

**ARKANSAS DEPARTMENT OF TRANSPORTATION
SYSTEM INFORMATION AND RESEARCH DIVISION
FISCAL YEAR 2021
REQUEST FOR PROPOSAL
RESEARCH PROJECT NO. TRC2107**

TITLE: Non-nuclear Moisture Content and Density Determination

ARDOT POLICY

All proposals shall be submitted electronically per the Proposal section of this Request for Proposal. As of Fiscal Year 2020, all research project contracts will be managed under Info Tech's Doc Express Paperless Contracting platform. All information on the utilization of this platform for research projects can be found at http://www.ardot.gov/System_Info_and_Research/research.aspx or from the Research Section.

PROBLEM STATEMENT

The nuclear density gauge is the most commonly used device to rapidly determine the moisture content and unit weight of subgrade soils, base courses, and asphalt pavements. Use of the nuclear density device requires special permitting, training, and may expose the user to additional amounts of radiation. Although trying to reduce the use of nuclear density devices has been of interest to ARDOT, previous research projects found that while the previously available non-nuclear technologies were capable of accurately determining the density of the material, the devices were not able to accurately determine the moisture content of material. Moisture content is a critical parameter that must be carefully controlled during earthwork operations to ensure the proper performance of subgrade materials. There have been a number of studies done that have demonstrated the usefulness of various technologies to determine moisture content, but most of these studies only considered one or two soil types and very little priority was given to methods that do not require soil specific calibrations. A review of these methods along with other new technologies needs to be completed to determine if there are potential methods that can produce similar results to the nuclear gauge.

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AREA OF STUDY

The main objective of this study is to determine if there are any technologies capable of replacing the nuclear density gauge for moisture and density determination. This objective can be broken down into two parts, density determination and moisture determination, and emphasis is put on finding methods of determining moisture content in various materials. There are currently non-nuclear methods of determining density of subgrade material that can provide accurate results compared to the nuclear density gauge, but other methods need to be considered as well to determine the best possible replacement for the nuclear density gauge.

METHOD OF STUDY

The research will be carried out under these objectives:

1. Determine which non-nuclear devices that rapidly and accurately determine soil moisture and density are comparable to the nuclear density gauge.
2. Evaluate what methods of determining moisture content are available that have the same ease of use and speed as the nuclear gauge.
3. Determine the most accurate and rapid methods of determining moisture content, density, or a combination of the two.
4. Develop a testing and procedure manual and training module.

BENEFITS

A detailed cost-benefit analysis shall be included in the proposal. The analysis must include but is not limited to the following:

1. Detailed cost analysis on savings to the Department with full implementation of the projects findings.
2. Any anticipated benefit not foreseen as a cost savings.

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TIME AND FUNDING OF STUDY

Work will begin no earlier than July 1, 2020, contingent upon acceptance of the proposal and availability of research funds. The length of the project shall be 24 months. A final report is to be drafted and presented to the Research Subcommittee no later than the last day of the project. Up to 25% of the estimated project costs will be withheld pending final acceptance of the final report. Failure to deliver the required Final Report at the end of the project will result in the cancellation of the project and 25% of the total project cost will be retained by the Department.

REPORTS

All reports must be in accordance with the 2019 Research Manual (available at http://www.ardot.gov/System_Info_and_Research/research.aspx or from the Research Section). All reports are required to be submitted through the appropriate Doc Express process. An Implementation Report which details the recommended means/techniques for using the project results shall be submitted to the Department six (6) months prior to the research project's Final Report. All Final Reports are required to be reviewed by a technical editor before submission to the Department. An oral report to the Transportation Research Committee may be required. In addition to reports and publications, the Department shall be furnished one (1) copy of any master's thesis or doctoral dissertation which is a result of any investigation or study on this project. The submitting of any report to be published by an outside publication or presentation on this project before its completion; shall be submitted for the Department's approval before submission.

PROJECT DELIVERABLES

The proposed research will provide ARDOT with:

1. Implementation plan that will include the cost benefit of transitioning testing away from nuclear density towards a new method.

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2. Operator's manual detailing method, procedures, and details needed to perform selected techniques.
3. Field ready measurement system for determining moisture content, density, or a combination of both.
4. Training module and on-site training for use of equipment and procedures.

AUTHORIZATION TO BEGIN WORK

A letter separate from the contracting documents authorizing the beginning of work will be transmitted through Doc Express initiating the project. Any cost incurred before the authorization letter is received, will not be eligible for reimbursement. The project will begin work no earlier than July 1, 2020.

EQUIPMENT

A complete physical verification of all software and equipment purchased or built for use on this project and the actual location of the equipment will be made each year. An Equipment Capitalization Notice is available from the Research Section for the reporting of software or equipment purchased during the project. All software developed on the project will be completed in open source format and ARDOT shall be provided a copy of the source code. If non-expendable or special equipment is purchased with project funds, the equipment is owned by ARDOT and disposition of the equipment will be determined by ARDOT at the project's closeout session.

All rental rates shall be approved by ARDOT before the approval of the proposals. Should a subcontract be part of the proposal, ARDOT will not approve the purchase of any equipment in the subcontract. Any equipment purchased through ARDOT's Transportation-Related Research Grant Program is not eligible for rental rate charges.

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All equipment shall be purchased in accordance with the State of Arkansas purchasing laws.

PROPOSALS

Proposals shall be submitted in two separate electronic formats, a word document and a pdf, to Research@ardot.gov no later than the end of business on April 3, 2020. This is a firm deadline. All procedures shall be in accordance with the 2019 Research Manual and Federal Aid Policy Guide (FAPG). In the event of policy contradiction, the FAPG shall govern.

Upon approval of the electronic version of the Proposal by the Research Subcommittee the Project Manager will initiate the process within Doc Express to acquire the appropriate electronic signatures from all parties.