
Evaluation of Driven Piles Behavior in Providence RI Testing Program

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ABSTRACT

The reconstruction of the intersection of RT. I-195 and I-95 in Providence RI will require the use of driven pile foundations to support various bridges. Extensive subsurface exploration had been conducted, revealing a typical soil profile of a granular fill overlaying a thick varved silt layer underlaid by glacial till and bedrock. Due to the sensitivity of the varved silt layer and significant past construction difficulties in that area, a large scale load testing program was carried out.

The testing program was conducted at two areas designated as test area 1 and 2. It included axial compression load tests, lateral load tests and pull-out tests of various types of piles. At test area 1 the axial compression load tests were carried out on a 14" square prestressed precast concrete pile (PPC), a 14" diameter concrete filled pipe pile (PP) and a 14x102 H-pile. Instrumentation of the axially tested piles included six to nine vibrating wire strain gages (VWSG) and four telltales in each pile. Test results were mainly targeted for the determination of the piles' ultimate capacities as well as design parameters for each layer.

Five lateral load tests were performed in areas 1 and 2. PPC and PP piles were loaded in area 1 and H pile and PPC pile were loaded in area 2. The H pile in area 2 was laterally loaded relative to both pile axes directions (lower and higher inertia modulus). Instrumentation of each laterally loaded pile included an inclinometer tube extending to depths of up to 40ft below pile top for pile deflection monitoring and VWSG for moment distribution monitoring. The strain gages were positioned at different elevations on the upper part of the pile as pairs around the line of symmetry parallel to the load application direction. As a result, in addition to the standard pile top displacement observation, the instrumentation enabled the monitoring of pile deflection and the estimation of the bending moment distribution along the pile.

The current work presents and discusses the design phase estimation (pre construction) of the axial pile capacities in compression to those measured in area 1. The analysis and measurements are reviewed in light of recently developed reliability based parameters for load and resistance factor design (LRFD) for deep foundations.

The lateral behavior of the driven piles in areas 1 and 2 are studied in detail. Comparisons are held between pile deflections and moments due to lateral loading that were calculated during the design stage to those obtained by the field measurements. Attempts are made to "calibrate" the analysis and comparisons are held between the calibrated analyses and subsequent field testing. In order to gain further insight into the adequacy of the analyses of pile deflections due to lateral loading, a data base of twenty five case histories was analyzed. Comparisons are held between calculated and measured responses of pile behavior under lateral loads. Controlling parameters are identified and discussed.

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