Steel Girder Bridge with RC Deck Retrofit from Non-Composite to Composite Behavior

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Abstract

In the past, a number of steel girder-reinforced concrete deck bridges on county roads in the United States have been built as non-composite. Most of these bridges currently have load postings limiting the capacity of bus and truck loads on their roadways. Recent research showed that post installed high strength bolts could be used as shear connectors in rehabilitation work to achieve partial composite design by deploying 30% to 50% of the connectors typically required for a full composite design. This paper presents details on the analysis, design, and field application of post-installed shear connectors on a non-composite concrete deck steel girder bridge in Kentucky. In order to minimize traffic disruption and construction costs, the shear connectors were inserted on the bottom side of the deck through the top flange of the steel girder. While the load rating increased by 132%, field tests conducted before and after installation of the shear connectors showed that the bridge's live load deflections were reduced by more than 27%.

Keywords: Bridge Decks; Steel Girders; Shear Connectors; Composite Deck; Field Testing.

1 Introduction

Most steel girder bridges constructed presently are designed to be fully composite with the concrete deck. The current design codes in the US [1, 2] specify design criteria to achieve fully composite action between deck and steel girder in the design of bridges. The common practice is to weld shear studs onto the top flange of steel girders before casting the concrete deck to facilitate the shear transfer at the interface. A number of steel girder-RC deck bridges on county roads have been built as non-composite in the past. Most of these bridges currently have load postings limiting the capacity of truck loads on their roadways.

Previous research conducted by Dedic and Klaiber [3] showed that high strength bolts could be used as shear connectors in rehabilitation work, and that their strength and stiffness was comparable to that of welded shear studs. Recent research carried out at the University of Texas at Austin, in collaboration with the Texas Department of Transportation, has looked at the possibility of achieving composite action through post installed shear connectors to connect the existing deck to the steel girders [4, 5, 6]. Several methods of installing shear connectors were studied by Kwon [4] and three methods were selected for experimental and analytical evaluation: double-nut bolt, high tension friction grip bolt, and adhesive anchor [4, 5]. The research concluded that using a partial composite design deploying 30% to 50% of the connectors typically required for a full composite design, a 40% to 50% increase in load carrying capacity could be achieved. Due to a better fatigue performance of post installed

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