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16. Abstract

This research project focused on developing guidelines to aid less experienced maintenance personnel in selecting repair methods and materials for treating pavement distress. The first phase of this project is detailed in Research Report 0-4395-1 and included a literature review, visits to field sites, and laboratory testing with common materials used for maintenance base repairs. Based upon the findings from the work completed in Phase 1, a field guidebook was drafted for use by maintenance personnel to aid in selecting a repair strategy based upon distress type, distress severity, and importance of the road. This report describes the remaining phase of the project. With TxDOT personnel, the research team visited several locations in need of maintenance treatments and documented what treatment would be recommended from the draft field guide. The research team also noted the treatment planned by the TxDOT maintenance supervisor. In this manner, the recommendations from the draft field guide were checked to ensure they were relatively consistent with the state of the practice within TxDOT. Based upon the findings and comments received, the research team made some minor changes and additions to the draft field guide to finalize the guide for publication and distribution. The final version of the guide is available as Product 0-4395-P2.

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FINALIZATION OF GUIDELINES FOR MAINTENANCE TREATMENTS OF PAVEMENT DISTRESS

by

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Report 0-4395-2
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DISCLAIMER

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EXECUTIVE SUMMARY

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. With the loss of more experienced employees, this research project focused on developing guidelines to aid less experienced personnel in selecting repair methods and materials and thus help ensure knowledge transfer between employees. The research team made efforts to specifically focus on distresses common in expansive soil environments.

In the first phase of this project, the research team conducted an extensive literature survey relevant to pavement maintenance and rehabilitation strategies, a survey within several TxDOT districts regarding what maintenance treatments they typically used for various distresses, an evaluation of repairs performed in several TxDOT districts, and a laboratory analysis of some common materials used for maintenance base repair in the San Antonio District. Research Report 0-4395-1 presents the details of the Phase I work. Based upon the findings from the work completed in Phase 1, a field guidebook was drafted for use by maintenance personnel to aid in selecting a repair strategy based upon distress type, distress severity, and importance of the road. Approximately 24 copies of the draft field guide were distributed within TxDOT for review.

This report describes the remaining phase of the project. With TxDOT personnel, the research team visited several locations in need of maintenance treatments and documented what treatment would be recommended from the draft field guide. The research team also noted the treatment planned by the TxDOT maintenance supervisor. In this manner, the recommendations from the draft field guide were checked to ensure they were relatively consistent with the state of the practice within TxDOT. Additionally, based upon feedback from the limited circulation of the draft field guides, the research team added some material to the field guide regarding soil-specific issues such as determining if a soil is suitable for chemical treatment, selecting a treatment level, and sulfates. After these changes, the field guide was finalized. The final version of the field guide is available as Product 0-4395-P2. Finally, reports of the longevity of maintenance repairs were solicited and evaluated to determine what treatments typically were optimal for various cases of distress (roughness, longitudinal cracking, and fatigue cracking). For maintenance treatments of roughness, a cold-mix surface patch typically required the least resources and provided as good a life expectancy as full-depth repairs. Optimal treatments for longitudinal cracking and fatigue cracking will depend on the severity of the distress, costs of locally available repair materials, and traffic control requirements.

CHAPTER 1

FIELD VISITS WITH DRAFT FIELD GUIDE

SUMMARY

After completion of the draft field guide, the research team visited several sites in need of maintenance treatments in the San Antonio District. The distress was documented and the field guide employed to recommend a treatment. This chapter presents the sites visited, a description of the distress, and the recommendation from the field guide. In most cases the recommendations from the field guide were similar to the planned maintenance activity from the maintenance supervisor, indicating the reasonableness of the field guide recommendations. The only discrepancies were due to existing material type at the site or/and preferences of the Maintenance Office. For example, the field guide suggests lime is overall a more permanent stabilizer for plastic clays, but one office visited reported they prefer to use cement with their particular soils; similarly, another office routinely uses black base material for base repairs because they can allow traffic on it sooner than if a treated flex base were utilized. Overall, the field visits and discussions with TxDOT indicate the recommendations from the field guide are good general starting points to narrow down treatment options, and TxDOT personnel visited felt the field guide would be a useful resource when training a less experienced employee.

