

Abstract

Cement concrete pavements are being constructed in many new road projects in India as they are considered to be economical especially for the highly trafficked segments of national highways. In the present work, a three-dimensional finite element model has been developed for the analysis of jointed concrete pavement. The FE modeling considers several aspects of analysis and design like slab-foundation interaction, interface behavior between concrete slab and foundation, load transfer at joints by dowel bar and aggregate interlocking mechanisms, effect of temperature variation, nonlinear deformational response of concrete etc. Push-off tests have been conducted in the laboratory on model concrete pavements with different interface conditions (smooth and rough) and on different types of foundations (base and subbase) to obtain the values of coefficient of friction, which is a parameter for modeling interface condition. The FE model has been validated with the experimental results available in the literature and also from the results of structural evaluation of in-service concrete pavements carried out in the present work using Falling Weight Deflectometer.

Using the validated FE model, some of the current design issues have been examined. The effect of different pavement and joint related parameters on the load transfer characteristics of a doweled joint has been evaluated. The group action of the dowel bar system was also examined and useful relationships have been developed for estimation of the relative load shared by the individual dowel bars. The effect of different interface conditions on critical stresses under individual or combined action of wheel load and temperature differential has been studied. A generalized expression has been proposed for estimating the critical (edge) stress in the slab subjected to the combined action of axle loading and positive temperature gradient. A fatigue performance model has been developed based on fracture mechanics principles for predicting crack propagation within the concrete slab under cyclic loading.

Keywords: Cement concrete pavement, finite element model, interface condition, load transfer, dowel bar, aggregate interlocking, crack propagation, fatigue.

