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Finite Element Modeling of the Effects of Loss of Rigid Pavements Slab Support Due to Built-In Curling

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Abstract : Accurate determination of thermo-mechanical responses of jointed concrete pavement slabs is essential to implement an effective mechanistic design. Temperature-induced curling of concrete slabs can produce premature top-down cracking in rigid pavements. Curling of concrete slabs can result from daily temperature variation through the slab thickness. The slab curling can also result from temperature gradients due hot weather construction, drying shrinkage and creep that are permanently built into the slabs. The existence of permanent curling implies that concrete slabs are not flat at zero temperature gradient. In this case, slabs may not be in full contact with the underlying base layer when subjecting to traffic. Built-in curling can be a major factor producing loss of slab support. The magnitude of stresses induced in slabs is influenced by the stiffness of the underlying foundation layers and the contact condition along the slab-foundation interface. An approach for finite element modeling of the effect of loss of slab support due to built-in curling is presented in this paper. A series of parametric studies is carried out for a pavement system loaded with a combination of traffic and thermal loads, considering different built-in curling and different foundation rigidities. The results explain the effect of loss of support in the magnitude of stresses produced in concrete slabs. The results of parametric study can also be used to evaluate whether the governing equations that are used to idealize the behavior of jointed concrete pavements and the effect of loss of support have been accurately selected and implemented in the finite element model.

Keywords : built-in curling, finite element modeling, loss of slab support, rigid pavement
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