2016 Interim Changes Related to Concrete Structures, Part 2

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The discussion of the agenda items that the American Association of State Highway and Transportation Officials (AASHTO) Subcommittee on Bridges and Structures (SCOBS) adopted at their 2015 annual meeting begun in the last issue continues in this column. 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 became the 2016 Interim Revisions, that have been published and are now available from AASHTO. The remaining agenda items related to concrete structures, agenda items 6 through 9, follow.

Agenda Item 6

The 2013 interim revisions extended the minimum yield strength of reinforcement for use in selected design articles to 100 ksi. This included its use in reinforced-concrete bridge decks. However, the use of a yield strength of 100 ksi in connection with Equation 5.7.3.4-1, the crack-control equation that limits bar spacing, results in unrealistically close bar spacing in bridge decks. Agenda item 6 adds that bar spacing need not be less than 5 in. for control of flexural cracking where higher strength reinforcement is used. In addition, it restores commentary removed with the 2005 Interim Revisions that suggests, for calculation purposes, a value of d_c not greater than 2.0 in. plus the bar radius may be used.

Agenda Item 7

Agenda item 7 increases the compressive stress limit at transfer in Article 5.9.4.1.1 to $0.65 f'_{ci}$ for pretensioned and post-tensioned concrete components, including segmentally constructed bridges. While previous research[1] suggests that the concrete compressive stress limit at transfer for prestressed concrete components can safely exceed $0.65 f'_{ci}$, concrete in the precompressed tensile zone subjected to compressive stresses at transfer greater than $0.65 f'_{ci}$ can experience microcracking, leading to unconservative predictions of the external load required to cause cracking.[2-5]

Agenda Item 8

Agenda item 8 represents a complete rewrite of the strut-and-tie method (STM) of Article 5.6.3. In addition, concrete members are delineated as being composed of beam regions (B-Regions) and disturbed regions (D-Regions) with specifications for the design of each. The proposed provisions take advantage of an extensive research effort sponsored by the Texas Department of Transportation at the University of Texas-Austin,[6,7] which involved a thorough examination of previous tests, primarily of deep beams; additional large-scale, deep-beam tests at University of Texas-Austin; and a comparison of current AASHTO provisions and those which have been used in Europe for many years. The most significant changes in the proposed provisions are

- elimination of distributed reinforcement if an associated efficiency factor is used,
- use of simple concrete efficiency factors similar to those in the *fib* (International Federation for Structural Concrete) *Model Code for Concrete Structures*,
- use of the existing AASHTO confinement factor to increase the usable concrete strength where there is clear distance on all sides of a bearing plate or load plate,
- provision of expanded design rules to size the nodes in the STM,
- use of a single panel truss model for shear span-to-depth ratios less than 2.0,
- elimination of principal tensile strain as a criterion for nodal capacity, and
- elimination of a separate strut capacity check away from the nodes.

Agenda Item 9

The revisions to Chapter 5 of the *AASHTO LRFD Bridge Design Specifications* in Agenda item 5, discussed in the last issue, include the term "equilibrium density" as determined by ASTM C567 in the definition of lightweight concrete. Agenda item 9 adds the term "equilibrium density" to Article 8.2.3 of the *AASHTO LRFD Bridge Construction Specifications* for consistency.

References

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3. Birrcher, D. B., O. Bayrak, and M. E. Kreger. 2010. "Effects of Increasing Allowable Compressive Stress at Prestress Transfer." *ACI Structural Journal*. American Concrete Institute, Farmington Hills, Mich., Vol. 107, No. 1, January-February.
4. Heckmann, C. and O. Bayrak. 2008. *Effects of Increasing the Allowable Compressive Stress at Release on the Shear Strength of Prestressed Concrete Girders*. Technical Report 0-5197-3, Center for Transportation Research, Bureau of Engineering Research, University of Texas at Austin.
5. Schnittker, B. and O. Bayrak. 2008. *Allowable Compressive Stress at Prestress Transfer*. Technical Report 0-5197-4, Center for Transportation Research, Bureau of Engineering Research, University of Texas at Austin.
6. Birrcher, D. B., R. G. Tuchscherer, M. R. Huizinga, et al. 2009. *Strength and Serviceability Design of Reinforced Concrete Deep Beams*. Technical Report 0-5253-1, Center for Transportation Research, Bureau of Engineering Research, University of Texas at Austin.
7. Larson, N., E. F. Gómez, D. Garber, et al. 2013. *Strength and Serviceability Design of Reinforced Concrete Inverted-T Beams*. Technical Report 0-6416-1, Center for Transportation Research, Bureau of Engineering Research, University of Texas at Austin.