Louisiana Transportation Research Center
The Louisiana Transportation Research Center (LTRC) is a research, technology transfer, and training center administered jointly by the Louisiana Department of Transportation and Development (DOTD) and Louisiana State University (LSU). LTRC provides a setting in which the thresholds of technology can be explored and applied in practical ways. By merging the resources of DOTD and LSU, a versatile core of facilities and expertise is brought to bear on the rapidly evolving challenges in the transportation field.

Since its creation by the Louisiana legislature in 1986, LTRC has gained national recognition through its efforts to improve transportation systems in Louisiana. The center conducts short-term and long-term research and provides technical assistance, training, continuing education, technology transfer, and problem-solving services to DOTD and the transportation community at large. The center is largely supported through funding authorized by DOTD and the Federal Highway Administration (FHWA).

LTRC merges the resources of the state and local government, universities, and private industry to identify, develop, and implement new technology to improve the state’s transportation system. By harnessing these valuable resources, LTRC is empowered to find innovative solutions to Louisiana’s transportation problems.

In addition to its affiliation with LSU, LTRC fully participates with other universities in Louisiana. By combining their resources with those of DOTD, the center eliminates duplication of effort and provides a richer base of support. The center also provides an avenue for multi-disciplinary support from universities to meet the practical and academic needs of the transportation industry in such areas as engineering, law, business and management, basic sciences, planning, and environmental studies.

To enhance the center as the focus for transportation-related research, technology transfer, and education in Louisiana, the LTRC foundation, a non-profit organization, has been established. The foundation provides an excellent partnership opportunity for DOTD, state universities, and the private sector.

In these and other ways, LTRC is paving the way for more efficient and beneficial research and training, thanks to a combination of modern techniques, locally available resources, and a wide pool of support.

For additional information, contact
Louisiana Transportation Research Center
4101 Gourrier Avenue
Baton Rouge, Louisiana 70808
www.ltrc.lsu.edu

William D. Ankner, Ph.D.
Secretary

Michael V. Martin, Ph.D.
Chancellor
This publication is a report of the transportation research, technology transfer, education, and training activities of the Louisiana Transportation Research Center for January 1, 2007–June 30, 2008. The center is sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University.

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Director’s Message

To:
Dr. William D. Ankner
Secretary, DOTD

Dr. Michael V. Martin
Chancellor, LSU

Mr. William Temple, P.E.
Chief Engineer, DOTD

Dr. David Constant, P.E.
Interim Dean
College of Engineering, LSU

From:
Harold “Skip” Paul, P.E.
Director, LTRC

It is a privilege to share with you the many accomplishments of LTRC reported herein. First, you will note that we have changed the period of the report from an annual year to a fiscal year basis. As a result, this report actually encompasses 18 months from January 2007 through June 2008. I will let the articles in this report speak for themselves and will draw your attention to a few items that I would like to highlight in this message.

I had the extraordinary opportunity to participate on an international scan tour which took me from Stockholm, Rotterdam, Brussels, and Paris on to Tokyo and Seoul before returning home. The nine-person team examined practices of Transportation Research Program Administration, focusing on the themes of Setting the Research Agenda; Partnership Models and Joint Research Activities; Conduct of Research: Performance, Quality and Value; and finally, Delivery: Getting the Research Results into Widespread Practice. There were wonderful lessons learned that will be applied here at home.

On a closer level, LTRC conducted a very successful Peer Exchange with peers from eight states participating either at LTRC or via video conference. Focus areas concentrated on growth opportunities for LTRC and the establishment of our new library.

The 2007 Transportation Engineering Conference sponsored by LTRC was attended by over 1,600 transportation professionals. Over 60 technical sessions were delivered in this very successful technology transfer event.

Finally, we welcomed Ms. Sandra Brady as our new librarian and look forward to expanding our vision in information management, and we recognize the leadership that Dr. Marie Walsh brought to the National LTAP Association while serving as their President from July 2007 through July 2008. It is always gratifying to see staff succeed at the national level.

Respectfully submitted,

Harold “Skip” Paul, P.E.
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 full resources of LSU as a Carnegie Designated Doctoral/Research Extensive Institution are also available. The unique position of LTRC provides access to virtually all of LSU and DOTD’s resources to pursue its mission.

LTRC houses more than 90 employees and up to 30 students in two adjacent facilities. The LTRC building is a 25,300 square foot facility that includes five research laboratories, a classroom, a conference room, and offices. The laboratories are used to conduct advanced research into asphalt materials, concrete, soils, pavements, and geotextiles. The 14,000 square foot Transportation Training and Education Center (TTEC) houses a lecture hall, a computer-based training classroom, and two general classrooms that are all equipped with advanced education and training equipment and distance learning/video-conferencing capabilities. A comprehensive transportation library and offices are also included.

LTRC has identified research areas of strategic importance and has developed expanded capabilities for concentration in several areas: the Engineering Materials Characterization and Research Facility (EMCRF), a laboratory facility specializing in fundamental materials characterization; the Geotechnical Engineering Research Laboratory (GERL), a laboratory focusing on transportation earth-works, structural foundations, and geosynthetics, which includes mobile equipment, including the mini-cone intrusion technologies for in-situ characterization of geomedia; and Pavement on the Move (POM), a multi-use mobile laboratory for collecting data from field construction projects as well as research and training.

Although remote from the center, the Louisiana Pavement Research Facility is an important facility that streamlines pavement loading research by compressing years of road wear into months of testing. The six-acre facility is located on the west side of the Mississippi River and incorporates an Accelerated Loading Facility (ALF™).

The addition of TTEC greatly enhances LTRC’s mission by facilitating the delivery of training, professional development opportunities, and technology transfer to engineers, technicians, undergraduate and graduate students, and professionals from both the public and private domains.

LTRC is a budget entity of the Louisiana Department of Transportation and Development. Funding is a combination of State, State Planning and Research (Part II, Federal) 100 percent federal, Surface Transportation Program (STP-federal), and external contracts and grants, such as the National Cooperative Highway Research Program, the U.S. Army Corps of Engineers, and the National Science Foundation.
Throught its transportation-based science and technology program, LTRC’s research section serves the transportation field by furthering knowledge and solving problems encountered by DOTD and the general transportation community. Input is solicited from DOTD, universities, and industry. In addition, a major portion of LTRC’s budget is used to fund contract research studies with Louisiana universities. The research section is organized in two major groups—Materials, which incorporates asphalt, concrete, and structures research; and Pavements & Geotechnical. Other research areas include Management & Policy Analysis.

