

ABSTRACT

Effects of Coarse Aggregate Angularity On Permanent Deformation of Hot Mix Asphalt

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Permanent deformation is a critical failure mechanism and a serviceability performance indicator in flexible pavement that can be influenced by the potential of coarse aggregate stone-to-stone interlocking properties. Interlocking is dependent on coarse aggregate angularity and this has an effect on rut susceptibility of mixtures. The research aimed to investigate the effects of changes in coarse aggregate angularity on the deformation of hot mix asphalt (HMA). The aim was accomplished by conducting laboratory aggregate test using Aggregate Imaging System (AIMS) and mixture performance tests of four mixes (rounded, sub-rounded, sub-angular, angular) designed and classified with different combinations of AIMS coarse aggregate angularity index (CAI). The results revealed that there is a correlation between coarse aggregate angularity and laboratory-measured axial permanent deformation strains. Most empirical deformation prediction models do not account for the direct inclusion of an angularity parameter. The thesis explores the use of artificial neural networks (ANN), multiple linear regression (MLR), gene expression programming (GEP) and finite element method (FEM) as unconventional approaches to predict, simulate and evaluate the effects of particle angularity on permanent deformation behaviour of asphalt concrete (AC). The GEP approach selected as the chosen research model concluded satisfactory outcomes of the estimation of permanent deformation with an inclusion of an angularity parameter. The FEM summarized the research with simulations that evaluated the angularity effects on permanent deformation of laboratory cylindrical samples using variation of coefficients of creep material model. Observations concluded that with some improvements creep models could be used to predict permanent deformation in asphalt mixes.

Keywords: Lee P. Leon; Aggregate Angularity; Artificial Neural Network; Gene Expression Programming; Finite Element Methods; Permanent Deformation.