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Quantification of Dowel-Concrete Interaction in Jointed Plain Concrete Pavements Using 3D Numerical Simulation

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Abstract : Load transfer between adjacent slabs of the jointed plain concrete pavement (JPCP) system is inevitable for long-lasting performance. Dowel bars are generally used to ensure sufficient degree of load transfer, in addition to the load transferred by aggregate interlock mechanism at the joints. Joint efficiency is the measure of joint quality, a major concern and therefore the dowel bar system should be designed and constructed well. The interaction between dowel bars and concrete that includes various parameters of dowel bar and concrete will explain the degree of joint efficiency. The present study focuses on the methodology of selecting contact stiffness, which quantifies dowel-concrete interaction. In addition, a parametric study which focuses on the effect of dowel diameter, dowel shape, the spacing between dowel bars, joint opening, the thickness of the slab, the elastic modulus of concrete, and concrete cover on contact stiffness was also performed. The results indicated that the thickness of the slab is most critical among various parameters to explain the joint efficiency. Further displacement equivalency method was proposed to find out the contact stiffness. The proposed methodology was validated with the available field surface deflection data collected by falling weight deflectometer (FWD).

Keywords : contact stiffness, displacement equivalency method, Dowel-concrete interaction, joint behavior, 3D numerical simulation
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