Air Void Analyzer for Plastic Concrete
Principal Investigator: John Eggers, P.E., LTRC

Analysis of Rainfall- Accident Relationships Using High Resolution Radar-Rainfall Data
Principal Investigators: Xiaoduan Sun, Ph.D., P.E., and Emad Habib, Ph.D., P.E., ULL

Combined Soil Moisture and Dynamic Cone Penetrometer (DCP)
Principal Investigators: Martin Feldman, Ph.D., Dooung Hah, Ph.D., and Ashok Srivastava, Ph.D., LSU

Development of Geotechnical Information Database – Computer Program to Expedite Soil Sub-grade Survey Data to Designers
Principal Investigators: Gavin Gautreau, P.E. and Pallavi Bhandari, Computer Analyst III, LTRC

Effect of Drainage in Unbound Aggregate Bases on Flexible Pavement Performance
Principal Investigators: Murad Y. Abu-Farsakh, Ph.D., and Mingjiang Tao, Ph.D., LTRC

Evaluating the Effects of Heavy Sugar Cane Truck Operations on Repair Cost of Low Volume Highways
Principal Investigator: Aziz Saber, Ph.D., P.E., LTU

Evaluation of Superpave Mixtures Containing Hydrated Lime
Principal Investigators: Louay N. Mohammad, Ph.D. and Sam Cooper, P.E., LTRC

Flexural Strength and Fatigue of Steel Fiber Reinforced Concrete (Hale Boggs Deck)
Principal Investigator: John Eggers, P.E., LTRC

An Innovative Framework for Unsaturated Soils Subjected to Cyclic Variations in Moisture
Principal Investigator: Radhey S. Sharma, Ph.D., LSU

Measurement of Elevations of Hurricane Protection System in Southeast Louisiana
Principal Investigator: Roy K. Dokka, Ph.D., LSU

A Novel Technique for Stiffening Steel Structures
Principal Investigator: Ayman M. Okeil, Ph.D., P.E., LSU

Performance Evaluation of Louisiana Superpave Mixtures
Principal Investigator: Louay N. Mohammad, Ph.D., LTRC

Strengthening of Bridge Girders using Fiber Reinforced Polymers
Principal Investigators: V.J. Gopu, Ph.D., P.E., LTRC, and Paul H. Ziehl, Ph.D., P.E., University of South Carolina

Tubular Steel Fender Units for Pier Protection Against Vessel Collision
Principal Investigator: George Voyiadjis, Ph.D., LSU

Update of Correlations between Cone Penetration and Boring Log Data
Principal Investigators: Khalid Alshibli, Ph.D., and Ayman Okeil, Ph.D., LSU

Use of Reinforced Soil Foundation (RSF) to Support Shallow Foundation
Principal Investigators: Murad Y. Abu-Farsakh, Ph.D., P.E., LTRC and Issaldin Al-Moh’dk, Ph.D., LSU

LSU: Louisiana State University    LTU: Louisiana Tech University
ULL: University of Louisiana at Lafayette
Calibration of Resistance Factors Needed in the LRFD Design of Driven Piles

Principal Investigator: Dr. Murad Abu-Farsakh, Louisiana Transportation Research Center
Co-Principal Investigators: Dr. Ching Tsai, Louisiana Department of Transportation & Development and Dr. Sungmin Yoon, Louisiana Transportation Research Center

The main objective of this research project is to calibrate the resistance factors needed for implementing the LRFD design method for both driven piles and drilled shafts based on local soil database and Louisiana design experience.

For LRFD calibration of driven piles, forty-two square precast-prestressed concrete (PPC) piles that were tested to failure were included in this investigation. The predictions of pile resistances were based on static analysis, three CPT direct methods (Schmertmann method, De Ruiter and Beringen method, and Bustamante and Gianeselli (LCPC) method), and the average of three CPT methods. In addition, dynamic measurements with signal matching analysis of pile resistances using CAPWAP, which is based on the measured force and velocity signals obtained near the pile top during driving, were evaluated. The Davisson interpretation method was used to determine the measured ultimate load carrying resistances from pile load tests. The predicted ultimate pile resistances obtained using the different prediction methods were compared with the measured resistances determined from pile load tests. Statistical analyses were carried out to evaluate the capability of the prediction design methods to estimate the measured ultimate pile resistance of driven piles.

Reliability based analyses, using first order second moment (FOSM) method, first order reliability method (FORM), and Monte Carlo simulation method were conducted to calibrate the resistance factors for the different pile design methods used by DOTD. For each pile design method, the target reliability values and the corresponding resistance factors, as well as the efficiency factors, were determined and compared with AASHTO recommended values. The analysis for drilled shafts is in progress.
Modeling Evacuation Traffic
Principal Investigator: Dr. Brian Wolshon, Louisiana State University

Over the last decade, the Departments of Transportation in 12 coastal states threatened by hurricanes have developed plans for the implementation of contraflow traffic operations on freeways during evacuations. Contraflow involves the use of one or more inbound travel lanes for the movement of traffic in the outbound direction. It is a logical and cost-effective strategy because evacuation traffic can be loaded into underutilized inbound lanes, thereby significantly increasing outbound capacity without the need to construct additional lanes.

This project involved two closely related studies which evaluated the implications of contraflow evacuations on freeways. The research focused on what are widely regarded to be the most critical locations of contraflow segments, the initiation and termination points. The termini configurations are important because they effectively dictate the capacity of these segments as they control how many vehicles can get in and out. In the research, traffic simulation models were developed to simulate the operation of planned configurations under varying levels of traffic demand to assess their operating characteristics. The results showed that many of the current designs of the initiation and termination points will likely restrict the ability of the segments to be used to their maximum effectiveness. Another key finding was the extent to which the spatial and/or temporal spreading of traffic demand can yield significant benefits to the overall effectiveness of contraflow freeway evacuations. With an increased awareness of these issues, the findings can be used to enhance the effectiveness of existing evacuation plans.

Impact of Edge Lines on Safety of Rural Two-Lane Highways
Principal Investigator: Dr. Xiaoduan Sun, P.E., University of Louisiana at Lafayette

Rural two-lane highways in Louisiana carry one-third of the total vehicle miles traveled (VMT) and have experienced a considerably high percentage of fatal crashes. Each year, more than half of all fatal crashes have occurred on this type of highway, where the dominant crash type is running-off-roadway (ROR).

