



Project Summary Report 1856-S
Project O-1856: Develop a Method to Tie Double "T" Flanges Together to Get Proper Lateral Load Transfer

Author: Harry L. Jones

A New Connection Detail Reduces Cost of Double Tee Bridges

The prestressed concrete double tee bridge may be the structure of choice for short- to medium-range spans where speed of construction is an issue. Primarily used on off-system roads, this mode of construction is receiving more attention because of increasing labor costs associated with the pan form bridge that has been in use for well over 50 years in these circumstances.

An important issue in double tee construction is the

type of connection used to join the edges of adjacent tee flanges. When only an asphalt wearing surface is applied to the completed structure, these connections are the only means by which a tee supporting wheel loads is able to share loading with neighboring tees and hence gain the structural efficiency necessary to make this type of construction viable. Figure 1 shows the detail currently used by the Texas Department of

Transportation (TxDOT). It is made from a combination of steel plates embedded in the edge of the tee flange during fabrication and a pair of steel angles that are field welded to these embedded plates to complete the connection. The assembly is typically spaced longitudinally at 5-ft intervals along the length of the bridge.

In an attempt to further reduce construction costs and also improve performance characteristics, TxDOT asked

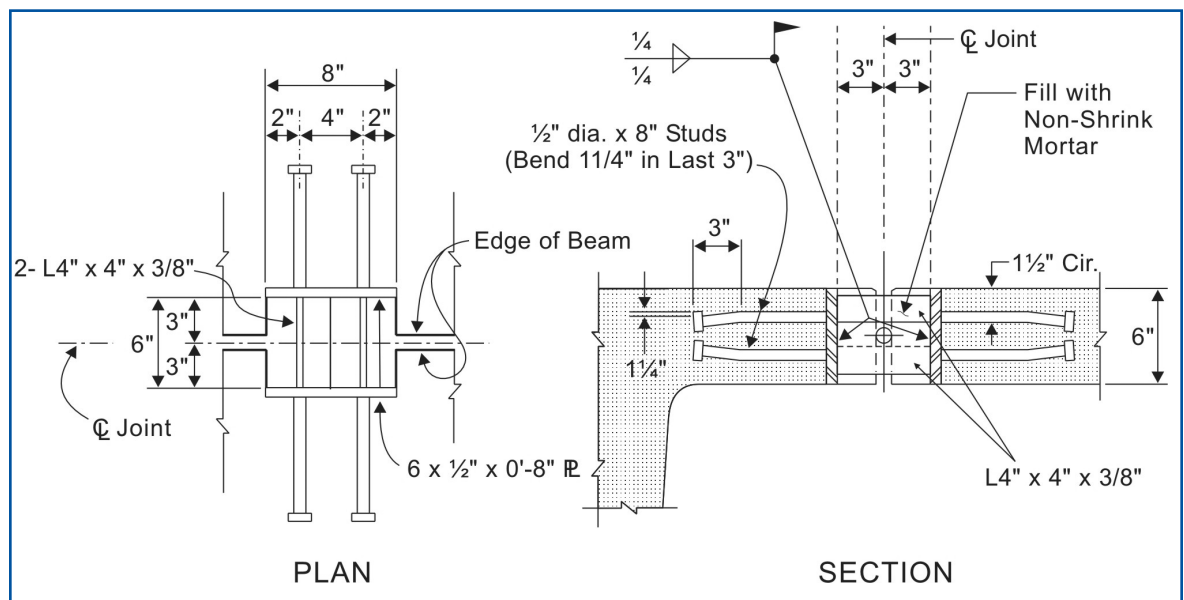


Figure 1. Modified TxDOT Lateral Connection.



the Texas Transportation Institute (TTI) to conduct a study of alternative lateral connections and to provide recommendations for a new detail.

What We Did . . .

The research team began the project by performing a literature search that identified various lateral connections used in double tee construction. Some of these connection types were in use by transportation agencies in other states, while others were used in parking garage construction. The results of this effort were compiled in an interim report to TxDOT and used as a basis for discussions with representatives of both the Bridge and Construction Divisions in Austin. The prototype detail shown in [Figure 2](#) evolved from those discussions. It was believed to be a less expensive alternative to the current connection because the weld between the steel bar and embedded plates could be accomplished much more easily and consequently more quickly. In addition, the finished weld is more accessible, making inspection of the completed installation practical.

