

Dynamic complex modulus predictions of hot-mix asphalt using a micromechanical-based finite element model

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Abstract:

A micromechanical-based finite element (FE) model was used to predict the dynamic complex modulus (E^*) of the hot-mix asphalt (HMA). The microstructure of HMA was captured with a high resolution scanner. Two material phases (aggregates and sand mastic) of HMA were modelled with finite elements. The sand mastic herein was composed of fines and asphalt binder with some fine aggregates. The dynamic complex modulus of the sand mastic under different temperatures and loading frequencies was measured in an experimental program. The corresponding principles were applied to bridge the elastic simulation and viscoelastic behavior with the input of the viscoelastic mastic properties. The input parameters in the FE model include the dynamic complex modulus of the sand mastic, the elastic modulus of the aggregates, and the microstructure of the HMA. The E^* values of the HMA were measured and used to compare the E^* predicted from the FE model. It is found that the FE approach used in this paper has the ability to predict HMA dynamic modulus across a range of temperatures and loading frequencies. The FE prediction of the E^* was compared with a recently developed discrete element modelling approach and found the E^* prediction from these two approaches to be very similar.