Florida Department of Transportation Research

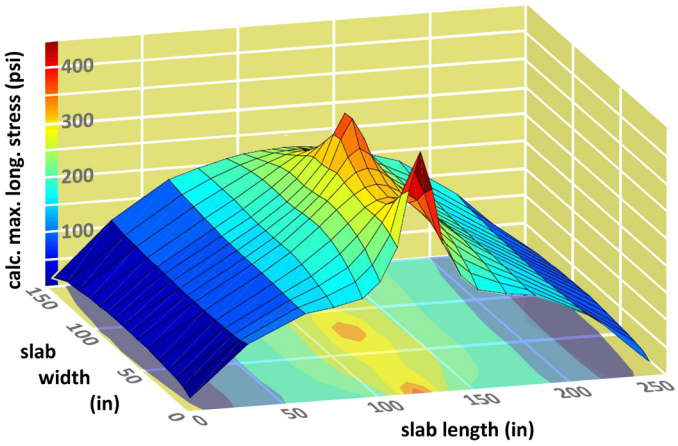
Evaluation of Long-Life Concrete Pavement Practices for Use in Florida
BDK75 977-48

Current Florida construction practices produce asphalt pavements with a service life of 12 to 20 years before needing rehabilitation; concrete pavements are typically designed for 20 years. However, pavements with much longer design lives are possible. Increased traffic on roadways, costs due to maintenance-related traffic delays, and increasing construction costs have led the Florida Department of Transportation (FDOT) to evaluate various pavement design parameters which would yield pavement service lives of 50 years or more.

In this project, University of Florida researchers studied designs and construction practices for long-life concrete pavements suitable for Florida. The researchers divided their work into four parts: simulating long-life pavement designs; evaluating drainage issues; evaluating performance-related factors; and examining life-cycle costs of concrete pavements in Florida. Models based on the Mechanistic-Empirical Pavement Design Guide (MEPDG) were used to evaluate the effects of various design factors on pavement performance. Researchers also conducted a literature review of current long-life pavement practices in other states and countries.

Three concrete pavement designs currently used by FDOT were chosen for analysis using the MEPDG model. Various design factors and their relative effect on pavement performance were evaluated, including climatic parameters, slab thickness, aggregate type, and base material properties. Slab thickness and aggregate type were the two most significant factors affecting predicted performance of evaluated pavements. Base material type and stiffness had no significant effect on predicted performance.

The Long-Term Pavement Performance (LTPP) database was used to evaluate effects of various factors on performance of jointed plain concrete pavements, yielding important findings for durability of long-life pavements — the computed critical stress-to-strength ratio was the most significant parameter related to the LTPP pavement performance. Lower stress-to-strength ratio correlated with better performance. Critical stress analysis using typical Florida designs showed that the most significant factors affecting concrete's stress-to-strength ratios were slab thickness, elastic modulus, modulus of rupture, and coefficient of thermal expansion. Variations in base and subbase properties had minimal effect on stress-to-strength ratios for concrete slabs when they were 11 inches or more thick.



Calculated maximum longitudinal stress as a function of slab width and length was generated by the finite element program FEACONS.

Based on this study, three typical Florida concrete pavement designs were shown to be suitable for use as long-life pavements, if slab thickness was adequate and the concrete has low elastic modulus, low coefficient of thermal expansion, and adequate flexural strength. Slab thickness of 13 or 14 inches was recommended. In addition to meeting the present FDOT specifications for these three designs, the concrete mixture to be used must be designed and evaluated according to the procedure recommended in the report.

Replacement over time of existing pavements with long-life pavements, where feasible, promises a more durable, cost-effective, and efficient highway system.

Project Manager: Abdenour Nazef, FDOT Materials Office
Principal Investigator: Mang Tia, University of Florida
For more information, visit http://www.dot.state.fl.us/research-center