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Influence of Inclined Wheel Loading on the Structural Responses of Pavement Using 3-D Finite Element Modeling

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Abstract

Inclined wheel loading significantly affects pavement structural responses, including increased stress–strain, rutting, and accelerated pavement deformation. Most of the studies consider tire–pavement stress distribution under static load in the design process. Literature indicates that, as of now, the stress distribution during the turning traffic is reportedly different from the real condition. In this study, a computational three-dimensional (3-D) finite element (FE) modeling was undertaken to investigate the influence of tire inclination angle on pavement structural responses. FE modeling tool ANSYS is used to develop a 3-D tire–pavement interaction model. For the FE simulation, pavement layers including cement–treated sub–base, cemented base, and soil subgrade were considered isotropic linear elastic. The behavior of the bituminous layer material was modelled as a viscoelastic material. Three sets of wheel loading parameters were considered for a standard axle load of 80 kN with a tire pressure of 650 kPa; the tire tilt angles varied between 0°, 4°, and 8°. The findings from each set were compared and consisted of maximum shear stress and vertical strain. The result showed that the contact pressure was substantially higher under inclined wheel loading than under static loading. In line with the results, inclined wheel loads caused the maximum shear stresses and vertical strains. Moreover, this approach can be considered a new approach for more realistic tire–pavement contact modeling of a more comprehensive pavement structure.

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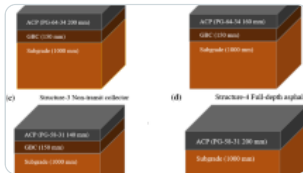
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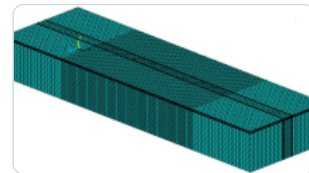
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