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

DEMAND for conditions 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 30 buildings of 20 stories 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 bidirectional Osterberg cell (O-cell) static load tests on piles at two projects in Miami. Both schemes involve auger cast (CPA) piles to depths exceeding 50m 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 pressurized, the two elements of the pile react against each other in a manner similar to performing two conventional load tests simultaneously (FF Summer 2003).

There are exceptions who are reluctant to try to insert O-cells instead of the reinforcing steel cage into CFA piles as these have to be charged through wet concrete or grout to the required depth.

Reinforcing cages with length 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 the wet concrete/grout is not an insurmountable difficulty if the assembly is not long. Ground conditions on these projects are typical for Florida, mostly sand with little by dense layered siltstone. During a bi-directional O-cell test, the load is applied equally in both directions and in these cases directly at the critical load and resistance interface.

HJ Foundation used a crane-mounted hydraulic CPA rig to form the 600mm and 760mm diameter, 3m and 8m long test piles. The 300mm and 400mm diameter O-cells were placed at 2.1m and 8m within the cage assemblies.

As is usual in Florida, the piles were filled with grout which in these cases also contained peat similar to that of 15% in sand and a retarder. The grout and fine aggregate mix was designed for a typical strength of 25N/mm² and a slump of 200mm.

The full length reinforcing steel cage with the O-cells fixed to them were then lowered into the ground holes. The O-cell and cage assembly were slipped smoothly through the grout with minimal resistance. Bell 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 went well 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 3m pile and 15MN for the 8m one, with relatively small movements indicating the capacity was higher than the loads mobilised.

If the load test had been performed by application of load at the pile head, stresses of about 42N/mm² 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 CPA piles, which are believed to be the largest installed in North America.

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