Evaluation of Performance and Maximum Length of Continuous Decks in Bridges

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Problem Statement

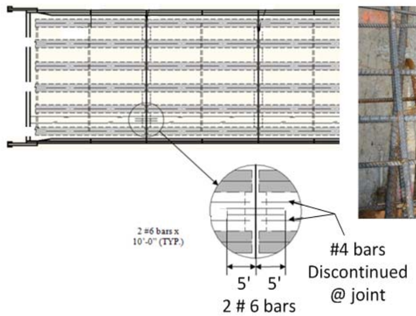
Georgia DOT currently constructs bridge decks minimizing the number of expansion joints on the bridge. This is done by placing one heavy mat of bar reinforcement over intermediate bents and pouring the deck continuously over the bent. The continuous bridge decks have continuous reinforcement over the juncture between two edge beams and a construction joint for crack control. This zone is often termed a "link-slab." It was desired to understand the performance history of this process, which joint types perform the best, and the maximum and/or optimum length of continuous, "joiintless" bridge decks.

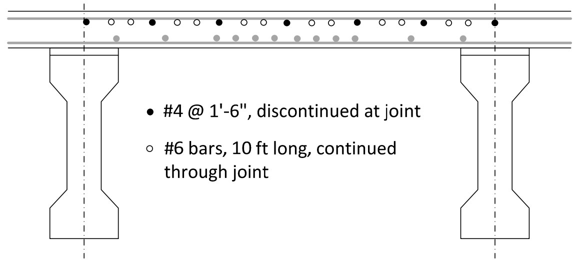
Project Objective

The objective of this research was to evaluate the performance history of continuous bridge decks in the State of Georgia, to determine why the current design detail between adjacent simple spans works, to recommend improvements to this design detail, and to recommend the maximum and/or optimum length of continuous, "jointless" bridge decks.

Background

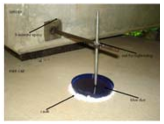
The current link-slab detail in Georgia uses two #6 bars spaced between each #4 bar in the top layer of deck reinforcement (typically spaced at 1-ft 6-in on center). Generally, this detail performs well. Its design was based on historically good performance.





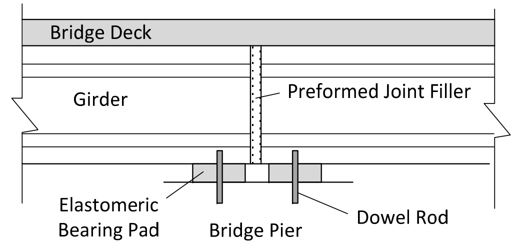
Research Approach

This research included field surveys of bridge decks, field experimental measurements and analytical studies.



Findings

- The link-slab reinforcement experiences almost no axial load due to thermal and gravity loading.
- The need for dowel action of the link-slab reinforcement is limited because of the use of edge beams below the deck.
- The only significant loads in the link-slab reinforcement are due to lateral and longitudinal forces in the deck, typically due to vehicle braking, wind and earthquake effects.
- The small space (tolerance) between the dowel restraint bars located within the bearing at the bottom of each girder and the cast-in round or slotted hole in the girder (at fixed or expansion bearings) permits sufficient movement to relieve any longitudinal force at the bearing due to girder rotation; yet, the dowels still restrain any excessive transverse and longitudinal motion.



- The rotations in the link slab are centered approximately about the link-slab reinforcement.
- Concrete shrinkage occurring soon after the deck is placed causes a crack to occur at the construction joint. The estimated size of the shrinkage crack is larger than the deformations caused by thermal and gravity loading. Thus, the link-slab moments generated in the deck are negligible.

Recommendations

- Care must be exercised in installing the construction joint at the link slab such that cracking does not occur prior to making the joint.
- The top layer of longitudinal reinforcement in the deck would be sufficient for the link-slab reinforcement. This top layer could be continued across the construction joint as a replacement for the current #6 bars for the link-slab reinforcement.
- If the skew is less than 15 degrees, the transverse reinforcement may be continued across the construction joint, as is done in Texas. Otherwise, the transverse reinforcement should be discontinued as is done currently. Further analytical studies are needed to confirm the effects of skew.
- The maximum length of the bridge deck before expansion joints are required is dependent on the expansion joints and their installation. If Georgia DOT continues to use the Evazote joint design for the expansion joint at each abutment, then the maximum length between expansion joints should be 400 ft.

Project Benefits

Joints in bridge decks are a significant maintenance problem. Elimination of joints between bridge spans can significantly reduce maintenance costs. Determining the best jointless detail and finding the maximum distance between required joints will minimize bridge deck maintenance costs.