IMPLEMENTATION IMPACTS

Louisiana Implements New Transportation Research

VOLUME 3 | SUMMER 2014

LTRC

Created by the Louisiana legislature in 1986, LTRC's mission is to effectively merge the resources of the Department of Transportation and Development (DOTD)/ LTRC and state universities to provide transportation related research, education, and training in a manner that addresses the problems and needs of DOTD and the transportation industry, supports local government, advances transportation technology, benefits Louisiana's universities, and provides optimal return on taxpayers' dollars.

LTRC's functions and duties are to develop and conduct a nationally recognized research program in transportation systems; offer educational and training programs; develop and implement a technology transfer program; establish cooperative relationships with universities, associations, and agencies; and report and publish research findings.

Located on the LSU campus in Baton Rouge, LTRC provides researchers and students access to excellent laboratories and state-of-the-art research equipment. The unique position of LTRC provides access to virtually all of DOTD's and LSU's resources to pursue its mission.

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Edge Lines Reduce the Number of Crashes on Rural Two-lane Highways

Researchers predict a 15% crash reduction

Recent research has concluded that placing pavement edge lines on rural two-lane highways in Louisiana not only changes vehicle lateral positions but also reduces crashes. For edge lines on narrow, rural two-lane highways (pavement width less than 22 ft. and bigger than or equal to 20 ft.), there is a 15% expected crash reduction. The crash reduction is consistent in all crash types and particularly significant in single vehicle crashes.

Most of single vehicle crashes are run-off-road (ROR) crashes.
Reducing the number of ROR crashes is a top priority for the 5,600 miles of narrow, rural two-lane highways in Louisiana. An inexpensive countermeasure was investigated to reduce the higher percentage of crashes and fatalities associated with this type of highway. The original study and a follow-up implementation study compared the difference of before and after edge-line placement.

The benefits overwhelmingly offset the cost associated with edge line implementation. The most conservative estimation for benefit and cost ratio is 19 to 1. The study therefore recommends the use of edge lines on narrow, rural two-lane highways whenever it is financially and operationally feasible.

Based on the study results, the Traffic Engineering Management of DOTD is seeking a larger safety fund for each district to conduct systematic edge line striping project on narrow, rural two-lane highways due to its high benefit. In addition, the DOTD's PM standards and Safety Management of the Department is being updated to add this safety measure.

The provided recommendation helps DOTD's future plan on improving the safety of rural two-lane highways.

This study was recently announced by the AASHTO Research Advisory Committee (RAC) as being awarded a spot on its 2014 Sweet Sixteen High Value Research Projects list.

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LTRC Project Nos. 07-7P / LTRC 13-2P
Safety Improvement from Edge Lines on Rural Two-Lane Highways / A Comprehensive Study on Pavement Edge Line Implementation

New Approach Slab Design Decreases "Bridge Bumps" in the Road

LTRC has recently completed several research projects to alleviate the bridge bump problem that motorists experience when travelling from roadway pavements to bridge structures. Where other preload or accelerated settlement techniques are not completely successful or cost prohibitive, LTRC's new design for these approach slabs increases the slab flexural stiffness to allow traffic support without detrimental deflection even if the slab

[Approach Slab continued]

were to lose its contact with the embankment. To validate or verify this new design, the approach slabs at Bayou Courtableau Bridge were fully-instrumented and monitored over a period of two years.

The west approach slab of the bridge was designed using the new design, while the east approach slab was designed using the traditional method. The monitoring program showed that the new design performed as predicted with the roughness profiles superior than that of the old design. In fact, the roughness in the new joint was half of the roughness of the older design.

The bump problem is very common in southern Louisiana where bridge embankments are constructed over deep, highly compressible and often organic soils. The approach slab can lose its contact and support from the soil with the progress of embankment settlement, causing a change in slope grade at the approach slab/bridge deck joint and/or fault at the roadway pavement/approach slab joint.

Following the findings of this study, DOTD adopted the new design methodology for bridge approach slabs when differential settlements are anticipated. The extra cost associated with new design method is minimal compared to the improved performance and expected savings from maintenance and repair.

