HIGHLIGHTER

EVALUATION OF PERFORMANCE OF ASPHALT PAVEMENTS CONSTRUCTED USING INTELLIGENT COMPACTION TECHNIQUES

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PROJECT TITLE
EVALUATION OF PERFORMANCE OF ASPHALT PAVEMENTS CONSTRUCTED USING INTELLIGENT COMPACTION TECHNIQUES

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OVERVIEW Long-term performance of asphalt pavements depends on the quality of the subgrade and asphalt layers. A well designed and compacted subgrade would drain well and have high strength and adequate load bearing capacity. Quality control during preparation of subgrade and construction of asphalt layers is usually limited to determining moisture content and taking density readings at selected spots or using other methods. These methods, however, require additional time and cost and often do not adequately reveal deficiencies in construction quality. Intelligent Compaction (IC) techniques have been developed to continuously monitor the quality of compaction of subgrade and asphalt layers during construction and to adjust the machine parameters to ensure uniform compaction. In this project, compaction quality of several stabilized subgrades and asphalt layers, constructed using the IC technology, was evaluated.

RESULTS The primary goal of this project was to demonstrate the use of an IC technology, called Intelligent Compaction Analyzer (ICA), in improving the quality of compaction of stabilized subgrades and asphalt layers during construction (Figures 1). The ICA technology was developed at the University of Oklahoma. It uses coupled vibration data (roller and pavement layers), extracts features from these data and uses these features to estimate compaction quality parameters (i.e., density, dynamic modulus, and ICA modulus) in real-time using a trained neural network (Figure 2).

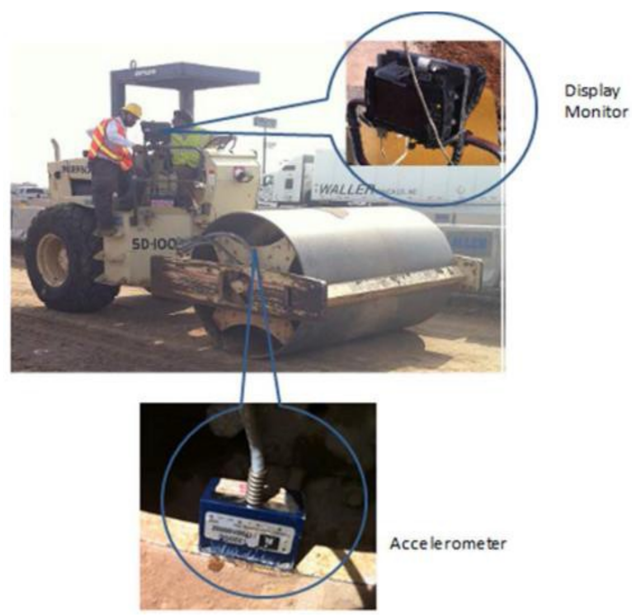

Figure 1 Vibratory Roller equipped with ICA

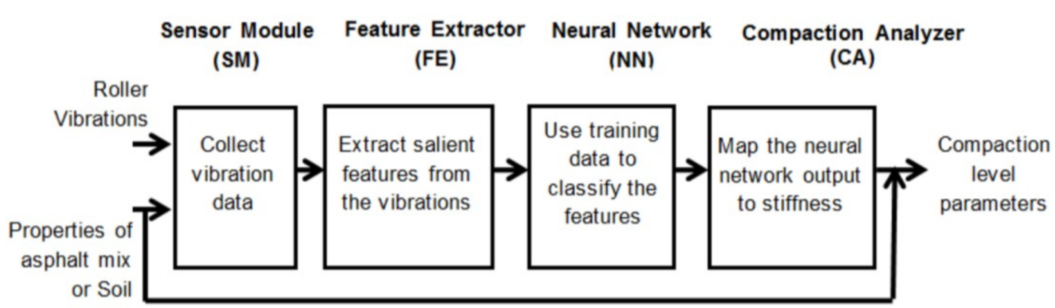

Figure 2 Flowchart of modules involved in estimation of compaction parameters by the ICA