The new detail also calls for a continuous grout shear key between the adjacent flange edges along the entire length of the bridge. This represents a substantial departure from the

current detail that joins the edges only at 5-ft intervals. Although this clearly is an additional expense relative to the current design, the use of a simple “backer rod” dropped into the crevice created by the (newly designed) sloping flange edges was thought to be a very efficient means for forming the key. The shear key was added primarily to combat reflective longitudinal cracks in the asphalt wearing surface over the area between adjacent tee flanges that had been documented in many of TxDOT’s existing double tee bridges.

What We Found . . .

The research team developed a series of tests to document the structural performance of the newly proposed connection detail shown in [Figure 2](#). Test specimens simulating a 1-ft-wide transverse strip of flange slab and embedded connection were first tested. These tests proved to be enlightening in that in every case the connection failed as a result of inadequate anchorage. Consequently, the 1/2 in. x 8 in. studs that were a carry-over from the old detail in [Figure 1](#) were replaced with #4 reinforcing bar of sufficient length to fully develop the anchorage of the new detail in [Figure 2](#).

As a final proof-of-concept test, a full-scale section of a bridge was built in TTI’s structural test facility and subjected to a

series of simulated wheel loads. The structure consisted of a pair of 30-ft-long double tees connected laterally at 5-ft intervals with the new welded bar detail and shear key construction. Load cells measured reaction forces, and gages mounted on the shear key measured strains in the bridge.

Data from these sensors compared reasonably well with predictions from an analytical model developed in the project. The analytical model was then used to explore perturbations on the proposed connection detail, such as variations on the 5-ft connection spacing and the influence on load transfer of the grouted shear key.

The principal conclusions resulting from this work were that the shear key was indeed a very important component of the connection, and that the welded bar at 5-ft spacing served primarily to keep the flange edges from separating under load, enabling the shear key to perform most of the lateral load transfer between tees.

The analytical model was used to predict forces in the connection when joining the several different sizes of tees used by TxDOT and over a range of spans appropriate to each tee. The proposed connection in [Figure 2](#) is capable of resisting the largest