PLEASANTON AREA OFFICE

FM 1332 WB West of SH 16

Description

Site has fatigue cracking with popouts and has already had patch material applied (Figure 1.1).

Field Guide Recommendation

A full-depth patch to good material is needed.

Figure 1.1. FM 1332 WB West of SH 16.

FM 1332 WB Near End of TxDOT Maintenance

Description

Approximately 1.25-inch rut depth through the section exists (Figure 1.2).

Field Guide Recommendation

The rut is both wide and deep. Consider a full-depth repair with additional base thickness and/or a subgrade treatment.

Figure 1.2. FM 1332 WB Toward End of TxDOT Maintenance.

I 37 East Side Frontage Road Site 1

Description

The site already has a strip seal; approximately a 50-ft section in the sealed section appears to have been patched with cement treated base (CTB). There is no distress in the CTB section. The remainder of the site has moderate rutting at the outside wheel path. Figure 1.3 shows the site.

Field Guide Recommendation

Consider a CTB repair such as what appears to have been applied (and is performing well) in part of the section.

Figure 1.3. I 37 East Side Frontage Road Site 1.

I 37 East Side Frontage Road Site 2

Description

Site has a seal coat and extensive fatigue cracking with popouts occurring (Figure 1.4).

Field Guide Recommendation

A full-depth patch is recommended. Patch material has already been applied to buy some time, but like the strip seal is only covering up the problem. The distressed areas should be repaired with a good flex base or treated material (new or existing).

Figure 1.4. I 37 East Side Frontage Road Site 2.

I 37 East Side Frontage Road Site 3

Description

Site has fatigue cracking and wide ruts approximately 1.125-inch deep. There is some exposed base in the cracked areas. The site has already had a newer seal coat applied.

Field Guide Recommendation

Because of the high severity rutting and the presence of fatigue cracking, a full-depth repair is warranted.

Figure 1.5. I 37 East Side Frontage Road Site 3.

I 37 East Side Frontage Road Site 4

Description

The site has fatigue cracking at the edges with popouts occurring, as shown in Figure 1.6.

Field Guide Recommendation

Consider a base patch with a lightly stabilized material or, alternatively, recycling the existing edge with a reclaimer and adding a low level of cement. Consider adding a couple of feet to the road width to increase edge support.

Figure 1.6. I 37 East Side Frontage Road Site 4.

I 37 West Side Frontage Road Site 1

Description

Extensive fatigue cracking exists with rutting at the exit ramp from I 37 (Figure 1.7).

Field Guide Recommendation

Upcoming contract work is scheduled for parts of the I 37 west side frontage road. Treatment at this site depends on if it is part of the upcoming contract work. If included in the contract work, a strip seal to keep water out (or perhaps no treatment at all, depending on the time frame until the contract begins) would probably be adequate. If not part of the contract work, the distressed section should be patched with a higher quality base material and/or an increased base thickness.

Figure 1.7. I 37 West Side Frontage Road Site 1.

I 37 West Side Frontage Road Site 2

Description

Figure 1.8 shows longitudinal cracks near the edge, and some transverse cracking, at this site. From the crack pattern, the site looks like it may have a treated base.

Field Guide Recommendation

The larger cracks could be filled and sealed, and the smaller cracks could be sealed. Since there is upcoming contract work on the section, other sites should receive higher priority.

Figure 1.8. I 27 West Side Frontage Road Site 2.

FM 2924 by RM 516

Description

Site has fatigue cracking and approximately 2-inch rut depth at the outside wheel path as shown in Figure 1.9.

Field Guide Recommendation

Suggestions include reconstructing the edge, if possible widening the edge to increase edge support, and consider increasing the base thickness.

Figure 1.9. FM 2924 by RM 516.

FM 791 West of 74 Ranch

Description

Greater than 2-inch rut depth exists in the wheel paths, popouts are occurring, and bare base is exposed. The existing pavement structure appears to be cement treated based upon the block cracking present. The distressed section already has seen maintenance activity. Figure 1.10 shows the site.

