

**TECHNICAL SUMMARY**

Field and Lab Evaluation of the Use of Lime Fly Ash to Replace Soil Cement as a Base Course

Summary of Report Number 303  
September 1997

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**INTRODUCTION**

Louisiana has a long history of using soil cement as a base material for highways. Soil cement bases are economical, attain high compressive strengths and are relatively easy to design and construct. A wide variety of soil types can be successfully used to make soil cement, making it a versatile material. When soil cement base is properly constructed as a part of a well designed flexible pavement system, excellent results are obtained.

Unfortunately, soil cement has some disadvantages. Cracking caused by shrinkage and nonuniformity mixture are the most obvious and the most often cited. This usually results in uniformly spaced transverse cracks which may reflect up through the asphalt surfacing. Whether this is a structural problem or merely an aesthetic one it is open for debate. Factors such as crack width and water infiltration can cause stripping of hot mix, weakening of base, and pumping of the subgrade layer. The amount of cement added is often much greater than necessary to obtain design compressive strength, therefore creating a greater potential for more cracking.

In the late 1980's, Louisiana highway officials in the northwest (Shreveport) district noticed that pavements constructed using lime/fly ash bases in the adjacent Texas highway district west of Shreveport were in excellent condition while similar pavements constructed with soil cement bases in Louisiana were cracked and required maintenance. The two districts share similar geographical characteristics and construction techniques. The main difference was in the materials used in construction of the base. Test sections using Texas specifications for lime/fly ash base were requested. An LTRC research proposal was drafted to evaluate lime/ fly ash as an alternate to soil cement base.

Originally, LTRC researchers hoped to install test sections on new roadways. This would have allowed adequate time to custom design a lime/fly ash test section for the specific

base soil to be used on each project using Texas laboratory evaluation procedures. However, most of the scheduled work in the northwest district and throughout the state was reconstruction of existing roadways. Louisiana's highway infrastructure is reasonably well established, and in the foreseeable future, most construction will be to update and upgrade the existing highway system. For this reason, sections of two existing state highways scheduled for reconstruction were selected for installation of test sections. Both highways had soil cement bases which would be pulverized and treated to form the new base.

**OBJECTIVE**

The purpose of this project was to design and construct lime/fly ash stabilized base course test sections which would be economical compared to a soil cement stabilized base, utilize a recyclable material, and possibly reduce shrinkage cracking on bases and the subsequent reflective cracking of the riding surface. Satisfactory results from this project would increase confidence in the use of lime/fly ash as an alternate to cement stabilized treated base: thus resulting in greater utilization of lime/fly ash for base stabilization. Factors such as a crack mapping procedure, durability comparison between lime/fly ash and soil cement stabilized base and structural number determination for lime/fly ash bases were studied.

**RESEARCH APPROACH**

Upon completion of construction, monitoring strips were placed on the lime/fly ash pavement test sections as well as adjacent to the soil cement control sections on both projects. The reconstructed pavements were monitored for five years. The monitoring primarily consisted of crack mapping, Dynaflect readings and rutting depth of pavement sections. Also, this study compared lab and field results to determine if the laboratory design was accurate.

Research was limited to evaluation of reconstructed bases. Old pavement and cement treated base was used as the construction material to be treated using lime/fly ash or cement. No evaluation of lime/fly ash as an alternative to soil cement base treatment in raw soil was performed.

Two projects were chosen for test sections. The test sections were on LA 507 and LA 518. Both highways had soil cement stabilized bases which would be pulverized and treated to form new bases. Each test section would be 0.4 km(0.25 miles) long and use different percentages of lime and fly ash. Due to time constraints, the two most common treatments of lime/fly ash used in Texas were selected: 2 percent lime/4 percent fly ash, and 3percent lime/6 percent fly ash. The construction process was monitored closely to insure conformance with the specifications chosen for the project. Test specimens were molded in the field during construction utilizing blended base material prior to compaction. Laboratory test specimens were made later from materials taken from, but not mixed, at the test sites. Comparison tests were run using laboratory samples at 7, 28, and 56 days.

The evaluated reconstruction work was on rural, low volume state highways. No evaluation of high volume pavement performance was made.

## CONCLUSIONS

The soil cement stabilized control sections cracked earlier and more extensively than the lime/fly ash test sections. Results indicate that lime/fly ash is less prone to shrinkage than the soil cement stabilized base.

Both percentage selections of lime/ fly ash did comparably well. Based on visual observation of the crack maps, the 2 percent lime/4 percent fly ash did better on one project than the 3 percent lime/6 percent fly ash, yet, it did worse on the other.

Dynalect results for the test lanes and control sections on both LA 518 and LA 507 have generally decreased over five years of monitoring.

It was determined that no significant rutting occurred in any of the test or control section monitoring strips.

The unconfined compression strengths of the lime/fly ash bases were much lower than soil cement bases. This fact did not result in reduced structural numbers or decreased long term performance.

None of the test or control sections have shown any noticeable deterioration. Although cracking ranges from almost non-existent in some test section's monitoring strips to fairly heavy in other control section monitoring strips, road quality and "rideability" are still excellent.

## RECOMMENDATIONS

Based on the results of this study, lime/fly ash should be considered for use as an alternate for soil cement 1) where it is more cost effective and 2) where it is important to reduce surface cracking. This study was limited to reconstruction usage of lime/fly ash on rural, low volume roads. More research should be considered using lime/fly stabilization on reconstruction projects with different types of base material. Monitoring of the test sections on LA 518 and LA 507 should be continued on an annual basis.

Since this study was initiated, several types of synthetic base reinforcement have become available, including composite bases using lime/fly ash stabilization and synthetic reinforcement. These new methods of stabilization and reinforcement should be evaluated through research-oriented testing.

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