Texas A&M Transportation Institute

Texas Department of Transportation

PROJECT SUMMARY REPORT

0-7027: Accelerating Mix Design for Cement-Treated Base

Background

Base material treatments offer various advantages for pavement performance. In Texas, cement treatment is commonly used to treat roadway or stockpile materials. Current test procedures perform cement-treated base (CTB) mixture design using 6-in.-diameter, 8-in.-tall specimens cured for 7 days in accordance with Tex-120-E.

This project aimed to streamline CTB mixture design with an accelerated process and lab procedures similar to those recently developed for emulsified and foamed asphalt. By employing indirect tensile (IDT) strength from 4-in.-diameter, 2-in.-tall specimens, the accelerated mix design approach can produce results faster and with less material than current CTB mix design methods using unconfined compressive strength (UCS) (Figure 1).

Figure 1. Rapid Mix Design Specimens (Left) versus Single Compressive Strength Specimen (Right) for CTB Mixture Design.

What the Researchers Did

Researchers synthesized existing CTB mixture design practices. They sampled eight distinct materials for upcoming construction projects and conducted a comprehensive lab evaluation of those materials under varying curing conditions and durations. Researchers coordinated with Texas Department of Transportation districts on four demonstration projects, and they collected and analyzed post-construction falling weight deflectometer measurements on the two projects that were constructed during this research. Researchers developed a CTB mechanistic check that synergizes the rapid mix design procedure with pavement analysis tools.

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What They Found

Standard CTB mixture design methods commonly use a 7-day moist-cured compressive strength, while the literature suggests potential viability of 1- to 3-day accelerated cure methods involving elevated temperatures and submersion.

Three of four IDT methods evaluated in this project correlated well with reference UCS values, suggesting viability of 72-hour and even 30-hour IDT tests. IDT by 72-hour accelerated cure (IDT_3), with specimens sealed in bags and maintained at 104°F, followed by a 24-hour moisture conditioning by water submersion, provided the best basis of mix design from the IDT methods analyzed in this project.

The demonstration projects highlight the advantages of the small sample, rapid mix design for CTBs. For most projects, assessing various material combinations required less material and time. Two projects were completed that showed base modulus values over 300 ksi. Comparing lab and field modulus results indicated reasonable agreement between values for various cement contents.

This project's findings demonstrate that IDT_3 can estimate the modulus of rupture and resilient modulus values for CTB. Integrating these estimates into fatigue life models could facilitate an improved link between the lab and expected field performance, allowing mix design to feed into pavement analysis to perform a mechanistic check on the CTB layer during pavement design.

What This Means

The developed rapid mix design method for CTB should be added to Tex-120-E as Part III. Product 0-7027-P2B presents the recommended method. Compared to UCS, the rapid mix design approach reduces the test turnaround time for strength results from 7 to 4 days and reduces the material quantity required for the strength testing from 180 lb to less than 60 lb.

Based on project data, Table 1 provides IDT_3 minimums that correspond to common historical UCS values. Given this project's scope and data, the accelerated mix design procedure for CTB is suitable for road-mixed or stockpiled base materials.

Table 1. IDT_3 Mix Design Minimums.

Tex-120-E UCS Target (psi)	IDT_3 Minimum (psi)
175	34
220	43
300	59
500	98

The mechanistic check from this project should be added to the Texas Flexible Pavement System. The full research report provides a framework for how this mechanistic check could be efficiently implemented.

For More Information

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