FRP Deck Bridge: Design, Construction, and Evaluation as a Temporary Bypass Structure

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ABSTRACT

Bridge replacement projects are becoming common due to the deteriorating bridge infrastructure, both in Iowa and nationwide. To minimize the inconvenience to roadway users, temporary roadway bypasses can be constructed to route traffic around the construction site. The Iowa Department of Transportation (Iowa DOT) maintains a stockpile of steel temporary bridge spans that can be used as either single-span bridges or linked together to form multi-span temporary bridge crossings. Due to the deteriorating condition of the steel temporary bridges, the Iowa DOT initiated a research project to determine if a fiber-reinforced polymer (FRP) deck bridge could be a suitable replacement for the existing steel temporary bridge spans. To aid in answering this question, the Iowa DOT applied for and was awarded TEA-21 Innovative Bridge Research and Construction (IBRC) funding. The FRP deck bridge for these temporary bypass applications is comprised of two 39 ft. 10 in. by 13 ft. 6 1/2 in. pieces that are spliced together with steel splice plates along the centerline of the roadway to form a bridge that spans 39 ft. 0 in. and is 24 ft. 0 in. from face of barrier rail to face of barrier rail for two 12 ft. 0 in. traffic lanes. The bridge was fabricated on temporary supports and preliminarily load tested, as shown in Figure 1. Preliminary load testing of the FRP deck bridge was satisfactory and indicated that the design control is primarily with regard to deflection limitations rather than strength limitations.

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Figure 1. Bridge on temporary supports subjected to test load

In May 2007, the FRP bridge was delivered to its inaugural project site near Ft. Atkinson, Iowa, and installed as a temporary bridge to provide an alternate route for traffic while the mainline bridge was being replaced. The design of the bridge is such that the entire structure may be loaded onto one tractor trailer and hauled to the site and handled with a relatively small crane, as shown in Figure 2. Once onsite, the two slab sections are set on the abutments and joined with custom-fabricated steel plates and outfitted with steel barrier rails. The completed structure can be installed and ready for traffic in less than two days once the abutments are in place.

Figure 2. Bridge sections on trailer for transport

The bridge has been in service for several months and remains so, with only minor construction and serviceability issues requiring attention. Design details of the abutment seats and backwalls were found to be difficult to fabricate and required modification. In addition, variances in elevation between the approach slabs and the edge of the bridge sections resulted in minor deterioration of the edge of the bridge panels and subsequently modification of this design detail as well. The bridge has since been in use under service-level loads and functioning sufficiently. Prior to removal at the completion of the project, the bridge will again be load tested and evaluated.

Factors that may influence whether the Iowa DOT chooses to replace the stockpile of steel temporary detour bridges with FRP bridges include in-service load test results, the life-cycle cost analysis, durability

of the system under service, and availability of FRP bridge fabricators. Life-cycle costs and durability have yet to be evaluated.

Key words: composites—fiber-reinforced polymer—FRP bridge—temporary bridge