ผลของความชื้นและการบดอัดต่อค่าโมดูลัสคืนตัวของวัสดุพื้นทางแบบไม่เชื่อมแน่น

Influences of Moisture and Compaction on Resilient Modulus of an Unbound Base Material

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Abstract

Resilient modulus (Mr) is a key parameter of unbound granular base material demanded in the modern Mechanistic-Empirical (M-E) pavement design approach. Because of its better representing mechanistic response of base layer, the resilient modulus is introduced as key characteristic of soil and aggregate materials in replacement of the conventional California Bear Ratio (CBR). In contrast to the CBR which is the bearing capacity at the single condition i.e. optimum moisture content and modified proctor compaction, the resilient modulus is highly dependent on the moisture content and compacted density. In this research, a crushed limestone is selected as a representative unbound granular material (UGM). A series of compacted cylindrical-shaped samples are prepared at various moisture content and compaction for carrying out cyclic triaxial testing methods for determination of Resilient Modulus using AASHTO T 307 procedure. The results of these tests provide the resilient modulus characteristic of unbound granular based materials for using in the Mechanistic-Empirical Pavement Design.

Keywords: Resilient modulus, Mechanistic-Empirical Pavement Design, cyclic load triaxial test.

1. Introduction

Currently the pavement design method is evolving to the new Mechanistic-Empirical (M-E) approach. The M-E approach has many significant benefits over the empirical design approach. One major success is it can estimate the stresses and strains in the pavement layers and correlate those values to identify the distress patterns and the progress rate at a given pavement structure. This is possible by the knowledge of mechanistic behavior of pavement materials responding to the repeated loads. In order to obtain stresses and strains of the road base layer, the resilient modulus of the base material must be known. The resilient modulus can be obtained by conducting a set of laboratory test using the cyclic triaxial apparatus.

The Resilient Modulus (*Mr*), an equivalent to the elastic modulus, is calculated using the recoverable strain under repeated loads. To calculate Mr, Equation (1) is expressed where σ_d is the applied deviatoric stress (σ_1-σ_3) and ε_r is the recoverable strain.

$$Mr = \frac{(\sigma_1 - \sigma_3)}{\varepsilon_r} = \frac{\sigma_d}{\varepsilon_r} \quad (1)$$

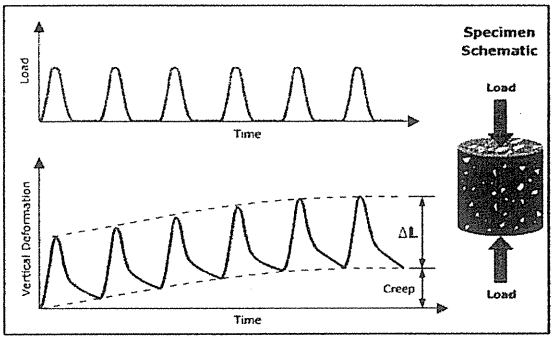

Fig. 1 Loads and deformation characteristics of resilient modulus test [1]

A number of factors can affect the *Mr* of unbound granular materials (UGM); they are stress state, water content, density or compaction level, aggregate type, gradation, percent fines. A number of researchers have developed models in attempt to predict the *Mr* of granular materials. The prediction model is essential to the M-E pavement design as an input to analyze stresses and strains in the layered unbound granular material.

2. Literature Review

Magnusdottir and Erlingsson [2] studied resilient modulus or stiffness of unbound granular base course materials by using repeated load triaxial testing (RLTT). It was discovered that the material stiffness clearly increased when the compaction level increased. As the compaction effort was increased and the stiffness increased. Moisture