Florida Department of Transportation Research

Phase II: Field Load Testing of Shallow Foundations in Florida Limestone

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Current Situation

Most bridges in Florida are supported by deep foundations, however, some areas in the state have near-surface competent limestone layers. These layers can be utilized to support bridge structures providing substantial savings to the State by eliminating the need for driving piles or installing drilled shafts.

As shown here in a sample taken in the vicinity of the load test, Miami limestone has very high variability as well as a wide range of porosities. From left to right, high variability with high porosity (left) to low porosity (right).

This project was Phase II of an ongoing investigation focused on characterizing the engineering properties of near surface calcium-carbonate formations. Phase I (BDV31-977-51) investigated the ultimate strength and load-settlement response as a function of confining stress and made extensive use of a high strength triaxial cell specially constructed for testing soft rock. It concentrated mainly on the development of a strength-envelope for Florida limestone—like that of Mohr-Coulomb strength envelope for soils—and produced a series of design equations for shallow foundation design on limestone formations.

Phase II sought to validate some of those results.

Research Objectives

The objectives of this research project were to validate the Phase I bearing capacity equations as well as methods for estimating footing settlement under service and ultimate load states.

Project Activities

The University of Florida research team conducted three shallow foundation load tests at different locations under different boundary conditions to validate the Phase I bearing capacity equations. This also included different limestone strengths and formations in South Florida.

The first test involved a 42-inch by 42-inch booting embedded 3 feet below the water table in Miami limestone. The second involved a 60-inch by 72-inch footing on a 10-foot-thick layer of Miami limestone overlying sand to validate the punching-shear models developed under Phase I. The final test involved a 60-inch by 60-inch footing in a strong 5-foot-thick Ocala limestone layer over a weathered limestone mixed with loose sand and soft clay.

For each test, different levels of pressure were applied to assess the parameters of rock near the footing. The team then tested various methods to predict load settlement and made recommendations for implementation.

Project Conclusions and Benefits

Results were consistent with the Phase I bearing capacity equations. Phase III of this effort will focus on implementation of the design equations into software that can be utilized by geotechnical and structural designers to adequately evaluate shallow foundation performance for bridge support in Florida.

For more information, please see fdot.gov/research.