Florida Department of Transportation Research

Effect of Polymer Slurry Stabilization on Drilled Shaft Side Shear over Time

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Current Situation

Pilings are used for many Florida structures to provide a solid foundation in the state's sandy, clayey soils. Many pilings are installed as drilled shafts, meaning simply that a hole is drilled and then filled with steel-reinforced concrete. But Florida's high water tables mean that installation isn't that simple. Groundwater will begin to fill a hole as soon as it is drilled, which could destabilize the walls over time. Slurry, a dense mixture of water and either a clay or polymer powder, is added to the hole to prevent groundwater intrusion. Concrete is piped into the bottom of the hole, pushing the slurry up and out. However, if the slurry is in the hole too long, a layer of slurry material can build up on the walls, which can affect the bearing strength of the piling. For this reason, the Florida Department of Transportation (FDOT) sets limits on how long slurry can be left in a drilled shaft before concrete is poured. These limits are well established for clay-based slurries, but research is needed to set correct limits for the time that polymer slurries can remain in a hole before concrete is poured.

Slurry pours out of a steel collar as cement is piped into a drilled shaft excavation.

Research Objectives

University of South Florida researchers tested the bearing strength of pilings placed in holes exposed to slurry for shorter and longer periods of time.

Project Activities

Small-scale and large-scale drilled shafts were constructed using slurries made from one of three polymer products or, for comparison, bentonite clay. Small-scale tests involved casting 32 tenth-scale shafts and slurry exposure times from 0 to 96 hours. In small-scale tests, weight-bearing capacity was reduced for bentonite-constructed (BC) shafts – up to a 50% reduction was observed after 96 hours of exposure. However, polymer-constructed (PC) shafts showed no reduction in capacity. Instead, small-scale PC shafts showed 26% higher capacity than BC shafts, when averaged across all exposure times.

For full-scale testing, five 2-ft-diameter shafts were constructed with slurry exposure times of 2 and 48 hours. Large-scale PC shafts also performed better (15%) than BC shafts. However, full-scale tests showed no reduction in capacity in either BC or PC shafts, even at prolonged slurry exposure times.

Up to this point, tests had shown that PC shafts performed better when compared to BC shafts, but how did these shafts compare to current design standards? To allow a direct comparison of the test shafts with design standards, the researchers calculated "resistance factors." All the BC shafts had lower resistance factors than the standard, indicating lower than expected capacity. For PC shafts, the factors were higher at all exposure times, which suggested the possibility of removing slurry exposure time limits for polymer slurries altogether.

Project Benefits

Improved knowledge about the use of polymer-based slurries indicates that these slurries can lead to more flexible construction schedules without reducing the strength and capacity of drilled shaft pilings.

For more information, please see www.fdot.gov/research/.