Texas A&M Transportation Institute

PROJECT SUMMARY

Texas Department of Transportation

0-6722: Spread Prestressed Concrete Slab Beam Bridges

Background

The Texas Department of Transportation uses precast prestressed concrete slab beam bridges for shorter-span bridges of approximately 30–50 ft in length. Conventional slab beam bridges have slab beams placed immediately adjacent to one another with a cast-in-place (CIP) topping slab. While these bridges are used extensively, they are more expensive than traditional prestressed I-beam structures on a per-square-foot basis. This project investigated the use of slab beams that are spread apart with precast concrete panel (PCP) stay-in-place forms between beams and a CIP concrete deck. Design guidelines have been developed for this alternate spread slab beam bridge system.

What the Researchers Did

Preliminary designs were developed to assess the potential of a spread slab beam bridge system. A full-scale spread slab beam bridge was constructed at the Texas A&M University Riverside Campus and tested to assess constructability, in-service performance, and behavior. Field testing was conducted for the Riverside bridge and a US 69 on-system bridge to evaluate load distribution behavior and to provide data to guide analytical modeling of this bridge system. Analytical models were developed to investigate an array of possible bridge geometries. Based on these models, recommendations were developed for shear and moment load distribution factor (LDF) relationships for the design of spread slab beam bridges.

What They Found

Researchers found the following:

- *Constructability*: Spread slab beam bridge systems that use PCPs with a CIP concrete deck, similar to I-girder bridges, provide another relatively simple method for short-span bridge construction (Figure 1). This method was successfully implemented for a US 69 on-system bridge and the Riverside test bridge. Camber of the slab beams tends to increase due to higher prestressing forces. Thus, the bedding strip installation can require increased depths (up to 4 in. total) at the beam ends.
- *Observations*: Limited deck cracking was observed and likely occurred during curing. Care should be taken during deck curing to avoid unexpected cracking. For the Riverside bridge, a deck surface crack was observed along the length of the bridge at the transverse center line (centered on a PCP). The crack occurred within the first week after deck placement, and the width did not increase after the crack appeared. Minor deck cracks were also observed at the US 69 bridge.
- *Performance*: For both bridges, the desired performance was achieved for in-service loading. During field testing, the beam live load deflections were within the design limits. No major cracking or reduction in the overall stiffness of the bridge superstructure was observed. No cracks or unexpected behavior was observed for either bridge during dynamic tests (up to 40 mph).

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Texas A&M Transportation Institute

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- *Dynamic impact*: The maximum dynamic impact factor for the Riverside bridge was 37 percent with a dump truck traveling at 40 mph. This increased to 43 percent for the US 69 bridge, also with a dump truck traveling at 40 mph.
- *Transverse and interface shear*: The current transverse and interface shear reinforcement provided in the standard slab beam sections should be maintained as a minimum for spread slab beam designs. Shear requirements should be carefully reviewed during design to ensure that the standard transverse and interface shear reinforcement is adequate. The height of the interface shear reinforcement (H-bars) above the top of the slab beam should be increased to provide the required development length.

What This Means

LDF relationships for shear and moment were developed to facilitate implementation of the spread slab beam system. The American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) LDF equations for spread box beams were reviewed for applicability to spread slab beams. The AASHTO LDFs range from being unconservative to very conservative. For example, the AASHTO expressions slightly underestimate shear for interior spread slab beams. Unique LDF expressions were developed for spread slab beam bridges to provide an appropriate level of conservatism. The proposed moment LDF for interior slab beams (multiple lanes loaded) is identical to the AASHTO LRFD spread box beam equation.

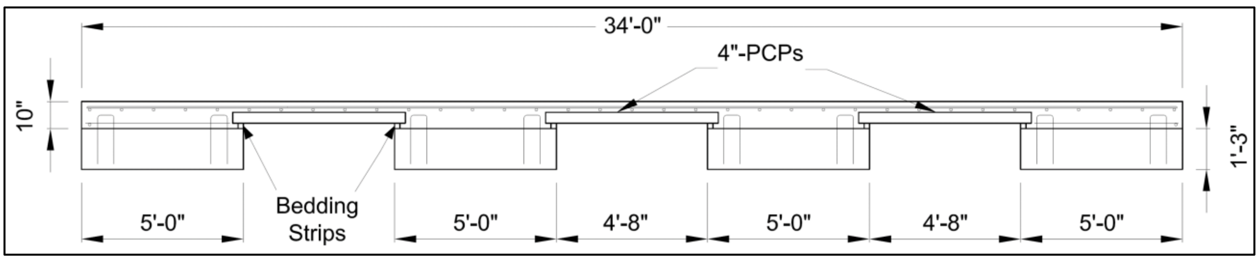

Figure 1. Transverse Section of the Riverside Bridge.

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