Proper pavement marking would be an inexpensive countermeasure to reduce accidents. Marking edge lines is expected to provide a visual guide, which would help confine vehicles within the traveled lane. The effects of edge lines were documented in a number of past studies, and the Manual on Uniform Traffic Control Devices (MUTCD)
provides the guidelines for edge line implementation. However, rural two-lane highways with narrower lane widths caused concern, namely the presence of edge lines would influence drivers to operate closer to the centerline, increasing the risks of head-on and sideswipe crashes. While DOTD makes efforts to comply with the updated MUTCD, concerns arise on the installation of edge lines on narrow rural two-lane highways. It has been widely suspected that edge lines on narrow roadways may make motorists operate vehicles closer to the centerline, and thus increase the risk of head-on and sideswipe collisions.

To address this concern, a project was conducted by a research team led by Dr. Xiaoduan Sun at University of Louisiana at Lafayette. The goal of this project was to determine if the implementation of edge lines on narrow rural roadways has any negative impact on driver behavior that affects highway safety. Specifically, the objectives were to investigate the impact of edge line marking on the wheel tracking of vehicles under various roadway alignment and traffic conditions, examine the potential tort liability arising from the implementation of edge line markings on narrow two-lane highways, and develop a recommended guideline for the application of edge line markings on two-lane highways in Louisiana.

The study was conducted on the selected rural two-lane highways in Louisiana that are between 20 and 22 feet wide. The variables considered in the analysis were highway geometry (pavement width, pavement condition, and road alignment) and traffic conditions (traffic volume, operating speed, and percentage of heavy vehicles).

The before-and-after measurements at 10 sites (seven tangent sections and three curve sections) with about 20,000 vehicles show that the edge line has a positive impact on rural narrow two-lane highways in Louisiana particularly at night. With edge lines, centralization of vehicles’ position is more apparent during nighttime, which reduces the risk of ROR and head-on collisions; edge line markings generally cause drivers to operate their vehicles away from the road edge, irrespective of the roadway alignment; magnitude of the impact of edge line markings is influenced by roadway width, time of the day, frequency of heavy vehicles, pavement condition, and traffic from the opposite direction. This study also found that edge lines have no or little effect on the average operating speed. Due to limited number of curved sections, the edge line impact on curved sections is not conclusive.

An implementation study is currently investigating the qualitative safety effect in terms of number of crashes before-and-after edge line as a continuation of this project.
Asphalt tack coat is a light application of asphalt, usually asphalt diluted with water.

Optimization of Tack Coat for HMA Placement

Principal Investigator: Dr. Louay Mohammad, Louisiana Transportation Research Center
Co-Principal Investigators: Joe Button, Texas Transportation Institute and James Scherocman, consultant

LTRC was awarded National Cooperative Highway Research Program (NCHRP) Project 9-40 to determine the optimum application methods, equipment type and calibration procedures, application rates, and asphalt binder materials for the various uses of tack coats and to recommend revisions to relevant AASHTO methods and practices related to tack coats. Asphalt tack coat is a light application of asphalt, usually asphalt diluted with water. It is used to ensure a bond between the surface being paved and the overlying course. A tack coat provides necessary binding between pavement surface layers to make sure that they act as a monolithic system to withstand the traffic and environmental loads. A strong tack coat binding between the layers of a pavement is critical in the transference of radial tensile and shear stresses into the entire pavement structure. On the other hand, insufficient bond decreases pavement bearing capacity and may cause slippage. Insufficient bonding may also cause tensile stresses to be concentrated at the bottom of the wearing course. Such concentrated stress may accelerate fatigue cracking and lead to total pavement failure. Few guidelines are available for proper selection of tack coat material type, application rate, and placement.

To meet the objectives of this study, two mechanical test devices were developed during this project. The first device characterizes the quality of the bond strength of tack coat materials in tension in the field, while the second one measures the interface shear strength of cylindrical specimens. A field test was conducted, which included various surface conditions and three types of emulsified tack coats—CRS-1, SS-1h, and Polymer modified “trackless” tack—considered at three application rates of 0.14, 0.28, and 0.70 l/m2. The majority of the cases showed statistically significant difference between clean and dusty conditions. However, no significant difference was found between dry and wet conditions. Also, the researchers generally noted that the application rate related to measured shear strength (i.e., higher application rates yield higher shear strength). This ongoing study will also examine concrete surfaces and milled surfaces in the final report due to be complete in 2009.
Evaluating the Effect of Heavy Sugar Cane Truck Operations on Repair Cost of Low Volume Highways / Monitoring System to Determine Impact of Sugarcane Truckloads on Non-Interstate Bridges

Principal Investigators: Dr. Aziz Saber, P.E., and Dr. Freddy Roberts, P.E., Louisiana Tech University

This study assesses the economic impact of overweight permitted vehicles hauling sugar cane on Louisiana highways. The highway routes being used to haul these commodities were identified, and statistically selected samples were used in the analysis. Approximately 270 control sections on Louisiana highways are involved in the transport of this commodity. Three different gross vehicle weight (GVW) scenarios were selected for this study including: 80,000 lb., 100,000 lb., and 120,000 lb. The current maximum allowable GVW is 80,000 lb. while the maximum 100,000 lb. GVW is the permitted load for sugar cane trucks and is currently the highest load level permitted by Louisiana laws.

The methodology for analyzing the effect of these loads on pavements was taken from the 1986 AASHTO design guide and involves determining the overlay thickness required to carry traffic from each GVW scenario for the overlay design period. Differences in the life of an overlay were calculated for different GVW scenarios and overlay thickness and costs were determined for a 20-year analysis period. These costs were developed for samples taken from all the control sections included in the study. These net present worth costs from the samples were expanded to represent the cost for all control sections carrying sugar cane.

Results indicate that the damage to pavement overlay from each sugar cane truck with a GVW of 100,000 lb. costs about $2,072/year; the damage to bridge fatigue costs about $3,500/year. Therefore, the current sugar cane truck permit fee of $100/year is not adequate and should be increased to recover these costs. The legislature should not consider raising the GVW level to 120,000 lb. because the pavement overlay costs increase two fold, and the bridge repair costs become very large. Moreover, the magnitude of the damage caused by the 120,000 lb. GVW for a FHWA Type 9 truck makes the risk of bridge damage and even bridge failure too significant to ignore.

