CONCRETE BRIDGE PRESERVATION

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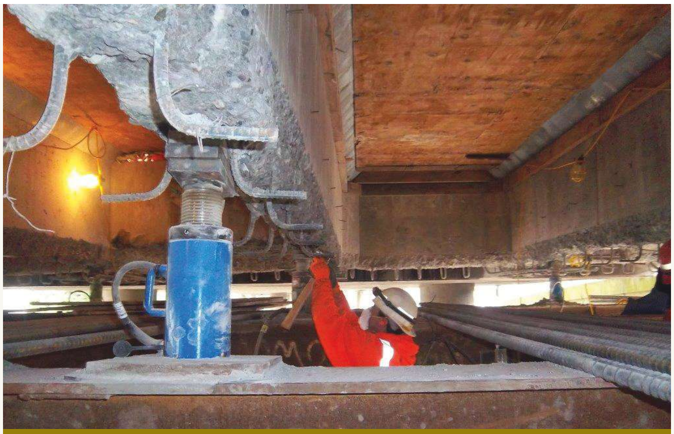

Box girder is temporarily supported after the deteriorated bottom slab was removed. Photo: Washington State Department of Transportation.

In-Service Replacement of a Reinforced Concrete, Box-Girder Bottom Slab

by Craig R. Boone, Washington State Department of Transportation

With an aging infrastructure and limited funding, engineers are being called upon to find practical solutions to transportation issues. One recent example is a bridge repair that was completed by the Washington State Department of Transportation (WSDOT). The repair consisted of removing and replacing the bottom slab of a reinforced concrete box girder while maintaining traffic on the bridge deck. The successful completion of this repair saved millions of dollars in construction and user costs, and minimized disruptions to the nearly 25,000 vehicles that use the bridge every day.

In recent years, WSDOT bridge inspectors were finding significant deterioration in the bottom slab of span 11 of Bridge 5/537S. The bottom slab had large areas of spalling with exposed rusty reinforcement. The concrete had a powdery consistency, and was easily removed for its full depth. Because of this, the bridge was classified as structurally deficient. WSDOT considered removing and replacing the span, but recognized the bridge would be out of service for months. Fortunately, the space below the bridge was vacant, which meant there was an opportunity to temporarily support the existing structure. With a strong desire to maintain traffic on the bridge, and recognizing that other elements of the bridge were still in good condition, WSDOT decided to remove and replace the bottom slab while temporarily supporting the span. The temporary support system was designed such that traffic could be maintained on the bridge deck.

Design of the repair included several unique challenges, the first of which was how to temporarily support the span in a way that would allow the bottom slab to be removed and replaced. Small holes were created in the bottom slab so jacks could be inserted to support the webs, just above the bottom slab. Because the positive moment reinforcing steel was to be removed, jacks had to be closely spaced at 7 ft 6 in. on center along the length of the span to provide nearly continuous support (54 jacks total).

A second challenge was the design of the interface between the existing webs and the new bottom slab. Details were developed with a focus on ensuring good concrete consolidation and no air pockets. Also, shear keys were chipped into the bottom of the existing webs to ensure composite behavior between the new and existing concrete.

A third challenge resulted from providing access hatches to each cell. The access hatches meant less room for new positive-moment reinforcing steel. The original capacity of the bridge was restored using smaller, higher-strength reinforcing bars that were placed in bundles between the hatches.

Traffic was maintained on the bridge for the duration of the repair, with the exception of 2 days when the concrete was placed and allowed to gain a strength of 2 ksi. The temporary support system was left in place for 28 days following the concrete placement. The total time to construct the repair was 3 months, and the total cost to design and construct the repair was approximately $1 million.

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