Field Guide Recommendation

Reconstruct the section. Both wheel paths are rutted, so there is a layer (base/subgrade or both) that is deficient. Prior to the work, try to verify the condition of the subgrade soil. From the wide rut widths it seems the subgrade may be weak and either a subgrade treatment or a thicker base is needed. Edge support also may be lacking at this site; if possible extend the road width to keep the wheel paths from being right at the edge. Proof roll the subgrade after the existing base is removed to identify weak spots. Try to find a good quality, non-moisture susceptible base, and make sure it gets compacted adequately.

Figure 1.10. FM 791 West of 74 Ranch.

SH 173 West of SH 16

Description

Medium-severity fatigue cracking exists in both wheel paths; rutting also exists and there are numerous maintenance patches throughout the section. Contract rehab work is being initiated on the road. Figure 1.11 shows the section.

Field Guide Recommendation

Do nothing, since under the contracted rehab the contractor must keep the road passable.

Figure 1.11. SH 173 West of SH 16.

FLORESVILLE AREA OFFICE

FM 3335 Just East of RM 526

Description

Cracking, shoving, and popouts occurred at the outside edge, as shown in Figure 1.12. The pavement structure is a sandy clay subgrade with a poor quality sandstone base.

Field Guide Recommendation

A base repair is necessary; consider widening the section for more edge support.

Figure 1.12. FM 3335 Just East of RM 526.

FM 3335 Fatigue Cracking

Description

This site, shown in Figure 1.13, has severe alligator cracking covering more than half the width of the lane.

Field Guide Recommendation

A full-depth repair is needed. On this road, TxDOT has had good success with using cement mixed in with the existing material.

Figure 1.13. FM 3335 Fatigue Cracking.

FM 3335 from FM 1107

Description

Figure 1.14 shows a section on FM 3335 from the intersection with FM 1107 to approximately 3000 ft east of FM 1107 that TxDOT maintenance forces rehabilitated in the summer of 2003. Prior to the work, the section had numerous locations with edge failures and popouts (like Figure 1.12) and fatigue cracking (like Figure 1.13). TxDOT treated the existing sandstone base with cement, then added 9 inches of new limestone flex base. As of this report date there is no distress in the section.

Field Guide Recommendation

Not Applicable. Site is shown to illustrate good performance of TxDOT repair. One method suggested in the field guide is treating the existing base, and if the pavement is structurally inadequate the guide suggests consideration of an additional base thickness. At this site, TxDOT performed both, and the results were good.

Figure 1.14. FM 3335 from FM 1107.

SEGUIN AREA OFFICE

FM 775 Site 1

Description

Medium-severity fatigue cracking exists at the outside edge, along with some rutting, as shown in Figure 1.15.

Field Guide Recommendation

A base repair is needed; consider widening the edge for increased edge support.

Figure 1.15. FM 775 Site 1.

FM 775 Site 2

Description

Figure 1.16 shows the extensive cracking, popouts, and shoving occurring at the site.

Field Guide Recommendation

A full-depth patch is needed. A stabilized base and a widened edge would decrease the likelihood of the problem reoccurring.

Figure 1.16. FM 775 Site 2.

BEXAR METRO

Loop 13

Description

The hot-mix surfacing on this pavement structure is approximately 15 years old. This site has extensive cracking and shoving occurring, as shown in Figure 1.17.

Field Guide Recommendation

Problems at this site may be partially caused by excessive moisture and lack of edge support. A base repair is suggested that addresses both issues. Utilizing a base repair with non-moisture susceptible materials and increasing edge support should provide a good repair.

Figure 1.17. Loop 13.

FM 1346 at S. Foster

Description

Figure 1.18 shows the failure at this site. Wide, deep ruts exist along with fatigue cracking.

Field Guide Recommendation

A full-depth repair is warranted at this site and based upon the wide rutting, an increased base thickness and/or a subgrade treatment should be used.

Figure 1.18. FM 1346 at S. Foster.

FM 1346 at FM 1516

Description

This site is at a four-way intersection. High- to medium-severity fatigue cracking exists as shown in Figure 1.19, with some popouts starting to occur.

