

Focus on Research

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"Focus on Research updates engineers and technicians on items of interest upcoming in active research projects."

TxDOT AND ROBOTICS: THE FUTURE IS HERE

Many TxDOT activities are dangerous, repetitive or labor intensive. Other disciplines such as defense and energy research have developed advanced robotic techniques. The application of robotic technologies in transportation, particularly highway work, has the potential for mitigating hazards to both motorists and department workers. Robotics can also increase the efficiency of repetitive task work.

Study 0-1440, *Application of Robotics and Other Automated Techniques to the Construction, Maintenance, and Inspections of Highway Systems*, started out as a feasibility study scheduled to end in August 1993. The study aimed to identify solutions to operational field problems, determining whether or not conversion of tasks to robotics was feasible. The study's technical panel, encouraged by preliminary results, hopes to fund a follow-up study to include a multiyear hardware development phase. The Administration will have to approve detailed economic feasibility studies and hardware prototype development of the most promising systems. Sandia National Laboratories in Albuquerque, NM, is participating in the study, identifying existing hardware that might be adapted for TxDOT use.

This research gives TxDOT a systematic approach to the problem of technology transfer and implementation of robotics that improve operations and reduce associated human risk. Potential applications under investigation are:

- automated culvert clean-out and inspection,
- underwater bridge inspection,
- roadway density measurement,
- drilled shaft inspection,
- flagging for traffic control,
- placement and retrieval of traffic cones,
- and traffic signal maintenance.

The Technical Panel Chairman encourages TxDOT personnel to suggest activities that may be improved through automation.

Area A — Technical Panel Chairman: Tom Yarbrough, P.E., Office of Research and Technology Transfer, (512) 465-7685

Researchers — Walter Boles and Don Maxwell, TTI

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Research Area Titles

- Area A: "Administration and Policy"
- Area 1: "Planning, Economics, Environment and Transit"
- Area 2: "Materials, Construction, Maintenance and Pavement Design"
- Area 3: "Traffic Operations, Geometric Design and Right-of-Way"
- Area 4: "Structural Design"



STUDY TO DEVELOP TOOLS FOR EVALUATING LIGHT RAIL WITHIN AN URBAN SIGNAL SYSTEM

Several Texas cities are investigating the planning and development of light rail transit. For example, both Austin and El Paso are undertaking preliminary studies that explore available rail transit options.

In these and other cities, traffic managers need to analyze the effects light rail transit will have on traffic signals, as well as the effect traffic signals may have on train operations. Texas' Cooperative Research Program created Study 0-1278, *Development of Analytical Tools for Evaluating Operations of Light Rail at Grade within an Urban Signal System*, to fill the need for appropriate methods of analysis.

To develop the necessary analytical tools, Study 0-1278's plan is to:

- contact other transit agencies and cities with light rail systems to obtain and compare analytical methodologies;
- select a study site with and without a light rail system;
- compare operations in the study cities;
- and to assess the reliability of the theoretical methods in use.

The primary product of the research will be a standard methodology for evaluating light rail at-grade crossing operations within a signalized network. With such a tool, transit authorities and the cities involved, as well as TxDOT, would be in a better position to identify the locations where at-grade operation presents a high potential for traffic disruption.

Study 0-1278 began in August 1991 and ends in August 1994.

Area 1 — Technical Panel Chairman: Ed Collins, Austin District
Researchers: Carol Walters and Dan Fambro, TTI

RECYCLING SECOND GENERATION ASPHALT-RUBBER PAVEMENTS

Federal regulations require the incorporation of more waste-tire rubber into pavement materials. Eventually, transportation agencies will need to recycle these asphalt-rubber pavements. Through recycling asphalt rubber pavements, TxDOT can realize potential economic, environmental and conservation benefits. Research Study 0-1333 is exploring the options available for recycling these pavements and the potential construction, environmental, and structural problems associated with the recycled materials.

Currently, this study is preparing to monitor an asphalt-rubber recycling project on Interstate 10 in the San Antonio District. The project is scheduled for the fall of 1993, with a report outlining the construction phase and quarterly monitoring reports to follow.

Area 2 — Technical Panel Chairman: Bobby Lindley, P.E., Abilene District
Researcher: Bill Crockford, TTI

SOCIAL, ECONOMIC, AND ENVIRONMENTAL EFFECTS OF ELEVATED AND DEPRESSED FREEWAYS ANALYZED IN STUDY

TxDOT is continually upgrading existing highway systems in urban and suburban areas. This upgrading involves improving highways or freeways on the existing route or on a new route paralleling the old route or bypassing the central city. The choice of grade level at a particular point may be an attempt to mitigate negative noise and esthetic impacts on a residential neighborhood. The main objective of Study 0-1327 is to determine the social, economic, and environmental effects of elevated and depressed freeways in urban and suburban areas.

This study will help TxDOT select affected environmentally sensitive urban freeway designs and help to maintain effective public relations with those directly and indirectly affected by the construction of elevated and depressed freeway improvements.

Some preliminary results are ready for field testing in residential, commercial, downtown, and suburban areas. The Office of Research and Technology Transfer encourages TxDOT employees to recommend possible testing sites. Study 0-1327 continues through August 1995.

TxDOT design and planning engineers can use the study results to prepare environmental statements and to document the expected social, economic, and environmental impacts of a proposed elevated or depressed freeway project. Transportation officials also could disseminate this information at public hearings on a proposed project.

Area 1 — Technical Panel Chairman: John Kelly, P.E., Dallas District
Researchers: Jesse Buffington and Jerry Bullin, TTI

HOUSTON DISTRICT TESTS AUTOMATIC EARLY INCIDENT DETECTION SYSTEM

In recent years, TxDOT has developed comprehensive traffic and incident control plans to manage traffic volumes on urban freeways. These efforts include several vehicle detection and closed circuit television systems. These systems monitor traffic conditions and operate signals, changeable message signs, and various motorist information systems.

