Longitudinal Cracks in the Webs of Precast, Prestressed Concrete Girders: To Repair or not to Repair?

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With the increased use of higher strength concretes, deeper girders, and larger amounts of prestressing, longitudinal cracks in the webs of precast, prestressed concrete bridge girders have become more prevalent during the last two decades. These cracks generally appear at the ends of girders following transfer of the prestressing force. Sometimes they become more noticeable when the girders are lifted from the casting bed. Nonprestressed transverse reinforcement is provided at the ends of the girders to control the width of these cracks.

In practice, there has been no consistent understanding of the impact of end-zone cracking on the strength and durability of the girders. Thus, the assessments made by bridge owners vary from doing nothing to total rejection of the girders. Other reactions include debonding of strands at the girder ends, limiting prestressing levels, reducing the allowable concrete compressive stress at the time of transfer, injecting epoxy into the cracks, and coating the girder ends with sealants. There has been no consensus among owners on the level of tolerance allotted to these longitudinal cracks.

With this in mind, National Cooperative Highway Research Project 18-14 was initiated to establish a user's manual for the acceptance, repair, or rejection of precast, prestressed concrete girders with longitudinal web cracks. The research involved the following activities:

- Structural investigation and full-scale testing of girder specimens to study the effect of end zone cracking and transverse reinforcement details on shear and flexural strengths.
- Epoxy injection to investigate its ability to restore the tensile capacity of cracked concrete.
- Durability testing to investigate what repair methods and materials should be used if repair is deemed necessary.
- Field inspection of bridges to check if the in-service condition of end zone cracking changes with time.

Based on the research, the following proposed crack width limits were developed:

- Cracks narrower than 0.012 in. may be left unrepaired.
- Cracks ranging in width from 0.012 in. to 0.025 in. should be repaired by filling the cracks with approved specialty cementitious materials, and coating the end 4 ft of the girder web side faces with an approved sealant.
- Cracks ranging in width from 0.025 in. to 0.05 in. should be filled by epoxy injection and the end 4 ft of the girder web coated with a sealant.
- For girder webs exhibiting cracks wider than 0.05 in., the research team recommends that the girders be rejected unless shown by detailed analysis that structural capacity and long-term durability are sufficient.

Although the report does not address the timing of repairs, state practices vary from repairing before shipment to repairing after girder erection and the deck has been cast. In the latter case, the crack widths are likely to be less as a result of prestress losses and the application of dead load. Consequently, a less intrusive and less expensive repair procedure may be appropriate.

Perhaps more importantly, the research suggests that transverse reinforcement details have been shown by experience to control end-zone cracking so that repair is not needed. More details about this reinforcement and the repair materials used in the research are given in the full report along with recommendations about repair procedures.

Steve Seguirant of Concrete Technology Corporation, Federal Way, Wash., served as a consultant on the project.

EDITOR'S NOTE

This article is based on NCHRP Report No. 654 titled *Evaluation and Repair Procedures for Precast/Prestressed Concrete Girders with Longitudinal Cracking in the Web*, which is available at www.trb.org/Publications/Blurbs/163575.aspx.

Cracks ranging in width from 0.025 in. to 0.05 in. should be filled by epoxy injection. Photos: Mohsen Shahawy, SDS Engineering Consultants Inc., Tallahassee, Fla.