Field Guide Recommendation

The extensive cracking across all the lanes at this site indicates more than a surface treatment is necessary. A full-depth repair, or perhaps removing the cracked surface and placing hot-mix asphalt (HMA), would be suggested treatment options.

Figure 1.19. FM 1346 at FM 1516.

Loop 106

Description

Figure 1.20 shows the failure location at this site. Fatigue cracking with rutting and popouts has occurred; maintenance has already applied patch material to the surface, but the problem area has rapidly expanded beyond the area of the surface patch. Fines are pumping from the cracks. The maintenance supervisor reported a nearby project resulted in extensive heavy truck traffic, which caused rapid deterioration in the pavement structure.

Field Guide Recommendation

A full-depth patch is warranted. Assuming the problem was accurately diagnosed as resulting from a sudden and temporary increase in truck traffic, a patch to solid material with a base of similar quality as the existing material should suffice.

Figure 1.20. Loop 106.

CONCLUSIONS

From the visits to TxDOT maintenance sites and discussions with TxDOT maintenance supervisors, the recommendations from the draft field guide are good starting points for treatment options and are relatively consistent with the state of the practice within TxDOT. From the visits, it was apparent that maintenance forces often encounter edge failures on FM roads that manifest themselves in the form of fatigue cracking at the edge accompanied by rutting or shoving. As currently written, the field guide does not specifically address this problem in the fatigue cracking section; thus, text was added to the fatigue cracking section to incorporate recommended reconstruction and widening of the edge for locations with edge failures.

CHAPTER 2

FINALIZATION OF FIELD GUIDE

SUMMARY

Based upon comments received regarding the draft field guide, the research team added a few additional topics to the guide. These additions broadened the scope of the guide to deal more specifically with treating subgrade soils. Additionally, after visiting the field sites with TxDOT (detailed in Chapter 1 of this report), some minor changes were made to the fatigue cracking section of the guide.

CHANGES MADE TO FIELD GUIDE

The initial review of the draft field guide revealed TxDOT desired more material in the guide specifically relevant to treating plastic subgrades. The research team added the following subsections for circumstances where TxDOT Maintenance may be considering a subgrade soil treatment:

- *Determining the Suitability of Subgrade Soil for Chemical Treatment* – this section discusses the necessity of a soil to have plasticity in order to react with chemical lime; this section also discusses constraints on subgrade treatment from sulfates and organics.
- *Considerations in Selecting a Subgrade Treatment* – this section contrasts time requirements and permanency of treatment for cement and lime treatment of clayey soils.
- *Selecting a Treatment Level* – this section presents methods available for selecting a treatment level for soils; additionally, typical treatment levels are provided for general guidelines when no test results are available.

In addition to the three additional subsections added to the field guide, the research team noted that in many instances maintenance forces face edge failures that exhibit fatigue cracking (oftentimes accompanied by rutting) as the primary distress. The draft guidelines did not specifically mention this problem in the fatigue cracking section; thus, revisions were made to include reconstructing and widening the edge if the fatigue failures were at the pavement edge. With the addition of the new subsections and the additional reference to edge failures in the fatigue cracking section, the guide book should serve as a good tool to aid in the training and transfer of knowledge to less experienced employees in TxDOT Maintenance. The final version of the field guide is available as Product 0-4395-P2.

CHAPTER 3

EVALUATION OF REPORTED REPAIR PERFORMANCE

SUMMARY

This project involved examining which maintenance repair technique for various cases of distress provides the best repair. In the first phase of this project, the team visited numerous sites with TxDOT where repairs had been made, and the team evaluated the performance of the repair. As part of the second phase of this project, TxDOT maintenance personnel were asked to document some basic information about their repairs for the research team to analyze. Information regarding the method of repair, the time to perform the repair, and the life of the repair was reported to the research team. This information is summarized in this chapter, and all the responses are summarized in the Appendix of this report. Distresses focused on were roughness, longitudinal cracking, and fatigue cracking. From the inputs provided by TxDOT maintenance personnel, a cold-mix asphalt surface patch was the fastest to construct and provided as long a service life as other typical maintenance methods. For longitudinal cracking, inputs provided indicate a base repair with asphalt base typically provided the longest life; no major difference in time to construct different repairs for longitudinal cracking was reported. For fatigue cracking, cement-treated base provided the longest life and also took the longest time to construct. With the exception of longitudinal cracking, the findings from the reports of repair performance match well with basic recommendations in the field guide developed in this project. The first phase of this project indicated conventional full-depth base repairs for longitudinal cracking typically last no longer than crack seal treatments. Unless distress is severe or new and innovative full-depth repair techniques are employed, little incentive exists to perform a full-depth patch for longitudinal cracking.

