

JUST THE FACTS

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**Estimating the Setup of Piles Driven into Louisiana Clayey Soils**

**PROBLEM**

Pile setup in saturated cohesive soils is a time dependent phenomenon, in that the friction resistance capacity of pile increases with time. Field observation indicates that pile setup is significant in the coastal area of Louisiana and that the driven pile capacity can continuously increase for a long period after pile installation. The ultimate capacity of a driven pile can be much greater than the initial capacity obtained immediately after installation, as reported by case histories in the literature and local field testing data in Louisiana.

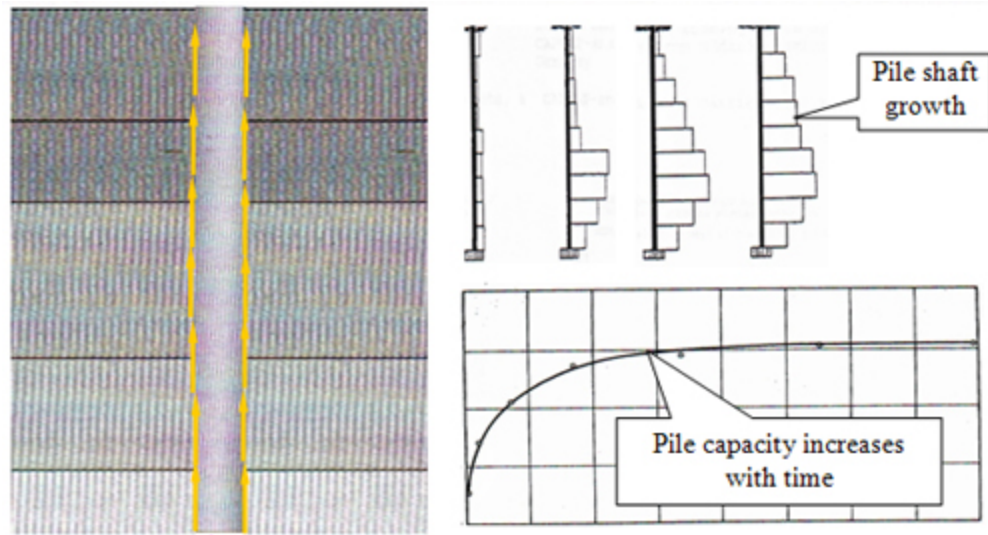
The Louisiana Department of Transportation and Development (LADOTD) spends millions of dollars annually on the construction of driven pile foundations. The current design practice for driven piles at LADOTD is based on pile resistance at 14 days after initial driving, and due to the lack of a systematic approach to handling the issue, the long term development of pile capacities is not considered. Such has led to a conservative pile design for many projects. Therefore, the need for the development of a reliable design methodology that will account for the benefit of pile setup phenomenon during the pile foundation design and allow for a more cost effective pile design exists. A prediction method for pile setup and a field calibration/validation method during construction are expected to be developed for use. The research shall identify the conditions in which pile setup may be considered in design, magnitude and rate of pile setup, reliability associated with the setup estimation, and resistance factors to be used in load and resistance factor design (LRFD).

**OBJECTIVES**

The objective of this research is to provide LADOTD engineers with a simple, rational, and accurate method for predicting the capacities of piles over time after driving in varied soil conditions.

SPECIAL POINTS OF INTEREST:

- Problem Addressed
- Objectives of Research
- Methodology Used
- Implementation Potential



Pile Setup Prediction

## **METHODOLOGY**

The research team will identify the factors governing the setup, relate the setup magnitude and rate to pile and soil types, and make recommendations regarding the beneficial use of the pile setup based on the research results. A significant research effort will be made in an attempt to incorporate the effect of excess pore pressure dissipation and soil aging into the pile setup prediction equations. To use the existing geotechnical exploration methodology and testing to estimate pile setup is preferable. Magnitude and rate of pile setup, reliability associated with the setup estimation, and resistance factors to be used in load and resistance factors design (LRFD) will be analyzed and evaluated. Subject to the availability of pile setup data, the proposed research will focus on:

- The establishment of a database including all available pile testing data in Louisiana. The database will be easily manipulated, regrouped, plotted, displayed, and printed as needed. All calculations will be embedded in the database.
- The application of the semi-logarithmic model to Louisiana soils to obtain pile setups at different times for different types of soils at different pile foundation sites.
- The reliability analysis of the pile setup and the incorporation of the significant growth of pile capacity from setup into the LRFD method, corresponding to different setup time.
- The enhancement of the quality of the pile setup prediction equation and the development of new mathematical models, such as the bearing capacity growth rate-based differential equations.
- The development of a mechanistically-based model that incorporates the factors of pore pressure dissipation and frictional angle increase due to soil aging. (No pore pressure data is required.)
- The validation and improvement of the established model by applying it to those completed and ongoing projects.

## **IMPLEMENTATION POTENTIAL**

The research team will work with LADOTD to provide guidelines for the future pile foundation design considering long-term pile setup. The research may lead to a more cost effective pile design in the future, which will be integrated into relevant specifications. Recommendations will be made regarding the beneficial use of the pile setup based on the research results. The developed mathematical models could potentially be applied to pile foundation practices of other states. Detailed recommendations on the future research effort of pile setup will also be made.



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*For more information about LTRC's research program, please visit our Web site. [www.ltrc.lsu.edu](http://www.ltrc.lsu.edu)*