Design of Rigid Pavement Joint Spacing for Rural Roads

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When it is compared with the flexible pavements, tensile stresses along the pavement layers are more significant in rigid pavements. Shrinkage stresses and thermal stresses are the dominant contributors to develop the tensile stresses in rigid pavements. Providing lateral joints in appropriate spacing is one of the better solutions to overcome the said stresses. Rigid pavements are usually exposed to solar radiation severely and this incorporates with the development of varying thermal stresses as well. Rate of receiving heat flux from solar radiation, thermal properties of concrete and heat loss from concrete due to convection parameters of surrounding are the main influences of the temperature variation of an exposed concrete slab. This research produces a methodology to incorporate the temperature variation of concrete slab by the use of a 3D finite element model (FEM) approach, to estimate the relevant deformation of concrete due to its exposure to the solar radiation. ANSYS (Version 12.0.1) was used for this FEM analysis, to obtain thermal variations of an exposed pavement slab. Laboratory scale slab was used to verify the results obtained from the FEM. Verified FEM is capable of producing the lateral stresses and its corresponding deformations of concrete pavement for daily thermal variation. Lateral deformations due to shrinkage effect were calculated according to the BS 8110 part 2:1985 shrinkage model.

Opening of the joint crack is restricted by the load transfer requirement in consecutive pavement slabs. Aggregate interlocking is an efficient load transfer mechanism for the thin concrete pavements which are commonly used in rural roads. Effectiveness of aggregate interlocking mechanism depends on strength of the concrete, strength of aggregate, maximum aggregate size, friction of cracked surfaces, slab thickness and joint opening. Lateral joint opening vary with the pavement life and it is directly affected to the Load Transfer Efficiency (LTE). Another key aspect of this study is to carry out an experimental investigation to obtain a relationship between crack width and LTE in a rigid pavement joints. 150 mm thick test concrete pavement slab was cast with grade 25 concrete, 20 mm coarse aggregate was used to obtain the LTE at cracked joint. Standard single axel, single wheel load of 40 kN was used to simulate the tire load. From the obtained results, it was observed that LTE decreases non-linearly with the increase of crack width.

This paper describes a procedure to obtain the joint spacing for thin rigid pavements by the use of the FEM results and LTE experiment outcome. According to the study, joint spacing for rigid pavements in rural areas can be provided even beyond the specified values of ACPA.

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