ROUGHNESS

Repairs used for treating roughness fell into four categories: full-depth patch with cement treated base, full-depth patch with asphalt base, a cold-mix asphalt surface patch, or a hot-mix asphalt surface patch. Full-depth repairs typically took 3 to 4 hours per station to construct; the surface patches typically took 2 to 3 hours per station. Figure 3.1 illustrates repairs of roughness with CTB typically had the shortest lives, and the expected life of repairs with asphalt base, a cold-mix surface patch, or a hot-mix surface patch were approximately the same at 2 to 4 years. Of all the options, the cold-mix surface patch will likely be the least expensive to construct for most maintenance offices, and since this treatment typically provides the same life as other more costly treatments, a cold-mix surface patch for roughness will generally be the optimal maintenance treatment.

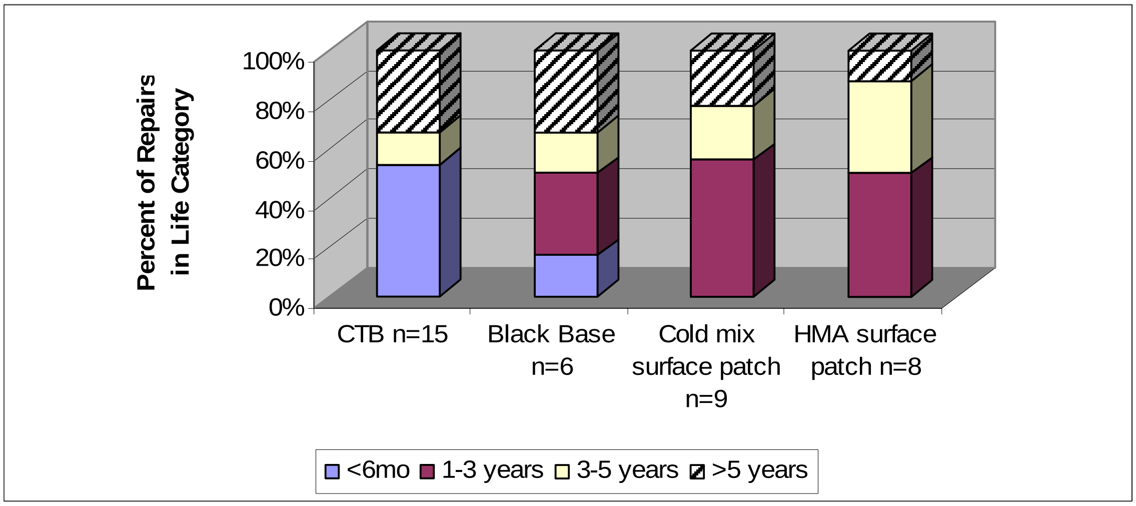

Figure 3.1. Distributions of Life Expectancies for Repair Methods of Roughness.
Note: n is the total number of repairs reported in category

LONGITUDINAL CRACKING

Reported treatments for longitudinal cracking included CTB, cold-mix surface patch, or asphalt base. The expected time per station to construct each was between 3.5 and 6 hours. Figure 3.2 shows the distribution of life expectancies for these treatments. Overall the reported repairs with asphalt base had the longest expected life. Since longitudinal cracking typically results from subgrade shrinkage, it is no surprise that the CTB repairs typically have the shortest life since the stiff CTB cracks when the subgrade moves. Despite the reported results of the asphalt base repairs for longitudinal cracking, the research team believes if a full-depth repair is going to be made, the best method is to use the geogrid reinforcement method described in the first report from this project (0-4395-1). The Bryan District rehabilitated approximately 3.6 miles of OSR in 2000 using this technique. Figure 3.3 shows the section in July of 2004; there are no visible longitudinal cracks in the section.