The study recommends that the legislature keep the GVWs at the current level, but increase the permit fees sufficiently to cover the additional pavement and bridge costs or change the configuration of the axle on the trailer from a tandem to a triple, effectively changing the vehicle from a FHWA Type 9 to a Type 10 vehicle. Under these circumstances, the permit fee can be reduced to zero and a tax incentive of $683 can be given to each truck for the conversion. It is recommended to allocate more highway funding for handling the extra damage caused by the increase of truck load limits.
## Active Research

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LTRC: Louisiana Transportation Research Center  
LSU: Louisiana State University  
LTU: Louisiana Tech University  
ULL: University of Louisiana at Lafayette  
SU: Southern University
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<td>LSU</td>
<td>Guoqiang Li</td>
<td>Development of Advanced Grid Stiffened (AGS) FRP Tube-Encased Concrete Columns</td>
<td>1-Sep-2005</td>
<td>31-Aug-2008</td>
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<tr>
<td>07-1ST</td>
<td>LTRC</td>
<td>Murad Abu-Farsakh, Sungmin Yoon</td>
<td>Structure Health Monitoring of the I-10 Twin Span Bridge Over Lake Pontchartrain</td>
<td>1-Nov-2007</td>
<td>31-Oct-2010</td>
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<td>07-3ST</td>
<td>LSU</td>
<td>Steve Cai</td>
<td>Use of Fiber Reinforced Polymer (FRP) Bars in Highway Concrete Bridges</td>
<td>1-Oct-2007</td>
<td>30-Apr-2009</td>
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<td>LSU</td>
<td>George Voyiadjis, Steve Cai, Sharma</td>
<td>Integral Abutment Bridge for Louisiana’s Soft Soil</td>
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<td>08-4GT</td>
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<td>Murad Abu-Farsakh, Qiming Chen</td>
<td>Support Study to Evaluation of the Base/Subgrade Soil Under Repeated Loading</td>
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<td>LSU</td>
<td>Steve Cai</td>
<td>Development of Scour Monitoring Techniques Using Fiber Optic Sensors</td>
<td>30-Sep-2008</td>
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<td>05-1SS</td>
<td>LSU/ULL</td>
<td>Sherif Ishak, Brian Wolshon, Xiaoduan Sun</td>
<td>Evaluation Of The Traffic Safety Benefits Of A Lower Speed Limit And Restriction Of Trucks To Use Of Right Lane Only On I-10 Over The Atchafalaya Basin</td>
<td>1-Jan-2005</td>
<td>31-Aug-2008</td>
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**LTRC:** Louisiana Transportation Research Center  **LSU:** Louisiana State University  **LTU:** Louisiana Tech University  **ULL:** University of Louisiana at Lafayette  **SU:** Southern University
## Active Research

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<th>Project No.</th>
<th>Agency</th>
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<th>Title</th>
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<th>End Date</th>
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<td>07-7P</td>
<td>ULL</td>
<td>Xiaoduan Sun</td>
<td>Safety Improvement from Edge Line of Rural Two-Lane Highways</td>
<td>1-Jul-2007</td>
<td>30-Jun-2010</td>
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<td>08-2SS</td>
<td>LTRC</td>
<td>Chester Wilmot</td>
<td>LOOP Environmental Monitoring: 2008-2010 Beach Elevation, Beach Vegetation, and Land Loss and Habitat Change Surveys</td>
<td>1-Jan-2008</td>
<td>31-Dec-2010</td>
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*LTRC: Louisiana Transportation Research Center  LSU: Louisiana State University  LTU: Louisiana Tech University  ULL: University of Louisiana at Lafayette  SU: Southern University*

### Total Number of Active Research Projects by Fiscal Year

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<th>Year</th>
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<td>2009</td>
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Because training is a necessary component of career advancement, DOTD supports and promotes an environment of continual learning. This atmosphere allows employees to maximize their potential and provide qualified personnel crucial to the effective management of the transportation system. Through specialized and intensive job-specific training and education programs, LTRC reaches out to the individual working in the transportation industry.

LRRC manages DOTD’s Structured Training Programs; develops maintenance and construction training materials and programs; coordinates seminars, workshops, and conferences for continuing education and professional development; and contracts with the private and public sectors for unique training needs.

Structured Training Programs
The DOTD Structured Training Program is a department-sanctioned, progressive training curriculum that requires specific work-related training be completed at each level of an employee’s career path. DOTD supports and promotes an environment of continual learning and feels that training is a necessary component and an integral part of career advancement. Structured training can involve professional development, technical skills training, continuing education, hands-on, and on-the-job training. The program manages the work force development for the personnel in construction, maintenance, and supervisory/leadership positions. The program also provides liaison assistance to headquarter personnel and district training personnel for policy interpretation and compliance decisions.

The Construction and Materials Training Program manages the Inspector/Technician Certification Program for DOTD and the Louisiana transportation industry. This program develops construction and materials training materials and coordinates the training, testing, authorization, certification, and recertification of inspectors and technicians statewide in each area of construction.

The Maintenance Training Program focuses on the development of new job-specific courses related to job functions, work processes, and safe operation of equipment used by maintenance field personnel. These courses promote an awareness of safe practices and attitudes needed for maximum job performance.

Construction and Maintenance Course Development
There were 17 courses developed in this time period, 7 in construction and 10 in maintenance.

Construction Courses/Projects Completed
» Application of Quality Assurance Specifications for Portland Cement Concrete and Structural Concrete (Updated to latest specifications)
» Application of Quality Assurance Specifications for Asphaltic Concrete (Updated to latest specifications)
» Introduction to Surveying (course revision)
» Mathematics for Surveyors (course revision)
» Module One: Training for the Automated Lightweight Profiler—Pre-Operation Procedures
» Location and Design Advanced Math Geometry and Trigonometry (conversion from SI Metric units to English)
» Levee and Flood Control Works Inspection (4 training modules)

Maintenance Courses/Projects Completed
» Fall Protection/Aerial Lift Safety/Safety Harnessing
» Workplace Safety
» Trailer Mounted Boom Lift
» Basic Flagging Procedures (course revision)
» Maintenance Math Volume 1 (course revision)
Education & Training

- Front End Loader (course revision)
- Forklift (course revision)
- Power and Hand Tool Safety (supplemental materials)
- Training Needs Assessment of Basic Maintenance
  Trades Functions
- IMSA recertifications

Construction and Maintenance Current/On-Going Projects

A total of 15 projects are currently ongoing, 9 in construction and 6 in maintenance.

