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Understanding Surface Failures in Thick Asphalt Pavement: A 3-D Finite Element Model Analysis

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Abstract : This study investigates the factors contributing to the deterioration of thick asphalt pavements, such as rutting and cracking. We focus on the combined influence of traffic loads and pavement structure. This study uses a three-dimensional finite element model with a Mohr-Coulomb failure criterion to analyze the stress levels near the pavement's surface under realistic conditions. Our model considers various factors, including tire-pavement contact stresses, asphalt properties, moving loads, and dynamic analysis. This research suggests that cracking tends to occur between dual tires. Some key discoveries include the risk of cracking increases as temperatures rise; surface cracking at high temperatures is associated with distortional deformation; using a uniform contact stress distribution underestimates the risk of failure compared to realistic three-dimensional tire contact stress, particularly at high temperatures; the risk of failure is higher near the surface when there is a negative temperature gradient in the asphalt layer; and debonding beneath the surface layer leads to increased shear stress and premature failure around the interface.

Keywords : asphalt pavement, surface failure, 3d finite element model, multiaxial stress states, Mohr-Coulomb failure criterion
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