CENTER FOR TRANSPORTATION RESEARCH
THE UNIVERSITY OF TEXAS AT AUSTIN

Project Summary Report 0-4418-S
Project 0-4418: Bridge Slab Behavior at Expansion Joints
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PROJECT SUMMARY REPORT

Development of New Bridge Deck Details at Expansion Joints

The Texas Department of Transportation (TxDOT) currently uses, for most of its bridges, the "IBTS" standard detail for bridge slab ends at expansion joints (Figure 1). That detail has enabled TxDOT to eliminate the use of diaphragms at slab ends by increasing the transverse stiffness at slab ends. Slab ends are stiffened by a 2-in. increase in slab thickness and reduced reinforcement spacing for skewed slabs. The origin of this detail is unknown, but it has been used successfully by TxDOT for years. Currently, TxDOT uses a combination of prestressed concrete deck panels as stay-in-place formwork and cast-in-place concrete topping for the interior portion of bridge decks.

All bridges in Texas are designed according to AASHTO provisions. However, concerns about trucks operating beyond their legal weight limits, as well as increased truck traffic as a result of the North American Free Trade Agreement (NAFTA), have led many TxDOT districts to increase their design loads.

Prior to this research project, the capacity and behavior of the IBTS slab end detail under applied AASHTO design loads had not been verified by tests. This research is intended to show how loads are carried at free ends of slab; how skew affects behavior at free ends; how serviceability and capacity are affected by the

