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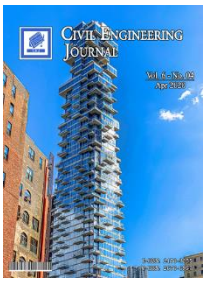

Model Development for the Prediction of the Resilient Modulus of Warm Mix Asphalt

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Abstract

Increasing material prices coupled with the emission of hazardous gases through the production and construction of Hot Mix Asphalt (HMA) has driven a strong movement toward the adoption of sustainable construction technology. Warm Mix Asphalt (WMA) is considered relatively a new technology, which enables the production and compaction of asphalt concrete mixtures at temperatures 15-40 °C lower than that of traditional hot mix asphalt. The Resilient modulus (Mr) which can be defined as the ratio of axial pulsating stress to the corresponding recoverable strain, is used to evaluate the relative quality of materials as well as to generate input for pavement design or pavement evaluation and analysis. Based on the aforementioned preface, it is possible to conclude that there is a real need to develop a predictive model for the resilient modulus of the pavement layer constructed using WMA. Within the experimental part of this study, 162 cylindrical specimens of WMA were prepared with dimensions of 101.6 mm in diameter and 63.5 mm in thickness. The specimens were subjected to the indirect tension test by pneumatic repeated loading system (PRLS) to characterize the resilient modulus. The test conditions (temperature and load duration) as well as mix parameters (asphalt content, filler content and type, and air voids) are considered as variables during the specimen's preparation. Following experimental part, the statistical part of the study includes a model development to predict the Mr using Minitab vs 17 software. The coefficient of determination (R^2) is 0.964 for the predicted model which is referred to a very good relation obtained. The Mr value for the WMA is highly affected by the temperature and moderately by the load duration, whereas the mix parameters have a lower influence on the Mr.

Keywords: Warm Mix Asphalt (WMA); Hot Mix Asphalt (HMA); Resilient Modulus (Mr).

1. Introduction

Warm-Mix Asphalt (WMA) is an asphalt mixture that is commonly used in technologies that allow the manufacturing of asphalt mixtures at lower temperatures than those used for the preparation of Hot-Mix Asphalt (HMA). WMA is used as a technique to reduce the emissions of pollutant, energy consumption, and viscosity of the asphalt binder. The benefits of reducing the viscosity are that sufficient aggregate coating is obtained during the mixing, which enhances its workability and allows mix compaction at reduced temperatures [1].

WMA is offers different advantages from the conventional HMA. Firstly, it allows reduction of the production temperature of asphalt mixtures, which in turn help save more energy as compared to that by HMA, which depends mainly on the type of fuel used and the production temperature. Secondly, it offer the possibility of reducing greenhouse gas emissions through the reduced temperature of WMA production [2]. WMA achieve all the properties

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