

Request for Research Funding for FY 2023-2024

Project Number (Research Center Use Only): GEO-24-03

Requesting Office	Geotechnical	Priority	3 of 3
Proposed Title	Drilled Shaft Imaging with 2D Ultrasonic Waveform Tomography		
Justification	<p>Drilled shaft integrity tests are critical in verifying the as-built condition of the drilled shaft. Commonly, drilled shafts lack the redundancy of pile foundations; therefore, assessing the as-built conditions are even more critical in meeting the design requirements, both in terms of capacity and long-term durability. Two integrity tests are commonly used: (1) Thermal Integrity Profiling (TIP) or (2) Crosshole Sonic Logging (CSL). The advantage of TIP is that it can assess conditions outside the reinforcement cage but is has a relatively short window to perform the test related directly to the concrete's heat of hydration. The advantage of CSL is that it can be performed much later after the shaft has been constructed, but is limited to assessing the shaft's integrity within the reinforcement cage. This new 2D ultrasonic waveform tomography offers the advantage of being able to the CSL data (i.e., being able to test several weeks after the shaft has been constructed) but also, being able to assess the shaft integrity both inside and outside the reinforcement cage.</p>		
Impact	<p>Currently, Thermal Integrity Profiling (TIP) is used for verifying the integrity of constructed drilled shaft per FDOT Specifications. If the testing is requested outside the window of thermal testing in the Specifications, then Crosshole Sonic Logging (CSL) is performed. As mentioned above, CSL has the disadvantage of not being able to assess the integrity of the drilled shaft outside the reinforcement cage, which is typically where most deficiencies occur and are the most significant when assessing long-term durability issues. Having this new technique would allow for an alternative method which uses the same CSL raw data but being able to obtain results beyond the window of thermal testing to assess the integrity of the drilled shaft both inside and outside the reinforcement cage.</p>		
Affected Offices	<p>Geotechnical (Larry Jones & Rodrigo Herrera), Construction (Juan Castellanos), Materials (David Horhota). Updates by the researcher will be presented in annual Geotechnical Research in Progress (GRIP) meetings to district geotechnical staff and consultants.</p>		
Existing Work	<p>As a result of BC-353-19 Factors Affecting Anomaly Formation in Drilled Shafts, Thermal Integrity Profiling (TIP) was developed to assess the integrity of drilled shafts (and the as-built concrete cover) outside of the reinforcement cage. FDOT Research Project BDV25 TWO 977-09 Use of the Thermal Integrity System for Evaluation Auger Cast Piles expanded the use of TIP to Auger Cast Piles (ACP).</p>		
Keywords Used In Existing Work Search (Cannot leave blank)	<p>Drilled Shaft Imaging, Drilled Shaft Integrity, Ultrasonic Waveform Tomography, Ultrasonic Waveform Imaging</p>		
Related Contracts (Give contract numbers)	<p>The following FDOT research contracts and associated papers: BC-353-19 Factors Affecting Anomaly Formation in Drilled Shafts BDV25 TWO 977-09 Use of the Thermal Integrity System for Evaluation Auger Cast Piles</p>		
Funding Request	\$250,000	Anticipated Duration	30 months
Project Manager	David Horhota	Contracting Method	Direct contract with University of Florida (Dr. Khiem Tran)
Equipment	N/A	<p>This methodology uses the same equipment used for the Crosshole Sonic Logging (CSL) that is commonly used to assess drilled shaft integrity, which is already owned by the Department (SMO and several districts) as well as geotechnical consultants.</p>	

Urgency	1=Urgent Need	Having this new technique would allow for an alternative method, which uses the same CSL equipment and raw data, but being able to obtain results beyond the window of thermal testing to assess the integrity of the drilled shaft both inside and outside the reinforcement cage.
Implementability	2=High Likelihood to Implement Results	Being a new analysis technique to process the ultrasonic wave information, this work is needed to show that it can be successfully used under varying conditions and with acceptable accuracy needed by the Department. A Phase 2 effort might be needed to optimize the analysis methodology to make it efficient for statewide implementation. Although, this PI has been shown to be an effective researcher regarding his previous work with geophysical testing and producing practical results.
<p>Project Benefits (Succinct, complete explanation)</p> <p>This project would deliver a geophysical tool that would allow the Department to verifying the integrity of drilled shafts beyond the window of thermal testing and to assess the integrity of the drilled shaft both inside and outside the reinforcement cage. Thermal Integrity Profiling (TIP) must be performed in a limited time window and Crosshole Sonic Logging (CSL) does not provide an assessment outside the reinforcement cage. In addition, this new analysis method uses the same access tubes as the existing tests, and uses the same equipment and raw data files as the CSL test.</p>		
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
<input type="checkbox"/> Materials Enhancement	Improved verification test	Means to verify the as-built conditions of drilled shafts under conditions where current test methods are lacking to provide results.
<input type="checkbox"/> Materials Savings		
<input type="checkbox"/> Time Savings	Alternative acceptance method	When thermal testing is not possible and there are concerns about the drilled shaft integrity outside the reinforcement cage, many times coring is required. This test method could provide a much quicker and easier means to accept the drilled shaft versus coring.
<input type="checkbox"/> Lives Saved/Injuries Prevented		
<input type="checkbox"/> Other (Explain)		

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