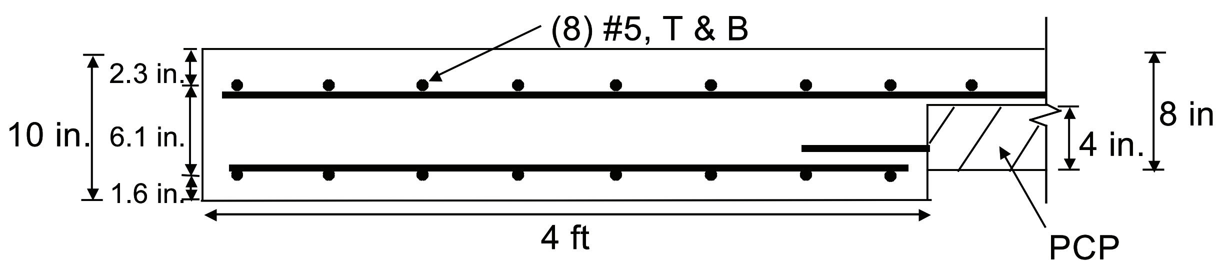

Figure 1: Cross-sectional view of IBTS detail

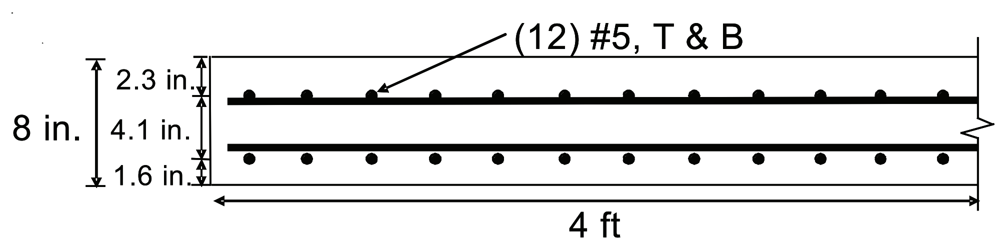

Figure 2: Cross-sectional view of UTSE detail

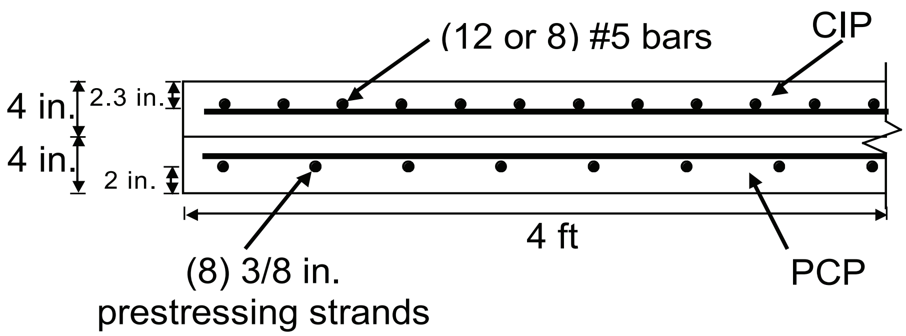

Figure 3: Cross-sectional view of PCPE detail

use of the IBTS detail and the elimination of diaphragms; and how this behavior can be modeled for design purposes. In addition to understanding the behavior of the slab end with the IBTS detail, alternate end details, including a cast-in-place detail with a uniform thickness of 8 in. (UTSE-Figure 2) and a detail including the stay-in-place precast prestressed concrete panels (PCPE-Figure 3), were also developed and investigated.

What We Did…

A total of three full-scale bridge deck specimens were constructed and tested. Two of the full-scale specimens, 0° (Figure 4) and 45° (Figure 5) skews, were constructed to test the effect of skew on the IBTS and UTSE details. Test results showed that at design load levels, skew had no significant effect on the behavior of the two details, particularly under typical design loads. All test areas failed in shear, predominantly punching shear. The UTSE detail failed at slightly lower load levels than the IBTS

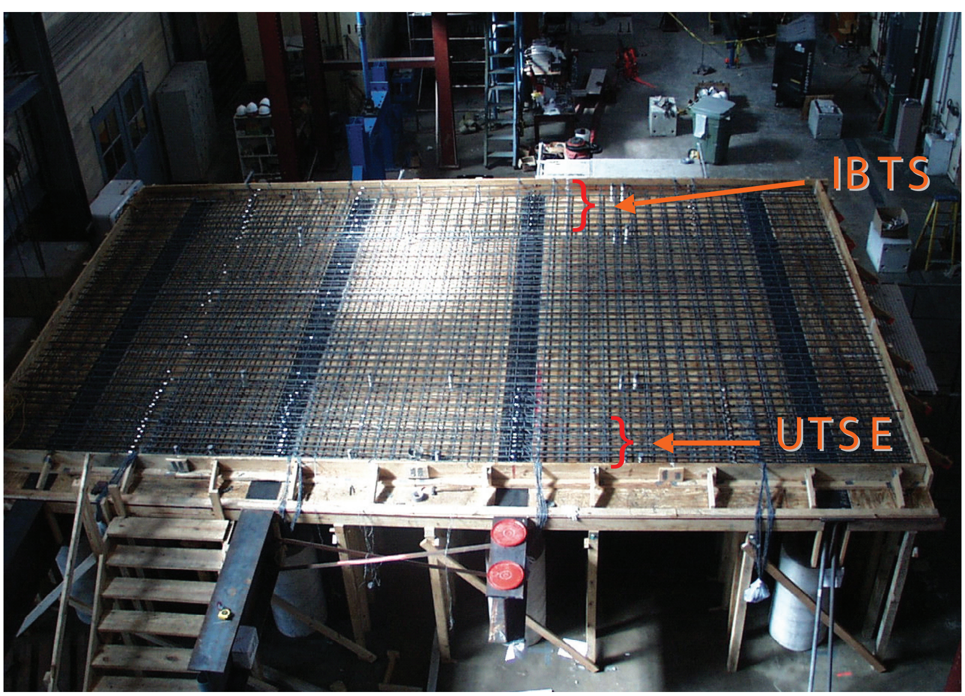

Figure 4: Full-Scale Test Specimen with 0° skew

detail due to a 2-in. difference in section depth. However, both details had ultimate capacities at loads well above the design load levels.

Another objective of the research was to develop alternate details and investigate construction issues of those alternate details. Since the UTSE detail performed satisfactorily at design and ultimate load levels, an alternate detail using the stay-in-place PC panels in the end regions was developed and tested. Use of PC panels in the end regions eliminates special formwork construction and reduces safety concerns associated with such formwork construction at heights. The third full-scale bridge deck specimen was built with the PCPE detail.

