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3D Numerical Simulation of Undoweled and Uncracked Joints in Short Paneled Concrete Pavements

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Abstract : Short paneled concrete pavement (SPCP) with shorter panel size can be an alternative to the conventional jointed plain concrete pavements (JPCP) at the same cost as the asphalt pavements with all the advantages of concrete pavement with reduced thickness, less chance of mid-slab cracking and or dowel bar locking so common in JPCP. Cast-in-situ short concrete panels (short slabs) laid on a strong foundation consisting of a dry lean concrete base (DLC), and cement treated subbase (CTSB) will reduce the thickness of the concrete slab to the order of 180 mm to 220 mm, whereas JPCP was with 280 mm for the same traffic. During the construction of SPCP test sections on two Indian National Highways (NH), it was observed that the joints remain uncracked after a year of traffic. The undoweled and uncracked joints load transfer variability and joint behavior are of interest with anticipation on its long-term performance of the SPCP. To investigate the effects of undoweled and uncracked joints on short slabs, the present study was conducted. A multilayer linear elastic analysis using 3D finite element package for different panel sizes with different thicknesses resting on different types of solid elastic foundation with and without temperature gradient was developed. Surface deflections were obtained from 3D FE model and validated with measured field deflections from falling weight deflectometer (FWD) test. Stress analysis indicates that flexural stresses in short slabs are decreased with a decrease in panel size and increase in thickness. Detailed evaluation of stress analysis with the effects of curling behavior, the stiffness of the base layer and a variable degree of load transfer, is underway.

Keywords : joint behavior, short slabs, uncracked joints, undoweled joints, 3D numerical simulation
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