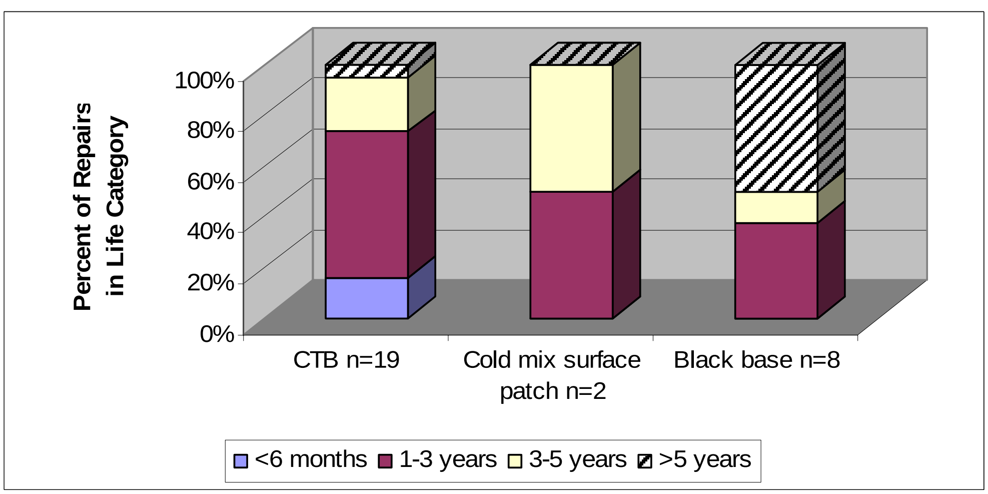

Figure 3.2. Distributions of Life Expectancies for Repairs of Longitudinal Cracking.
Note: n is the total number of repairs reported in category


Figure 3.3. OSR in July 2004.

FATIGUE CRACKING

A seal coat is the most frequently used treatment TxDOT Maintenance applied to fatigue cracking. Although a seal coat is faster to apply than other maintenance treatments, the seal coat does not address the source of the problem (whether it is a structural failure or poor surfacing). Other reported techniques for treating fatigue cracking include removing the surface and placing new mix, HMA overlays, or a full-depth repair with CTB. Figure 3.4 illustrates that seal coats typically have the shortest life of the repair methods (1 to 3 years). Repairs with CTB had much better expected lives (3 to 5 years) and compared to other methods of repairs had little uncertainty regarding how long the repair would last. The overall expected life of repairs with HMA overlays or removing the distressed surface and placing new mix were comparable to the expected life of repairs with CTB; however, the reported lives of these two treatment options was more variable. This increased variability is almost certainly attributable to the fact that the life of a mill and inlay treatment or an HMA overlay treatment is dependent upon whether the treatment was appropriately applied to a structurally sound pavement.