What We Found…

Bridge slabs designed with the IBTS, UTSE, and PCPE details performed well under AASHTO LRFD Design Tandem Load. For bridge slabs constructed with girder spacing less than 10 ft and skews less than 45^{o}, cracking can be assumed to be minimal or non-existent under AASHTO LRFD Design Tandem Load. When slab ends are subjected to overloads, cracking was minimal (lengths were less than 24 in. and widths smaller than 0.01 in.) until approximately 1.5 x AASHTO LRFD Design Tandem Load.

For bridge slabs constructed with expansion rails, results showed that expansion rails contribute significantly to the behavior and capacity of slab ends. However, excluding the contribution from the expansion rails is a conservative approach.

The Researchers Recommend…

Use of the two new slab end details (UTSE and IBTS) developed in this research project is recommended. Both of the details are simpler than the existing slab end detail (IBTS). Implementation of the end details developed in this research will increase construction speed and will result in substantial savings.

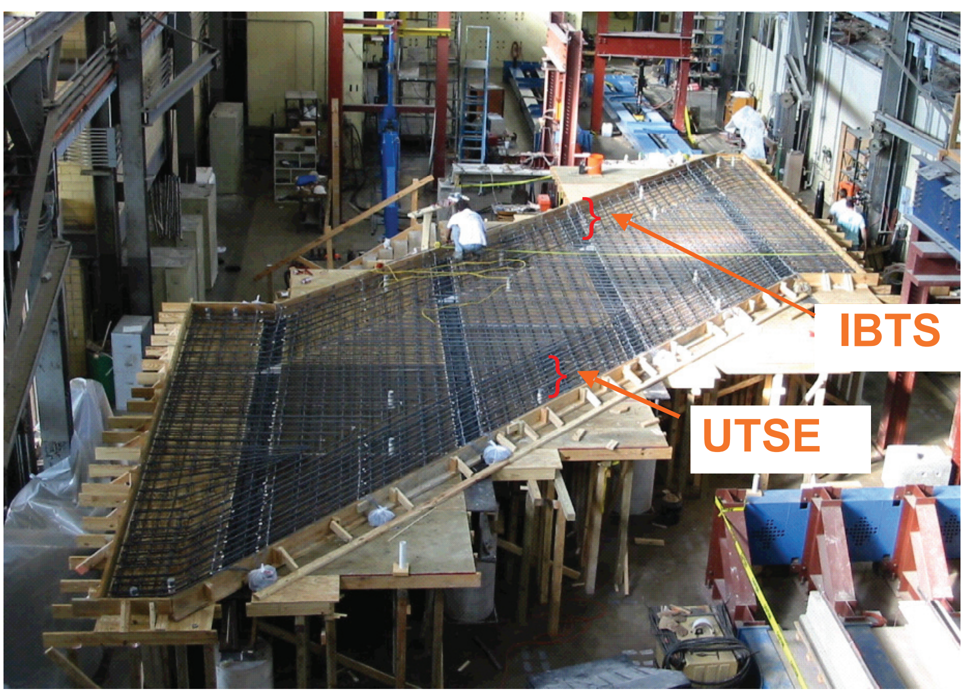

Figure 5: Full-Scale Test Specimen with 45^{o} skew

For More Details...

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The research is documented in the following reports:

0-4418-1 *Bridge Slab Behavior at Expansion Joints*

To obtain copies of a report: CTR Library, Center for Transportation Research,
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For more information, please contact Tom Yarbrough, Research and Technology Implementation Office, (512) 465-7403 or email at tyarbro@dot.state.tx.us.

Your Involvement Is Welcome!

Disclaimer

This research was performed in cooperation with the Texas Department of Transportation and the U. S. Department of Transportation, Federal Highway Administration. The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the FHWA or TxDOT. This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. Trade names were used solely for information and not for product endorsement. The engineer in charge was Oguzhan Bayrak.

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