PROJECT SUMMARY

Texas Department of Transportation

0-6903: Assess Deflection-Based Field Testing for Project Acceptance

Background

The Texas Department of Transportation's (TxDOT) current practice for field compaction quality control and acceptance for base, subbase and soil layers is to determine the compacted density by nuclear density gauge (NDG). TxDOT has also considered several stiffness-based devices to replace NDG because stiffness parameters are more relevant to pavement design. Since both density and stiffness measurements are spot tests, they cannot represent the quality and uniformity of compaction in a continuous manner. For design-build projects an additional challenging step is the design verification. The current process based on laboratory resilient modulus tests is tedious and marginally representative of the in situ properties. Even though modulus-based nondestructive testing can be conceptually considered as a straightforward solution to this problem, one cannot simply extrapolate the use of these testing devices on existing roads to the design verification.

What the Researchers Did

This research aimed at developing practical test protocols and specifications to improve the general quality of compaction of earthwork construction and facilitate the design verification by means of deflection-based field testing. The other objective was to achieve uniformity of compacted geomaterials and intelligent compaction (IC).

A protocol to estimate the uniformity and mechanical properties of compacted geomaterials for design verification employing deflection-based devices and intelligent compaction rollers was proposed. Field studies were carried out to evaluate, improve and validate the proposed protocol. Several pavement structures in different construction sites were proof-mapped using IC technology and evaluated using different deflection/modulus-based spot tests. The research team developed a research-grade data acquisition system (DAQ) to measure the vibration of any available roller to expedite the conduction of the research tasks, since the IC rollers were available on a limited number of ongoing earthwork projects. Geospatial data were represented in maps that were generated using an approach that makes use of rectangular grids (see Figure 1). Each grid was represented by an IC measurement value (ICMV) characterizing the stiffness of that grid and the coefficient of variation of the ICMVs in that grid to represent its variability. This approach facilitated the comparison of geospatial data obtained with IC roller and spot test measurements.

A comprehensive database was assembled using the data collected at construction sites throughout Texas to evaluate whether relationships exist among ICMV and spot test deflection-based measurements. Though no direct relationships could be established, trends were identified that related those measurements. Those trends were used to propose a protocol of design verification and acceptance. The protocol is recommended for implementation to help TxDOT verify the uniformity and design stiffness of compacted pavement geomaterials during the construction process.

What They Found

Through interaction with contractors and TxDOT representatives, and based on the database of IC and spot test results at numerous sites, a protocol for

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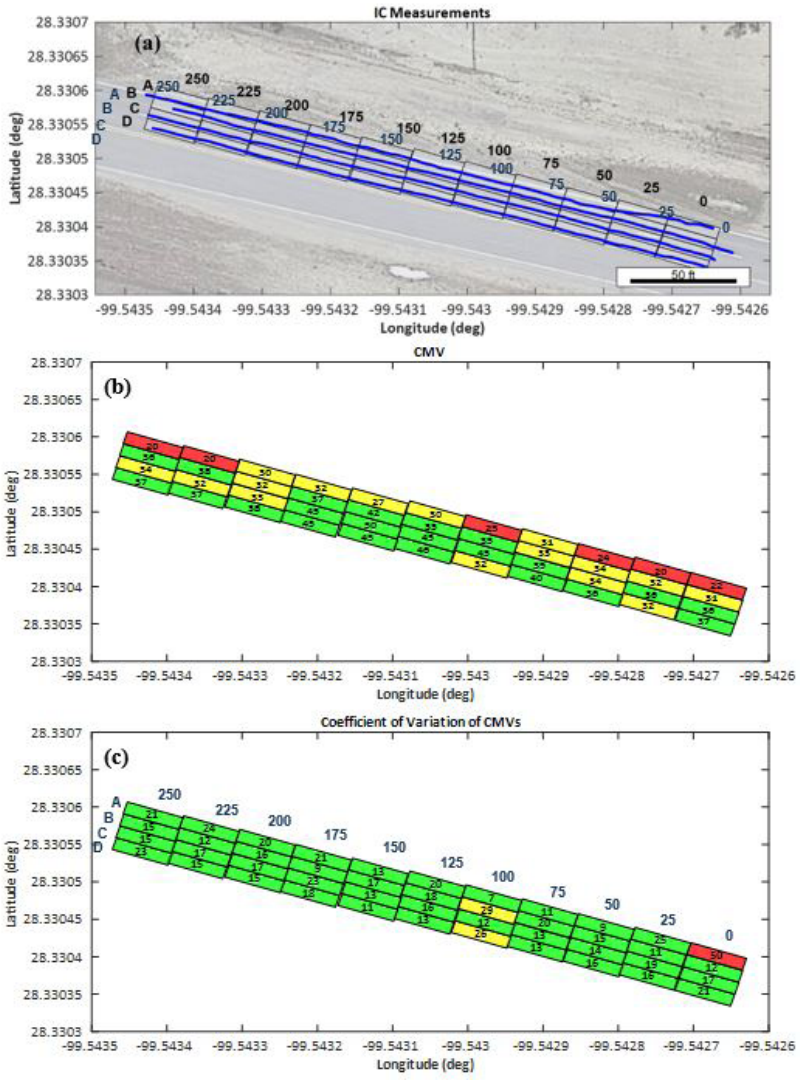

Figure 1 – Geospatial Representation of (a) Proof-mapped Line Passes, (b) CMV Mapping, (c) Coefficient of Variation of CMVs

project acceptance of earthwork that integrates the IC proof rolling with deflection-based devices was proposed (see Figure 2). A key factor of this protocol involves reporting not only ICMVs but also their coefficients of variation. The proposed protocol seems to address some of the main concerns frequently brought up as the shortcomings of more mechanistic quality management approaches.

What This Means

The proposed method provides TxDOT engineers a means to verify the uniformity and design stiffness requirements of compacted geomaterials. Failure to perform deflection/modulus-based testing can lead to the acceptance of sections that do not meet the design requirements (even though they pass the density) that may lead to premature failure and/or reduction of service life. Some of the evaluated sites showed that there was a definite need for denser evaluation of earthwork before acceptance. With the implementation of the proposed specifications for design verification, TxDOT will be able to save significantly the rehabilitation and reconstruction costs due to premature failure of constructed highway pavements.

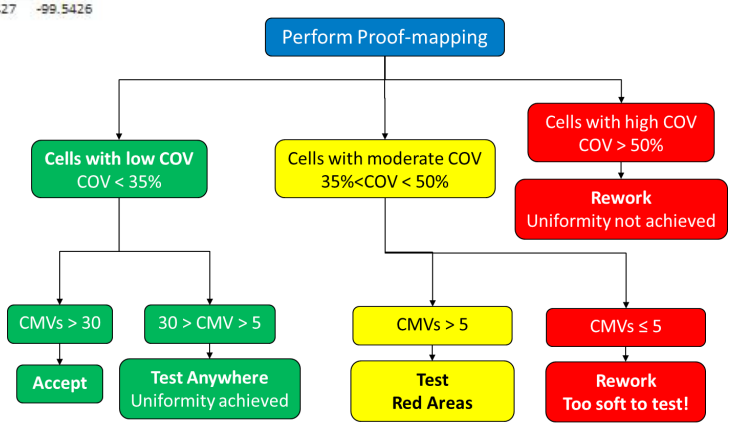

Figure 2 – Proposed Protocol for Project Acceptance

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