Statement No. 33

Arkansas State Highway and Transportation Department
Transportation Research Committee

RESEARCH PROBLEM STATEMENT

DATE: 09/12/2016 | **PROJECT AREA:** Materials

TITLE: Mapping subsurface conditions for transportation applications

PROBLEM STATEMENT:

Each year AHTD spends millions of dollars to deal with troublesome soil and rock layers, which cause slope stability issues along roadways or require removal of rock layers. The remediation of slopes or removal of bedrock can be both time consuming and expensive. While slope stability and shallow bedrock issues may be unavoidable or even expected on certain projects, unexpected subsurface conditions during construction can lead to significant cost overruns, change orders, and construction delays. If a more accurate/complete 3D understanding of the subsurface conditions was available during the design phase, some problems could be avoided or at least budgeted for during construction. Currently subsurface conditions are assessed on transportation projects using drilling and sampling along the project alignment. While this provides an acceptable level of accuracy for projects where problematic soil and rock layers depth and thickness are consistent, significant errors can exist when conditions are variable both inline and crossline to the alignment. To provide a more complete picture of the subsurface layering where conditions are quite variable, a continuous 3D subsurface profile can be developed rapidly using Capacitively Coupled Resistivity (CCR). CCR is a drag along array resistivity system that measures the electrical resistance of soil and rock formations. This system can be used to provide continuous 3D models of the subsurface and has been shown to be effective at identifying weak clay seams, which exhibit higher moisture levels (due to high PI) and bedrock location (due to lack of moisture). Knowledge regarding the location of these layers can be used in slope stability analysis and used for developing better estimates of rock cut quantities on transportation projects.

OBJECTIVES:

The objective of the study is to determine the applicability of using Capacitively Coupled Resistivity (CCR) to map problematic soil and rock locations along highway alignments. The study will identify 4 sites (either AHTD project sites or commercial sites) where soil and bedrock locations are quite variable or where weak clay seams are causing slope stability issues. Sites will be tested using CCR to develop 2D and 3D cross sections and subsurface maps of soil and/or rock layers. For slope stability sites, failure surfaces will be identified using CCR mapping. These failure surfaces will be modeled using finite element and standard slope stability analyses to develop possible solutions. For rock excavation sites, rock elevations will be estimated using CCR along the alignment and used to estimate rock cut quantities based on design drawings. These rock cut estimates will be compared to estimates based on drilling logs and true project excavation quantities.

FORM OF RESEARCH IMPLEMENTATION:

Project outcomes and implementation will take the form of a comprehensive research report detailing the ideal equipment, testing parameters, and best practices for identifying problematic soil layers and bedrock layers, as well as approaches to deal with these issues. A cost/benefit analysis will be completed to determine the benefit of using CCR for identifying these problematic soil or rock layers. In addition, individual and group training will be provided on how to use and implement data and results from the research.

REVIEWER: Joseph Jabo **Estimated Project Duration:** 24 month

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Standing Subcommittee Ranking	Advisory Council Ranking	Statement Combined with Statement Number(s)
1/5	4	