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Project Summary Report 0-4395-S
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Project 0-4395: Optimum Spot Base/Subgrade Repair Techniques for Moderate to High Traffic Highways over Highly Expansive Subgrade Soils

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PROJECT SUMMARY REPORT

Development of Guidelines for Maintenance Base Repairs on Expansive Soils

With finite resources and an extensive road network to maintain, Texas Department of Transportation (TxDOT) maintenance forces must select roadway repair methods that are structurally sound, capable of being opened early to traffic, and straightforward in construction. TxDOT anticipated the loss of more experienced employees, and this project focused on developing guidelines to aid less experienced personnel in selecting repair methods and materials. Efforts specifically focused on distresses common in expansive soil environments.

What We Did...

After a literature review regarding existing guidelines for maintenance treatment and pavement rehabilitation techniques, the research team created and conducted a survey of maintenance supervisors and assistant maintenance supervisors within TxDOT to establish the common maintenance practices utilized. Fifty-two respondents indicated what materials and methods they would employ for repairing roughness, longitudinal cracking, and fatigue cracking distresses. Subsequently, the research team visited field sites where maintenance repairs had previously been performed. Through visual assessment, falling weight deflectometer testing, and coring, the research team gauged the performance of the repairs.

After conducting the survey and field site visits, the research team obtained common base materials used by maintenance forces in the San Antonio District. These materials included two limestone aggregates and two cold-mix asphalts. Through laboratory tests including strength, moisture susceptibility, and modulus, the research team gauged the performance of these common repair materials. Results from the survey, field visits, and laboratory testing served as the basis for a draft field guide for selecting maintenance repair methods for roughness, longitudinal cracking, and fatigue cracking distresses. Although not a focal point of this project, rutting was also covered in the guide.

After several reviews of the draft field guide, the research team visited numerous sites with TxDOT personnel to ensure that the recommendations from the guidebook were relatively consistent with the state of practice within TxDOT. The Texas Transportation Institute (TTI) then formatted the guidebook, shown in Figure 1, in final form for publication.

What We Found...

TxDOT maintenance supervisors use distress type, experience, and traffic level as the major factors in selection of a repair technique. For roughness, cold-mix level-ups were the most common treatment. Field investigations indicated that little incentive exists to perform a full-depth repair for roughness unless the distress is severe or the subgrade will be treated as part of the repair.

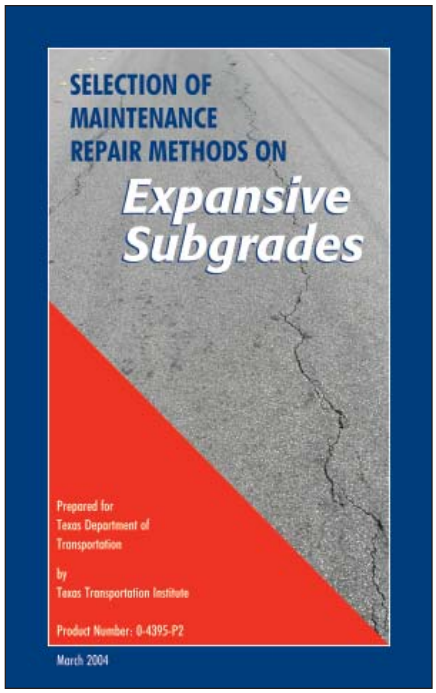

Figure 1. Guidebook Developed during Project.

For longitudinal cracking, the most common treatment was smoothing the surface with cold mix. Field investigations indicate that little incentive exists to perform full-depth repairs on sections of longitudinal cracking unless some special treatments are applied or the distress is severe, such as if significant edge breakup exists. Conventional full-depth patches and surface patches only mask the source of the problem (the expansive subgrade), and sites where the cracks were filled and sealed typically perform just as well as the full-depth repairs and the surface patches.