The Houston District funded Study 7-1958, *Development and Implementation of an Automatic Vehicle Identification (AVI) System for the IH-10 (Katy), IH-45 (North), and US 290 (Northwest) Freeways and High Occupancy Vehicle (HOV) Lanes*, to test early incident detection abilities of new AVI equipment. Researchers have installed electronic tag vehicle identification equipment at several sites along the freeways mentioned in the study title. Study 7-1958 started in December 1992 and will end in August 1996.

The overall objective of this study is to develop an accurate, real-

time traffic monitoring system that identifies specific vehicles at close-interval detection stations along freeways and HOV lanes. The roadside AVI equipment reads tags and identifies vehicles. Computers monitor travel times between detection stations. If an identified vehicle fails to show up at the next detection station, the computer automatically warns traffic operations personnel that an incident may have occurred between detection station x and y. The traffic operations team confirms the incident by closed circuit television or by other surveillance methods and responds immediately according to the size of the incident.

Reliable, automatic early incident detection will improve traffic flow on the Houston freeways. Other urban districts will benefit from the experience the Houston District is gaining in Study 7-1958.

Area 3 — Technical Panel Chairman: Steve Levine, P.E., Houston District; Researcher: William McCasland, TTI

STUDY SURVEY SEEKS TO ASSESS MOTORIST AWARENESS OF TRAFFIC CONTROL DEVICES

Several national studies, among them a recent report by the Transportation Research Board Committee on Traffic Control Devices, have identified increasing problems in motorists' understanding of traffic control devices (TCDs). These problems may be due to:

- increasing driving complexity, especially in urban areas;
- increasing age of the driving population;
- increasing use of new and unfamiliar TCDs; or
- insufficient driver education.

Study 0-1261, *Assessment and Improvement of Motorist Understanding of Traffic Control Devices*, began in September 1990 and will

end in August 1994. By means of a detailed motorist survey, the study is determining the extent of difficulties encountered by drivers on Texas highways. Several interim reports are already available. The final report will make recommendations for improving motorists' understanding of TCDs. These recommendations will include new TCD standards, new materials for drivers' education, and/or suggestions for public awareness campaigns.

Area 3 — Technical Panel Chairman: Lewis Rhodes, P.E., Traffic Operations Division; Researchers: Jim Mounce and Katie Womack, TTI

NOVACHIP PAVING PROCESS STUDIED

Research Study 9-553, a 100 percent federally funded project, introduced TxDOT to NOVACHIP, a paving process developed in France and used throughout Europe. NOVACHIP is a coarse pavement consisting of hot-mix material laid over a heavy tack coat. The coarse aggregate thickness ranges from 3/8 to 3/4 of an inch. Potentially, this process can be used as an alternative to chip seals, microsurfacing, plant-mix seals, or thin overlays. This surface rehabilitation process primarily restores skid resistance and surface impermeability.

In October 1992, the French contractor for this process laid NOVACHIP in the San Antonio District around New Braunfels on US 281 and SH 46.

This study will report on the initial construction phase and on subsequent 6-month evaluations for the next 3 years. Recently, the researchers submitted a report that discusses the construction phase and the first 6-month evaluation.

Area 2 — Technical Panel Chairman: Greg Malatek, P.E., Office of Research and Technology Transfer; Researchers: Joe Button and Cindy Estakhri, TTI

UPDATED HYDROLOGIC TECHNIQUES FOR TEXAS

TxDOT uses regional regression equations to size approximately 90 percent of bridges and culverts on the highway system. The department based current regression equations on stream gage records collected through 1974. Right now, large areas of the Valley and Panhandle are undefined in terms of regression equations due to a lack of stream gage data. The statistical average standard error of prediction for the current equations range from 35 to 50 percent. Apparent extremes occur on the order of 300 percent or higher. The result can be structures that are severely undersized in terms of hydraulic capacity, or grossly oversized resulting in unnecessary construction costs.

Study 0-1301 (which started in September 1991 and will end in August 1996) is working with much new data now available from established stream gage sites. Researchers are establishing and operating additional stream gage stations in the previously undefined regions of the state. The updated regional regression equations will use statistical techniques that should show a significant

improvement in terms of standard error of prediction. The improved flood prediction equations will make use of Geographic Information System (GIS) digitized elevation, slope, drainage area, and other related data. Once TxDOT approves the statewide predictive equations for flood peak, volume, and hydrograph characteristics, researchers will develop a micro-

structures (resulting in economic and operational benefits), but also improved tools for use in evaluating scour potential for hydraulic structures.

The results of the research will immediately affect TxDOT procedures: the old regression equations will become obsolete and new methodologies will be adopted. TxDOT will test the results by

Researchers are establishing and operating additional stream gage stations in the previously undefined regions of the state.

computer program for use by TxDOT. This software will include enhanced climatic and topographic information within a GIS system for greater utility and ease of use in predicting flood characteristics.

Benefits of Study 0-1301 should include not only more accurately "sized" hydraulic

applying the new methodologies to several sites throughout the state and, with favorable results, will update the Hydraulics Manual to reflect the new procedures.

Area 4 — Technical Panel Chairman:
Peter Smith, P.E., Hydrology and Hydraulics Section, Design Division
Researcher: Marshall Jennings, USGS

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*The purpose of **Focus on Research** is to update engineers and technicians on items of interest in active upcoming projects. The contents of the various articles do not necessarily reflect the official views of the FHWA or TxDOT.*

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