Annual Meeting Research Digest No. 2002-18
a publication of the Pacific Earthquake Engineering Research Center

UC Berkeley/PEER Drilled Pier Load Test Program

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Overview

Drilled pier design is usually based on theoretical calculations of ultimate load capacity, using field and laboratory data. Load-deformation characteristics for the drilled piers are usually defined using empirical methods. These theoretical and empirical approaches generally result in uneconomical drilled pier design. The adverse impacts of these conservative foundation design approaches have become accentuated under current performance-based approach to the design of structures. Load test of prototype drilled piers offer the most direct and reliable means of establishing the ultimate capacity and load-deformation characteristics of drilled piers. This test program was aimed at minimizing the cost of foundation and superstructure design on a current UC Berkeley project, through accurate definitions of geotechnical parameters that are required input to the performance-based design process.

Applicability

The load test program involved the installation and subsequent load testing of six drilled piers in two test areas at the Underhill Parking Lot located between Haste Street, Channing Way, Bowditch and College Avenue. The presented results are therefore applicable only to similar piers located on the site encompassing the test areas. The results could however be extrapolated to other project sites in the immediate vicinity of the test site if the subsurface conditions are similar and appropriate methods for such extrapolation are used.

Test Piers

The test piers were installed and allowed to cure for at least 14 days before they were load-tested. Each test pier was instrumented using optical fiber strain bars supplemented by some electrical resistance strain gages.

The identification numbers, locations, dimensions and the bearing conditions at the tips of the piers are summarized in Table 1.

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Table 1
Information Relating to Test Piers

Test Area	Test Pier Location	Test Pier Identification	Pier Diameter (inches)	Pier Length (feet)	Pier End-Bearing Condition
Test Area 1	West	A1-20B	24	20	Compressible Material
Test Area 1	Center	A1-19	30	19	Native Soil
Test Area 1	East	A1-20A	24	20	Compressible Material
Test Area 2	West	A2-20	24	20	Compressible Material
Test Area 2	Center	A2-30	24	30	Compressible Material
Test Area 2	East	A2-25	24	25	Compressible Material

Load Tests

Each test pier was subjected to a Pile Load Test (PLT). The PLT was repeated on test piers A1-20B, A2-25 and A2-30. The PLT involved hydraulically lifting and releasing a 25-metric ton mass from predetermined heights onto a striker plate that transmits energy to the test pier. Large dampening springs spread the impact load over a 200-milisecond period. This pseudo-static test, which is performed using a specially designed mobile, track-mounted load tester, was aimed at simulating dynamic loading conditions. The load transmitted to the pier was measured with a load cell and the displacement of the top of the pier was measured using an optical diode transmitter-optical camera lens receiver arrangement.

Test Pier A1-19 was subjected to compression test per ASTM D1143 (Quick Method) and Test Piers A1-20B, A2-30, and A2-25 were tested in tension per ASTM D3689 (Quick Method). Static loads applied to the test pier were recorded using a load cell with a calibrated hydraulic ram gauge as a back up. Displacement of the top of the pier was measured using extensometers with a dial gage as a back up.

Strain measurements were also recorded at discrete locations along the lengths of the test piers during both the PLT and the static load tests.

Results

Figure 1 shows the load-displacement curves for the both the PLT and static load test on Test Pier A1-20B, which was located in Test Area 1. Figure 2 shows the corresponding curves for Test Pier A2-25.

The curves show that ultimate capacity derived from the PLT results would be higher than the ultimate capacity derived from the static test results. The results suggest that the ultimate capacity of drilled piers have typically been underestimated in the past.

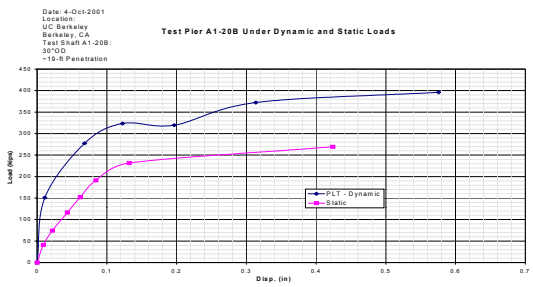

Figure 1 – Load vs. Displacement

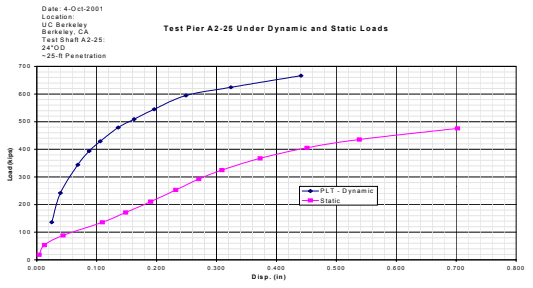

Figure 2 – Load vs. Displacement

For further information

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Acknowledgment

This work was jointly supported by the University of California capital Projects and Pacific Earthquake Engineering Research Center.

References

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Keywords

Drilled piers, displacement, load, static, dynamic, gage, ultimate capacity, optical, test, area, PLT.