The Bryan District developed a promising new method for dealing with longitudinal cracking and has used this method on several farm-to-market rehabilitation projects. After recycling the existing roadbed, a geogrid placed on top of the recycled surface serves as an initial barrier to upward crack propagation. A thin flexible base overlay on top of the geogrid serves as a stress relief layer. To date, sections rehabilitated with this basic design, illustrated in Figure 2, exhibit significantly reduced or no longitudinal cracking.

For fatigue cracking, maintenance forces typically apply a spot seal coat. Field evaluations indicate that spot seals over fatigue cracking are best as short-term treatments for lower-volume roads since cracks reflect through the seal coat in a relatively short time frame and fines resume pumping. When the base is repaired, field visits show good performance with cement-treated bases.

Testing common maintenance base repair materials in the lab indicated that treatment with 2 to 3 percent Type 1 cement should provide adequate strength, moisture resistance, and economy in reasonable quality limestone aggregates. Gravel aggregates will require approximately 3 to 4 percent cement. Figure 3 shows that cement-treated limestones were substantially stronger and stiffer than common black bases; furthermore, the modulus of the asphalt bases varied significantly with temperature.

Maintenance personnel should be aware of some special issues that can arise when dealing with plastic soils. If the soil will be

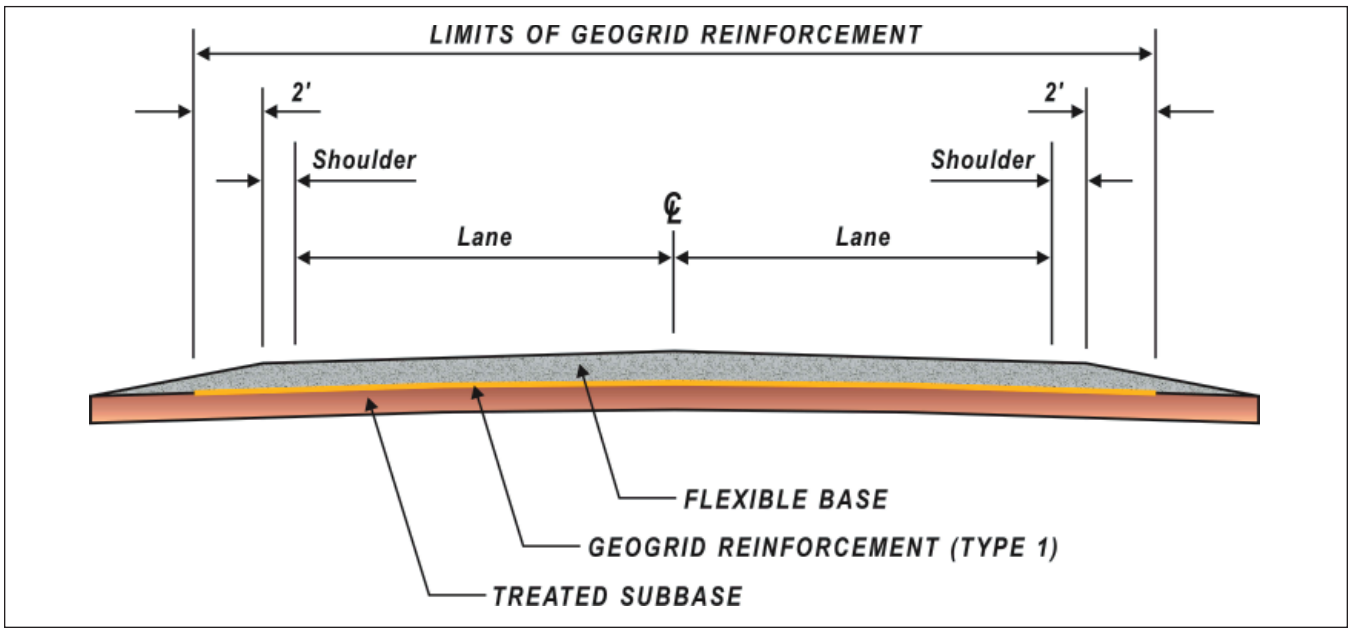

Figure 2. Bryan District Rehabilitation Design.

