



0-6374: Effects of New Prestress Loss Predictions on TxDOT Bridges

Background

In 2008, TxDOT initiated Project 0-6374 to investigate prestress losses in pretensioned concrete girders. The prestress loss estimates in the AASHTO LRFD Bridge Design Specifications had been recalibrated in 2005 to be more accurate for “high-strength [conventional] concrete.”

Greater accuracy implies less conservatism, the result of which may be flexural cracking of beams under service loads. Project 0-6374 was therefore funded to provide an experimental evaluation and an engineering recommendation of whether implementation of the new prestress loss estimates (currently outlined in AASHTO LRFD 2012) is appropriate for TxDOT.

The primary objectives of TxDOT Project 0-6374 were to:

- Assess the conservatism and accuracy of the current prestress loss provisions.
- Identify the benefits and weaknesses of using the AASHTO LRFD 2004 and 2012 prestress loss provisions.
- Make recommendations to simplify the prestress loss provisions of AASHTO LRFD 2012.

What the Researchers Did

The conservatism and accuracy of the AASHTO LRFD Bridge Design Specifications were evaluated through the use of a prestress loss database that included 30 field-representative girders—fabricated and tested during TxDOT Project 0-6374. Implementation and implications of the prestress loss provisions were examined within an extensive literature review and parametric study. Synthesis of the experimental and analytical

results supported the development of reasonably conservative, precise prestress loss provisions:

- *Assembly of prestress loss database:* A comprehensive database of available experimental investigations pertaining to prestress loss was compiled. The database contains information on 237 specimens, including 140 specimens for which prestress loss was reported or enough information was provided to calculate prestress loss. The database—in combination with the project experimental results—provided a relevant empirical basis for assessment of the various prestress loss provisions.
- *Experimental assessment of prestress losses:* The development of prestress loss was monitored in a total of 30 full-scale prestressed concrete girders—some of which were nearly 3 years old at the time of final loss assessment. The specimens were representative of a broad range of the most influential factors that may affect prestress losses in structures fabricated within the state of Texas, including type of concrete, coarse aggregate, sectional geometry, and climate.

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- *Parametric study of design implications:* A comprehensive parametric study was completed. Over 1800 different bridge designs were completed to account for all of the influential design parameters, including cross-section type, girder spacing, bridge span length, and concrete release strength. The results of the parametric study were used to identify the impact of the various loss provisions of the design of standard TxDOT bridges.
- *Development of new prestress loss provisions:* New prestress loss provisions were developed through simplification and recalibration of the method outlined in AASHTO LRFD 2012. The simplification process was driven by a desire to eliminate unnecessary complexity (e.g., time dependency) within the code, while conservatively accounting for typical materials and construction practices found in the state of Texas.

What They Found

The prestress loss provisions within the 2004 AASHTO LRFD Bridge Design Specifications were found to be overly conservative, though relatively straightforward to implement. The AASHTO LRFD 2012 prestress loss provisions were found to be unnecessarily complex, unconservative, and no more precise than the AASHTO LRFD 2004 provisions. The *proposed prestress loss provisions* performed well in comparison to both the AASHTO LRFD 2004 and 2012 methods.

The final set of provisions was found to be:

- *Simple to implement:* The TxDOT Project 0-6374 prestress loss provisions required approximately one-tenth of the total number of mathematical operations required by—and one-third the total number of variables included in—AASHTO LRFD 2012.
- *More conservative and precise:* The TxDOT Project 0-6374 prestress loss provisions only resulted in unconservative estimations for six of the database specimens, compared to 60 specimens for AASHTO LRFD 2012. The recommendations also resulted in less scatter, with a characteristic coefficient of variation (COV) equal to 0.21, as compared to a COV of 0.26 for AASHTO LRFD 2012.

What This Means

Implementation of the Project 0-6374 recommendations will:

- Enable simple, conservative estimation of prestress losses by TxDOT bridge designers.
- Yield more efficient designs without sacrificing the long-term serviceability and durability typically associated with pretensioned concrete bridge girder construction. Use of the TxDOT Project 0-6374 prestress loss provisions will result in up to six less prestressing strands relative to the current TxDOT design standard (AASHTO LRFD 2004).

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