

PROJECT SUMMARY REPORT

0-7112: Development of a Continuous for Live Load Prefabricated Steel Accelerated Bridge Construction (ABC) Unit for Texas Bridges

Background

Countless bridge projects occur in urban centers, highways, or heavy traffic zones. Conventional bridge construction can be time consuming, which leads to traffic delays, cost overruns, and safety issues. Prefabricated accelerated bridge construction (ABC) units alleviate most of these issues. Construction techniques using ABC units provide faster construction times, safer construction sites, and lower costs than their cast-in-place counterparts. One of the challenges is the weight of the precast units. For this reason, steel beams are typically used. The other primary challenge is the field connection at the interior supports (pier bents). This has been—and currently is—an area of research.

This project aimed to develop a prefabricated steel ABC transverse connection detail at the bridge piers that allows the structure to behave simple for dead load and continuous for live load (SDCL). The connection must be easy to fabricate, fast to assemble, safe, cost-effective, and durable long term.

What the Researchers Did

The following major tasks were completed for this project:

- Developed an **array of connection concepts** from what was learned in the literature and the field assessment. Then presented the concepts at a workshop to an industry review panel (IRP) and TxDOT for refinement.
 - Performed **full-scale experimental testing** for each of the four concepts selected by the IRP and TxDOT. Figure 1 provides a photo of a precast unit fabricated and tested as part of this study.
 - Created **analytical finite element models of the tested specimens** to validate the modeling methodology. Then analyzed variations of the connection detail.
 - Performed a **finite element parametric study** to capture the global bridge behavior.
 - Identified the **final recommended connection** detail and provided **design guidance** in the form of a design example and standard drawings.
- Research Performed by:**
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- Project Completed:**
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- Performed a detailed **literature review** including SDCL bridge systems, ABC technology, and SDCL systems used with ABC technologies.
- Conducted a **field assessment** on the recent Texas Department of Transportation (TxDOT) steel girder ABC project in Dallas, Texas (I-635 over Old Seagoville Road).

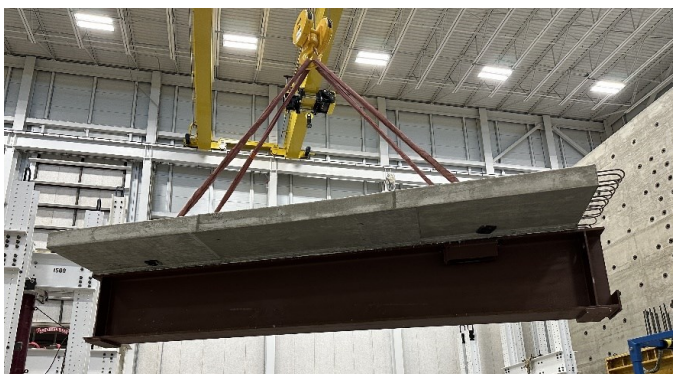


Figure 1. Steel ABC Unit Fabricated and Tested.

What They Found

The research study successfully developed a prefabricated steel ABC transverse connection detail that is continuous for live load. Figure 2 provides a simplified detail of the recommended connection.

Essentially, there are three main components for this field connection: deck slab, beam top flange, and beam bottom flange. Balancing the factors stated earlier (fabrication, assembly, safety, cost, and durability), the researchers found the connection illustrated in Figure 2 to be the best alternative. It was determined that a conventional cast-in-place closure pour (roughly 2 feet wide) with supplemental reinforcement is the most effective/efficient connection of the slab. A positive connection of the beam top flange was found to be critical despite the recommendations from prior studies. As a result, a bolted top flange splice was provided to transfer the significant tension at this location. Finally, prefabricated steel end plates were selected to transfer the compression present at the bottom of the connection.

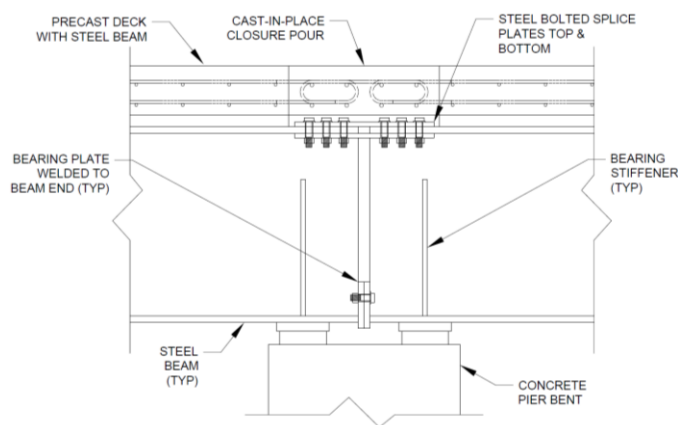


Figure 2. Steel ABC Recommended Connection Detail.

What This Means

As a result of this research study, future TxDOT bridge projects can be effectively executed with a compressed project schedule, reducing impacts on the traveling public and project costs. More specifically, the following value has been added to Texas as a result of this study.

- **Enhanced knowledge:** This project significantly advanced the understanding of ABC techniques and provided innovative strategies for steel bridge ABC connection design and construction for TxDOT.
- **Expedited project delivery:** The prefabricated steel ABC units allow for quick assembly, reducing construction time, labor, and traffic disruptions.
- **Cost efficiency:** The durable ABC connection reduces maintenance and the need for future replacements, lowering life-cycle costs.
- **Extended service life:** The ABC connection details minimize deck cracking, improving the reliability and durability of steel bridges to meet high performance.

For More Information

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