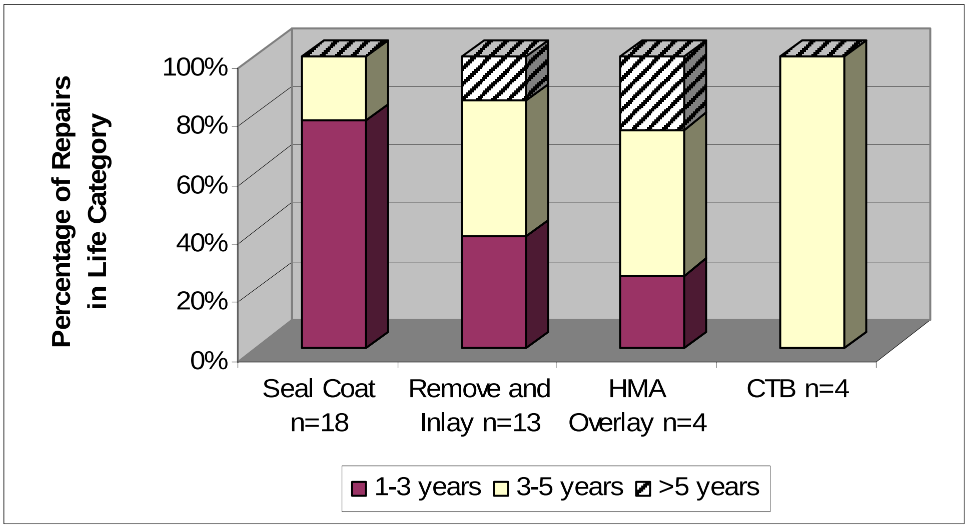

Figure 3.4. Distributions of Life Expectancies for Repair Methods of Fatigue Cracking.
Note: n is the total number of repairs reported in category

CONCLUSIONS

Clearly numerous options exist for treating pavement distresses, and the treatment applied oftentimes depends more on availability of resources rather than solely what is the best treatment. Even within TxDOT the availability and cost of materials can vary widely between different offices. Furthermore, the traffic control requirements for constructing a repair can significantly vary. Because of these reasons, the most cost-effective repair method for the identical distress can differ depending on which road the distress is located. Below are summarized findings for the three distress categories focused on in this project.

- Roughness: A cold-mix surface patch was both the fastest to construct, and provided a service life as long as other methods utilized such as cement-treated base and black base patches.
- Longitudinal Cracking: The best treatment depends on the severity of the cracking. TxDOT responses indicated the best performance was obtained by performing a base repair with asphalt base. However, the first phase of this project investigated a method for treating longitudinal cracking that employed full-depth recycling with geogrid reinforcement and a flex base overlay; this method has shown to provide superior performance to conventional full-depth repairs of sections with longitudinal cracking. For cracks that are not faulted, crack seal typically provides just as long a service life as a conventional full-depth patch.
- Fatigue Cracking: If the problem is only with the surfacing, replacing the surface material or perhaps even sealing the surface are good options. If a structural problem exists, a structural repair provides the best long-term performance. TxDOT reported the best results with cement-treated base.

CHAPTER 4

CONCLUSIONS

This project focused on examining maintenance techniques for repairs over expansive subgrades. In the first phase of work, an extensive literature survey was conducted, field sites of maintenance repairs were visited and evaluated, and material commonly used for maintenance repairs were tested in the laboratory. The research team then drafted a field guide for selecting repair treatments for use in assisting less experienced maintenance personnel. Research Report 0-4395-1 describes that work. In the second phase of this project, feedback was received regarding the draft field guide, the research team visited several sites in need of maintenance repairs with TxDOT personnel, and the research team solicited and examined TxDOT personnel reports of maintenance treatments. The primary function of the second phase of work was to validate the guidelines in the field guide. Findings from this project support the following conclusions:

- The optimal maintenance treatment of roughness distress, in most cases, is a surface patch. Time constraints for maintenance work typically do not allow for subgrade treatment (the typical primary source of roughness), and full-depth patches typically provide only the same service life as a surface patch.
- For longitudinal cracking, treatment is largely dependent on severity. For non-faulted cracks, the cracks can simply be sealed. Little incentive exists to perform a full-depth repair unless techniques such as the geogrid reinforcement method are used (described in Report 0-4395-1). For faulted cracks, a base repair may be necessary; in these instances, though, cracks typically reoccur quickly when cement-treated base is used because the stiff base cracks when the subgrade shrinks. Sealing the cracks and applying a surface level-up typically provides a repair that lasts as long as a CTB repair. Better repair lives have been reported when using asphalt base; additionally, reconstruction with geogrid reinforcement should provide a longer-lasting repair.
- For fatigue cracking, use of cement-treated base most consistently provides the best repair life. However, if the cause of the cracking is diagnosed properly (such as if cracking is because of aged HMA), applying a new surface will provide an acceptable life. Structurally, a reasonable quality flex base treated with 2 to 3 percent cement was found to be mechanistically superior, and less moisture susceptible, than typical asphalt bases used by maintenance forces.
- Recommendations in the field guide match well with field observations and TxDOT's current state of the practice. The field guide should provide a good starting place for less experienced personnel to reference for assistance in selecting a maintenance treatment.