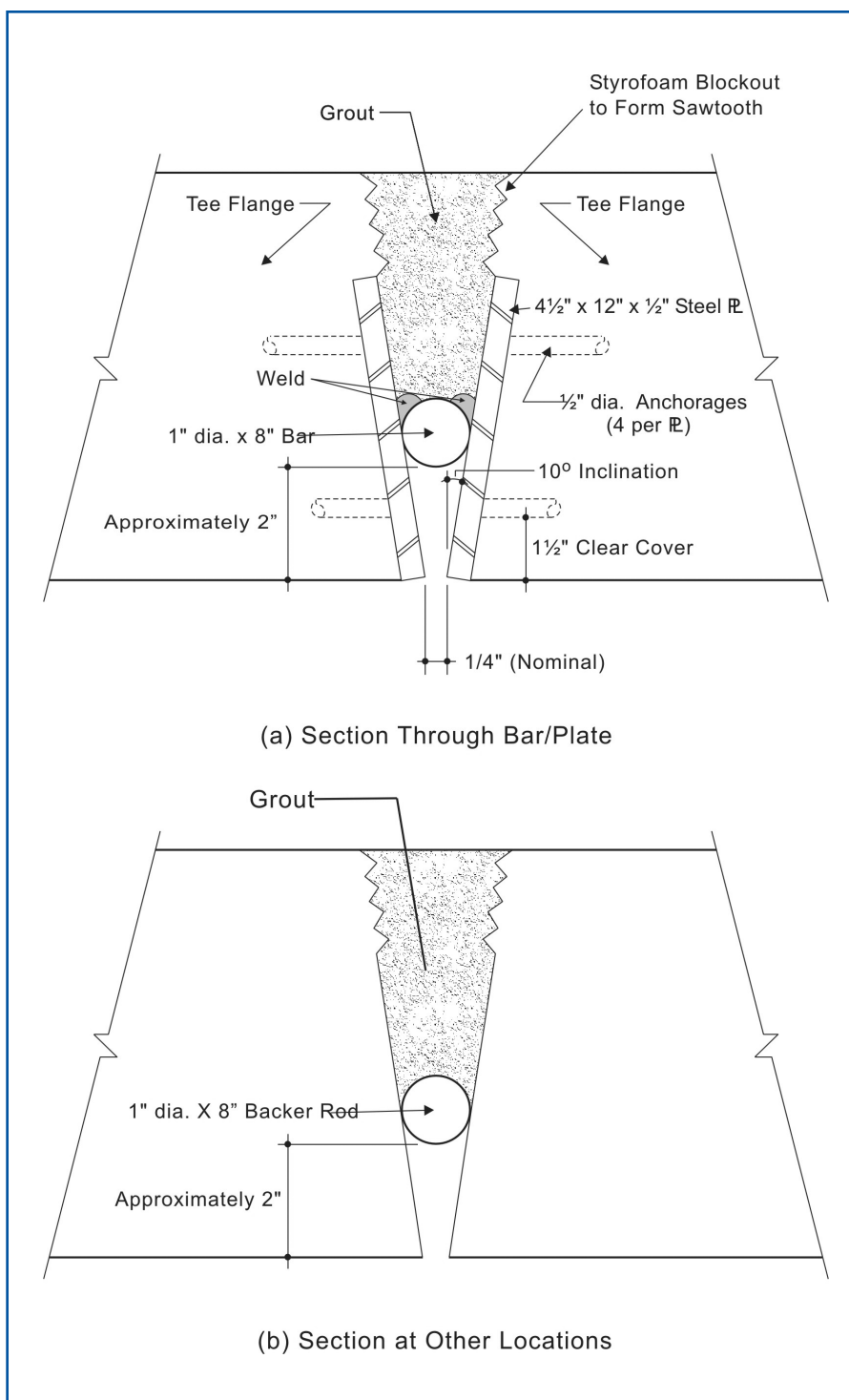


Figure 2. Proposed "Simple" Connection Detail.

of those predicted forces.

Another phase of the testing program subjected the full-scale bridge section to 2 million cycles of simulated truck wheel loads. Inspection of the structure afterward revealed no signs of distress in any of the elements making up the lateral connection between flanges. The final test of the bridge applied a single concentrated load of 95,000 lb at several locations along the connection in an attempt to precipitate a failure under this gross overload condition. None were observed.

The Researchers Recommend . . .

As a result of this project, the research team was able to recommend the adoption of the connection detail shown in [Figure 2](#) and to justify that recommendation with realistic performance data. Connection force components appropriate for various conditions were also presented for possible use in connection detail design.



For More Details . . .

Report 1856-2, Lateral Connections for Double Tee Bridges

Research Supervisor: Harry L. Jones, Texas Transportation Institute, (979) 845-4304,
h-jones@tamu.edu

TxDOT Project Director: Jeff Cotham, Bridge Division, TxDOT, Austin, (512) 416-2187,
JCOTHAM@dot.state.tx.us

To obtain copies of the report, contact Dolores Hott, Texas Transportation Institute, TTI Communications, (979) 845-4853, or e-mail d-hott@tamu.edu. See our on-line catalog at <http://tti.tamu.edu>.

TxDOT Implementation Status December 2001

The information gained from this research will be used by the TxDOT Bridge Division to modify the double-tee standards. The new connection is being tested on a few small construction jobs, which will determine if there is a need for any tuning adjustments to the standard details. Ultimately, implementation of the results of this research project will be through statewide usage of the new standard double-tee beams.

For more information, contact: Tom Yarbrough, P.E., RTI Research Engineer, at (512) 465-7685 or e-mail tyarbro@dot.state.tx.us.

Your Involvement is Welcome!

Disclaimer

The contents of this report reflect the views of the author, who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Federal Highway Administration or the Texas Department of Transportation. This report does not constitute a standard, specification, or regulation. Not intended for construction, bidding, or permit purposes. The engineer in charge of the project was Harry L. Jones, P.E. #35066.