Approved Changes to the Ninth Edition *AASHTO LRFD Bridge Design Specifications* and New Concrete Bridge Resources

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This article focuses on changes to the ninth edition of the American Association of State Highway and Transportation Officials' *AASHTO LRFD Bridge Design Specifications*[1] regarding decks with partial-depth precast concrete panels and post-tensioned bridges that were approved at the May 2023 meeting of the AASHTO Committee on Bridges and Structures (COBS). These changes were prepared by the AASHTO Concrete Committee (previously, AASHTO Technical Committee T-10). The changes will be included in the forthcoming 10th edition of the AASHTO LRFD specifications.[2] In addition to the specification changes, this article discusses new resources for concrete bridges that have been approved by AASHTO COBS and are being developed.

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

The use of partial-depth precast concrete panels continues to gain popularity. Accelerated deck construction, reduced labor costs, and improved construction quality and deck performance are commonly cited reasons for this trend. A recent Federal Highway Administration (FHWA) publication identifies this technology as an underused, potentially promising technology.[3] (For details of the FHWA report, see the FHWA article in the Winter 2024 issue of *ASPIRE®*.) Over the years, the use of partial-depth precast concrete panels has extended from concrete bridges to superstructures that use steel girders, curved bridge applications, and, recently, spliced-girder bridges. The use of precast concrete panels over the interior bent (negative moment region) creates unique engineering challenges. One of those challenges relates to the design of reinforcement in the negative moment regions within the decks. For continuous steel girders, Article 6.10.1.7 of the AASHTO LRFD specifications requires that the total cross-sectional area of the longitudinal deck reinforcement be at least 1% of the cross-sectional area of the concrete deck and that it be placed in two mats with two-thirds in the top and one-third in the bottom. The commentary indicates that when precast concrete panels are used as deck forms, the reinforcement placement recommendation can be waived at the discretion of the engineer.

A conservative interpretation of AASHTO LRFD specifications may result in the calculation of the top mat reinforcement on the basis of the full deck thickness (typically 8 to 10 in.) and placement of this reinforcement in the cast-in-place (CIP) portion of the deck (**Fig. 1**). This approach is overly conservative and results in impractical quantities of reinforcement. If we acknowledge that the lower portion of the deck already has well-defined joints at the panel boundaries, we can better appreciate the intent of the reinforcement placed within the CIP concrete. That intent is to control the widths of the cracks, should they form within the CIP portion. This working agenda item offers clarification that for decks with partial-depth precast concrete panels, regardless of whether the panels are supported by steel or concrete girders, the 1% reinforcement requirement should be calculated for the CIP portion of the deck and placed in that portion. The proposed changes implement the recommendations of Ge et al.[4]

It is important to recognize that in concrete spliced-girder construction, the negative moment reinforcement is provided in the form of post-tensioned tendons, and typical structural designs do not rely on the deck reinforcement as a negative moment reinforcement. It is also important to recognize that some owners, in an effort to better control the width and distribution of deck cracks in the negative moment region, use a stress limit for the deck reinforcement under service loads. For example, limiting stress in the top mat reinforcement placed in the direction of traffic to 18 to 20 ksi will result in narrower cracks than cases in which stresses are allowed to reach 40 ksi under service loads.

This change is not intended to replace all design considerations. Rather, it is intended to provide clarity on the 1% requirement in its application to decks that use partial-depth precast concrete panels.

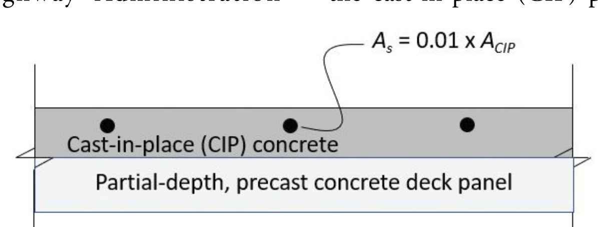

Figure 1. The forthcoming 10th edition of the *AASHTO LRFD Bridge Design Specifications*[2] will clarify the provision for longitudinal deck reinforcement in the negative moment region. When partial-depth precast panels are used, the 1% requirement should be based on the cast-in-place portion of the deck and placed in that portion. Figure: University of Texas at Austin.