Construction Current/On-Going Projects

- Management of the Inspector/Technician Certification Program for DOTD and the Louisiana transportation industry
- Revisions of Specialty Area Tests to keep current with specifications
- Conversion of testing materials to the IQ-Box web-based e-testing platform
- Module Two: Training for the Automated Lightweight Profiler – IRI Readings
- Base Course Inspection (course book revision)
- Excavation and Embankment Inspection (course book revision)
- Basic Asphaltic Plant Inspection (course book revision)
- Asphaltic Concrete Paving Inspection Volumes 1 and II (course book revisions)
- Introduction to Highway Plan Reading

Maintenance Current/On-Going Projects

- Traffic Signal Installation Plan Reading and Inspection
- Herbicide Applicator Certification
- SOCL Herbicide Spray Rig
- SOCL Sweepers (revision)
- IMSA Program Revitalization (Signs and Markings Level one)
- Letter Bid Study Guide

Support for Higher Education

LTRC coordinates the statewide DOTD Engineer Resource Development Program (ERDP), which provides structured rotational training for entry-level engineers. LTRC also manages the Cooperative Education Program for engineering students, a cooperative endeavor between DOTD and universities within Louisiana to employ full-time university students to perform engineering work and receive practical experience in the field of civil and transportation engineering. During 2007–2008, 3 people participated in the ERDP and 62 participated in the Cooperative Education Program. In addition, more than 50 graduate students were supported through LTRC research during 2007–2008.

LTRC also facilitates the DOTD Support Program for Civil Engineering Studies, a cooperative endeavor between DOTD and Louisiana state universities with civil engineering programs. It provides practical experience to civil engineering students who select transportation-related topics among their engineering design courses. DOTD supports this program financially, and universities grant academic credit to its participants. The senior design projects are transportation-related and are included in courses for which junior- or senior-level students receive a grade. At the end of the senior design project, participants provide copies of the final report to LTRC and give a 15-20 minute presentation. Louisiana Tech, Southern, and Louisiana State University participated in the program during 2007-2008.
**Management Development Training Program**

This program oversees several mandatory supervisory, management development, and career development training programs: the Leadership Training program, a structured training program for DOTD employees in a professional job series; the Engineering Technician Supervisory Training program, a supervisory training program for DOTD Engineering Technicians; the DOTD Supervisory Maintenance Training program, for trades, crafts, and maintenance supervisors; and the Civil Service Supervisory training program for supervisors not covered by other DOTD training programs.

There are currently **2,234** employees actively participating in leadership training.

The number of employees completing instructor-led courses for this period of time was **2,737**.

---

- **Leadership Training Program**: 989 employees (44%)
- **Engineering Technicians Supervisory Training**: 655 employees (29%)
- **Supervisory Training for Maintenance Personnel**: 436 employees (20%)
- **Civil Service Mandatory Supervisory Training**: 34 employees (2%)
- **Supervisors not covered by other programs**: 120 employees (5%)

- **Leadership Training Program**: 1,822 employees (67%)
- **Engineering Technicians Supervisory Training**: 582 employees (21%)
- **Supervisory Training for Maintenance Personnel**: 486 employees (29%)
- **Civil Service Mandatory Supervisory Training**: 90 employees (3%)
- **Supervisors not covered by other programs**: 61 employees (2%)
LTRC Establishes a Transportation Library

LTRC has established a transportation library at its Transportation Training and Education Center, with the goal of supporting researchers at LTRC, at the Louisiana Department of Transportation and Development, at Louisiana State University, and across the nation in their transportation related research. The idea behind the library is that having access to appropriate resources and knowing where to find valuable information quickly is key to facilitating quality research.

The first step toward establishing the library involves collecting and inventorying materials. Until now, various publications have been housed on open shelves in the halls of LTRC, in storage buildings, in offices, and in workrooms. Once the publications have been organized in one designated area, seeing what is available and filling gaps with needed resources will be possible.

Also involved in the process is choosing and implementing a system that will manage cataloging and circulation. The catalog will be available online and will provide anyone with Internet access with the ability to search the collection and request materials. The circulation system will allow for checking materials in and out of the library and tracking use of the library. Knowing who is using the library, how often it is being used, and the purposes for which it is being used will help library personnel serve the customers with precision.

The Library News Blog, created to facilitate communication between the library staff and customers, contains entries, such as “Why a Blog?” and “LTRC TTEC Library Introductions.” Library staff members hope a steady flow of information will enable the library to fulfill its purpose of supporting research. Topics that will be discussed on the blog in the near future include: Moodle, new items cont. on page 18

TTEC's strategy is to assist and enable workforce development using principles of Strategic Human Capital Improvement. The goals of this strategy are to:
» Create and provide sound training.
» Transition current classes/training into the distance learning environment where appropriate.
» Incorporate instructional design concepts, utilizing the talents of formally trained designers to update and modernize courses.

The Transportation Training and Education Center is dedicated to the delivery of transportation training, professional development opportunities, continuing education, and technology transfer to engineers, technicians, and other professionals from Louisiana's public and private sectors. Through this new facility, LTRC is expanding the scope and availability of training, thereby serving a larger population.

A 100-seat classroom style lecture facility is one of the state-of-the-art learning environments available at TTEC. The center also includes two general purpose classrooms, a hands-on computer classroom, and an executive conference room.

The Library News Blog, created to facilitate communication between the library staff and customers, contains entries, such as “Why a Blog?” and “LTRC TTEC Library Introductions.” Library staff members hope a steady flow of information will enable the library to fulfill its purpose of supporting research. Topics that will be discussed on the blog in the near future include: Moodle, new items cont. on page 18
External Training Activities

LTRC’s external training program continues to supply the professional development and technical skills training necessary for the career growth of all DOTD employees. This training program, which is vital for DOTD and private industry, is increasing its offerings to the wider transportation community. External training satisfies specific needs by providing job-specific training topics through partnerships with universities and private training providers.

TTEC was the host for the majority of these events, which included National Highway Institute (NHI), FHWA, and Northwestern University courses. With 95 offerings from January 2007–June 2008, more than 2,000 DOTD employees received training. Approximately 660 consultants and state/local government employees and nearly 60 FHWA personnel attended training as well.

