Request for Research Funding for FY 2022-2023			
SPR Subpart B Project: GEO-23-03			
Requesting Office	Geotechnical	**Priority**	3 of 4
Proposed Title	Determination of in-situ rock density and strength with SH-Love wave tomography		
Justification	As part of the implementation for projects BDV31-977-51: Strength Envelopes for Florida Rock and Intermediate Geomaterials and BDV31 TWO 977-124: Field Load Testing of Shallow Foundations in Florida Limestone, it was determined that identifying the in-situ rock density was critical to effectively design shallow foundations for Florida limestone. Recognizing that shallow foundations would provide a much cheaper bridge foundation than alternative deep foundations if designed properly, a means to identify the rock density and strengths would be needed. The proposed project has shown that this new and innovative geophysical test method can be used to assess the large scale (big picture) picture of the site's rock to determine if the site is a viable option to use shallow foundations and a means to direct rock coring operations to obtain the design parameters needed to design the shallow foundation.		
Impact	As with all geophysical tests, they have the advantage over conventional borings or soundings to assess the soil properties over a larger test area. Soil properties have been shown to change over a relatively small area and these changes can be missed by conventional testing. Therefore, the test method developed from this project can be used at sites with limestone at the surface (especially in Miami-Dade County) as candidates for shallow foundations for bridges. The results can be used to assess the site's rock density and strength to determine if is a viable option to use shallow foundations and a means to direct rock coring operations to obtain the design parameters needed to design the shallow foundation based upon the design methodologies from projects BDV31-977-51 and BDV31 TWO 977-124.		
Affected Offices	Geotechnical, Design, Materials. Updates by the researcher will be presented in annual Geotechnical Research in Progress (GRIP) meetings to district geotechnical staff and consultants.		
Existing Work	FDOT Research Projects, BDK-75-977-66 and BDK-31-977-66, Detection of Sinkholes or Anomalies Using Full Seismic Wave Fields (Phases I and II), and BDV-31-977-82 Sinkhole Deflection with 3D Full Elastic Seismic Waveform Tomography, have been used seismic tests to produce compression and shear wave profiles. All these projects had successful outcomes from the PI, Dr. Khiem Tran who has shown himself to be a national expert in geophysical testing and a researcher that can produce a successful result. This project will be using a different source to generate different seismic waves, along with a different analysis methodology, to produce SH-Love wave profile which has been shown to be more sensitive to the in-situ densities than these other techniques.		
Keywords Used In Existing Work Search **(Cannot leave blank)**	in-situ rock density, seismic tomography, full waveform inversion, full seismic wave fields		
Related Contracts (Give contract numbers)	The following FDOT research contracts and associated papers: BDK-75-977-66, Detection of Sinkholes or Anomalies Using Full Seismic Wave Fields (Phase I) BDK-31-977-66, Detection of Sinkholes or Anomalies Using Full Seismic Wave Fields (Phase II) BDV-31-977-82 Sinkhole Deflection with 3D Full Elastic Seismic Waveform Tomography BDV31 TWO 977-122 In-service Assessment of Road Sinkholes with 2D Ambient Noise Tomography BDV31-977-51: Strength Envelopes for Florida Rock and Intermediate Geomaterials BDV31 TWO 977-124: Field Load Testing of Shallow Foundations in Florida Limestone		
Funding Request	$250,000	**Anticipated Duration**	24 months
Project Manager	David Horhota	**Contracting Method**	Direct contract with University of Florida (Dr. Khiem Tran)

Equipment	N/A	Equipment is already owned by the Department (SMO).
Urgency	4	This project would deliver a geophysical tool that will provide the Department with the capabilities to conducting a geophysical test to assess the site conditions which are being considered for shallow foundations for bridges. It would support the design methodologies developed from projects BDV31-977-51 and BDV31 TWO 977-124. Even though shallow foundations would be a cheaper foundation than alternative deep foundations, the locations in the state to take advantage of them is relatively small (i.e. south Florida).
Implementability	5	The PI has used this test methods for the field load test sites in project BDV31: TWO 977-124: Field Load Testing of Shallow Foundations in Florida Limestone. It has been successful, and this project is needed to enhance and optimize the test and analysis methodology to increase the resolution of the density results which are correlated to rock strengths that are critical to the design of the shallow foundations. In addition, the PI has been shown to be a very effective researchers regarding his previous work with geophysical testing and producing practical results.

Project Benefits (Succinct, complete explanation)

This project would deliver a geophysical tool that will provide the Department with the capabilities to conduct a site investigation for locations with shallow rock that are being considered for shallow foundations for bridges. This project will provide results that support the design methodology developed under projects BDV31-977-51 and BDV31 TWO 977-124. The advantages of the geophysical testing would be to assess the large scale (big picture) picture of the site's rock to determine if the site is a viable option to use shallow foundations and a means to direct rock coring operations to obtain the design parameters needed to design the shallow foundation. If shallow foundations were to be used, they offer a more cost-effective foundation than comparable deeper foundation alternatives.

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	Better knowledge of subsurface conditions	As with all geophysical testing, they have the advantage over conventional borings or soundings to assess the soil properties over a larger area. Soil properties can change over a relatively small area and these changes can be missed by conventional testing. Based on the results, the rock coring operations can be optimized to obtain the design parameters needed to design the shallow foundation. Therefore, the site investigation provides more confidence (less risk) in obtaining accurate rock properties used to design the bridge foundation.
o Materials Savings		
o Time Savings	Quicker overall field-testing times	The results from the geophysical testing can be used to assess the large scale (big picture) picture of the site's rock to determine if the site is a viable option to use shallow foundations and a means to direct (optimize) rock coring operations to obtain the design parameters needed to design the shallow foundation.
o Lives Saved/Injuries Prevented		

o Other (Explain)	Support use of cost-effective foundations	This project will develop a geophysical test providing results that support the design methodology developed under projects BDV31-977-51 and BDV31 TWO 977-124. If shallow foundations were to be used, they offer a more cost-effective foundation than comparable deeper foundation alternatives.

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