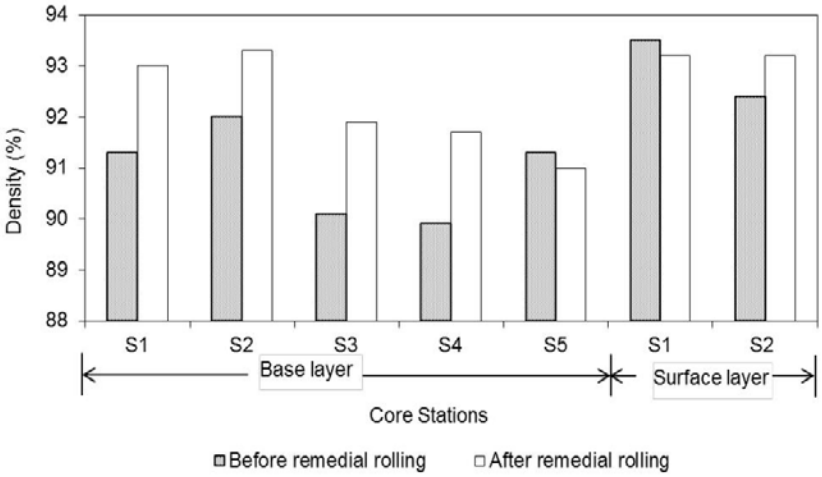

Figure 3 Demonstration of Densities following ICA Compaction Procedure

The ICA technology is capable of identifying under-compacted regions and remediating these regions with additional roller passes (Figure 3).

Six case studies were evaluated in this project. The first two case studies utilized data collected from the compaction of stabilized subgrades at two different locations. These data were used to refine a method (developed earlier) for estimating the level of compaction of the subgrade layer in terms of ICA modulus. This method was then used in Case Studies 3 and 4 to demonstrate the use of the ICA in improving compaction quality of stabilized subgrades modified with Cement Kiln Dust (CKD). A comparison of the ICA modulus with the modulus determined using statistical models (based on laboratory test data) shows that the ICA can estimate the modulus during compaction with an accuracy level suitable for quality control purposes in the field. In the last two case studies, the use of the ICA in improving the compaction quality of asphalt layers was demonstrated. A comparison of the ICA-estimated density with the density of field cores and those obtained by a *nuclear density gauge* shows that the ICA can estimate the density with a suitable level of accuracy (Figure 4).

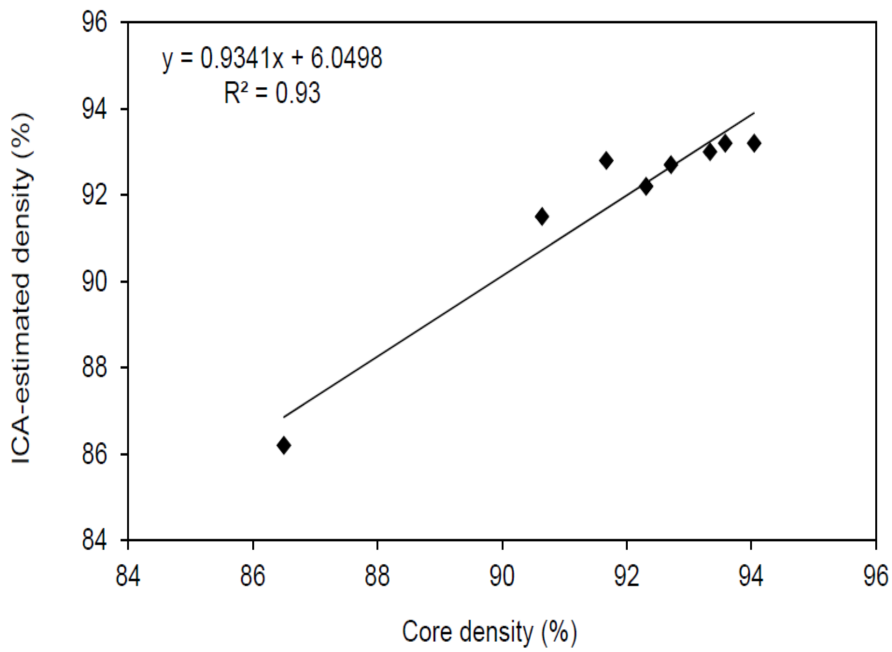

Figure 4 Correlation between Core Density and ICA-Estimated Density

Overall, the variance of ICA-densities was smaller than the variance observed in the traditional compaction process. The ICA moduli were validated by comparing them with the laboratory equivalent resilient modulus of the stabilized subgrade. The ICA moduli were also validated by comparing them with the *falling weight deflectometer* and *dynamic cone penetration* test results, wherever possible.

Although the IC technology is gaining popularity as a real-time compaction quality monitoring tool, additional studies are needed involving varying soil types and additive types. It is necessary for DOTs to develop specifications or special provisions for both stabilized subgrades and asphalt layers to enhance implementation of IC. Also, there is a need to train DOT employees and construction crews for a broader acceptance of this technology. Moreover, the closed-loop control of vibratory compactors should be considered in future projects.

POTENTIAL BENEFITS Construction of high quality roads can help ODOT minimize pavement distresses such as rutting and cracking and to improve long-term performance of pavements. This study demonstrated the efficacy of the Intelligent Compaction Analyzer. It was found that the average subgrade modulus, average asphalt layer density/dynamic modulus, and the overall uniformity of compaction could be improved with the use of the ICA. Compaction quality control in real-time can help avoid over/under-compaction during construction and enhance pavement performance and longevity, and reduce overall costs.