Bridges (Working Agenda Item 218, COBS Agenda Item 27)

Article 5.12.5, Segmental Concrete Bridges, is taken in large part from the AASHTO *Guide Specifications for Design and Construction of Segmental Concrete Bridges*.[7] These guide specifications, which were first published in 1989 and last revised in 2002, are out of date and have been archived. Many of the provisions in Article 5.12.5 are also out of date and need to be revised to achieve consistency with the current AASHTO LRFD specifications. In addition, this agenda item includes revisions to several articles not in Article 5.12.5 that are related to the design of segmental bridges. This update will make the design provisions for segmental concrete bridges more consistent with the remainder of Section 5.

The Design of Decks with Partial-Depth Precast Concrete Panels in Negative-Moment Regions (Working Agenda Item 226, COBS Agenda Item 28)

The AASHTO LRFD specifications do not clearly define the design and reinforcement for negative-moment regions of decks when stay-in-place precast concrete panels are used. This working agenda item is intended to provide guidance on deck reinforcement for continuous concrete girder applications such as spliced-girder bridges. For continuous steel girders, Article 6.10.1.7 of the specifications includes a limit for the deck reinforcement over which 1% reinforcement in two mats (two-thirds in the top and one-third in the bottom) is to be used. From the commentary, the reinforcement placement recommendation can be waived at the discretion of the engineer when precast concrete panels are used.

The current lack of specific guidance often leads to engineers making conservative and costly decisions on how to reinforce the deck in negative-moment regions. This agenda item

offers the clarification that for decks with partial-depth precast concrete panels, the 1% reinforcement need only be calculated for the cast-in-place portion of the deck and placed in that portion. The proposed changes implement the recommendations of Ge et al.[8]

Clarifications for Post-Tensioned Concrete Bridges (Working Agenda Item 228, COBS Agenda Item 26)

The current requirements for post-tensioning systems and installation vary across the United States. As noted in National Cooperative Highway Research Program (NCHRP) Synthesis Report 562, *Repair and Maintenance of Post-Tensioned Concrete Bridges*,[9] results from a survey of bridge owners indicated that owners are referencing several specifications for post-tensioning, including the *AASHTO LRFD Bridge Construction Specifications*; PTI/ASBI M50.3, *Guide Specification for Multistrand and Grouted Post-Tensioning*; and PTI M55.1, *Specification for Grouting of Post-Tensioning Structures*.[10–12] The NCHRP report also noted that several states emulate the practices and specifications of other states. The report concluded that nonuniformity in post-tensionng specifications from state to state "is significant."

The goal of this agenda item is to establish consistent requirements for post-tensioning while making appropriate allowances for different protection levels (PLs) of post-tensioning systems. Variances in requirements—such as variances based on the aggressivity of the environment (that is, specifying a PL) or variances for regional requirements—are necessary and should be considered and included. Some variations, however, may represent relatively minor technical differences that can lead to issues related to misunderstandings or misinterpretations. The standardization of specifications in the post-tensioning industry has benefits; for example, it faciliates more widespread and effective training, as well as consistent inspection of post-tensioning systems and their proper installations. This two-part working agenda item references PTI/ASBI M50.3-19 and PTI M55.1-19. It also introduces changes to Sections 5 and 10 of the AASHTO LRFD specifications to align those sections with PTI/ASBI M50.3-19 and PTI M55.1-19, where differences exist, and to incorporate the PL concept on a national level.

Resources for Concrete Bridge Design and Construction (Working Agenda Item 229, COBS Agenda Item 30)

Resources for Concrete Bridge Design and Construction[13] is the first product developed under the collaboration agreement between AASHTO and the National Concrete Bridge Council (NCBC). This forthcoming document catalogs important resources for the design and construction of concrete bridges from AASHTO, the Federal Highway Administration (FHWA), NCBC member organizations, and selected other sources.

AASHTO LRFD Guide Specifications for Structural Design with Ultra-High-Performance Concrete (UHPC) (COBS Agenda Item 29)

AASHTO's forthcoming *Guide Specifications for Structural Design with Ultra-High-Performance Concrete*[14] is based on extensive research conducted by the FHWA, as well as research sponsored by PCI. T-10 developed the guide specifications through a year-long process of evaluation and revision, and it represents the best-known design guidance for nonprestressed and prestressed applications of UHPC. It is anticipated that material specifications compatible with the design provisions in the guide specifications will be ready for ballot in 2024.

References

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8. Ge, X., K. Munsterman, X. Deng, M. Reichenbach, S. Park, T. Helwig, M. Engelhardt, E. Williamson, and O. Bayrak. 2021. *Designing for Deck Stress Over Precast Panels in Negative Moment Regions*. FHWA/TX-19/0-6909-1/5-6909-01-1. Austin, TX: Center for Transportation Research, University of Texas at Austin. https://library.ctr.utexas.edu/ctr-publications/5-6909-01-1.pdf.
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13. AASHTO. Forthcoming. *Resources for Concrete Bridge Design and Construction*. Washington, DC: AASHTO.
14. AASHTO. Forthcoming. *Guide Specifications for Structural Design with Ultra-High-Performance Concrete*. Washington, DC: AASHTO.