Focus on Research

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

Study Enhances Nailed Wall Reliability

Nailed wall retention systems, which TxDOT has designed and constructed in both soil and rock, can potentially reduce excavation construction time and enhance the stability of the wall. However, because of a lack of effective design procedures, designs have been relatively conservative. Accordingly, TxDOT requires updated design procedures capable of producing walls that are less expensive and more reliable.

The overall objective of Study 0-1407, *Rock Nail Anchor Retaining Wall Design Criteria,* is to formulate a rational design procedure for nailed rock slopes and cuts that is integrally linked to materials used throughout Texas. In undertaking this objective, the researcher will:

- Examine the data to develop appropriate criteria for estimating nail forces and force-vs.-displacement relationships for design.
- Select appropriate case histories and determine appropriate values of parameters to use in the verification of design, basic rock descriptions, index properties, geometry of the wall and nails, and the property of nails.

Because it is currently not known how conservative or unsafe the designs for rock-nailed walls are, the design procedures to be developed through this research can permit more economical designs. Moreover, recommendations on specifications and construction details can be used to enhance wall constructability and long-term performance reliability.

Implementing the research findings can ultimately lead to changes in the *Design Manual* to include the improved designs. In addition, the study results can lead to increased use of retaining walls in urban areas, as well as to increased use of "top down" wall construction to reduce overall construction time. This project runs from September 1993 through August 1995.

Area 4 — Research Project Director (PD): George Odom, P.E., DES
Researcher: Dr. Priscilla Nelson, P.E., CTR

Need for Additional Toll Bridges Assessed

Project 7-1976, *Texas-Mexico Toll Bridge Study,* assesses the need for additional toll bridges along the Texas-Mexico border. The study will also determine the location and financial viability of these additional toll bridges (including their approach roadways).

The final products of the study will include reports, graphs, tables, statistical summaries, maps, and all other printed materials necessary to tabulate, explain, and present the study findings. All such findings will be integrated into a reliable origin-and-destination survey. The researchers will present conclusions regarding the need for, as well as location and financial viability of, additional toll bridges. The project runs from October 1992 through May 1994.

Area 1 — PD: Al Luedecke, P.E., TPP
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Texas Department of Transportation

Research and Technology Transfer Office, in cooperation with the FHWA

TTI Investigates Alternatives to Cutback Asphalt

Because of environmental concern, TxDOT has limited its use of cutback asphalt, a product whose volatility and hydrocarbon content will likely lead to its being outlawed in future regulations. Yet finding alternatives to cutback asphalt — principally used for prime coats — has proven difficult. Many products, including asphalt emulsion prime (AEP), are as volatile as cutback asphalt, and are thus incapable of resolving the long-term problem of environmental pollution.

Study 0-1334, *Improved Prime Coat Methods,* will identify practical prime coat applications that can replace cutback asphalt. Specific objectives include:

- Examining the importance of the bond between the base and various types of surface courses;
- Exploring materials and construction techniques that improve prime coat performance;
- Field testing and evaluating the various alternatives identified;
- Developing appropriate construction specifications and test procedures using criteria for quality assurance and control; and
- Suggesting material specifications for products that may be developed.

By using alternatives to cutback asphalt, the department can reduce the amount of potentially hazardous material released into the atmosphere. This research should also improve the durability of highways by identifying methods or materials that enhance the bonding between asphalt surfaces and flexible bases.

Should current construction techniques, which often specify cutbacks, be prohibited, the findings of this research could be implemented immediately. Benefits derived from this research include the following:

- Practical materials and techniques used for application of functional prime coats will be developed to replace the currently used cutback asphalt.
- Damage to prime coats caused by traffic and the elements, as normally experienced with emulsions, will be substantially reduced.
- Application processes for effective prime coats will be simplified.
- Cost-effective alternatives to asphalt cutbacks (and even emulsions) will be developed or identified.
- The consequent reduction in air and water pollution will reduce EPA pressures on TxDOT.

