HR-382 Investigation of Two Bridge Alternatives for Low Volume Roads

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ABSTRACT

Recent reports have indicated that 23.5 percent of the nation's highway bridges are structurally deficient and 17.7 percent are functionally obsolete. A significant number of these bridges are on the Iowa secondary road system where over 86 percent of the rural bridge management responsibilities are assigned to the counties. Some of the bridges can be strengthened or otherwise rehabilitated, but many more are in need of immediate replacement.

In a recent investigation, HR-365 "Evaluation of Bridge Replacement Alternatives for the County Bridge System," several types of replacement bridges that are currently being used on low volume roads were identified. It was also determined that a large number of counties (69 percent) have the ability and are interested in utilizing their own forces in the design and construct of short span bridges. After reviewing the results from HR-365, the research team developed one "new" bridge replacement concept and a modification of a replacement system currently being used.

Both of these bridge replacement alternatives were investigated in this study, the results of which are presented in two volumes. This volume (Volume 2) presents the results of Concept 2 -Modification of the Bearn-in-Slab Bridge, while Concept I - Steel Beam Precast Units is presented in Volume 1. Concept 2 involves various laboratory tests of the Beam-in-Slab bridge (BISB) currently being used by Benton County and several other Iowa counties. In this investigation, the behavior and strength of the BISB were determined; a new method of obtaining composite action between the steel beams and concrete was also tested. Since the Concept 2 bridge is primarily intended for use on low-volume roads, the system can be constructed with new or used beams.

In the experimental part of the investigation, there were three types of laboratory tests: push-out tests, service and ultimate load tests of models of **the BISB,** and composite beam tests utilizing the newly developed shear connection. In addition to the laboratory tests, there was a field test in which an existing **BISB** was service load tested. An equation was developed for predicting the strength of the shear connection investigated; in addition, a finite element model for analyzing the BISB was also developed.

Push-out tests were completed to determine the strength of the recently developed shear connector. A total of 36 specimens were tested, with variables such as hole diameter, hole spacing, presence of reinforcement, etc. being investigated.

In the model tests of the BISB, two and four beam specimens (L = 9,140 mm (30 ft)) were service load tested for behavior and load distribution data. Upon completion of these tests, both specimens were loaded to failure.

In the composite beam tests, four beams, one with standard shear studs and three using the shear connection developed, were tested. Upon completion of the service load tests, all four beams were loaded to failure. The strength and behavior of the beams with the new shear connection were found to be essentially the same as that of the specimen with standard shear studs.

In this investigation, the existing BISB (L = 15, 240 min (50 ft)) was determined to be extremely stiff in both the longitudinal and transverse directions, deflecting approximately 6 mm (1/4 in.) when subjected

to 445 kN (100 kips). To date, Concept 2 has successfully passed all laboratory tests. Prior to implementing a modification to the BISB in the field, a limited amount of laboratory testing remains to be completed.