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LTRC Project No. 05-1GT
Field Demonstration of New Bridge Approach Slab Designs and Performance

US 61 Utilizes New Pavement Base Structure to Save State Money

Incorporating slag into calcium sulfate mixtures potentially saves $118,000 per lane mile

In an effort to save the state money and utilize the findings from a recent research project, DOTD conducted full-scale test sections on the shoulders of US 61 (Airline Highway) in Sorrento with ground granulated blast furnace slag (GGBFS). The existing sections were failing due to significant moisture intrusion into the old non-standard calcium sulfate base course. However, to remove and replace with crushed stone would be too costly. As an alternative, LTRC researchers were able to provide a way to successfully stabilize the weak calcium sulfate by adding GGBFS into the blended calcium sulfate (BCS) base course, eliminating the need for excavation and replacement.

The cost for cutting slag into the existing calcium sulfate material was $19.50/s.y. per the contractor's change order, and using stone would have been approximately $35/s.y. This is a saving of $15.50/s.y., which translates into future savings of $118,000 per lane mile if used as a base course alternative to removal and replacement.

Two previous LTRC research projects led to these high-performing US 61 test sections. Researchers at the center discovered good pavement performance when using BCS, an industrial byproduct, when mixed (or stabilized) with 120-grade GGBFS.

A raw BCS base, without further chemical stabilization, can achieve relatively high strength and stiffness under a dry environment. However, if associated with severe moisture susceptibility problems under a wet environment, free moisture in BCS can cause short-term construction difficulties and potentially long-term performance problems should the moisture reach significant levels.

The projects were tested in the laboratory as well as on the field. The laboratory study led to a better understanding of BCS-strength deterioration in a wet environment and ways to eliminate or reduce such deterioration by stabilizing BCS with various suitable cementitious agents. Accelerated loading field testing at LTRC's Pavement Research Facility proved a slag-stabilized BCS layer as a base course can dramatically improve its performance after slag stabilization.

The slag-treated BCS test sections were well received by the District forces, so much so, that they have requested funding for additional BCS stabilization projects along the same US 61 corridor for continued shoulder repair.

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LTRC Project No. 13-2GT
Implementation of Slag Stabilized Blended Calcium Sulfate (BCS) in a Pavement Structure

Warm-mix Asphalt Provides More Cost Savings than Hot-mix

Louisiana estimates an annual cost savings of $3.22 million on fuel savings

LTRC recently completed research on their evaluation of warm-mix asphalt (WMA) technologies. Some notable advantages of using WMA mixtures in lieu of hot-mix asphalt (HMA) mixtures include reduced aging (less oxidation), reduced plant and roadway emissions, lower fuel cost, and increased densities with less compaction effort. The latest estimates indicate that Louisiana produces three million tons of asphalt mixture per year, of which, approximately 2 million are now produced using the WMA technologies. Therefore, Louisiana estimates an annual cost savings of $3.22 million on fuel savings alone when WMA mixtures are used in lieu of HMA mixtures.

LTRC's research revealed that production and laydown temperatures of asphalt mixtures can be reduced, and subsequently reduce energy consumption as compared to HMA mixtures. In general, production temperatures for HMA mixtures are between 300°F and 350°F and WMA mixtures can be produced between 230°F and 290°F. The results showed that the reduction in production and placement temperatures had no negative performances when compared to conventional HMA mixtures. Reduced energy consumption resulted in fuel savings of 12% - 14% for WMA mixtures and an average energy savings of $1.61 per ton of mixture as compared to HMA mixtures—which translates into the previously stated fuel savings of $3.22 million.

Specifications developed as part of this research for qualification of WMA technologies were implemented in the Louisiana Standard Specifications for Roads and Bridges.

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LTRC Project No. 07-1B
Evaluation of Warm Mix Asphalt Technology in Flexible Pavements

Bridge Repair Solution Costs a Fraction of Traditional Alternatives

Louisiana implements latest technology into local bridge structures

LTRC provided research implementation support for demonstrating the use of high-strength composites for structural repair when the pile cap of an end bent of the Morganza Spillway Bridge suffered extensive damage at the girder bearing locations. The project demonstrated a useful implementation of existing technology for cost-effective rehabilitation of bridge structures. The overall cost of the repair ($15,000) using carbon fiber and inorganic polymer coating was one-third the cost of providing an external reinforcement retrofit, one-sixth the cost of replacing the pile cap, and one-tenth the cost of utilizing VARTM (Vacuum Assisted Resin Transfer Molding) cap repair.

The damage was due to the pounding of the girders at the bearing locations by the adjacent concrete deck located on the approach side of the bent. The pounding caused heavy spalling of the concrete on the west face of the pile cap at the girder bearing locations and the spalling extended all the way to bearing plates.

