IMPLEMENTATION IMPACTS

Louisiana Implements New Transportation Research

VOLUME 1, ISSUE 1 | SPRING 2012

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.

CONTACT US

Louisiana Transportation Research Center
4101 Gourrier Avenue
Baton Rouge, Louisiana 70808
225.767.9131

www.ltrc.lsu.edu
www.dotd.louisiana.gov

www.twitter.com/LTRC_Updates

www. facebook.com
(search Louisiana Transportation Research Center)

Concrete Testing Device Provides Substantial Savings

Surface Resistivity Meter Saves the State $1.5 Million

LTRC researchers recently implemented a new quality assurance testing device called the surface resistivity device. Implementation of the device began with the I-10 Twin Spans and Caminada Bay bridges. The cost benefit analysis shows that DOTD will save about $101,000 in personnel costs and an estimated $1.5 million in quality control costs, which will indirectly benefit the Department for current operations. The savings will be much greater for DOTD, suppliers, and contractors when permeability requirements are applied statewide.

Because of successful research findings, surface resistivity measurements have been included in DOTD specifications, and a TR test method (with relevant training material) is being implemented. In fact, within six months of this project's completion, LTRC purchased 11 surface resistivity meters for distribution and provided training around the state for preparations of upcoming statewide permeability requirements.

This equipment gives an indication of a concrete's ability to resist chloride ion penetration, which is important because structural steel corrosion will not occur if water and chloride ions are not allowed to reach it.

Research showed that the use of surface resistivity devices will benefit the state economically by significantly reducing both the cost of testing equipment and the number of man-hours required to conduct quality assurance testing. Research also showed a very strong correlation between the surface resistivity device and existing conventional testing. Correlations found also show 28-day surface resistivity measurements can be used to predict 56-day rapid chloride ion penetration.

DOTD Implements Soil Measuring Device to Increase Life of Pavements

Estimated Savings on a Single Project: $350,000/year

In response to three extensive LTRC research projects evaluating a device called the dynamic cone penetrometer (DCP), it has been implemented in the subgrade soil investigation of the DOTD pavement design process. By utilizing the DCP, engineers will be able to gather subgrade strength information to design pavements with a longer life. The savings on one project was determined to be approximately $350,000 annually, based on life-cycle analysis.

DOTD standards and procedures have recently been revised and LTRC has developed computer software and training for proper DCP use across the state. Serving as a tool to measure stiffness index (DCPI) and capable of quickly gathering information on pavement subgrade soils and base courses (or foundations), DCP proves to be a valuable asset in designing pavements built to last.

Currently, DOTD District Laboratory engineers and Headquarters' Pavement and Geotechnical Unit are utilizing the DCP and data in their daily operations.

Aggregate Mixture Found to Increase Safety on Roads

I-20 Accidents Reduced 80%

Test sections across the state paved with an open-graded friction course (OGFC) have shown to save lives. In fact, one project on I-20 reduced wet weather accidents by more than 80% over a three-year period and eliminated all fatalities in that same period. Presently, design procedures and construction specifications have been implemented for use in Louisiana as set forth in the latest adopted Asphalt Pavement Design Policy for DOTD. Currently, over 160 lane miles of OGFC for interstate construction are under contract with Louisiana.

Since OGFC pavements consist of a high percentage of air voids, the open structure of this mix promotes the effective drainage of rainwater, which also minimizes hydroplaning during wet weather. This characteristic also reduces splash and spray behind vehicles, increasing visibility and improves wet-weather skid resistance. Other benefits include lower pavement noise and reduced roadway glare during wet weather, which improves the night visibility of pavement markings.

Although OGFC pavements have been used throughout the United States with positive results since the 1950s, Louisiana researchers set up OGFC test sections across the state and monitored and documented the construction and performance of OGFC. Their results showed that OGFC pavements had safety benefits that were hard to ignore, wiping away past negative perceptions of the material.

