Prefabricated Concrete Barrier Elements for ABC Projects

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ABSTRACT

Many transportation agencies have embraced Accelerated Bridge Construction (ABC) to reduce both the traffic impacts and societal costs. The most common approach to ABC is to utilize prefabricated elements, which are connected together on-site to construct a bridge. ABC will not be effective if the barrier requires cast-in-place construction. Therefore, a precast concrete barrier was explored with two barrier-to-deck connection alternatives, in addition to a new barrier-to-barrier connection between the two adjacent prefabricated elements.

Following input from the Department of Transportation in several states, the standard 42-in tall F-shape barrier segment was chosen for the investigation that is designed to sustain an impact load corresponding to Test Level (TL) 4 as specified in the Manual for Assessing Safety Hardware (MASH). The barrier segments are 12 feet long and include a 0.5-inch tolerance for construction purposes. Items that were considered in the design of the connections were minimal damage to deck, easy replacement of barrier, constructability, durability, and cost. To address the potential need for easy replacement of a damaged barrier, one of the two barrier-to-deck connections investigated includes inclined reinforcing bars through the barrier with threaded ends connected to bar splicers embedded in the bridge deck. The second barrier-to-deck connection, which emphasized cost effectiveness, is designed with U-shaped bars. These bars are inserted into the barrier from the underside of the bridge deck overhang. In both cases, the ducts housing the reinforcing bars in the barriers require grouting. To establish a structural barrier-to-barrier connection, a detail consisting of headed reinforcement in the longitudinal and transverse directions was designed.

To evaluate the adequacy of the design of the prefabricated barrier and connections, a full-scale test unit was performed utilizing two precast barriers and a portion of a bridge deck with overhang. The test unit was subjected to several different tests under quasi-static load to verify the load resistance and the load distribution. The first two tests were performed prior to establishing the barrier-to-barrier connection. Overall, the barriers and their connections performed well. Of the two barrier-to-deck connections, one with the inclined bars performed satisfactorily; however, the connection with the U-bars experienced premature failure. Following the analysis of data, a plan for improving the U-bar connection has been formulated for further evaluation.

The workshop presentation will focus on the design of the connections, construction, performance of the barriers and connections, and appropriate refinement to the tested details.