CENTER FOR TRANSPORTATION RESEARCH

PROJECT SUMMARY

Texas Department of Transportation

0-6723: Development of Rapid, Cement-Based Repair Materials for Transportation Structures

Background

The state of Texas has been plagued by various durability-related issues in recent years, including deterioration from alkali-silica reaction, delayed ettringite formation, corrosion of reinforcing steel, volume changes (plastic shrinkage, drying shrinkage, thermal effects, etc.), and spalling of continuously reinforced concrete pavements. These durability-related issues, coupled with other factors that contribute to reductions in service life (e.g., service loads and defects), have resulted in the need to repair concrete structures and to do so in a timely, efficient fashion, with minimal disruption to the traveling public. Thus, the need for rapid, cement-based repair materials has emerged, especially in highly congested urban areas. The goals of this research project, funded by the Texas Department of Transportation (TxDOT), were to evaluate a range of rapid repair materials and to provide recommendations on the most efficient, economical, and durable repair materials and methodologies.

What the Researchers Did

The focus of this project was to evaluate a range of repair materials across a range of properties (fresh, hardened, and durability) that affect the performance of horizontal repairs, such as on pavements and bridge decks. This project included a significant laboratory and field evaluation program, examining several classes of rapid concrete, including calcium aluminate cement (CAC) concrete, high early-strength portland cement concrete, calcium sulfoaluminate cement concrete, and concrete containing fly ash as the sole binder. Figure 1 summarizes the overall scope of this comprehensive research project.

What They Found

After performing a comprehensive evaluation in the laboratory and in large-scale field trials, the research team thoroughly characterized the key properties of a wide range of rapid repair materials. The performance of the various repair materials was compared to current TxDOT specifications, and a general ranking of performance across the range of key properties was developed. These findings were then synthesized and incorporated into recommendations on the use of the various candidate repair materials in rapid, horizontal repair applications.

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Project Completed:
8-31-2014

Fresh Properties	*Hardened Properties*	*Durability Properties*
• Water demand • Slump and slump retention • Air-entraining agent demand • Admixture/binder compatibility • Setting time • Bleeding	• Compressive strength • Tensile strength • Flexural strength • Elastic modulus • Heat of hydration (isothermal and semi-adiabatic calorimetry) • Maturity (for selected binders) • Drying shrinkage • Thermal expansion/contraction • Restrained and unrestrained volume change (using cracking frame approach, as per TxDOT 4563 and 6332) • Bond strength (with substrate)	• Alkali-silica reaction • Delayed ettringite formation • External sulfate attack • Freeze-thaw • Salt scaling • Transport properties (resistivity, diffusion, etc.) • Corrosion of reinforcing steel

Figure 1. Fresh, Hardened, and Durability Properties Evaluated for Rapid Concrete Repair Materials.

What This Means

It is expected that the overall findings of this study will allow TxDOT to more effectively select repair materials and mixture proportions for rapid, horizontal repair applications. The overall project findings, from both the laboratory and field studies, can serve as the basis for improving TxDOT's test methods, specifications, and practices for applying rapid repair materials that will extend the service life of Texas' transportation infrastructure.

For More Information

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Keyword: Research