TECHNICAL SUMMARY
In-Place Cement Stabilized Base Reconstruction Techniques Interim Report, "Construction and Two Year Evaluation

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INTRODUCTION

This interim report documents the construction process and two-year evaluation of ten field test sections constructed with various crack mitigation techniques.

In fiscal year 1999 – 2000, DOTD spent $160 million dollars on its rural overlay program. Reconditioning the existing soil cement base courses with additional cement is used extensively because of its cost effectiveness ($4 to $5 per square yard). However, excessive shrinkage cracks associated with stabilizing or restabilizing soil cement bases can allow water infiltration into the subgrade resulting in premature failures.

Soil cement is a composite material of pulverized soil, Portland cement, water, and possibly admixtures compacted to a high density to form a hardened structural material with specific engineering properties. When Portland cement is blended with water and soil, a hydration process and chemical alteration of the soil begins. This mixture hardens to form a rigid material that is durable and resistant to rutting. Unfortunately, the hardening process also causes the material to contract, which produces shrinkage cracks. Factors that can influence shrinkage cracking in soil cement bases are cement content, moisture content, density, compaction, curing, and fine grain soils.

OBJECTIVE AND SCOPE

The purpose of this research is to evaluate the effectiveness of soil cement shrinkage crack mitigation techniques. Ten test sections, 1000 feet long, were constructed on LA 89 in Vermilion Parish. The shrinkage crack mitigation methods being evaluated include cement content, synthetic fiber reinforcement, interlayer, curing membrane, and curing periods.

After the test sections were constructed, their structural properties were assessed with the Dynaflect and Falling Weight Deflectometer (FWD). Crack mapping was conducted visually by field technicians and with ARAN by the pavement management section. The crack mapping of the field test sections will continue for a period of 5 years and a final report will be issued at that time.

RESEARCH APPROACH

Cement stabilized design (CSD), governed by DOTD TR 432M/432-99, refers to soil aggregate or recycled bases blended with cement to produce a compressive strength of 300 psi in seven days. It is generally used with 8.5-inch thick base courses. Cement treated design (CTD) refers to materials blended with low cement contents (four to six percent) and a minimum seven day compression strength of 150 psi. It is generally used with base courses that are 12 inches thick. Test sections were built using both design methods. The control section is the typical design which is cement stabilized. Polypropylene fibers were blended in concentrations of 0.1 and 0.05 percent by weight in both CTD and CSD design test sections. An interlayer was constructed using a 0.5 inch thick asphalt surface treatment layer in one test section while a thicker curing membrane was developed using a 0.2 gallon per square yard emulsified asphalt application rate with a 0.25 inch thick sand layer for another test section. In order to evaluate curing periods, test sections 1-9 were overlaid within seven days of the soil cement base course construction and test section 10 was overlaid between 14 and 30 days.

The test sections were evaluated through laboratory and field testing. Soil samples were taken from each test section after pulverization and prior to the addition of cement. These samples were used to conduct experiments in the laboratory. The samples were subjected to unconfined compression tests, durability tests, indirect tensile and strain, and indirect tensile resilient modulus tests. During construction of the test sections, samples were acquired and specimens were molded in the field and transported to LTRC. The specimens were subjected to unconfined compression and durability testing. The field program consisted of in-place material assessment using the Dynaflect and FWD, and crack mapping both the soil cement base course prior to being overlaid and the asphaltic concrete pavement surface.

CONCLUSIONS

During this monitoring period (May 1999 to March 2001), reflective cracks through the asphaltic concrete pavement have not been observed. Therefore, an analysis of the effectiveness of different shrinkage crack mitigation techniques is impossible at this time. The next scheduled ARAN survey is due in March, 2003.

The in-place base course assessment with the Dynaflect and FWD indicated that the test sections produced layer coefficients and resilient moduli that met or exceeded design standards and were consistent with other projects in Louisiana.

The cement stabilized, cement treated, and crack relief layer (asphalt surface treatment) test sections were in accordance with normal DOTD procedures. The emulsified asphalt curing membrane with sand was difficult to construct with the methods used. In order for it to be feasible, a better method for placing a thin layer (0.25 inches thick) of sand over the emulsified asphalt curing membrane needs to be developed. Fibers can be mixed into the soil easily with the stabilizer. However, the placement of fibers prior to mixing with the soil is tedious and labor intensive. A better method for distributing fibers needs to be developed. Even though moisture content control problems were encountered during construction in test sections 1 and 2, no adverse effects on the performance of the pavement structure were observed.

The addition of a crack relief layer (asphalt surface treatment) or curing membrane with sand adds about $3.00 per square yard to the base course. The cost increase due to the inclusion of fibers ranged from $6.90 to $16.29 per square yard. Due to this higher cost, fibers are economically unfeasible to use in soil cement base courses.

The laboratory evaluation proved to be inconclusive due to a high variability in testing results.

RECOMMENDATIONS

Cement treated base courses have been evaluated on LA 89 and other routes. Results have shown that cement treated bases perform as well structurally as cement stabilized bases. Of the shrinkage crack mitigation methods used in this study, cement treated bases are economically the most feasible and should be used unless conditions warrant otherwise.

The crack relief layer (asphalt surface treatment) is preferable to the emulsified asphalt curing membrane with sand because a device is available to place it appropriately and quickly.

Due to the increased cost of constructing a base course with fibers ($6.90 to $16.29), fibers are economically unfeasible to use.