

Segmental Bridges: Guide Specifications and AASHTO LRFD Bridge Design Specifications



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Concrete bridges constructed in short segments—also known as segmental bridges—are the subject of this article, which reviews some basic concepts and definitions, as well as the history of segmental concrete bridge design and construction, before turning to a discussion of specifications for this type of bridge.

Segmental concrete bridges can be constructed by either assembling precast concrete segments or casting the segments in place. The balanced cantilever technique can be used in both precast and cast-in-place concrete construction to minimize the unbalanced moments induced in the towers or pylons. Alternatively, in cases where environmental conditions or construction-related constraints necessitate the use of a top-down construction technique, span-by-span erection of the segments may be preferred.

Early examples of segmental concrete bridges can be found in Europe. To the best of my knowledge, such bridges were constructed in Germany and France in the 1950s and 1960s. Soon after segmental bridges were successfully designed and constructed in Europe, they were introduced in the U.S. as viable alternatives to long-span bridges. The first example of a long-span,

Precast segmental concrete box girder for U.S. Route 183 elevated viaduct, Austin, Tex. Photo: Oguzhan Bayrak.



segmental concrete bridge in the United States was built in the state of Texas over the Gulf Intracoastal Waterway in 1973. Since then, many cast-in-place and precast concrete segmental bridges have been built across the nation and are in service today.

During the early days, as the technology of segmental concrete bridge design and construction was being transferred to the United States, first principles, fundamentals of structural engineering, and the concrete bridge design provisions of that time were employed in designing and constructing such bridges. This “technology transfer” period helped the bridge engineering profession identify areas that required research and additional discussion.

With the conclusion of early research efforts and successful completion of the first few segmental bridge projects, the profession developed the *Guide Specifications for Design and Construction of Segmental Concrete Bridges*.¹ It is important to appreciate the fact that American Association of State Highway and Transportation Officials (AASHTO) guide specifications, including the one that applies to the design of segmental concrete bridges, are commonly used for new technologies and emerging materials or design techniques and therefore do not carry the weight of conventional AASHTO specifications. The first edition of the AASHTO *Guide Specifications for Design and Construction of Segmental Concrete Bridges*,¹ published in 1989, was assembled in an environment in which very little additional formal guidance existed, except documentation from the prior European experience and early research done by the Texas Department of Transportation in conjunction with the University of Texas. The second edition,² published in 1999, reflects 10 years of further U.S. experience during which many segmental bridges were designed and constructed.

In the 8th edition of *AASHTO LRFD Bridge Design Specifications*,³ design provisions that apply to segmental concrete bridges are covered in Article 5.12.5. The requirements listed within that section of the specifications are aimed at supplementing design requirements that apply to all concrete bridges. Separate treatment of segmental concrete bridges in Article 5.12.5 is necessitated by the segmental construction method, stages, and temporary support conditions during bridge construction. Article 5.12.5 covers “construction by free cantilever, span by span, or incremental launching methods using either precast or cast in place concrete segments which are connected to produce either continuous or simple spans.” Although spliced-girder bridges share some characteristics with segmental bridges, their design is covered in Article 5.12.3.4 because, in many ways, they are closer to conventional concrete girder bridges. Thus, the reorganized Section 5 of the 8th edition of AASHTO LRFD specifications streamlines the design provisions applicable to segmental concrete bridges and provides a valuable resource in designing tomorrow’s segmental bridges. With that stated, first principles will always remain primary method of choice for designing and constructing segmental concrete bridges.

References

1. American Association of State Highway and Transportation Officials (AASHTO). 1989. *Guide Specifications for Design and Construction of Segmental Concrete Bridges*, 1st ed. Washington, DC: AASHTO.
2. AASHTO. 1999. *Guide Specifications for Design and Construction of Segmental Concrete Bridges*, 2nd ed. Washington, DC: AASHTO.
3. AASHTO. 2017. *AASHTO LRFD Bridge Design Specifications*, 8th ed. Washington, DC: AASHTO. 