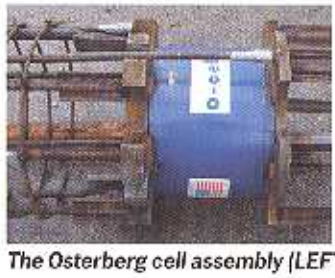
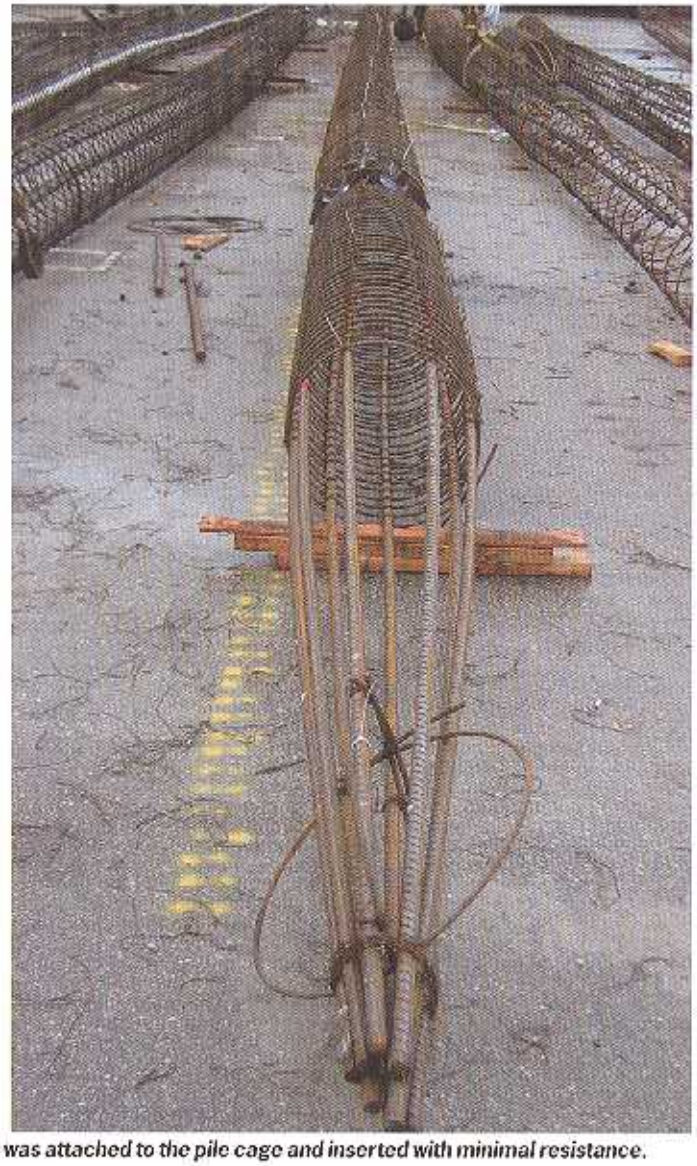
PILE TESTING

HIGH SOCIETY

Deep bi-directional static load tests have helped a Florida contractor test large CFA piles for skyscrapers in Miami. Melvin England reports.

The test only requires a reference beam.





The Osterberg cell assembly (LEFT) was attached to the pile cage and inserted with minimal resistance.

Demand for condominiums and high rise offices is taking off in many parts of the US, and Florida is no exception.

In Miami, Tampa and Jacksonville the skyline is changing rapidly. More than 50 buildings of 20 storeys or more are under way in the Miami area alone. These projects need to be completed quickly and efficiently.

Foundation load testing firm Loadtest was contracted by Miami-based contractor HJ Foundation to carry out bi-directional Osterberg cell (O-cell) static load tests on piles at two projects in Miami. Both schemes involve augercast (CFA) piles to depths exceeding 30m for working loads of about 8,000kN.

A bi-directional static load test requires a hydraulically driven, high capacity, sacrificial jack-like device – the O-cell – to be cast in the pile at a level where equal resistance exists above and below, so that when pressurised, the two elements of the pile react against each other in a manner similar to performing two conventional load tests simultaneously (*EF* Summer 2003).

There are sceptics who are reluctant to try to insert O-cells mounted on the reinforcing steel cage into CFA piles as these have to be plunged through wet concrete or grout to the required depth.

Reinforcing cages with lengths up to 12m are common in concrete, with greater lengths sometimes installed with the assistance of cage vibrators, particularly as the steel cross-section becomes a significant proportion of the pile.

Although an appropriate O-cell for the test loads required might measure about 25% of the cross-sectional area of the pile, insertion into wet concrete/grout is not an insurmountable difficulty because the assembly is not long.

Ground conditions on these projects are typical for Florida, mostly sand underlain by dense layered sandstone. During a bi-directional O-cell test the load is applied equally in both directions and in these cases directly at the critical sand and sandstone interface.

HJ Foundation used a crane-mounted hydraulic CFA rig to form the 610mm and 760mm diameter, 31m and 38m long test piles. The 330mm and 410mm diameter O-cells were placed at 21m and 30m within the cage assemblies.

As is usual in Florida, the piles were filled with grout, which in these cases also contained pea shingle less than 10mm in size and a retarder. The grout and fine aggregate mix was designed for a typical strength of 55N/mm^2 and a slump of 200mm.

The full length reinforcing steel cages with the O-cells fixed to them were then lowered into the grouted holes. The O-cell and cage assembly slipped smoothly through the grout with minimal resistance. Both cages reached the pile base without incident or difficulty and the O-cells were located precisely at their predetermined levels.

Unique to the O-cell method is the ability to conduct the test without overhead kentledge or reaction system. The implications for improved site safety are obvious, as is the applicability to congested areas and low headroom. At ground level, the only requirement is for a reference beam for the duration of the test.

Testing started after grout reached the required 28 day strength. Both piles proved to be robust and the test load exceeded ultimate design capacities on both projects. Total mobilised loads applied exceeded 12MN for the 31m pile and 19MN for the 38m one, with relatively small movements indicating the capacity was higher than the loads mobilised.

If the load tests had been performed by application of load at the pile head, stresses of about 42N/mm^2 would have been required: perhaps too close to the structural strength of the column for it to be a practical option.

The Miami projects illustrate how careful control of the cementitious mix can allow a steel reinforcing cage, complete with O-cell assembly and instrumentation, to be inserted into bored depths of 38m using only gravity. These are the deepest O-cells installed and used in CFA piles, which are believed to be the largest installed in North America.

Melvin England is director of Loadtest in the UK.