GRL engineers, inc.

Pile Dynamics, Inc.

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Pile Dynamics Celebrates 30th Anniversary

Pile Dynamics, Inc was founded in August 1972 to provide engineers, contractors, owners and agencies with an innovative tool for pile testing: the Pile Driving Analyzer®. Our PDA is now used all over the world, with many codes of practice incorporating PDI's quality assurance methods. During these past 30 years, PDI expanded its product range, but has remained focused on the deep foundations industry. Through joint efforts with our many clients, our technical team developed high performance, technically unsurpassed equipment. We thank our clients and staff who have made these achievements possible.

Crosshole Sonic Logging

by Scott Webster, GRL Engineers, Inc.

Crosshole Sonic Logging (CSL) is performed on a growing number of projects throughout the United States. CSL tests the concrete quality of recently constructed drilled shafts using steel or PVC access tubes placed around the perimeter of the reinforcing cage during construction. A transmitter and receiver are placed at the bottom of two parallel water filled tubes and then raised together to the shaft top while sonic/ultrasonic waves are transmitted between the tubes at intervals of a few inches. In this way, a log of the drilled shaft over depth is recorded and voids, soil inclusions, or weak concrete can be identified.

Research on CSL technology started in the 1970s in France, but a commercial system became widely available only in the late 1980s. By the mid 1990s, the FHWA and State Highway engineers began specifying CSL testing on a regular basis and in 1997 GRL began providing CSL services. Pile Dynamics, Inc., then developed a second generation CSL tester.

GRL has performed CSL testing with PDI's Cross Hole Analyzer™ (CHA) on numerous USA projects. The Windows® based CHA collects, evaluates and presents data to 100 m depth (with standard cable) or more. Two independent depth sensors allow the receiver and transmitter positions to be known at all times. This facilitates placing of sensors to different elevations for an improved evaluation of defect size and location. As a safety measure, the voltage in the probe cables is only 12 Volts which then is amplified in the transmitter to 800 Volts for clear signal transmissions through over 3.5 m of sound concrete. Replaceable probe cables feature a rugged polyurethane jacket for extended life. During data collection or reanalysis, the CHA user can choose to view processed results of wavespeed, signal arrival time, relative signal energy (on left half of each figure pair shown), along with a traditional "waterfall diagram" and all of the original signals (not shown here) in English or SI units. PDI's CHA complies with and exceeds the requirements of ASTM D6760.

Generally, GRL's experience suggests that the percentage of defective shafts on a given project is relatively small. However, on a recent project three of the fifty shafts tested were found to have defects. The original testing program consisted of testing only four out of fifty shafts. The left CHA record shown here, for tube pair 1-6 of one of these four shafts, clearly suggested a problem. After the CSL testing revealed this defect, the shaft was cored, confirming segregated concrete, i.e. mostly gravel, at the depth indicated. Post grouting of the zone of bad concrete was then performed and CSL testing was repeated. The right half of the figure shows a CSL record taken after the remedial grouting, and confirming that the grouting substantially improved the concrete quality in the affected zone.

After CSL revealed this production shaft with segregated concrete in the shaft middle (14 m depth), it was decided that all shafts should be CSL tested. Two more defective shafts were found, this time with a problem "soft toe". These shafts were core drilled to confirm the CSL results and were repaired by post grouting. Again, CSL tests performed after remedial grouting confirmed adequately repaired shafts.

Results such as these clearly show the need for quality control inspection of drilled shaft installations. Had the decision to extend testing to all shafts not been made, the two shafts with soft bottoms would not have been discovered. This would have resulted in a deficient foundation for the affected bridge piers.

Drilled shaft foundations tend to have reduced redundancy. making the quality of each shaft more important. It is suggested that all drilled shafts should have CSL access tubes installed to facilitate possible testing, should questions arise during construction. In our opinion, the cost of testing is small compared to the cost of potential failures due to defective shafts.

Original CHA Record

CHA Record after Post Grouting