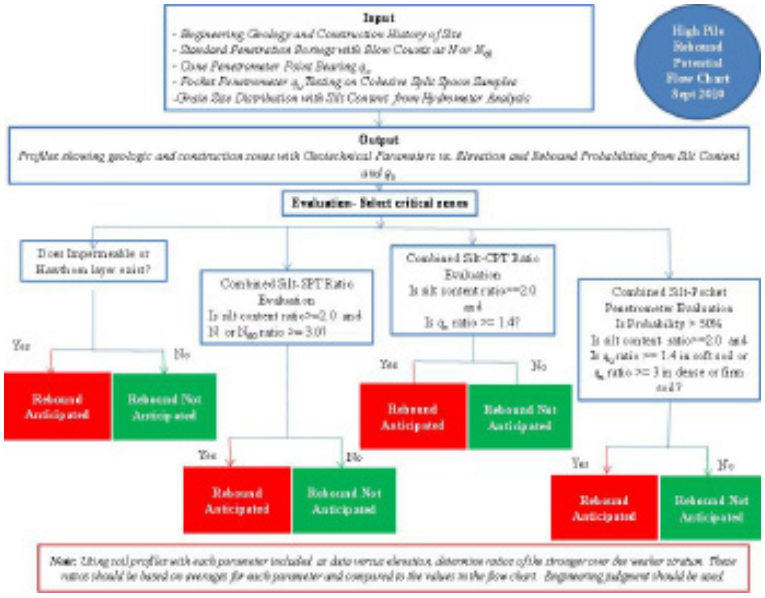
Florida Department of Transportation Research

Design Phase Identification of High Pile Rebound Soils
BDK81 977-01

FDOT engineers have experienced excessive pile rebound problems when installing large diameter pile foundations in certain soils types located in Districts 2, 3, and 5. During driving, piles have been observed to rebound up to one to two inches per blow, yielding costly construction delays, change orders and adversely affecting compliance with FDOT's bearing penetration specification.



The objective of the researchers at the Florida Institute of Technology, Department of Civil Engineering was to develop a design-phase geotechnical testing protocol to help FDOT and consulting engineers identify conditions that may produce high pile rebound when combined with certain pile driving combinations.

To develop soil profiles with strength and stiffness data, field and laboratory testing was conducted at two problematic FDOT project sites in the Orlando area and a third in the Florida Panhandle. The field-testing included conventional borings, pocket penetrometer unconfined compressive tests, cone penetrometer soundings with point bearing, sleeve friction and pore water pressure measurements, pressuremeter tests, and dilatometer soundings. Lab testing on disturbed samples yielded natural moisture contents plus grain size with hydrometer data, while testing of thin walled tube samples produced permeability and triaxial shear parameters. Pile Driver Analyzer (PDA) data was used to clarify the extent and amount of pile rebound, and a statistical analysis method was developed to evaluate rebound.

By combing PDA data, soil profiles, and geo-technical parameters, the researchers identified significant changes in soil properties between the overlying no-rebound zone soils and high rebound soils. Researchers proposed a procedure allowing engineers to evaluate soil properties using ratios of the no-rebound to rebound soils, requiring them to 1) construct a soil profile that includes geologic and construction history data, and 2) add geotechnical engineering parameters versus elevation. Once completed, this profile should be used to determine variations of 1) silt content, 2) soil strength, and 3) soil stiffness. A recommended logistic regression equation can also be used to predict the probability of high pile rebound by inputting the silt content and pocket penetrometer unconfined compressive strength values into the governing equation.

Researchers developed a flow chart outlining the process to help guide engineers through the decision making process for anticipating and possibly avoiding high pile rebound during construction. Avoiding rebound will result in significant monetary and time related savings. FDOT anticipates using data from future pile driving projects to validate the research and improve the database.

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For more information, visit http://www.dot.state.fl.us/research-center