Florida Department of Transportation Research

Embedded Data Collector – Phase II Load and Resistance Factor Design

July 2015

Project Number
BDV31-977-13

Project Manager
Rodrigo Herrera
FDOT Structures Office

Principal Investigator
Michael McVay
University of Florida

Current Situation

Piles that support bridge structures are designed for the specific site characteristics and loads that the piles are expected to bear. In Florida, driven piles are monitored during installation ("dynamically" tested) to assess resistance, compressive, and tensile stresses and to provide production pile lengths and driving criteria based on test pile findings (depth to bearing layer, required hammer settings, etc.). Dynamic load testing of driven piles is cost effective and has proven to be a reliable alternative to static load testing. Conventional dynamic load testing has historically been performed by climbing the leads to connect instrumentation (strain gauges and accelerometers) to the pile head after the pile has been raised into position. The current effort focused on the Embedded Data Collector (EDC) system, originally developed through research funded by the Florida Department of Transportation (FDOT) and consisting of gauges cast into concrete piles, eliminating the need for climbing leads on site. The system uses wireless technology to transmit data to a receiver on the ground.

Arrays of piles have been placed, and a barge is used to set the columns which will carry the roadway.

Research Objectives

The objective of the research was to develop resistance factors for Load and Resistance Factor Design (LRFD) design of driven piles using the Embedded Data Collector (EDC) system. In a previous research effort, the system compared well to dynamic load testing equipment. In this phase, a step toward implementation was taken by evaluating the reliability of EDC methods and comparing EDC results with static load tests.

Project Activities

An FDOT bridge project at Choctawhatchee Bay in Santa Rosa County provided an opportunity to monitor the installation of five piles that were subsequently statically load tested. Skin, tip, and total (skin + tip) resistance was predicted using three analytical methods, namely: UF-method (computes damping in real time after every hammer strike, eliminating the need for signal match analysis); fixed damping factor method (uses a constant damping factor for the entire drive, similar to conventional dynamic load testing); and a method developed by Dr. Khiem Tran of Clarkson University. Because the piles had a hollow core to control weight, it was possible to compare stresses and resistances using instrumentation located on both the solid and voided sections along the piles.

The researchers compared results from the three methods of predicting tip, side, and total resistance against static resistance (Davisson) for the five piles tested at Choctawhatchee Bay, as well as several other load tests from UF's database, to recommend LRFD resistance factors.

Project Benefits

This project introduces an alternative method of dynamic load testing of concrete driven piles. EDC eliminates need to climb leads on site, provides measured compressive stress near the pile tip, and eliminates need for signal matching while providing real-time damping factors for every hammer blow (UF-method).

For more information, please see dot.state.fl.us/research-center