APPENDIX

REPORTED TIMES TO CONSTRUCT AND LIVES OF REPAIR METHODS

Roughness

Repair Method	Time per Station (hrs)	Life (yrs)
black base	4-6	<6 mo
black base	>8	1-3
black base	3-4	1-3
black base	3-4	3-5
black base	1-2	5+
black base	2-3	5+
cold mix surface patch	<1	1-3
cold mix surface patch	>8	3-5
cold mix surface patch	1-2	1-3
cold mix surface patch	1-2	1-3
cold mix surface patch	2-3	3-5
cold mix surface patch	2-3	5+
cold mix surface patch	3-4	1-3
cold mix surface patch	3-4	1-3
cold mix surface patch	3-4	5+
CTB	2-3	5+
CTB	>8	1-3
CTB	2-3	1-3
CTB	2-3	1-3
CTB	2-3	1-3
CTB	3-4	1-3
CTB	3-4	1-3
CTB	3-4	1-3
CTB	6-8	1-3
CTB	>8	3-5
CTB	2-3	3-5
CTB	3-4	5+
CTB	3-4	5+
CTB	3-4	5+
CTB	6-8	5+
HMA surface patch	2-3	1-3
HMA surface patch	2-3	1-3
HMA surface patch	2-3	3-5
HMA surface patch	3-4	3-5
HMA surface patch	4-6	1-3
mill and HMA overlay	1-2	1-3
mill and HMA overlay	2-3	3-5
mill and HMA overlay	4-6	5+

Longitudinal Cracking

Repair Method	Time per Station (hrs)	Life (yrs)
black base	3-4	1-3
black base	6-8	1-3
black base	8+	1-3
black base	6-8	3-5
black base	1-2	5+
black base	3-4	5+
black base	3-4	5+
black base	4-6	5+
cold mix surface patch	6-8	3-5
cold mix surface patch	3-4	1-3
CTB	1-2	1-3
CTB	1-2	1-3
CTB	2-3	1-3
CTB	2-3	1-3
CTB	2-3	1-3
CTB	2-3	6mo-1
CTB	3-4	1-3
CTB	3-4	1-3
CTB	3-4	3-5
CTB	4-6	1-3
CTB	4-6	1-3
CTB	4-6	1-3
CTB	4-6	3-5
CTB	4-6	3-5
CTB	4-6	5+
CTB	4-6	6mo-1
CTB	6-8	3-5
CTB	8+	1-3
CTB	8+	6mo-1

Fatigue Cracking

Repair Method	Time per Station (hrs)	Life (yrs)
CTB	2-3	3-5
CTB	2-3	3-5
CTB	2-3	3-5
CTB	6-8	3-5
HMA overlay	4-6	5+
HMA overlay	2-3	3-5
HMA overlay	1-2	3-5
HMA overlay	2-3	1-3
remove and inlay	1-2	1-3
remove and inlay	1-2	1-3
remove and inlay	3-4	1-3
remove and inlay	3-4	1-3
remove and inlay	8+	1-3
remove and inlay	<1	3-5
remove and inlay	<1	3-5
remove and inlay	1-2	3-5
remove and inlay	1-2	3-5
remove and inlay	2-3	3-5
remove and inlay	6-8	3-5
remove and inlay	2-3	5+
remove and inlay	3-4	5+
remove and inlay	1-2	6mo-1
seal coat	<1	1-3
seal coat	<1	1-3
seal coat	<1	1-3
seal coat	<1	1-3
seal coat	1-2	1-3
seal coat	1-2	1-3
seal coat	1-2	1-3
seal coat	1-2	1-3
seal coat	3-4	1-3
seal coat	3-4	1-3
seal coat	3-4	1-3
seal coat	n/a	1-3
seal coat	n/a	1-3
seal coat	n/a	1-3
seal coat	<1	3-5
seal coat	1-2	3-5
seal coat	1-2	3-5
seal coat	2-3	3-5