INVESTIGATION OF THE EFFECT OF CURLING ON AS-CONSTRUCTED SMOOTHNESS AND RIDE QUALITY OF KDOT PORTLAND CEMENT CONCRETE (PCC) PAVEMENTS

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RESEARCH

Introduction

Smoothness plays a significant role in the construction, functionality, and performance of roadways. Many state highway agencies including the Kansas Department of Transportation (KDOT) have adopted specifications that require minimum levels of smoothness for newly built pavements. A number of factors contribute to the roughness or a lack of roughness: pavement distresses, built-in construction irregularities, traffic loading, environmental effects, and construction materials. Environmental effects such as temperature and/or moisture gradient across the thickness of the concrete pavement slab can cause curling, which also affects the roughness.

Project Objective

The objectives of this research were to evaluation and quantify the effect of PCC slab curling on the as-constructed and short-term smoothness and to identify the factors that affect curling and roughness, so that the occurrence of curling could be minimized through modifications to the design and/or construction techniques.

Project Description

Twelve test sections on six newly built concrete pavement projects on Interstate routes 70 and 135 were selected. Periodic longitudinal profile data was collected by a South Dakota-type profiler on each wheel path of both the driving and passing lanes. A digital method was developed to separate curling from the longitudinal profile using Fast Fourier Transform (FFT). International Roughness Index (IRI) values were calculated for the original profile, curled profile, and profile without curling. The contribution of curling to the measured roughness was found to be significant. Analysis of variance (ANOVA) was performed to compare mean IRI values with respect to different factors. Rate of application of curing compounds and time of the year when data was collected were found to be significant factors affecting the as-constructed smoothness and early life roughness of PCCP's. Double application of curing compound can reduce the curling as well as help retain short-term smoothness of newly built concrete pavements.

Project Results

A set of models was developed to describe early-life roughness in terms of different construction, geometric, and climatic variables. The as-constructed smoothness and early-life roughness are affected by the PCC slab thickness, compressive strength of concrete and base layers, percent air in concrete, and grade. The smoother a pavement is built, the smoother it stays over time. The factors that affected curling were: slab thickness and the stabilized base stiffness. Curling could be minimized using a subbase that would yield when the concrete slab expands or contracts. If curling could be minimized, roughness in terms of IRI becomes a function of the slab thickness, compressive strength of the concrete, change in Plasticity Index of the subgrade soil after lime treatment, and strength of the base layer.

Report Information

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