Request for Research Funding for FY 2022-2023			
SPR Subpart B Project: GEO-23-02			
Requesting Office	Geotechnical	**Priority**	2 of 4
Proposed Title	Implementation of Shallow Foundations on Florida Limestone in FB-MultiPier		
Justification	"Phase one" of this effort (BDV31-977-51) was very successful in accomplishing the goal of developing of a strength envelope for Florida limestone. "Phase two" (BDV31 TWO 977-124) and its three field load tests will validate the laboratory and finite element modeling from the previous project. Therefore, this project will take those projects' deliverables and implement the model into FB-Multipier software. Current AASHTO and NCHRP design methods for shallow foundations bearing on rock employ Hoek-Brown shear strength criteria, which are based on laboratory testing of rock core samples from sedimentary, igneous and metamorphic rocks with strength envelopes increasing with confining stress. However, FDOT research (BDV31-977-51) has shown Florida Limestone to be very sensitive to its bulk dry unit weight, confining stress and applied stress. For instance, laboratory testing of 100 pcf Miami Limestone cores revealed the rock's strength increased with confining stress, but subsequently diminished and even crushed at high confinement (>1,000 psi). Based on that project's laboratory testing and FE numerical models of shallow foundations with strength as a function of dry unit weight and confining stress, the ultimate capacity (i.e. bearing capacity equations) for footings on Florida Limestone were developed. The three field load tests performed to failure for the project BDV31 TWO 977-124 verified the adequacy of the developed bearing capacity equations under different conditions, i.e. different rock formations, unit weights, index measurements, as well as foundations of different sizes and depths. Implementation of these improved (field verified) bearing capacity equations will significantly improve current practice, i.e. use of rock's cohesion only or Hoek-Brown strength in existing bearing capacity equations.		
Impact	This project will take the previous projects' deliverables, the design methodology that has been field verified, and implement them into the FB-Multipier software platform that structural designers are comfortable with. The implementation of such a tool in design would allow for proper evaluation of the benefits of shallow foundations for certain projects, and the anticipated cost savings in those projects would be significant.		
Affected Offices	Materials (Geotechnical), Structures Design, and Construction. Updates by the researcher will be presented in annual Geotechnical Research in Progress (GRIP) meetings to district geotechnical staff and consultants.		
Existing Work	The previous efforts of developing a shear strength envelope and bearing capacity equation for shallow foundations, that has been calibrated with Florida rock, is the first of its kind and is ready for software implementation. This phase of the effort will be to implement those findings into the current FB-Multipier software platform that structural designers are comfortable with.		
Keywords Used In Existing Work Search **(Cannot leave blank)**	shallow foundations, bearing resistance, shallow foundation load test, footings on limestone, plate load test		
Related Contracts (Give contract numbers)	The following FDOT research contracts and associated papers: BDV31-977-51, Strength Envelopes for Florida Rock and Geomaterials BDV31 TWO 977-124 Field Load Testing of Shallow Foundations in Florida Limestone		
Funding Request	$200,018	**Anticipated Duration**	24 months
Project Manager	Rodrigo Herrera & David Horhota	**Contracting Method**	Direct contract with University of Florida (Drs. Michael Davidson & Scott Wasman)

Equipment	N/A	
Urgency	1	The use of shallow foundations has seen an increase in Design-Build type contracts, and rock strength methods that are locally calibrated are required to provide cost effective, reliable designs.
Implementability	1	Based on the successful findings of BDV31-977-51 and BDV31 TWO 977-124, developing a shear strength envelope and bearing capacity equation for shallow foundations (that has been calibrated with Florida rock), those deliverables are ready for software implementation. This phase of the effort will be to implement those findings into the current FB-Multipier software platform that structural designers are comfortable with.

Project Benefits (Succinct, complete explanation)

Current practice under conventional contracting methods in which the bridge designer works for the Department, and a finalized set of plans is provided to a construction contractor, is to use deep foundations for the vast majority of projects. In many instances substantial savings could be achieved if structural designers had a tool they could use to analyze the shallow foundation alternative in a design environment they are comfortable with. The goal of this project is to provide such a tool to designers (implementation of the previous projects' results into the FB-Multipier software), which will result not only in more frequent use of shallow foundations but will ensure that the model being used to design bridge footings is applicable to local conditions. The benefit to the State once the project is finalized is to provide foundation cost savings while maintaining the required level of reliability.

Project Benefits **(Select all that apply and explain)**	**Quantifiable Benefits (units, dollars, etc…if applicable)**	**Methodology or Data Sources Used to Determine Quantifiable Benefits. If not applicable, please give justification of project benefits**
o Materials Enhancement		
o Materials Savings	≈ $200,000	Assuming a project with 50 piles, 60 feet long each at $100/foot. While the piles would be eliminated from the project there would likely be some cost associated with a deeper excavation for footing construction, therefore not all the potential savings (50*60*100 = $300,000) would be realized.
o Time Savings	$10,000 to $200,000 per construction project	Depends on the project size
o Lives Saved/Injuries Prevented	Significant	Substantial improvements in this area are anticipated since there are regularly incidents that resulted in injuries/death during pile driving operations.
o Other (Explain)	Advancement of the state-of-practice	Providing a design tool (that structural designers are comfortable with) for shallow foundation design in Florida limestone is a significant advancement in current practice.

*Comments should explain and support urgency, financial benefit, and implementability scores