

## **Integral Abutment Details for ABC Projects**

Travis Hosteng, PE, Lowell Greimann, Ph.D., PE Sam Redd, Brent Phares, Ph.D., P.E.  
Iowa State University, Bridge Engineering Center, Ames, Iowa

### **ABSTRACT**

In areas of high traffic or in locations where long detours are the only option, long-term bridge construction can have significant impacts on the traveling public and surrounding communities. To minimize this impact, engineers and contractors prefabricate bridge elements and utilize technologies that facilitate rapid bridge assembly. This strategy is known as accelerated bridge construction (ABC) and has gained the attention of the bridge community, as information on and the benefits of ABC projects have been shared.

The potential in this movement has not fully recognized the advantages of certain bridge types, such as integral abutment bridges, given their limited use in ABC projects. Integral abutment bridges were developed as a means of eliminating the expansion joint from the bridge superstructure, because expansion joints present long-term maintenance concerns.

To eliminate the joint, integral abutments rigidly connect the superstructure and foundation so that the entire structure experiences thermal expansion and contraction as one. For this reason, the integral abutment is often large and heavily reinforced, which presents challenges for use in ABC projects. The size of the abutment presents weight issues, and mechanical splicing of the abutment to the deep foundation presents tight construction tolerances.

The research, which will be described during this presentation, investigated multiple integral abutment details for use in ABC projects through mechanical splicing of the integral diaphragm and the pile cap. To complete this work, details were evaluated in the laboratory based on constructability, strength, and durability. The construction process used to fabricate and erect the specimens was documented and will be presented, as this criterion often governs the design of ABC details.

The specimens were tested for strength and durability by simulating thermal loads and live loads. Strain gauges placed on the concrete and reinforcing steel captured the strain developed in the testing to evaluate strength. Displacement transducers placed across the precast joint measured the crack width that developed under loading to assess durability. The ABC details investigated were the grouted reinforcing bar coupler detail and the pile coupler detail. To establish baseline performances for an integral abutment, a typical cast-in-place detail was also constructed and tested.

In the grouted reinforcing bar coupler detail, a plywood template was used to “match cast” the pile cap and the integral diaphragm. The template marked the locations of the spliced reinforcing steel and served as the base for the formwork in the integral diaphragm, holding the grouted couplers in position. The template proved to be simple to construct and resulted in the successful alignment of 17 spliced steel bars and grouted couplers over the length of an 8 foot specimen.

A grout bed was pumped into the precast joint on the specimen. Unfortunately, grout leaked past two of the grouted coupler seals and obstructed the grouting of two couplers. Even with the two un-grouted reinforcing bar couplers, more than adequate strength was created by the connection, and the crack width that developed at the precast joint was comparable to that of the cast-in-place specimen.

The pile coupler detail was developed to facilitate the Lateral Slide construction method with integral abutments. The pile coupler reduced the number of spliced connections between the pile cap and integral diaphragm significantly to facilitate adequate construction tolerances. The pile splicing detail worked well during construction; however, the detail's performance in terms of strength and durability was less than ideal.