GRL Engineers, Inc.

Dynamic Load Testing of Helical Piles

Challenge:

The YWCA of Toledo wanted to add 11,000+ sf of usable space by installing a foundation through the existing basement swimming pool to support two new floors being constructed above it. Due to low clearance restrictions within the building structure, micropiles were used in the initial foundation design. The specialty foundation contractor, Toledo Caisson Corporation, realized potential cost savings by utilizing helical piles for the foundation and provided a redesign at a reduced cost. The piles could be installed quickly in low headroom conditions and achieve the equivalent required capacity of 200 kips in the glacial till soils. To confirm the helical pile capacity, GRL Engineers utilized dynamic load testing services.

Method:

The foundation test consisted of a helical pile with a 10' lead section containing 3 helices; 8", 10", and 12" diameter. Add-on sections were 7 feet in length. The helical piles were 5.5" diameter with a wall thickness of 0.361". A test pile was installed just outside the building prior to production pile installation. The total length of the test pile below the existing concrete lot grade was 85 feet.

During production pile installation, some piles were refused prior to reaching the design depth. Additional dynamic testing was performed to evaluate the pile capacity of the shorter piles, as well as piles installed to the full design depth.

Dynamic testing was performed under impacts from GRL's APPLE 7-2G, a load testing device utilizing a 4-kip ram weight and variable drop height. Drop heights used during testing ranged from 6 inches to 40 inches. This load testing device is capable of self-lifting the drop weight and can be handled by a variety of small equipment, such as forklifts and excavators, allowing for low headroom dynamic testing.

Results:

The load vs displacement curve generated from the pre-production dynamic testing (Figure 1) indicated no geotechnical plunging failure up to a load of 218 kips and confirmed the helical pile design was adequate.

The production testing was performed to evaluate capacity and compare the performance of shorter piles which refused above the apparent glacial tills to those installed full length to the till layer.

Load vs displacement curves were generated from the production dynamic testing of 3 production piles (Figure 2) installed to similar torque values, but lengths of approximately 35, 45, and 73 feet below existing grade. The resulting curves indicated very similar performance from all 3 piles regardless of installation depth.

Project Details

Client: Toledo Caisson Corporation

Location: Toledo, OH

GRL Office: Ohio

GRL Services

- High Strain Dynamic Testing with APPLE Systems
- CAPWAP® Analyses

Ultimately the piles were accepted as installed based on the results of the dynamic testing and installation information provided by the specialty contractor. This project is a great example of experience and ingenuity creating cost savings to the owner, while utilizing testing to confirm pile design and alleviate concerns when pile installation does not go as expected.

To learn more about GRL Engineers, visit www.grlengineers.com or email us at info@grlengineers.com.

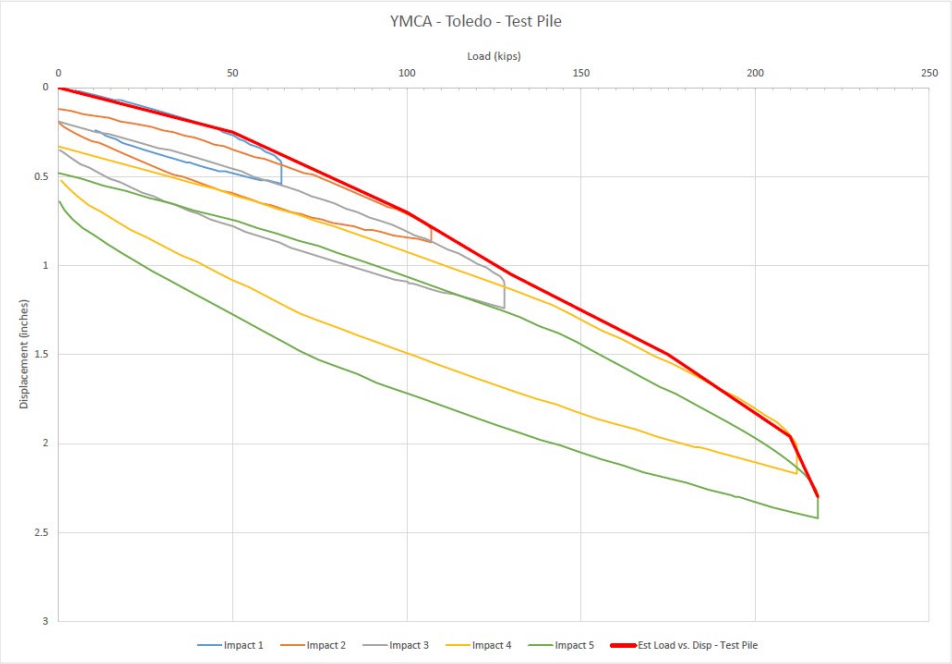

Figure 1. Estimated Load vs Displacement curve for pre-production test pile utilizing data from 5 impacts

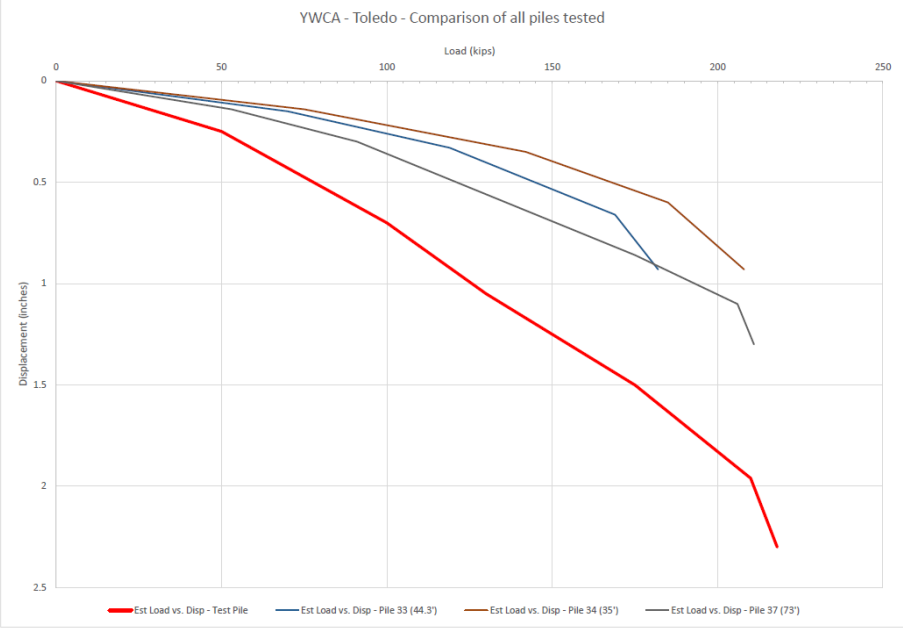

Figure 2. Comparison of estimated Load vs Displacement curves from 3 production piles and the pre-production test pile.