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

This working agenda item affects

Sections 5 and 10 of the AASHTO LRFD specifications and is intended to establish uniformity in bridge design and construction practices and the best available techniques recommended by the Post-Tensioning Institute (PTI) and the American Segmental Bridge Institute (ASBI). Consistent requirements for post-tensioning are intended to establish cost uniformity for expected levels of durability. Different protection levels, environmental exposure conditions, and owner-defined service life expectancy, can be invoked in design and construction. This working agenda item accommodates variations in requirements based on the aggressivity of the environmental exposure conditions or for regional requirements. The various protection levels cover conditions that include very dry conditions with little risk of corrosion, presence of freezing and thawing cycles, moderate or heavy use of deicing chemicals, and exposure to seawater and/or airborne salt.

In addition to the design and construction benefits, some of the potential benefits of standardizing specifications in the post-tensioning industry include the ability to deliver more widespread and more effective training, as well as consistent inspection and proper installation of post-tensioning systems. This working agenda item extensively references consensus-based documents such as PTI/ASBI M50.3-19, *Specification for Multistrand and Grouted Post-Tensioning*[5] and PTI M55.1-19, *Specification for Grouting of Post-Tensioned Structures*.[6] The design recommendations within this working agenda item propose changes to Section 5 of the AASHTO LRFD specifications, and the construction aspects propose changes to Section 10. Moving forward, compliance with PTI/ASBI M50.3-19 and PTI M55.1-19 will ensure compliance with the AASHTO LRFD specifications, and vice versa. See the Spring 2024 issue of *ASPIRE* for other working agenda items related to segmental concrete bridges and post-tensioning.

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

The durability, versatility, architectural appeal, and cost advantages offered by concrete bridges have led to their widespread use in the United States and around the world. Significant research and development efforts have been funded by a variety of sponsors, including federal and state governments, industry representatives, and others. There is now a wealth of information on concrete bridges dating back to the start of the 20th century, as well as some earlier sources. The National Concrete Bridge Council (NCBC), a council of allied industry organizations, provides a vast listing of such resources on their website: https://nationalconcretebridge.org.

The document developed as Working Agenda Item 229 is the first product developed under the AASHTO and NCBC collaboration agreement. This document lists resources for concrete bridge practitioners made available by AASHTO, FHWA, NCBC members, and selected other relevant sources. It is intended to be a catalog or "bookshelf" of important resources from these organizations for the design and construction of concrete bridges. From onboarding a new generation of bridge engineers to providing resources to those who want to refresh their knowledge by studying documents that form the basis of our current concrete bridge design and construction practices, this document is a key publication. It is intended to assuage the workforce-development challenges we currently face in this country by providing a concise front-end listing of all available resources commonly used in the concrete bridge industry.

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

AASHTO developed *Guide Specifications for Structural Design with Ultra-High-Performance Concrete*[7] based on research performed by FHWA, research and development sponsored by PCI, and other research efforts in the United States and around the world. The development of the guide specification was driven by the need for explicit guidance on how to design bridges using ultra-high-performance concrete (UHPC), whose failure mechanisms may differ from those of conventional concrete. The guide specification addresses both reinforced and prestressed UHPC applications and provides the guidance that owners and designers need to predict the capacity of components in a framework that is consistent with the AASHTO LRFD specifications.. The Perspective article by Tom Murphy and Oguzhan Bayrak in the Winter 2024 edition of *ASPIRE* covers key attributes of this publication. The appendices addressing detailed material qualification and conformance testing, compatible with the design provisions in the guide specification, are currently under development and will be balloted when ready.

References

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