Individual Registrations

In addition to managing courses in-house, the center provides the opportunity to attend courses, conferences, seminars, and other educational and training opportunities offered by outside parties. During 2007–2008, LTRC managed registrations for 777 employees to attend 348 conferences, courses, seminars, and other educational and training opportunities offered by outside parties.

During 2007–2008, 3,656 students attended 420 computer and technical contract courses offered through LTRC. The types of courses are shown below:

### Computer Classes
- 288

### CADD Classes
- 40

### ArcGIS Training
- 15

### Electrical Maintenance & Troubleshooting and ArcFlash
- 21

### Nuclear Gauge and Radiation Safety Classes
- 2

### Mechanic Classes
- 2

### ATSSA Classes
- 39

**LTRC Establishes a Transportation Library, cont. from page 17**

coming to the library, hints for using new databases, and the limited availability of ASTM standards.

TTEC’s library will share information with the libraries of various participating departments of transportation. Such will allow users of the TTEC library to take advantage of resources at libraries nationwide. Sharing will also allow users from all over the country to benefit from TTEC’s resources. The networking provided by organizations such as The Eastern Transportation Knowledge Network and the Transportation Library Connectivity Pool will help TTEC’s library staff to better serve its myriad of customers.

A web site intended to provide easy access to all TTEC library resources is currently being developed. The page will be equipped with a chat feature that will allow visitors to communicate with the librarian in real time. Interested parties can access the library Web page through a link on LTRC’s Web site.
Transportation Engineering Conference Moves to a New Venue

The Louisiana Transportation Research Center held the 2007 Louisiana Transportation Engineering Conference at the Baton Rouge River Center February 11-14. The conference is held on a biennial basis and is intended to foster a better relationship and greater understanding between DOTD, FHWA, and the transportation industry (contractors, consultants, universities, suppliers, and parish/local agencies). The conference could not be held as scheduled in 2006 because of the lingering effects of Hurricanes Katrina and Rita. The Program Committee planned and brought to fruition 72 technical sessions, several how-to clinics, and a myriad of alternative sessions dealing with various management and workplace issues. Many in attendance at the 2007 conference received credit for up to 16 professional development hours (PDH), one of which is the biennially required hour in Professional Ethics. A conference Web site allowed for online registration and provided extensive program information.

Student Shadowing was a new program incorporated into the engineering conference this year. The program was introduced to familiarize college junior and senior engineering students with the many opportunities and engineering disciplines available within the DOTD. The goal of the program was to encourage students to consider careers in transportation, particularly with DOTD. DOTD Human Resources coordinated the effort to match students and DOTD mentors based on areas of interest and/or geographical location. Students accompanied their mentors to technical sessions, DOTD table displays, and vendor exhibits. Mentors were asked to introduce their students to DOTD employees and administrators and take the opportunity to discuss the multitude of positive aspects of employment with DOTD. Student Shadowing allowed for a first contact between DOTD and prospective engineers.

LTRC is currently planning the 2009 Louisiana Transportation Conference, set for February 8-11, 2009, at the Baton Rouge River Center (www.ltrc.lsu.edu/ltc_09).
Peer Exchange Highlights Opportunities for Growth

While internal organizational reviews are critical to progress, periodic critiques from outside experts can provide invaluable insight, leading to best practice implementation. Such is the philosophy behind peer exchange.

In order to manage State Planning and Research (SP&R) funds, LTRC must conduct a peer exchange every three to five years, according to federal regulations (23 CFR 420 Subpart B). Peer exchange is an opportunity to review research and development and technology transfer activities. Its intent is to strengthen weak programs while enhancing strong ones.

LTRC’s peer exchange team convened in Baton Rouge for three days in May for an informal open dialogue and exchange of ideas. During the meetings, LTRC staff presented information about current focus areas and practices, and the invited participants shared their state practices and took part in brainstorming sessions.

The 2008 peer exchange team included representatives from Arizona, Florida, Iowa, Mississippi, South Dakota, Texas, Wisconsin, and Wyoming, along with officials from FHWA, LTRC, and DOTD headquarters. With the distance learning technology available at LTRC’s TTEC, remote team members were able to participate in sessions via videoconference. This year’s peer exchange focused on the following key areas:

- Enhancing university relationships
- Exploring new research topics
- Effectively cooperating with regional peers
- Measuring and reporting on the value of research
- Developing LTRC’s transportation library

The results from all presentations, interviews, and breakout sessions were compiled into a final report that identified LTRC’s strengths in the aforementioned areas as well as opportunities for improvement and growth.

Technical Assistance Projects

LTRC’s technical assistance program provides laboratory testing, field testing, and forensic investigation in direct response to Departmental inquiries for expert analysis on DOTD projects. LTRC also provides assistance to state universities for laboratory or field testing on research projects not funded by LTRC. During the 2007-2008 fiscal year, LTRC responded to 79 of 80 technical assistance requests.

The 2007 LTRC peer exchange was the first to utilize distance learning technology available at TTEC.

Technical Assistance Projects

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Total Number of Technical Assistance Projects

2001-2008
LTRC Seminar Focuses on Bridge Projects

LTRC held a bridge structures seminar on February 20–21, 2008, in New Orleans, Louisiana. The seminar boasted 150 attendees from 13 states and featured presentations on major bridge projects, moveable bridges, bridge maintenance, bridge rehabilitation, structures research, and bridge design. Several of the 17 participating speakers were from Louisiana. DOTD Chief Engineer William “Bill” Temple opened the series by welcoming participants to what he hopes will be the first of many such opportunities for the sharing of vital research. Following are examples of the session offerings:

» DOTD’s Ching Tsai contributed to a session centered on the American Association of State Highway and Transportation Officials Load and Resistance Factor Design Code. He explained that, in compliance with a Federal Highway Administration mandate, DOTD and LTRC have an ongoing research project that calibrates the risk levels (in terms of resistance factors) associated with deep foundations in Louisiana.

» Dr. John Kulicki, CEO at Modjeski and Masters and member of the National Academy of Engineering, gave a presentation on Luling Cable Stay Replacement summarizing the seven year process that culminated in AASHTO’s 1993 adoption of LRFD.

» Bruce Peterson, of Louisiana TIMED Managers, presented information concerning the Huey P. Long Bridge widening project. The project involves a unique widening and rehabilitation project that will incorporate an existing long span steel truss and existing cantilevered floor beam brackets into the widened multi-truss bridge.