Researchers Localize Federal Mandate for Further Cost Savings in Design

In response to a mandate set by FHWA and AASHTO requiring all federally funded bridges to be designed using the load and resistance factor design (LRFD) method, LTRC researchers discovered that the current AASHTO recommended resistance factors for some design methods were based on collected databases that do not represent Louisiana soils or design practice, which are somewhat over-conservative, resulting in increased costs. In addition, AASHTO does not provide recommended resistance factors for other specific design methods used in Louisiana.

In order to continue securing federal funds and to provide an efficient and consistent design, the research team at LTRC used locally collected databases to determine the resistance factors for deep foundations in Louisiana. It was found that local resistance factors were about 10% higher than those recommended by AASHTO, which will be translated into cost savings, specifically in the design of driven piles and drilled shafts.

The research results have been implemented by the DOTD Geotechnical Design group and are reflected in their design manual. Recommended resistance factors have been implemented on many projects for the design of new driven piles and drilled shafts.

Use of High Performance Concrete Saves Millions on I-10 Twin Span Bridge

Applied Research Saves $14.6 Million on One Project

Following a successful performance of a bridge built with high strength, high performance concrete (HPC) , DOTD utilized HPC in the I-10 Twin Span, where savings in excess of $14.6 million dollars were realized on that bridge alone. With HPC, you can also expect an increased service life for bridges and significant cost savings over time.

Over the last 20 years, LTRC has experimented with high strength concrete, sponsoring research work to address design and construction issues related to the material; and over the last 10 years, DOTD Bridge Design through LTRC and partners Tulane, CTL, Henry Russell consulting services, and Gulf Coast Prestressed conducted research that has enabled bridge design to effectively apply the research.

Following a research recommendation to implement HPC into a local structure, the first project to utilize the concrete was the design and construction of the Charenton Canal Bridge, which opened to traffic November 1999.

Researchers then conducted long-term performance-monitoring of the HPC Charenton Canal Bridge to measure behavior and strain.

The successful performance of this bridge demonstrated that a high performance concrete bridge could be designed and built in Louisiana using locally available materials.

As a result, HPC was used in the design and construction of several additional bridges, including the I-10 Twin Span.

New Concrete Mixtures Turn Waste into Quality Roads

Potential Savings of $4.8 Million Annually

By utilizing by products of other industries (fly ash and slag) in creating new cement mixtures for local roads and structures, recent cost-benefit analyses indicated a potential material cost savings around $25,000 per lane-mile when replacing 70% Portland cement with fly ash and slag.

In bid year 2007-2008, 191 lane-miles of concrete pavement were let for construction. Replacement of 70% Portland cement, as is allowed by the new DOTD specifications, with fly ash and slag on that quantity of pavement leads to a material cost savings near $4.8 million per year. The savings will be much greater when structural concrete numbers are included.

Researchers have found that by mixing "waste materials," such as fly ash and slag, with Portland cement, they can make a comparable (or better) product, all while cutting material costs and reducing pollution for the state.

Current Louisiana specifications allow only a maximum 20% replacement of Portland cement with either fly ash or slag. This research project investigated mixtures incorporating various supplemental cement combinations and their performances. The study indicated that cement mixtures containing up to 70% fly ash and slag exhibited concrete test results that were similar or better than those obtained from control mixtures containing no supplemental cement materials.

Edge Lines on Rural Roads Reduce Crash Rate by 17%

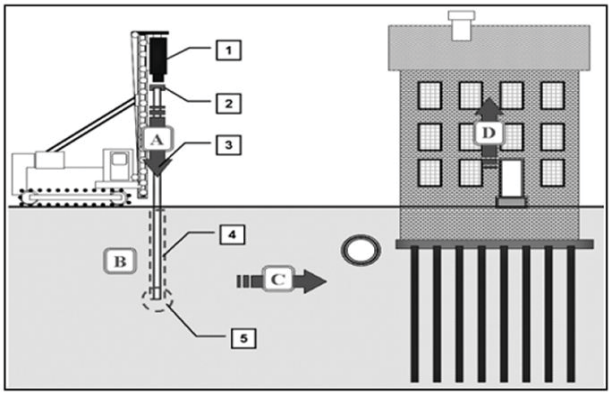
In an effort to heighten safety on the 5,600 miles of narrow, rural two-lane highways in Louisiana, researchers found that by adding edge lines an average of 17% crash reduction was found.