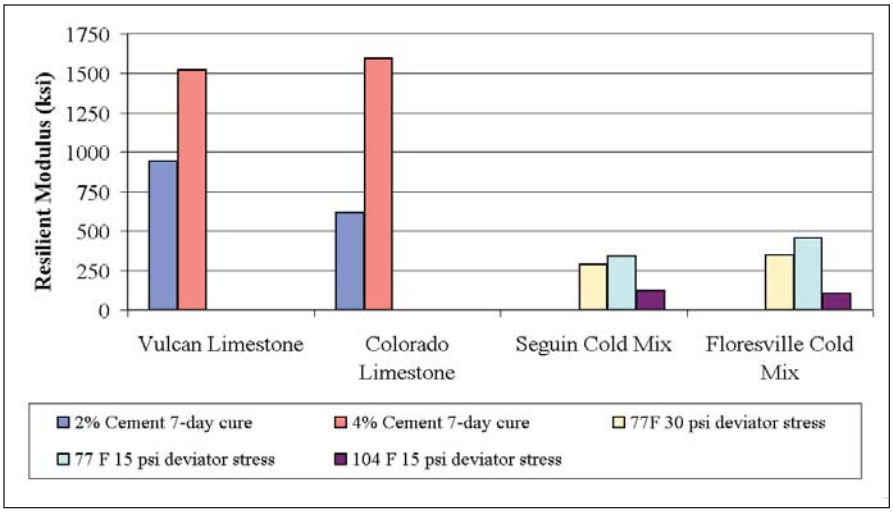

Figure 3. Test Results of Maintenance Base Materials.

treated, chemical lime reacts better with plastic soils than cement. An application rate of 6 percent is a good general value for lime-treated soils. If considering subgrade treatment, maintenance forces must be aware of organics and sulfates. Soils high in organics will typically be dark in color and have a distinct odor; organic contents in excess of 1 percent can significantly decrease the effectiveness of lime treatment. Likewise sulfates, typically observed in the form of gypsum crystals in the soil as shown in Figure 4, react with lime or cement and cause heaving in the road. Sulfates in excess of 0.3 percent can result in pavement damage. The district pavement engineer can assist with determining the level of organics or sulfates in a soil if excess levels are suspected.

The Researchers Recommend...

Based upon the findings from this project, the research team recommends the following treatments:

- Roughness: for most severities of roughness, milling or a surface patch should be sufficient. For high-severity roughness on crucial roadways, reconstruction with subgrade treatment should be considered and the area or district pavement engineer should be contacted.
- Longitudinal Cracking: Crack filling and sealing or strip seals can be employed for less severe longitudinal cracks. For wider and/or faulted cracks, consideration should be given to reconstruction with geosynthetic reinforcement. If such work is beyond the scope of the maintenance office, the area or district pavement engineer should be contacted to consider whether contract repair or rehabilitation work may be necessary utilizing the geogrid reinforcement method. The maintenance office should fill and seal wide cracks, and if faulting is greater than 0.5 inch, a surface patch should be applied to remove the drop-off.
- Fatigue Cracking: Non-structural fatigue cracking (such as old, de-bonded, or segregated hot mix) can be treated by milling and placing new mix. For structural problems, a strip seal may be adequate if only a short-lived repair is needed (6 months to 1 yr. life), but increasing the structural capacity of the section is the only means for achieving a permanent repair. For maintenance treatments, use of cement-treated base, perhaps combined with an increase in base thickness, should provide adequate performance.

The information described in this report is summarized in a field guide format, available as Product 0-4395-P2. This guidebook should be distributed within TxDOT for use in assisting less experienced personnel in making pavement repair decisions.

Figure 4. Gypsum Crystals in Soil.

For More Details...

This research is documented in:

Report 0-4395-1: *Investigation of Maintenance Base Repairs over Expansive Soils: Year 1 Report*
Report 0-4395-2: *Finalization of Guidelines for Maintenance Treatments of Pavement Distress*

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Disclaimer

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