TECHSUMMARY December 2020

State Project No. 30001660 / LTRC Project No. 14-1ST

Evaluating Louisiana New Continuity Detail for Girder Bridges

INTRODUCTION

Over a period of 3 years, data collected from the Ouachita River Bridge in Harrisonburg, Louisiana was used to study the behavior of a partial continuity jointless deck detail (See Figure 1). The detail joins decks of adjacent spans with a link slab over supporting bents. Partial continuity introduces less restraint in comparison to full continuity details, which leads to lower straining actions and associated stress concentrations.

Figure 1
Ouachita River Bridge project

A structural health monitoring (SHM) system was employed to achieve the goals of this project. Data from a live load test, in addition to the long-term data, was analyzed and interpreted with the help of simplified two-dimensional (2D) and three-dimensional (3D) finite element (FE) models. Based on the findings of the research, recommendations were made to assist in adoption in construction of new bridges in Louisiana.

OBJECTIVE

The main objective of this project was to evaluate the performance of deck-only continuity; i.e., link slabs, under varying support and continuity conditions employed in the Ouachita River Bridge project with the following goals for the project:

1. Understand the behavior of link slab continuity and monitor deck crack development.
2. Evaluate the performance of the link slab continuity detail.
3. Provide DOTD with recommendations to assist in adoption in the *Bridge Design and Evaluation Manual.*

SCOPE

This study focused on one 4-span continuous segment, three 2-span continuous segments, and one simple span segment within the Ouachita River Bridge. The performance of the link slab was evaluated under thermal as well as live-load effects.

METHODOLOGY

The Ouachita River Bridge was chosen to evaluate the performance of the link slab detail for long-term effects using a SHM approach. The SHM system consists of 134 sensors

LTRC Report 626

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PRINCIPAL INVESTIGATOR:
Ayman Okeil, Ph.D., P.E. (FL)

LTRC CONTACT:
Walid Alaywan, Ph.D., P.E.
225.767.9106

FUNDING:
SPR: TT-Fed/TT-Reg-5

Louisiana Transportation Research Center

4101 Gourrier Ave
Baton Rouge, LA 70808-4443

www.ltrc.lsu.edu

(displacement, strain, and tiltmeter). In addition to interpreting link slab behavior using field collected data, visual inspections were also conducted and analytical models were developed to investigate the behavior of link slabs with attributes beyond those of the monitored segments.

CONCLUSIONS

Based on the results of this study, the following conclusions may be drawn:

1. Temperature changes (uniform and gradient) clearly caused the major changes in sensor readings. However, the response seemed to be more closely matched with changes in the temperature gradient throughout the day. For example, crack widths are also directly affected by temperature gradient variations on a daily basis.
2. Increasing the continuity of a segment introduces additional restraint to girder ends results in an increase of crack widths on the tension face of link slabs and an increase in link slab forces.
3. Recorded tension forces values in the link slabs over expansion supports are, in many cases, greater than the bearing pad supports can theoretically resist. This indicates that there is an additional restraint at the girder end, which could be due to debris accumulation in the gap between girder ends and surrounding shear keys.
4. The recorded crack widths are not alarming and do not require repair intervention, which implies that the used link slab reinforcement is adequate.
5. The crack control detail (transverse top groove in link slab) is not efficient in arresting link slab cracking.

RECOMMENDATIONS

Based on the findings of this project, the research team recommends the adoption of the link slab detail in construction of jointless bridge decks in Louisiana. Link slabs reduce the need for costly expansion joints (construction and maintenance). Link slab details are also easier to construct in comparison with full positive moment continuity details recommended in NCHRP Report 519. Furthermore, full continuity details attract large continuity moments, which have been observed (Project 08-1ST and Project 12-1ST) to cause girder end cracking.

Special consideration shall be given to support conditions in segments employing the link slab detail. The results presented in this report show that additional restraint to girder end movements leads to larger link slab forces and crack widths. It is not recommended that anchored end diaphragms be used with the link slab detail, which led to the largest observed crack widths and link slab forces. Furthermore, the use of shear keys can lead to unintentional restraint to girder end movement if it does not allow for longitudinal movement due to debris accumulation in the gap between the girder bottom flange and the surrounding shear key.

The link slab reinforcement used for the Ouachita River Bridge appears to be adequate and produce an acceptable link slab behavior. Regular inspection of the observed crack propagation and development are recommended to assess the adequacy of the link slab reinforcement over a longer period. Additional investigations are also needed to determine the maximum length that should be allowed for segments employing the link slab detail and the effect of braking forces on bearing pad movements in floating span configurations.