Lateral thinking in Tampa

DYNAMIC TESTING techniques developed for pile driving have been used to monitor driving of a horizontal steel casing under a road and railway in Tampa, Florida.

US pile integrity testing company Goble Rausche Likins used the Pile Driving Analyzer from sister firm Pile Dynamics for the project. GLR said the information obtained dramatically reduced the installation time on a second casing on a nearby site.

Contractor Ballast Nedam International and engineer HDR Engineers installed the 3m diameter, 91m long steel casing in spring 2001. The casing comprised 9m long steel sections with 25mm thick walls. The sections were joined with a high strength mechanical connector instead of welding each joint. Horizontal driving was carried out with an IHC S-90 hydraulic pile driving hammer with ram weight of 44.14kN.

The total number of blows needed to drive each section ranged from 4,000 to more than 20,000. Driving was controlled on site to achieve driving resistance blow counts in the range of 100-200 blows per 250mm of penetration.

GRL, working for HDR Engineers, performed dynamic testing during the two-week installation. Testing objectives included monitoring the performance of the hammer-casing system and evaluating soil behaviour.

GRL used a Pile Driving Analyzer Model PAK and performed additional analyses on data with its patented CAPWAP analysis software.

The PDA and CAPWAP analysis were originally developed for pile driving monitoring and dynamic load testing on bearing piles. As piles are normally installed vertically or at not more than 45°, to apply the same analysis methods to horizontal testing meant adjusting soil stiffness and damping parameters, says GRL. However adapting the procedure for the horizontal application was straightforward and yielded invaluable results, the firm said.

Dynamic measurements of strain and acceleration were typically taken 1m from the driving end of the casing section. Four strain transducers and four accelerometers were bolted to the side of the casing, covering about two thirds of its circumference.

Strain and acceleration signals were converted to forces and velocities by the PDA and stored digitally for later reprocessing. During driving, these force and velocity records were continually viewed on the analyser's LCD screen to evaluate data quality, casing integrity and qualitative aspects of soil resistance.

Other measurements taken near the driving end of the casing included maximum impact compression force and stress averaged from all four strain transducers, maximum velocity and displacement, maximum transferred energy, blows per minute and total soil resistance.

CAPWAP analyses indicated that the static component typically ranged between 20% and 40% of the total resistance, with about 40% of the soil resistance provided by end bearing (at or near the casing end). Results also provided more precise information on soil resistance parameters, maximum forces, stresses, transferred energy and displacements throughout the casing length.

An analysis of the monitoring data revealed that energy was being lost in the mechanical joints. Therefore, when a second horizontal casing was driven some time later, a larger IHC S-280 hammer was used.

This second, shorter, crossing project was accomplished in only two days compared with the two weeks required for the first crossing.