Pile Dynamics, Inc.



100% Dynamic Load Testing for Roadway Projects

The practice of 100% dynamic pile testing optimizes construction efficiency and economy and increases engineering reliability. On many design/build type projects, the contractor and the design engineer elect to implement 100% dynamic load testing to expedite the work, save time and money, and allow the use of lower safety factors in conventional allowable stress design procedures (or higher resistance-factors in LRFD designs). In the United States, the Federal Highway Administration (FHWA) has allowed higher design resistance factors (i.e., lower factors of safety) for piles where certain amounts of testing take place. Table 1 from FHWA GEC 012 – Volume I presents the various resistance factors depending on field determination methods including dynamic testing.

Project Details

Contractor: Florida Department of Transportation (FDOT)

Engineer: GRL Engineers, Inc. (Testing Company)

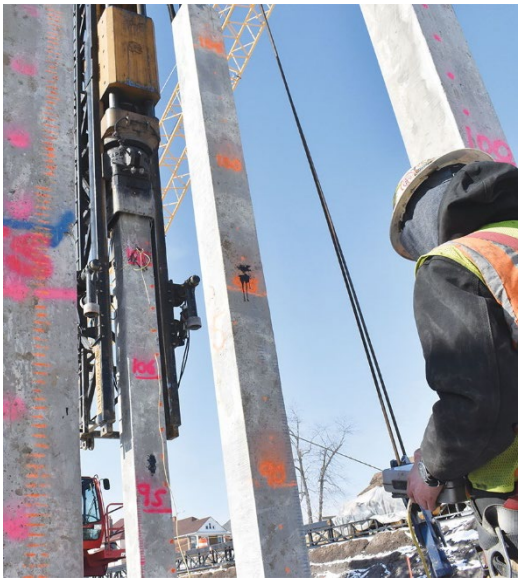
Location: Florida

Testing:

- GRLWEAP Analyses
- Dynamic Load Testing with the Pile Driving Analyzer® (PDA)
- CAPWAP® Analysis

1000-Meter-Long Bridge Design/Build Project

A design/build project for the construction of a 3,300 ft (1000 m) long bridge in Florida utilized 100% high strain dynamic testing. All 210 production piles and 12 initial probe Test Piles were tested with the Pile Driving Analyzer® (PDA) and data were analyzed with the CAPWAP® signal matching software. The piles were square precast prestressed concrete piles (24-in (610 mm)), with lengths varying between 65 and 140 ft (20 to 43 m). **According to the contractor, this approach to the piling work saved 17% of the foundation cost.**



SR 528 Central Florida Expressway Reconfiguration

The $118-Million SR 528 Central Florida Expressway reconfiguration was initiated to create a smoother, efficient transition for heavy Orlando International Airport Traffic flow on the Beachline Expressway. GRL Engineers performed GRLWEAP Analysis for pre-construction planning. Pile driving monitoring with the PDA was conducted during pile installations and restrike, and CAPWAP analyses were performed following driving. **The project was completed 8 months ahead of schedule – a marked accomplishment by any construction standards.**

Pensacola Bay Bridge Replacement

FDOT's Pensacola Bay Bridge connects the cities of Pensacola and Gulf Breeze in the Florida Panhandle. The route is one of the most important transport corridors and evacuation routes in the area. The replacement bridge project involved an expanded bridge design, constructed as a $480-Million Design-Build project, involving construction of two independent three-mile-long bridge structures extending from 2 to 3 lanes of traffic in each direction and providing an operationally safe transportation corridor for the traveling public. A total of 1,214 large precast prestressed concrete piles were utilized, some of which were 200-feet long. The Dynamic Testing Engineer of the design/build team performed 100% pile testing with the Pile Driving Analyzer (PDA) on the project and GRL Engineers conducted PDA Independent Verification Testing and related CAPWAP data analyses as part of the CEI services representing FDOT.

All Aboard Florida Passenger Rail

The All Aboard Florida Passenger Rail includes trains operating at speeds up to 125 mph to reduce travel time between the Central and Southern regions of Florida. Dynamic pile testing with the PDA was provided by GRL Engineers who also performed related services for various structures along the 35-mile-long portion of the rail between Cocoa and Orlando International Airport. For efficiency, GRLWEAP analyses were first performed to determine optimal hammer systems selection for the various pile sizes and end bearing capacities. The Pile Driving Analyzer and CAPWAP Signal Matching data analyses were used to determine the ultimate load bearing capacity for test piles and production piles. Some bridge locations utilized test piles and driving criteria for production piles, while others utilized 100% dynamic pile testing. Many of the long prestressed concrete piles required splicing. Monitoring the pile installations with the Pile Driving Analyzer (PDA) was critical so that driving stresses were kept within allowable limits to avoid pile damage.

Dynamic Testing Benefits Infrastructure Projects

Increasing the resistance factor for design has many advantages, including the use of smaller or shorter piles, smaller installation equipment, faster pile installation, and a reduction in the overall foundation carbon footprint. In many cases, as presented here, **the quickest and most efficient method to increase the resistance factor, according to the FHWA GEC 012 publication, is to increase the amount of dynamic testing to 100%**. Either through preplanning of the testing scope or during foundation construction, the implementation of 100% dynamic pile testing is a convenient and cost-effective tool that can be useful in the success of deep foundations projects.

To learn more Pile Dynamics, visit www.pile.com or email us at info@pile.com.

Table 1. Resistance Factor for Field Determination Methods from FHWA GEC 012 – Volume I

Condition	Resistance Determination Method	Resistance Factor
Nominal Geotechnical Resistance of Single Pile in Compression Dynamic Analysis and Static Load Test Methods, ϕdyn	Driving criteria established by successful static load test of at least one pile per site condition and dynamic testing* of at least two piles per site condition, but no less than 2% of the production piles.	0.80
	Driving criteria established by successful static load test of at least one pile per site condition without dynamic testing.	0.75
	Driving criteria established by dynamic testing* conducted on 100% of production piles.	0.75
	Driving criteria established by dynamic testing*, quality control by dynamic testing* of at least two piles per site condition, but no less than 2% of the production piles.	0.65
	Wave equation analysis, without pile dynamic measurements or load test, at End of Drive conditions only.	0.50
	FHWA Modified Gates dynamic pile formula (End of Drive condition only).	0.40
	Engineering News (as defined in AASHTO) dynamic pile formula (End of Drive condition only).	0.10
Nominal Geotechnical Resistance of Single Pile in Tension, ϕdyn	Static load test.	0.60
	Dynamic testing* with signal matching.	0.50

* Dynamic testing requires signal matching, and best estimates of nominal resistance are made from a restrike test. Dynamic tests are calibrated to the static load test, when available.