Florida Department of Transportation Research

Effect of Proximity of Sheet Pile Walls on the Apparent Capacity of Driven Displacement Piles

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Current Situation

Piles support many Florida structures. Sometimes, piles rest on rock, but more often, their load-bearing capacity depends on friction with the soil (side resistance) and soil resistance to further penetration (tip resistance). To design these piles, engineers must understand how the chosen pile type will interact with the different soil types found in Florida. Testing has shown that the interaction between a pile and the soil is affected by a nearby installation of a sheet pile wall (SPW), which is a wall made by driving a series of prefabricated, interlocking sections into the ground. When SPWs are temporary, their removal can affect the pile-soil interaction, affecting the capacity of the pile.

Research Objectives

University of Florida researchers conducted physical experiments, numerical simulations, and a parametric study to develop design recommendations for use by geotechnical and structural engineers to estimate changes in pile load capacity in various pile-soil-SPW systems.

Installation of a sheet wall pile.

Project Activities

To explore the numerous arrangements needed to understand the behavior of piles near SPWs, the researchers conducted experiments on scale models in a centrifuge. As an example of the scale of these experiments, the centrifuge basket that contained the models was 18 inches deep but because the centrifuge speed can be chosen to simulate pressures at different depths underground, it was possible to simulate piles driven to over 40 feet. Sand, a major constituent of many Florida soils, was precisely prepared and characterized for use as the medium for the scale studies. The scale model was outfitted with a variety of instruments to measure the forces and stresses that occurred during pile driving.

Centrifuge tests were modeled numerically using a combination of discrete element modeling (DEM) and finite element modeling (FEM). These numerical studies focused on three scenarios: (1) driving a pile into granular soil, followed by top-down loading of the pile; (2) driving a SPW and then driving a pile close by, followed by top-down loading of the pile; and (3) driving a SPW, driving a pile close by, removing the SPW, and, then, top-down loading of the pile. Exploring these scenarios resulted in the development of parameters that brought the numerical simulations into agreement with the scaled tests in the centrifuge, including a new understanding about the development of dynamic resistance in granular soil. Based on the results of the parametric study, the researchers made design recommendations that can be used by geotechnical and structural engineers to obtain a robust estimate of changes in load capacity for different configurations of pile-soil-SPW system.

Project Benefits

Better design methods for piles in Florida soils will help assure that pile foundations function as intended.

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