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Investigation of Concrete Properties to Support Implementation of the New AASHTO Pavement Design Guide
WHRP Project 0092-06-03

The paper(s) abstracted below report recent research that may be related to the subject matter or methodologies of this WHRP project. For access to the CD-ROM and full text of the paper, contact Hussain Bahia (bahia@engr.wisc.edu) or Greg Waidley (gwaidley@engr.wisc.edu) at WHRP or John Cherney (john.cherney@dot.state.wi.us) at the WisDOT Library.

Portland Cement Concrete Coefficient of Thermal Expansion Input for Mechanistic-Empirical Pavement Design Guide

Paper No. 06-2573

Authors: Mustaque Hossain, Taslima Khanum, Jussara Tanesi, Greg Scheiber, Rodney A Montney

Abstract: Portland cement concrete (PCC) has a positive coefficient of thermal expansion (CTE). The CTE is an important input parameter for the Jointed Plain Concrete Pavement (JPCP) design following the Mechanistic-Empirical Pavement Design Guide (MEPDG) because of its effect on critical PCC slab stresses and also on joint and crack openings. MEPDG suggests the use of PCC CTE input at three hierarchical levels depending upon the efficacy of design – level 1 from actual tests for highest accuracy; level 2 from less than optimal testing or by calculations considering the PCC as a matrix of aggregates and hardened cement paste and knowing their individual CTEs; and level 3 from agency database or knowledge. In this study, the effect of these hierarchical input levels of CTE on the predicted JPCP performance was studied for six inservice pavement sections in Kansas. The CTE results from the Long Term Pavement Performance (LTPP) projects in Iowa, Kansas and Missouri were also reviewed. The results show that the range of measured PCC CTE values in Kansas according to the AASHTO TP-60 protocol is quite wide. The calculated PCC CTE value is always higher than the measured value. The effect of PCC CTE input on predicted roughness (International Roughness Index, IRI) is more pronounced for JPCP with thinner slab or lower PCC strength. A combination of high cement factor and higher PCC CTE would result in higher JPCP faulting. In general, faulting is very sensitive to this input. PCC CTE also has a very significant effect on slab cracking. However, it does not affect the predicted IRI for a JPCP with widened lane and tied PCC shoulder. Level 2 CTE input may result in more conservative JPCP design than that using Level 1 input. The detrimental effects of high CTE value can be mitigated using higher PCC slab thickness, larger diameter dowel bars or widened lane with tied PCC shoulder. Among these alternatives, the widened lane appears to be the most effective solution since no additional cost is necessary for this strategy.

Measurement and Analysis of Early-Age Concrete Strains and Stresses in Continuously Reinforced Concrete Pavement Under Environmental Loading

Paper No. 06-0852

Authors: Jeong-Hee Nam, Seong-Min Kim, Moon C. Won

Abstract: The early-age behavior of CRCP in terms of concrete strains and stresses due to environmental loading was extensively investigated and is presented in this paper. The measured strains using strain gages in the actual CRCP cannot simply be used to calculate the concrete stresses by multiplying the elastic modulus of concrete because the measured strains include both the stress dependent and independent strains. The in-situ stress independent strains were measured using vibrating wire gages embedded in the modified half cylinders developed in this study and in the small beams. The total strains in concrete were measured using vibrating wire gages at different depths in both the longitudinal and transverse directions at the crack induced area and the surrounding areas in several test sections. The crack width variation through the depth of the pavement was also measured using the gages installed at the crack induced area. The in-situ coefficient of thermal expansion and drying shrinkage of concrete were successfully measured using the developed measurement devices, and these measured values were used to calculate the stress dependent strains. The concrete stresses were then calculated from the stress dependent strains and the calculated stresses were finally verified from the comparison between the calculated stress at the instant of cracking and the measured strength.