When asked about the seminar, Peterson said, “It was very good because it provided current local research on local problems and issues. In addition, it was an opportunity to learn more about local projects that have been completed or are currently underway. New techniques and construction methods highlighted in these projects help to provide designers and owners with information on available techniques that could be applied to projects they are currently working on.”

LTRC Director Harold “Skip” Paul brought the proceedings to a close with positive observations concerning the success of the seminar and the benefits sure to come from the wealth of information provided.

Dissemination of Information

Technology transfer’s ultimate goal is to disseminate practical knowledge to municipalities, parishes, and the transportation industry at large. LTRC’s Publications and Digital Media Development Program meets DOTD’s informational and training needs through newsletters, brochures, annual reports, capsules, Web development, and video production/photography. During 2007–2008, LTRC published 12 technical summaries, 9 project capsules, 2 implementation updates, 3 final reports, and 1 technical assistance report.
The Louisiana Local Technical Assistance Program (LTAP) is one of 58 centers in a national network that provides services to the local transportation community in each state, Puerto Rico, and the Native American Tribal areas. Each center operates independently to develop and implement programs that best meet the needs of the local transportation agencies while sharing a common national mission “to foster a safe, efficient, and environmentally sound surface transportation system by improving skills and increasing knowledge of the transportation workforce.” LTAP also shares four national focus areas that include infrastructure maintenance, safety, workforce development, and value delivery.

LTAP and the Local Road Safety Program

LTAP has continued its tradition of more than 25 years of service to Louisiana’s local road and transportation agencies. LTAP provides technical assistance, information transfer, technical training, and work force development opportunities. Over the years, LTAP has helped local agency personnel learn about new and proven technologies to better manage and maintain Louisiana’s local roads and bridges. Popular classes included inspection and maintenance of local bridges, basics of road construction and maintenance, work zone and safety, and heavy equipment operator safety. LTAP also works with the Louisiana Parish Engineers and Supervisors Association and the American Public Work Association to enhance professional development opportunities of local agency personnel.

A primary focus of LTAP has been the new Louisiana Local Road Safety Program (LRSP) which was initiated in 2006 to assist local communities in identifying and solving local road safety problems. Louisiana has one of the highest road fatality rates in the nation with a rate that is 40 percent higher than the national average. In 2007, 987 people were killed on Louisiana’s roads. Fatalities on Louisiana’s local roads account for over 20 percent of the total roadway deaths in Louisiana and nearly 40 percent of the total crashes. The LRSP provides on-site technical assistance by experienced traffic engineers, training for local road staffs and community representatives, local crash data analysis, and a funding program for local road safety improvement projects. Over 80 project applications were received in 2007, and 39 of the highest priority projects were selected for funding. Selection criteria included the potential of the project to reduce crashes that result in serious injuries and fatalities. Special consideration was given to projects that were supported by crash data, low cost, and considered to be readily implementable. The projects ranged in size from less than $5,000 to nearly $500,000, and implementation is managed by the LTAP and LRSP staff in cooperation with the DOTD. The LRSP provides the primary mechanism to implement the strategies in the Louisiana Strategic Highway Safety Plan that relate to local road safety.
LTAP Director Serves as National President

Dr. Marie B. Walsh, the Director of the Louisiana LTAP, served as the president of the National LTAP Association (NLTAPA) from July 2007 to July 2008. NLTAPA represents the 58 LTAP/TTAP state and regional centers to the Federal Highway Administration and to other external national partners involved in local transportation management and local road safety. During her term as president, she was instrumental in the formation of the NLTAPA Road Safety Committee to direct more national-level attention on the local road safety crisis and to focus LTAP efforts on local road safety. Over 60 percent of the nation’s roadway fatalities occur on rural or locally owned roads, which are managed by LTAP’s primary customer base. Nation-wide, LTAP centers are in an excellent position to assist local customers in improving road safety at the local level and play a role in driving down the number of deaths on all of America’s roads.

Dr. Walsh participates in a number of national road safety committees to represent LTAP and the local transportation providers. She is also a member of the TRB Road Safety Work Force Development Task Force and the Advisory Panel for an NCHRP study on the challenges and successes of attracting and retaining a skilled workforce. An active member of the Louisiana team to implement the Louisiana Strategic Highway Safety Plan, Dr. Walsh is a member of the Executive Committee for the Traffic Records Coordinating Council, the Board of Directors for the Baton Rouge Branch of the American Public Works Association, the Louisiana Parish Engineers and Supervisors Association, and Louisiana Operation Lifesaver.
## Publications & Presentations

### LTRC Final Reports

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<th>Report No.</th>
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<tr>
<td>417</td>
<td>Mohammad, L.N., Gaspard, K., Herath, H., and Nazzal, M.</td>
<td>Comparative Evaluation of Subgrade Resilient Modulus from Non-destructive, In-situ, and Laboratory Methods</td>
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<td>406</td>
<td>Mohammad, L.N., Herath, H., Gudishala, R., Nazzal, M., Abu-Farsakh, M., and Alshibli, K.</td>
<td>Development of Models to Estimate the Subgrade and Subbase Layers Resilient Modulus from In-situ Devices Test Results for Construction Control</td>
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<tr>
<td>409</td>
<td>Mohammad, L.N., Rasoulian, M., King W., and Martinez, M.</td>
<td>Evaluation of Stone/RAP Interlayers under Accelerated Loading</td>
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<td>393</td>
<td>Cooper, S., Mohammad, L.N., and Abadie, C.</td>
<td>Evaluation of Field Projects Using Crumb Rubber Modified Asphaltic Concrete</td>
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### LTRC Technical Summaries

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<td>Assessment of In Situ Test Technology for Construction Control of Base Courses and Embankments</td>
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<td>395</td>
<td>Fatigue and Shear Behavior of HPC Bulb Tee Girders</td>
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<td>396</td>
<td>Development of Laboratory Testing Facility for Evaluation of Base-Soil Behavior Under Repeated Loading: Phase-1: Feasibility Study</td>
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<td>399</td>
<td>Statewide Traffic Safety Study Phase I: Review of Current Traffic Safety Research, Practice, Analytical Procedures, and Databases</td>
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<td>Evaluation of Freeway Contraflow Evacuation Initiation and Termination Point Configurations</td>
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<td>408</td>
<td>Modeling Hurricane Evacuation Traffic: Development of a Time-Dependent Hurricane Evacuation Demand Model</td>
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<td>418</td>
<td>Monitoring System to Determine the Impact of Sugarcane Truckloads on Non-Interstate Bridges</td>
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<td>420</td>
<td>Assessing the Need for Intermediate Diaphragms in Prestressed Concrete Bridges</td>
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### LTRC Technical Assistance Reports

