

**Request for Research Funding for FY 2021-2022**

<b>Requesting Office</b>	Geotechnical	<b>Priority</b>	2 of 5
<b>Proposed Title</b>	Measuring While Drilling (MWD) Quick Method for Geotechnical Site Investigation and Characterization		
<b>Justification</b>	<p>Previous research efforts by FDOT has shown the advantages of using Measuring While Drilling (MWD) techniques to monitor various parameters during different geotechnical drilling operations such as for drilled shafts and auger cast piles. Another project showed the advantages of using MWD for a standard drill rig used for geotechnical site investigations. Although, its scope was primarily restricted to monitoring the coring procedure used for obtaining rock samples. The results showed that rock strength could be assessed through MWD and identified operational limits that optimized the drilling/coring process showing significantly improved rock sample recoveries than typically are encountered for Florida's soft limestone. This project identified the potential benefits of using the same technique for rotary drilling methods used for soil deposits. For typical site investigations, drilling from one depth to another is only a means to perform Standard Penetration Tests (SPTs) at the required depths, typically every 3 to 5 feet, and no information is obtained between SPT test depths. MWD allows for information to be obtained between SPT test depths to assess soil classifications and strengths that can be used in addition to the SPTs to obtain a near-continuous soil profile using the same drilling equipment currently being used for standard geotechnical site investigations.</p>		
<b>Impact</b>	<p>Previous work has shown the advantages of using MWD techniques to collect more information about the strength and characteristics of the subsurface conditions to provide the geotechnical engineer with a more complete profile of the soil conditions which directly result in less uncertainties and improved designs. The previous MWD geotechnical site investigation project focused on rock coring and assessing the strength properties of rock. Based on preliminary work, it appears the MWD process can be used for rotary drilling through soil to provide similar results. The goal of this research would be to obtain the strength of soil, soil classification, and a more refined soil stratigraphy through MWD of the rotary drilling process during typical site investigations. Currently, very limited soil information is obtained in the drilling process to get from one Standard Penetration Test (SPT) test depth to the next, but if the drill rig is equipped with MWD instrumentation, then this information can be used to provide a near-continuous soil profile, adding more complete subsurface information than the typical SPT N-value profile.</p>		
<b>Affected Offices</b>	<p>Geotechnical, Design, Materials. Updates by the researcher will be presented in annual Geotechnical Research in Progress (GRIP) meetings to district geotechnical staff and consultants.</p>		
<b>Existing Work</b>	<p>FDOT Research Projects, BDK75 TWO 977-61 and BDV31 TWO 977-20 (Drilled Shaft Resistance based on Diameter, Torque &amp; Crowd (Phases I and II)), and BDV31 TWO 977-91 (Implementation of Measuring While Drilling Shafts in Florida) showed the feasibility and benefit of monitoring drilling parameters during the construction of dilled shafts to assess the strength of rock and frictional capacity of the shaft. The current project BDV31 TWO 977-125 (Assessing Axial Capacities of Auger Cast Piles from Measuring While Drilling) is using a similar approach for auger cast piles. The internal SMO project BDV31 TWO 820-06 (MWD for Site Investigations) used similar MWD techniques for drill rigs used for typical geotechnical site investigations, and it showed the advantages of using MWD for rock coring applications.</p>		
<b>Keywords Used In Existing Work Search</b> <b>(Cannot leave blank)</b>	measuring while drilling, MWD, monitoring drilling		
<b>Related Contracts</b> <b>(Give contract numbers)</b>	<p>The following FDOT research contracts and associated papers:</p> <p>BDK75 TWO 977-61 Drilled Shaft Resistance based on Diameter, Torque &amp; Crowd (Phase I)</p> <p>BDV31 TWO 977-20 Drilled Shaft Resistance based on Diameter, Torque &amp; Crowd (Phase II)</p> <p>BDV31 TWO 977-91 Implementation of Measuring While Drilling Shafts in Florida (FLMWDS)</p> <p>BDV31 TWO 820-06 MWD for Site Investigations</p> <p>BDV31 TWO 977-125 Assessing Axial Capacities of Auger Cast Piles from Measuring While Drilling</p>		

<b>Funding Request</b>	\$250,000	<b>Anticipated Duration</b>	24 months
<b>Project Manager</b>	Larry Jones & David Horhota	<b>Contracting Method</b>	Direct contract with University of Florida (Dr. Michael Rodgers)
<b>Urgency</b>	5	The State Materials Office (SMO) drill rig is already instrumented with MWD instrumentation (from the previous rock coring study), so results for soil drilling can be obtained quickly and efficiently for researchers to analyze raw data and provide the best means to present this information to geotechnical engineers. A current FHWA EDC effort has identified MWD for site investigations as one of its key items for implementation, so timely results can be used in conjunction with this nationwide effort to standardize implementation. The overall goal of this effort is to provide more information to the geotechnical engineer during the boring program that will aid in reducing uncertainties and improve designs.	
<b>Implementability</b>	4	As mentioned above the SMO drill rig is already instrumented and can be used on pilot projects. The FHWA EDC project will aid in implementation of MWD on a nationwide basis in standardizing MWD procedures, and in providing notice to drill rig manufacturers to include this type of instrumentation as an add-on package for their equipment. This will help in overcoming the main hurdle to implementation which is the need to add this MWD instrumentation onto existing drill rigs.	

**Project Benefits (Succinct, complete explanation)**

This project would expand the use of MWD for wash rotary drilling through soils for geotechnical site investigations, which is the typical process used for most borings performed by the geotechnical industry. These borings are used on every FDOT project, so the outcome could greatly increase the frequency of MWD for a typical drill rig used for geotechnical investigations. This would result in an increased amount of subsurface information that would be available to the geotechnical engineer because it would provide soil characteristics between the depths where SPTs are performed; thereby, providing a more complete profile of the subsurface soils and conditions for a given boring. The overall goal to provide more information to the geotechnical engineer during the site investigation will aid in reducing uncertainties and result in improved designs.

<b>Project Benefits (Select all that apply and explain)</b>	<b>Quantifiable Benefits (units, dollars, etc...if applicable)</b>	<b>Methodology or Data Sources Used to Determine Quantifiable Benefits. If not applicable, please give justification of project benefits</b>
<input type="radio"/> Materials Enhancement	Better knowledge of subsurface conditions	Using MWD for the entire drilling process between SPT test depths would provide a near-continuous soil profile for every soil boring. This will provide more information giving a complete profile of the soil characteristics to the geotechnical engineer, especially the soil layering and additional soil parameters that can be related directly to the MWD information (such as strength, permeability, etc.), versus the typical boring profile of SPT N-values every 3' to 5' in depth.
<input type="radio"/> Materials Savings		
<input type="radio"/> Time Savings	Potential to perform borings quicker	Wash rotary drilling through soils is a very quick operation, and with MWD instrumentation, can provide information regarding soil characteristics that is currently not being obtained. This drilling is only a means to perform the SPT at the required test depth, with the typical interval being 3' to 5'. If information can be obtained from this drilling, there is a potential to be able to increase the test depths between SPTs resulting in faster times to perform a boring at a given location.
<input type="radio"/> Lives Saved/Injuries Prevented		
<input type="radio"/> Other (Explain)		

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