Upcoming Changes to the AASHTO LRFD Bridge Design Specifications

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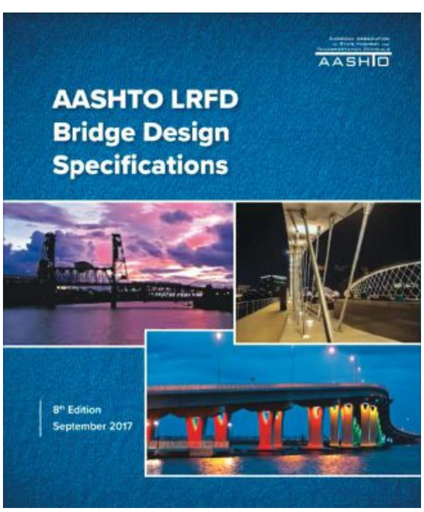
The 2019 meeting of the American Association of State Highway and Transportation Officials (AASHTO) Committee on Bridges and Structures took place in Montgomery, Ala., during the last week in June. In that meeting, three working agenda items prepared by AASHTO Technical Committee T-10 Concrete Design were approved. This article covers the three changes, which will appear in the 9th edition of the *AASHTO LRFD Bridge Design Specifications*, which is scheduled to be published in 2020.



Strand Debonding Rules

The first change relates to strand debonding rules. Strand debonding is a technique used for reducing stresses in the end regions of pretensioned concrete beams. The *AASHTO LRFD Bridge Design Specifications* 8th edition[1] limits the amount of debonding to 25% of the total number of strands within a pretensioned girder. This limit was imposed in recognition of the potential detrimental effects that excessive debonding could have on shear performance.

The Transportation Research Board's National Cooperative Highway Research Program (NCHRP) Project 12-91, *Strand Debonding for Pretensioned Girders*,[2] was initiated to develop recommended revisions to the current debonding provisions. The study considered both service and strength limit states and various beam cross sections. The proposed revisions to the AASHTO LRFD design specifications include outcomes of the NCHRP research, additional research by others,[3–5] and past practice.

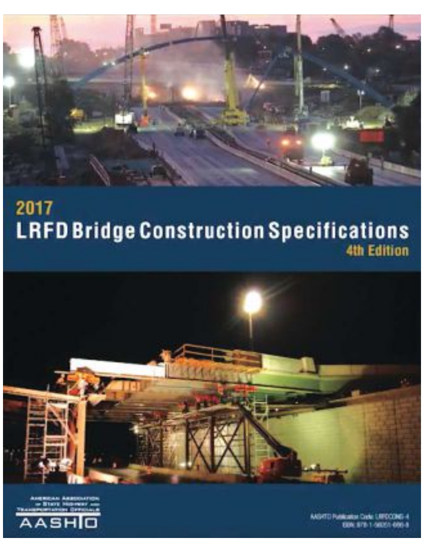
According to the adopted revisions to Article 5.9.4.3.3, straight pretensioned strands may be debonded at the ends of beams with the following restrictions:

- The number of strands debonded per row shall not exceed 45% of the strands in that row, unless otherwise approved by the owner.
- Debonding shall not be terminated for more than six strands at any given section. When a total of 10 or fewer strands are debonded, debonding shall not be terminated for more than four strands at any given section.
- Longitudinal spacing of debonding termination locations shall be at least $60d_b$, where d_b is the diameter of the strand.
- Debonded strands shall be symmetrically distributed about the vertical centerline of the cross section of the member. Debonding shall be terminated symmetrically at the same longitudinal location.
- Alternate bonded and debonded strand locations both horizontally and vertically.
- Where pretensioning strands are debonded and where service tension exists in the precompressed tensile zone, the development lengths, measured from the end of the debonded zone, shall be determined using Eq. 5.9.4.3.2-1 with a value of $\kappa = 2.0$.
- For simple-span precast, pretensioned concrete girders, debonding length from the beam end shall be limited to 20% of the span length or one-half the span length minus the development length, whichever is less.
- For simple-span precast concrete girders made continuous using positive-moment connections, the interaction between debonding and restraint moments from time-dependent effects (such as creep, shrinkage, and temperature variations) shall be considered.
- For single-web flanged sections (I-beams, bulb tees, and inverted tees):
  - Bond all strands within the horizontal limits of the web when the total number of debonded strands exceeds 25%.
  - Bond all strands within the horizontal limits of the web when the bottom-flange-to-web width ratio exceeds 4.
  - Bond the outermost strands in all rows located within the full-width section of the flange.
  - Position debonded strands farthest from the vertical centerline.
- For multiweb sections having bottom flanges (voided slabs, box beams, and U-beams):
  - Uniformly distribute debonded strands between webs.
  - Strands shall be bonded within 1.0 times the web width projection.
  - Bond the outermost strands within the section.
- For all other sections:
  - Debond shall be distributed uniformly across the width of the section.

- Bond the outermost strands located within the section, stem, or web.

Post-Tensioning Anchorage Hardware Requirements

The second change establishes consistency between the AASHTO LRFD design specifications and *AASHTO LRFD Bridge Construction Specifications*[6] with respect to the testing of and acceptance requirements for post-tensioning anchorage hardware. In the 8th edition of the AASHTO LRFD design specifications,[1] Article 5.4.5—Post-Tensioning Anchorages and Couplers requires anchorages to conform to the *AASHTO LRFD Bridge Construction Specifications*.[6] Prior to the 8th edition of the AASHTO LRFD design specifications, Commentary C5.4.5 required anchorages and couplers to develop 95% of the specified ultimate strength of the tendons; this requirement was contradictory to the *AASHTO LRFD Bridge Construction Specifications*, which led to confusion. The 8th edition of the AASHTO LRFD design specifications removed specific requirements and simply made reference to the *AASHTO LRFD Bridge Construction Specifications*[6] for anchorage requirements, which helped clear up confusion.



The newly approved change makes it clear that the requirements are based upon the *actual* ultimate tensile strength, not the specified tensile strength. The new provisions use the static strand-wedge testing requirements that are specified to be in accordance with PTI M50.1 *Acceptance Standards for Post-Tensioning Systems*[7] and will help standardize the testing requirements.

By specifying 95% of the actual ultimate tensile strength as the acceptance target, the updated requirements now align with the original research contained in NCHRP Report 356.[8] In addition, most of Article 10.3.2.1 of the *AASHTO LRFD Bridge Construction Specifications*[6] concerning the location of bonded tendon anchors is repeated in Article 5.9.5.6.1 of AASHTO LRFD design specifications,[1] which concerns the design of post-tensioning anchorage zones. This is because decisions on where to locate anchorages are usually made during the design phase of a bridge project. Finally, a sentence in Article 10.3.2.2 of the *AASHTO LRFD Bridge Construction Specifications*[6] was moved to Article 10.3.2.1 to improve clarity.

Detailing Ties in Reinforced Concrete Columns

The third change relates to the detailing of ties in reinforced concrete columns. According to the new rules, for columns that are not designed for plastic hinging, the spacing of laterally restrained longitudinal bars or bundles is not to exceed 24.0 in. measured along the perimeter tie. In this context, a restrained bar or bundle is one that has lateral support provided by the corner of a tie having an included angle equal to or less than 135 degrees. The change to reduce the spacing from 48.0 in. to 24.0 in. for laterally restrained longitudinal bars or bundles returns the language to the original intent of the 1980 Interim Revisions to the *AASHTO Standard Specifications for Highway Bridges*.[9] It is important to note that the 1980 interim revision references research by Pfister,[10] and the reduction in spacing is consistent with that research.

Conclusion

The three changes discussed in this article will improve the next edition of the AASHTO LRFD desgin specifications. In future articles, I will discuss in greater depth the technical background and implications of these changes based on feedback from the industry and our readers.

References

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