Florida Department of Transportation Research

Investigation and Development of an Effective, Economical, and Efficient Prestressed Concrete Pile Splice

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BDU79

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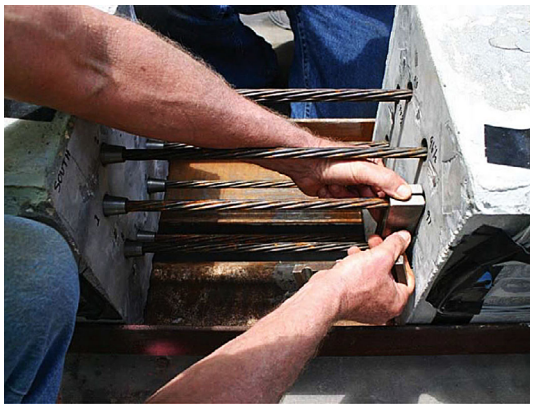
Current Situation

Large structures like bridges or tall buildings are often built on deep foundations – either precast concrete piles or cast-in-place drilled shafts. The pile or shaft must be long enough to reach a rock layer or to provide sufficient resistance to support the structure. For piles, the needed length may exceed what can be transported or lifted. Then, it is necessary to splice two piles together. There are many splicing methods; however, spliced piles are often held to a lower range of pile-driving forces, thus increasing blow counts and driving times. Also, splices can fail during construction or underperform while in service. Any splice design must be mechanically strong and corrosion resistant.



A worker removes a retaining clamp in preparation for closing this splice. The post-tensioning strands and mating surfaces of the pile segments are visible.

Research Objectives

University of South Florida researchers studied a new method of splicing piles, based on post-tensioning. If practical, this method would overcome many deficiencies in other splicing methods.

Project Activities

In a series of tasks, the researchers improved their design concept, ultimately demonstrating a workable and advantageous pile splicing method. They reviewed several designs using post-tensioning before selecting one which achieved splicing by post-tensioning strands through ducts cast into top and bottom pile segments. Post-tensioning was locked into the splice region via anchors embedded within the body of the pile on both sides of the splice. A machined header was designed for the casting bed to ensure alignment of ducts and splice surfaces. Extensive computer modeling prior to and during each test phase yielded improvements to the emerging design.

All components – splice header, ducts, chucks, strands, etc. – were tested before production of laboratory-scale piles, leading to a major and several minor refinements. Fourteen-inch -square prototyp pile segments were produced in 10-ft lengths; control piles were 20-ft long. Tests, including bending, four-point bending, and strand pull-out tests, were monitored with external and internal strain gauges.

Lessons learned from design, construction, and testing of prototype spliced piles were applied to full-scale piles, which were 24-in square, a common size used in Florida Department of Transportation (FDOT) projects. Forty-foot control piles and spliced piles made from two 20-ft segments were subjected to a program of bending tests. Additionally, a full-scale 100-ft spliced pile was subjected to unspliced driving conditions in a field demonstration. Analysis of all tests affirmed positive performance of the splice.

Project Benefits

The pile splicing design developed in this project has an important advantage over many other methods: prestressing forces are carried through the splice zone. This design may also provide improved corrosion resistance compared to other splice methods. Improved pile splicing can produce more reliable and durable foundations for Florida's transportation structures.

For more information, please see dot.state.fl.us/research-center