The repair of the damaged pile cap was carried out as a demonstrated effort in conjunction with a major repair that was being undertaken on the bridge. Structural grade high-adhesive epoxy concrete was utilized to patch the damaged areas of the pile cap. The repaired areas of the pile cap – namely, the bearing plate locations – were strengthened to prevent

delamination of the repair material by confining it with high modulus carbon composite wrapping. An inorganic polymer coating that provides UV protection and prevents mold and mildew growth was utilized. The carbon fiber composite has complete chemical adhesion with the pile cap and its high modulus fibers will not allow the repair material to separate from parent concrete material.

The project clearly demonstrates the significant cost-savings that can be realized from effective implementation of existing composites technology for repairing and rehabilitating damaged components of the nation's highway infrastructure.

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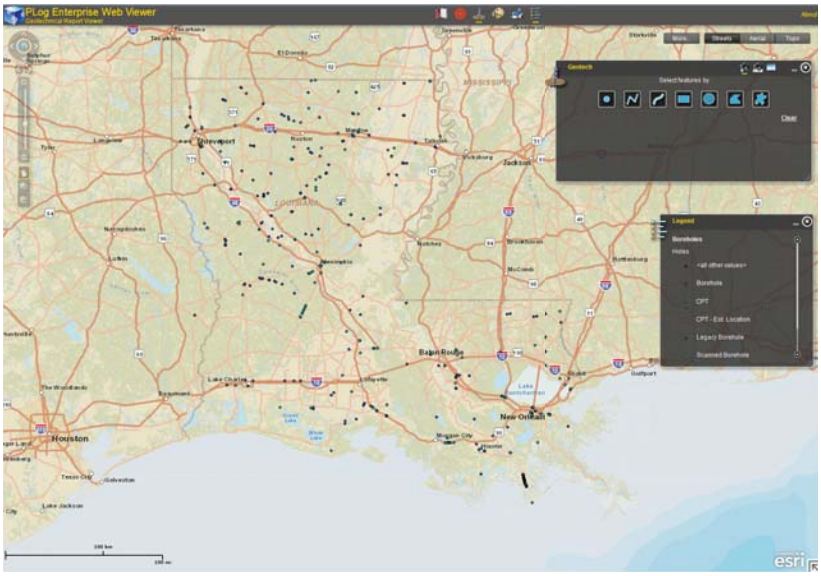
LTRC Project No. 12-3ST
Repair of Morganza Spillway Bridge Bent Pile Cap Using Carbon Fiber Reinforcement (CFR)

DOTD Geotechnical Information Database Expands

Second phase allows the Department to streamline data for future pavement design



LTRC first completed an initial geotechnical database in 2008, which preserved and allowed quick access to historical geotechnical data via a geographic information system (GIS). Before the database, accessing such data and combining it with new data for the purpose of design, analysis, visualization, and reporting was difficult because it was in the form of various formats (digital and non-digital). Recently, the second phase of this project has been completed to where the web-based GIS map converts the DOTD geotechnical data into a valuable asset that can be reused over time.

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LTRC Project No. 10-2GT
Geotechnical Information Database –Phase 2

If DOTD were to try to re-create this same data by reinvestigating the same sites (~600 boreholes and ~1100 CPT soundings), the cost is estimated at $9,300,000 ($10,000 per borehole/$3,000 per CPT sounding). Approximately $200,000 was expended to turn $9,300,000 worth of data into a usable asset. The return on investment of this asset going forward will be realized as new projects utilize the geotechnical database to supplement knowledge and reduce the amount of future site investigations needed for the design analysis.

The map-based interface provides a simple and direct way for DOTD to find historical geotechnical data, generate reports, and ultimately get the data in a digital format so it can be re-used on future projects. The system allows for the integration of historically acquired, recently acquired, and future data to create a composite database for a particular project that not only benefits that project, but also becomes part of a larger knowledge base available for use on other future projects undertaken by DOTD. The research created a plan to integrate and implement a customized data management system for DOTD.

The project ultimately developed a comprehensive geotechnical data management system to streamline the processes for borehole, lab testing, CPT, in-situ vane, and test pile load test data. The project is currently being utilized by the Geotechnical Design section and Materials Testing section, and it will allow for more accurate and cost effective design decisions. This database resource tool will continue to grow over time as more data is uploaded/entered by DOTD and its consultant partners.

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