RESEARCH PROJECT CAPSULE [06-3GT]

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TECHNOLOGY TRANSFER PROGRAM

Field Evaluation of Roller Integrated Compaction Monitoring

JUST THE FACTS:

Start Date:
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Duration:
24 months

End Date:
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Funding:
SPR

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Sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University

POINTS OF INTEREST:

Problem Addressed / Objective of Research / Mehodology Used Implementation Potential

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PROBLEM

Roller Integrated Compaction Monitoring (RICM) [i.e., intelligent compaction (IC) or continuous compaction control (CCC)] refers to the compaction of road materials, including subgrade soils, aggregate bases, stabilized materials, and asphalt-paving materials, using modern rollers equipped with an integrated IC or CCC measuring system.

The technology continuously records the roller's location and reaction to layer stiffness and plots the result during compaction operations, so the operator can adjust to ensure appropriate compaction effort. The recorded stiffness measurements can be correlated to conventional physical and engineering properties of materials, such as dry density, strength, and modulus. The field-generated data and plots also provide a good means for quality control/quality assurance (QC/QA) of compaction operations.

The features of RICM will help roadway engineers build consistent (uniform) quality layers to distribute the traffic loads to the subgrade and will greatly improve the construction quality of roadway compaction in Louisiana, if adopted by Louisiana Department of Transportation and Development (LADOTD).

Current departmental standards require contractors to build uniform pavement structure layers, but with no means to check and quantify it. Compaction with standard rollers is typically through a trial-and-error process and its quality control is based on the experience and judgment of individual contractors. The minimum spacing of 1000 ft. for quality assurance tests at selected point locations is expected to represent the entire section. In reality, many factors such as variation in soil gradation, soil composition, moisture contents, and subgrade condition affect the homogeneity of the compacted material, resulting in non-uniformity of compaction and hence stiffness.

RICM is a technology that can assist the contractor and the Department to improve the compaction process with a way to verify consistency throughout constructed pavement layers. The advantages over normal rollers [Global Positioning Systems (GPS), instrumentation (accelerometer and drive-power based), onboard computers for calculations and data collection with graphical displays for the roller operator, etc.] will help monitor and quantify the uniformity (or variability) of pavement layers across a continuous section, aid in controlling consistency, and help speed the compaction process.

There is a need to demonstrate and evaluate the emerging technology in real construction projects and its potential implementation logistics (specification, etc.) within Louisiana.

OBJECTIVE

The objectives of the research are to:

1. Demonstrate the value of CCC to accelerate construction, reduce re-work, and improve uniformity of pavement layers.
2. Evaluate the reliability and potential use of RICM data for acceptance and measurements of in-situ stiffness of the constructed earth materials, linking to properties that relate more directly to design (e.g., modulus), and in-service performance.
3. Establish long-term monitoring sections and monitoring protocols/assessments for LTRC to document the impact of implementing these technologies and specification approaches.

4. Demonstrate Strategic Highway Research Program (SHRP) 2 R-07 performance specifications for rapid renewal using non-destructive RICM technology and mechanistic-based in-situ point measurements on a new pavement section including subgrade, stabilized subgrade, base course, and hot-mix asphalt (HMA) layers.

METHODOLOGY

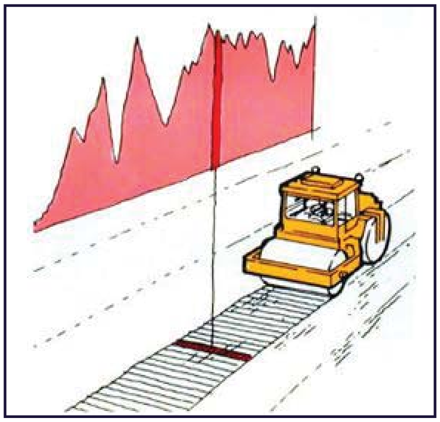
LADOTD project, 424-04-0053, has been selected to provide an evaluation of the technology. The site is located southeast of New Iberia, Louisiana, and consists of the extension of frontage roads from Darnall Road to LA 85 along US 90. This research will include smart rollers in the specifications and plans for the scoped project.

The typical cross section for the proposed demo location will require some fill-in areas and has several common layers used by LADOTD worth testing with the RICM systems. For the purposes of the demo project, the job will be divided into four test sections to evaluate the site under RICM rollers on fill, base course materials, and HMA layers under differing roller settings, visible and not visible to the roller operator.

SHRP2 and NCHRP researchers, including Dr. David White from Iowa State University, have assisted in the draft specification for the project. They are also familiar with the ability of the roller manufacturers to deliver the emerging technology. LTRC will work with them and share the data with SHRP2.

The research will shadow the normal acceptance process, collecting intelligent roller data from each pavement layer as measurement passes (soil) and compaction passes for HMA. Work will be coordinated through the LTRC Geotechnical and Asphalt laboratories with SHRP2 contacts, the district forces, and the construction contractor.

The RICM shadow testing, collection, and analysis of the data will be compared to the spot based testing conducted by LTRC and the district laboratory. The results will help refine the specification for future use and the development of a performance specification. Previous work by others (NCHRP and Wisconsin, Iowa, and Minnesota Departments of Transportation, etc.) will assist in the research and implementation within LADOTD. A secondary result of the project will be the ability to compare the RICM modulus/stiffness results against the designed values for each layer.



Compactometer Value in CCC (Thurner and Sandstorm, 2000)

IMPLEMENTATION POTENTIAL

RICM systems are not presumed to be a silver bullet or magic wand, but they can serve the contractor and the Department as a valuable tool in the toolbox. Desired densities or stiffness moduli will still be difficult to achieve if the soil is too wet or dry, regardless of the compactive effort. Similarly, HMA densities and moduli will be affected if the material is outside of the temperature requirements. Contractor means and methods in these areas still help to sculpt a successful project.

Moisture for soils and temperature for HMA must be at appropriate levels for compaction to occur. The RICM systems do not adjust these parameters. A need to monitor and document the parameters exists and will be studied as a minor part of the research.

Developed over recent years, intelligent compaction technology has made great strides in combining old and new technologies. Instrumentation, computer technology, and GPS have transformed the slow roller into one of the smartest devices on a jobsite. The new technology will hopefully benefit the contractor by speeding compaction by focusing efforts where needed to control uniformity.

The technology is still new and not mainstream yet, though its advantages are many, including consistency of coverage, digital documentation of efforts, visual representation of roller movements, possible alternatives to nuclear gauges, and stiffness measurements with location position. This project will evaluate the technology and its potential implementation logistics in hopes of creating quality, consistent layers for LADOTD roads.