Florida Department of Transportation Research

Embedded Data Collector (EDC) Evaluation Phase II - Comparison with Instrumented Static Load Tests

BDK75-977-24

Monitoring installation of driven pile foundations is critically important to ensure adequate safety of structures with piles, such as the many bridges which are maintained by the Florida Department of Transportation (FDOT). Dynamic load testing of driven piles is currently the method preferred by industry because it is cost effective and reliable for assessing static capacity. Prior to the use of the Embedded Data Collector system (EDC) in construction, dynamic load testing was accomplished using the pile driving analyzer (PDA), coupled with CAPWAP (Case Pile Wave Analysis) and wave equation analysis. This method involves external gauges fixed to the top of the pile, from which stresses and capacity vs. depth are computed using the Case capacity equation with the Case lumped damping parameter.

EDC comprises strain and accelerometer gauges placed near the top and bottom of the pile, from which stresses at both locations, total pile capacity, and end bearing can be displayed for every blow of the hammer. In addition, since the instrumentation is cast into the piles, there is no need to climb the leads to attach the gauges to the pile, thus speeding up the driving process. In a previous project for FDOT (BD545-87), researchers evaluated the effectiveness of EDC by comparing it to PDA/CAPWAP. That project yielded promising results, prompting FDOT's geotechnical team to pursue implementation of EDC.

In this project, University of Florida researchers evaluated EDC's reliability by comparing its results with static load tests, including comparison of predicted stresses, such as top and bottom compression, tension, energy, and damage, as well as capacity as found by a number of methods. In addition, for adoption of the EDC technology, FDOT required that load and resistance factor design (LRFD) parameters be established for EDC, based on instrumented static load tests. Also of interest was a comparison of skin friction and tip resistance predicted by EDC.

Correct installation of pilings is critical for ensuring the stability and safety of structures such as bridges.

For the dynamic load testing comparisons, researchers considered 139 instrumented piles tested with EDC, PDA, and CAPWAP both at end of initial drive and beginning of restrike. A total of 213,000 hammer blows were monitored and evaluated. For comparison, data were analyzed using five versions of SmartPile Review software. To improve or provide alternative assessment of skin friction, tip damping, etc. with EDC gauges, further research was performed and evaluated on piles for which static load testing was available.

For the LRFD assessment of the software package SmartPile Review, data for 12 static pile tests were collected along with EDC, PDA, and CAPWAP results. From the 12 piles, 17 independent measurements (i.e., total, skin, and tip capacities) were recorded. Independent values were identified as total and tip capacities for top-down tests and skin friction for uplift tests. The addition of results from five static load tests to the database will take place under a separate contract with the University, and resistance factors for LRFD will be provided at that time.

Continuing efforts to characterize the EDC system through efforts such as this project promise to bring this effective and efficient method to implementation in the near future.

Project Manager: Rodrigo Herrera, FDOT Geotechnical Office
Principal Investigator: Michael McVay, University of Florida
For more information, visit http://www.dot.state.fl.us/research-center