Response of a Reinforced Concrete Embedded Pile Under Lateral Loading. I: Field Testing

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Cast-in-drilled-hole reinforced concrete piles (also known as drilled shafts) are among the most common support structures in highway construction. Typically, drilled shafts have simple, prismatic geometries; yet, they display a complex, inelastic response under applied loading. The two major factors that affect their behavior are the interaction between the shaft and surrounding soil media, and the material inelasticity of the shaft itself.

This paper reports the results of the second in a series of five tests that subject CIDH foundation systems with variable head and geometric conditions to lateral loading. The test specimen is a two-feet diameter, partially embedded, reinforced concrete drilled shaft that extends 24 ft below ground line and 13'-4" above ground line. The test site consists primarily of low plasticity alluvial clay that is expected to exhibit an undrained response to the cyclic lateral loading. Loading was applied with a hydraulic control system in displacement-control mode. Hence, cyclic displacements of varying amplitude were applied and the associated loads were continuously measured. All loading was applied slowly, with the full suite of loading taking seven days to complete.

The internal deformations of the shaft were recorded during testing by a redundant set of instrumentation designed to record flexural and shear deformations. The instrumentation included 54 fiber-Bragg gratings (FBGs), 50 DC linear variable displacement transducers (LVDTs), 60 strain gauges, and 11 inclinometers. These sensors were positioned to provide the highest spatial resolution of data in the areas expected to experience the largest deformations (i.e., shallowly embedded portions of the shaft).

Yielding of the shaft was observed to occur at a top-of-column displacement of approximately 6" in both loading directions. Peak loads achieved following yielding were 28.6 kips in the South direction and 23.4 kips in the North direction. As of this writing, the test data have been reduced to provide complete load-deflection backbone curves for loading in both directions, curvature profiles at pre-yield deflection levels, the full moment-curvature relationship at ground line, and hysteresis curves documenting the cyclic behavior of the shaft soil system at pre-yield displacements.