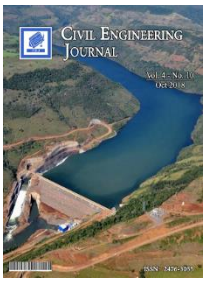
Available online at www.CivileJournal.org

Civil Engineering Journal

Vol. 4, No. 10, October, 2018



Equivalent Modulus of Asphalt Concrete Layers

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Received 29 August 2018; Accepted 10 October 2018

Abstract

A flexible pavement structure usually comprises more than one asphalt layer, with varying thicknesses and properties, in order to carry the traffic smoothly and safely. It is easy to characterize each asphalt layer with different tests to give a full description of that layer; however, the performance of the whole; asphalt structure needs to be properly understood. Typically, pavement analysis is carried out using multi-layer linear elastic assumptions, via equations and computer programs such as KENPAVE, BISAR, etc. These types of analysis give the response parameters including stress, strain, and deflection at any point under the wheel load. This paper aims to estimate the equivalent Resilient Modulus (MR) of the asphalt concrete layers within a pavement structure by using their individual MR values. To achieve this aim, eight samples were cored from Iraqi Expressway no. 1; they had three layers of asphalt and were tested to obtain the MR of each core by using the uniaxial repeated loading test at 25 and 40 °C. The samples were then cut to separate each layer individually and tested for MR at the same testing temperatures; thus, a total of 60 resilient modulus tests were conducted. A new approach was introduced to estimate the equivalent MR as a function of the MR value for each layer. The results matched the values obtained by KENPAVE analysis.

Keywords: Equivalent Resilient Modulus; Asphalt Concrete; Multi-Layer; Linear Elastic.

1. Introduction

Flexible pavement analysis is required to understand the behavior of asphalt mixtures under different conditions. There are different approaches to analyse the behavior of asphalt mixtures ranging from linear elastic to complex non-linear analysis. Layered Elastic Theory (LET) has been successfully used over the past 50 years to analyze flexible pavements [1]. LET was first developed by Burmister as an analytical solution for a two-layered system and then improved to a multi-layered system. The method is considered as a mathematically exact solution. It gives the response (stresses, strains and deflections) when subjected to a wheel load at any point in a multi-layered, linear elastic pavement, assuming the layer is horizontally infinite and lying on a semi-infinite subgrade [2]. Al-Mosawe (2016) [3] conducted a study based on the multi-layer elastic system to predict the permanent deformation in asphalt mixtures and the results showed good agreement with laboratory data.

The key parameter of pavement layers which is needed for the evaluation, design, and to estimate the remaining life of an existing pavement for the overlay design in pavements maintenance is the Resilient Modulus (Mr). The evaluation of Mr for asphalt concrete mixes is well documented in the ASTM and AASHTO standards, but for the existing pavement structure the calculation of the layer modulus or the entire structure modulus required two types of tests. The first type is the destructive test (DT) which is achieved by coring the asphalt concrete pavement then testing the cores in the laboratory to determine the resilient modulus. The second type is the non-destructive test (NDT), where the

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http://dx.doi.org/10.28991/cej-03091156