

Effects of Porosity Structure on the Moisture-Mechanical Damage Responses of a Viscoelastic Multiphase Medium

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Abstract:

A micromechanical modeling approach is developed to evaluate the impact of the porosity structure on the response of asphalt concrete as a viscoelastic multi-phase material under the combined action of moisture diffusion and mechanical loading. The critical impacts of the porosity structure on the coupled moisture-mechanical responses of asphalt concrete were highlighted by both experimental and numerical studies. In this presentation, a micromechanical modeling approach is used in combination with a methodology to randomly generate realistic pore properties within an asphalt concrete specimen. Finite element (FE) models are developed using nonlinear viscoelastic visco-moisture-mechanical damage constitutive relationships. The effects of varying the pore content, shape, and size distribution on the stress distribution and damage evolution within asphalt concrete specimens are then assessed. A numerical approach is also used to estimate the effective moisture diffusivity of asphalt concrete as a function of the pore shape and content. The outcome sheds light on our understanding of how the porosity structure of asphalt concrete affects its moisture-mechanical responses.