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<tr>
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<td>Wilmot, C.G., S. Varanasi, and S. Vadlamani</td>
<td>Analysis of Louisiana Vehicular Input Data for MOBILE 6</td>
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<td>08-2TA</td>
<td>Gaspard, K</td>
<td>Assessment of TriDyne Precast Panels</td>
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### LTRC Implementation Updates

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<td>Evaluation of Bearing Capacity of Piles from Cone Penetration Test Data</td>
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<td>347</td>
<td>Construction and Comparison of LA’s Conventional and Alternative Base Courses Under Accelerated Loading</td>
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### Publications & Presentations

#### LTRC Project Capsules

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<td>07-2S</td>
<td>Design of Lane Merges at Rural Freeway Construction Work Zones</td>
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<tr>
<td>07-1ST</td>
<td>Structure Health Monitoring of I-10 Twin Span Bridge</td>
</tr>
<tr>
<td>07-3ST</td>
<td>Repairing/Strengthening of Bridges with Post-Tensioned FRP Strands and Performance Evaluation</td>
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<td>Evaluation of Continuity Detail for Precast Prestressed Girders</td>
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<td>“Effect of Reinforcement on Resilient and Permanent Deformations of Base Course Material”</td>
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<td>Fu, H., Wilmot, C.G., and Baker, E.J.</td>
<td>“A Sequential Logit Dynamic Travel Demand Model and it’s Transferability”</td>
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Gaspard, K., 2007, “Laboratory assessment of Uretek,” Executive staff at LADOTD HQ and Uretek USA.


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Saber, A., 2007, “Cost of Proposed Higher Truck Loads on State Bridges,” ASCE/ACI Louisiana Civil Engineering Conference and Show, September, Kenner, LA.


Wolshon, B., Presentation to the Houston Forum on the subject of hurricane evacuation research within the Rice University SSPEED Center, Houston, TX, August 2007.

Wolshon, B., Presentation to the Kiwanis Club of Baton Rouge on the subject of hurricane evacuation in Louisiana, Baton Rouge, LA, April 2007.


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### Books/Journals Edited

- Associate Editor, *ASCE Journal of Materials in Civil Engineering*
- Associate Editor, *Journal of Engineering Research*
- Associate Editor, *International Journal of Pavement Research and Technology*
Transportation Research Board (TRB) Committees

- AHB20, Freeway Operations Committee
- ABJ70, Artificial Intelligence and Advanced Computing Applications
- ANB10 (4), Subcommittee on Emergency Evacuation
- A2B09, Full Scale Accelerated Pavement Testing
- AFK10, General Issues in Asphalt Technology
- AFK30, Characteristics of Non Bituminous Components of Bituminous Paving Mixtures
- AFK40, Characteristics of Bituminous-Aggregate Combinations to Meet Surface Requirements (committee chair)
- AFK50, Characteristics of Bituminous Paving Mixtures to Meet Structural Requirements;
- AFK 60, Flexible pavement construction and rehabilitation
- AFK 80, Basic Properties of Concrete
- AHD20, Pavement Maintenance Committee;
- AFP20, Committee on Exploration and Classification of earth Materials.
- AFSS0, Committee on Modeling Techniques in Geomechanics.
- AFSS70, Committee on Geosynthetics.
- AFP50, Committee on Seasonal Climatic Effects Including Frost Action on Transportation Infrastructure.
- AFSS40, Committee on Subsurface Soil-Structure Interaction.
- AFP40, Committee on Physicochemical and Biological Processes in Soils
- AFP10, Committee on Pavement Management Systems
- AFP60, Committee on Engineering Behavior of Unsaturated Soil

American Society of Civil Engineers (ASCE)

- Transportation and Development Institute, Planning and Economics Committee
- Highway Safety Committee
- Construction Institute Bituminous Committee.
- Bituminous Materials Committee (BMC)
- Baton Rouge Geotechnical Chair

National Cooperative Highway Research Program

NCHRP Project Panel Chair
- Project 9-36 on the Improved Procedure for Laboratory Aging of Asphalt Binders in Pavements.

NCHRP Project Panel Member
- Project 9-39 on Development of Procedures for Determining the Mixing and Compaction
- Temperatures of Superpave Asphalt Binders in Hot Mix Asphalt;
- Project 1-42A on Models for Predicting Top-Down Cracking of Hot-Mix Asphalt Layers.
- Project 20-05/Synthesis Topic 38-09, Correlation for Resilient Modulus Values of Subgrades and Unbound Pavement Materials
- Project 20-71, A Manual for Methodology of Experimental Design and Analysis
- Project 20-68A, U.S. Domestic Scan Program

Federal Highway Administration (FHWA)

- Asphalt Binder Expert Task Group
- Pavement Preservation Emulsion Task Group
- Highways for Life Innovative Technology Review Team

Miscellaneous

- Accelerated Pavement Testing Consortium and Technical Exchange Partnership (CAPT)
- Asphalt Pavement Analyzer User Group
- ASTM D 04.25 on Analysis of Bituminous Mixtures (Chair)
- Association of Asphalt Paving Technologists (AAPT)
- Committee on International Transportation
- Concrete Pavement Technology Center
- Conference Organizing Committee, National Conference on Disaster Planning for the Carless Society
- Engineering Geology and Site Characterization Committee, Geo-Institute
Organization & Committee Memberships

» Highway Safety Manual Task Force
» International Society of Asphalt Pavement
» International Steering Committee for Travel Survey Conferences
» Institute of Transportation Engineers Transportation Security and Evacuation Advisory Committee.
» Louisiana Engineering Society
» LTPP State Highway Agency (SHA) contact person
» National Research Council Committee on the Role of Public Transportation in Emergency Evacuation.
» National Society of Professional Engineers
» Research Advisory Group of the National Stone, Sand, and Gravel Association
» Southeastern Asphalt User Producer Group
» Scientific Committee, The Fifth International Conference on Maintenance and Rehabilitation of Pavements and Technological Control
» US Universities Council on Geotechnical Engineering Research (USUCGER)

Training Memberships

» American Society for Training and Development
» Civil Service Mandatory Training Coordinator for DOTD
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