Developing Guidelines for Assessing the Effectiveness of Intelligent Compaction Technology

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The performance of transportation infrastructure foundations and pavement structures is dependent on the compaction quality and uniformity during the construction process. The current state of practice for compaction quality control of pavement layers is to estimate in-situ density on randomly selected spots across the construction area. However, the inherent material variability and other sources of uncertainties during the production and construction phases introduce spatial variability that cannot be captured with random spot testing. A more comprehensive test method that can cover the entire compacted area is necessary to ensure the uniformity and durability of the compacted pavement layer. With the recent advancements of construction techniques such as Intelligent Compaction (IC), a comprehensive data set describing the construction process can be collected.

One of the main objectives of this study was to provide the means to ensure that the foundation layers of transportation infrastructure are properly constructed and rehabilitated using IC, which can extend the life and enhance the resilience of the infrastructure. The outcomes of this research can help to improve current practices in the construction of infrastructure foundation layers using an intelligent construction technique that optimizes performance and ensures uniformity and quality.

Study Methods

Many factors affect pavement compaction quality, which can vary. Such variability may result in an additional number of passes required, extended working hours, higher energy consumption, and negative environmental impacts. The use of Intelligent Compaction (IC) technology during construction can improve the quality and longevity of pavement structures while reducing risk for contractors and project owners alike. This study develops guidelines for the implementation of IC in the compaction of pavement layers as well as performing a preliminary Life-Cycle Cost Analysis (LCCA) of IC technology compared to the conventional compaction approach. The environmental impacts of the improved construction process were quantified based on limited data available from the case studies. The LCCA performed in this study consisted of different scenarios in which the number of operating hours was evaluated to estimate the cost efficiency of the intelligent compaction technique during construction.

Long-term monitoring of the performance of pavement sections compacted using IC technology can help estimate the effectiveness and efficiency of this technology compared to the conventional compaction practice.

Findings

The LCCA showed that the use of IC technology may reduce the construction and maintenance costs in addition to enhancing the quality control and quality assurance (QC/QA) process. The analyses also showed a reduction in energy consumption and the production of greenhouse gas (GHG) emissions with the use of intelligent compaction. However, a more comprehensive analysis is required to fully quantify the benefits and establish more accurate performance indicators. A draft version of the preliminary guidelines for implementation of IC technology and long-term monitoring of the performance of pavement layers compacted thereby is also included in this report.

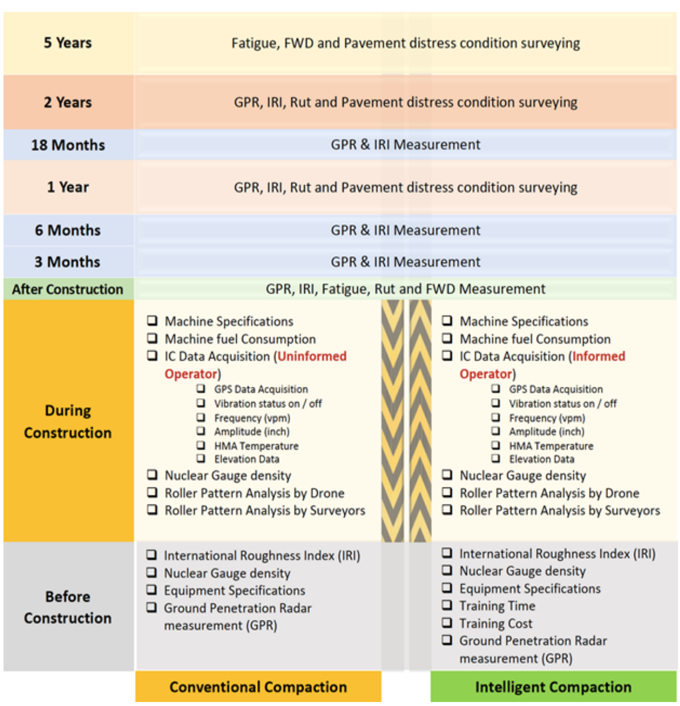

Figure 1. Draft Guidelines for Implementation and Performance Monitoring of IC

Policy/Practice Recommendations

IC can potentially reduce the time needed for construction. This reduction results in lower construction costs and lower environmental impacts. The improved compaction quality of the pavement layers by using IC, has the potential to minimize maintenance costs during the service life of the pavement.

The successful implementation of IC requires attention to many aspects of the construction process and collection of the appropriate geo-referenced field data. The collection and interpretation of IC data requires trained project personnel to be able to extract meaningful information both during and after the construction process.

About the Principal Investigator

Mehran Mazari is an Assistant Professor in the Department of Civil Engineering at California State University specializing in Transportation Infrastructures and Materials. His research interests include sustainable and resilient transportation infrastructure, transportation geotechnics and pavement materials, and non-destructive evaluation of transportation infrastructures. Dr. Mazari is the faculty director of the Sikand Center for Sustainable and Intelligent Infrastructure (Sikand SITI Center) and founding director of Sustainable Infrastructure Materials (SIM) research lab at California State University Los Angeles.

To Learn More

For more details about the study, download the full report at **transweb.sjsu.edu/research/1923**

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