SLAB CURLING PREDICTION MODEL

INTRODUCTION

This section of this study will provide information about the background and objectives of the work undertaken to complete the calibration and validation of the HIPERPAV curling model on one of the instrumented test slabs.

Background

The curling model adopted in HIPERPAV [(1)] is based on the classic model developed by Westergaard [(2)], which was developed to predict the deflections, strains, and stresses in a rigid pavement due to variations of temperature. As the stresses that develop due to curling alone, can not be measured directly, the calibration and validation of the curling models will be based on estimating the curling deflections

CURLING MODEL

The curling model adopted in HIPERPAV, is based on the Bradbury modified version of the classic model developed by Westergaard. [(2)] The deflection of the edge of the slab can be calculated through the use of equation 1 listed below:

$$Y_e = \frac{(1+\nu)\cdot\alpha\cdot\Delta T\cdot l^2}{h} \qquad \text{..... (1)}$$

Where:

- Y_e = Deflection of slab edge (inch),
- ν = Poisson ratio (unitless),
- α = Coefficient of Thermal Expansion (COTE) of the Concrete (με/°F),
- ΔT = Temperature differential between top and bottom (°F),
- l = Radius of relative stiffness, as defined in equation 2 (in), and
- h = slab thickness (in).

In equation 1, the Radius of relative stiffness, l, is defined as follows:

$$l = \sqrt[4]{\frac{E\cdot h^3}{12\cdot(1-\nu^2)\cdot k}} \qquad \text{..... (2)}$$

Where:

E = Modulus of Elasticity of the concrete (psi),

ν = Poisson ratio (unitless),

k = Modulus of subgrade reaction (psi/inch), and

h = Slab thickness (in).

Many of the parameters in equations 1 and 2 are time dependent and have to be determined for each time step.

In the following section, the data necessary for the calibration of the curling model will be documented. The section after that will present the curling model and discuss how all the data collected from the site was interpreted to predict the slab's edge deflection. Figure 1 presents a schematic of the sequence of parameters analyzed in the curling model section.

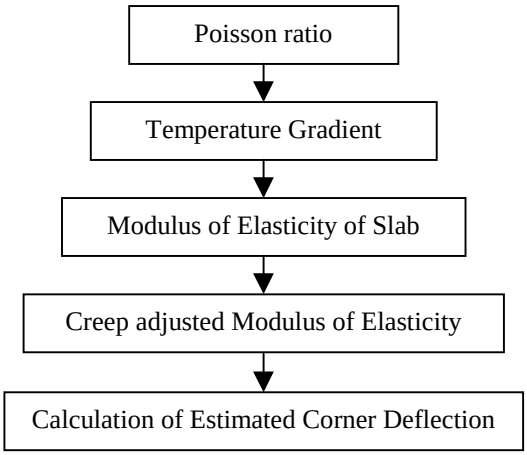

Figure 1. Scope of the main analysis components.

The results of the analyses are presented in the next sections of the study.

REFERENCES

(1) McCullough, B.F., and Rasmussen, R.O., "Fast Track Paving; Concrete Temperature Control and Traffic Opening Criteria for Bonded Concrete Overlays," Transtec, Inc., Austin, Texas, July 1998.

(2) Westergaard, H.M., "Analysis of Stresses in Concrete Roads caused by Variations of Temperature," Public Roads, United States Department of Agriculture, Bureau of Public Roads, Vol. 8, No. 3, May 1927.