In light of these results, edge lines are recommended for narrow, rural two-lane highways when financially and operationally feasible. Under these feasibility constraints, roadways with higher traffic volumes (or a history of accidents) should have priority.

When conducting this investigation, researchers identified roadway segments that will benefit most with pavement edge lines, implemented pavement edge lines at selected locations, and conducted a before-and-after study of those locations to estimate crash reduction factors.

Researchers Better Define Vibration Impacts of Pile Driving

Damage Monitoring Zone for Existing Structures Reduced from 500 ft. to 200 ft.



Woods, R.D., Dynamic effects of pile installations on adjacent structures. 1997, National Academy Press: Washington, D.C.

Researchers have recently recommended a change in pile driving damage monitoring distance to go from 500 ft. to 200 ft. The benefits of reducing vibration monitoring distances may be quantified by comparing costs of pre-construction surveying using different monitoring distances (unless determined otherwise due to nearby sensitive or historical structures). The benefits of these reduced pre-construction areas/costs should be evaluated against potential legal issues from nearby structures.

The major objective of this study was to provide readily-implementable recommendations for monitoring and controlling ground and structure vibrations generated by pile driving. The study recommended vibration thresholds for the Department, and provides a logical and rational method for evaluating pile driving vibration monitoring distances.

Piles have often been used to transfer heavy loads to stronger soil strata or temporarily retain earth or water in highway and bridge construction. DOTD spends millions of dollars annually on pile foundations. Despite the advantages of driven piles, its installation processes inevitably cause the surrounding ground to vibrate. The intensity of the vibration depends on the physical properties of the pile, pile installation method, and the soil. Depending on the intensity of the ground vibration, it can occasionally cause varying degrees of damage to adjacent buildings and structures, which must be monitored before and after pile driving.

Local Research Suggests Adjustment to National Guidelines

Following a recent research study on a new NCHRP continuity detail used in the spans of the John James Audubon Bridge, an LTRC researcher was invited to present specific findings to an AASHTO committee for concrete bridges. Following the presentation, discussion between the NCHRP and LTRC research team and research results sharing have begun.

In light of LTRC's investigation of the effectiveness of this new detail, DOTD decided not to adopt the new detail for skewed spans, and is now considering the adoption of a detail that differs from the NCHRP-recommended detail: running the concrete deck continuous over simply-supported girders.

Researchers found that this new detail did not perform well when used for skewed spans. They also found out that the design of the new detail did not account for thermal stresses that were the result of large temperature variation.

This study began when DOTD initiated a investigation to assess the performance of this new detail since it was used on spans of the John James Audubon Bridge. A segment of the bridge where a detail was built was instrumented and monitored for a period of two years for all types of stresses the bridge will encounter. To monitor the performance of the detail, relevant data (strains, slopes, gaps, and temperatures) were collected and analyzed.

LEARN MORE

Visit LTRC's publications Web page to read highlighted reports in full: **http://www.ltrc.lsu.edu/pubs_final_reports_5.html**

Report numbers and official titles in order of appearance:

10-1C / Evaluation of the Surface Resistivity Measurements as an Alternative to the Rapid Chloride Permeability Test for Quality Assurance and Acceptance

03-3P / Comparative Evaluation of Subgrade Resilient Modulus from Non-destructive, In-situ, and Laboratory Methods

04-5B / Implementation of New OGFC Specifications

07-2GT / Calibration of Resistance Factors needed in the LRFD design of Driven Piles

03-7ST / Long-Term Monitoring of the HPC Charenton Bridge

09-4C / Evaluation of Ternary Cementitious Combinations

07-7P / Safety Improvement from Edge Lines of Rural Two-Lane Highway

09-1GT / Update LADOTD Policy on Pile Driving Vibration Management

08-1ST / Evaluation of Continuity Details for Precast Prestressed Girders