The department will need to construct several test sections across the state to effectively evaluate the short- and long-term performance of the asphalt cutback replacements. From the test section findings, the researchers can estimate the costs associated with the products' use and can prepare training manuals/videos for statewide implementation (if the desired results are achieved).

The project got underway in September 1992 and will end in August 1994.

Area 2 —
PD: Joe Higgins, P.E., ABL
Researchers:
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Project Seeks to Upgrade Intersection Design Program

The current Interactive Graphics Intersection Design System (IGIDS) features an upgrade path that makes it more efficient. Presently, researchers are developing computer software that will permit interactive graphical presentation of all important aspects of at-grade intersection design on a variety of computer hardware configurations. Enhanced compatibility of software components and design files among these hardware systems will provide engineers with greater flexibility and efficiency in intersection design and modification.

In Project 0-1308, *Interactive Graphics Intersection Design System,* the researchers will develop a user-friendly IGIDS that aids engineers in the analysis, design, and modification of at-grade intersections. The specific objectives of this study are to:

- Develop an integrated IGIDS capable of designing intersection traffic control. This IGIDS will provide selection, design, and placement of all intersection traffic control features, including official traffic control devices and signal timing.
- Develop, in close cooperation with Information Systems Division personnel, the IGIDS function of plan preparation through the Automated Plan Preparation (APP) system.
- Complete the implementation of previously selected IGIDS functions and incorporate additional features, as identified by the department.

The IGIDS, along with training for its use, will be available to district and division design personnel. It will also be integrated into Level III training courses. The project got underway in September 1991 and will continue through August 1994.

Area 3 —
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Researchers Investigate Effects of Cement on Reinforcements

In Study 0-1359, *Corrosion Effects of Cement-Stabilized Backfill on Galvanized Steel Reinforcements,* researchers are investigating the effects of cement stabilization on galvanized reinforcing steel to determine whether the addition of cement accelerates or inhibits the corrosion of reinforcement.

The objective of this study is to determine whether the corrosion of earth reinforcement is a significant problem in cement-stabilized fill. Questions regarding corrosion in existing reinforcement and in new construction will be addressed as well. Other study objectives include the following:

- Collect data on the effect of cement addition on corrosion rates of reinforcing strips in soil.
- Identify field conditions under which such corrosion is likely to be a problem.
- Determine reliable methods of identifying potential problem sites, preferably in a nondestructive mode.
- Identify and investigate realistic techniques for assessing the corrosion rates and conditions at particular sites.
- Identify potential treatment and remedial measures for existing problem sites.
- Identify measures that would permit the use of cement stabilization on new retaining walls, where desired.

An understanding of the basic corrosion problems and solutions is likely to have a major impact on current design practice, both at TxDOT and elsewhere, since cement stabilization has in some cases been widespread. Developing economical treatment techniques can save money that might otherwise be spent on elaborate remedial measures. If future preventative measures can be identified, then existing construction designs need not be compromised, since there are currently large retaining wall projects being built almost entirely with cement-stabilized backfill.

Laboratory testing at the Texas Transportation Institute of Texas A&M has been the primary data collection approach used in this research study. Using a process of elimination, the project researchers will determine the optimum blend of cement in the stabilization of the galvanized steel reinforcements. At the end of this study, supporting data for the use of crushed concrete in the backfill could probably be permitted, subject to any specifications similar to those used for cement-stabilized fill.

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The study findings should also affirm the prevailing practice of adopting backfill corrosivity specifications more expressly to address corrosion and its underlying causes, rather than adopting backfill resistivity as a general overall measure.

The project got underway in September 1992 and will conclude in August 1994.

Area 4 —
PD: Mark McClelland, P.E., DES
Researcher:
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Study Focuses on Implementation of Rubberized Asphalt

Although asphalt rubber is being used in hot mix, state DOTs have few guidelines or specifications available for the proper application, mix, and testing of this product. TxDOT needs such guidelines for the optimal implementation of rubberized pavements.

The objective of Study 0-1332, *Short-Term Guidelines To Improve Asphalt-Rubber Pavements,* is to optimize performance of asphalt concrete pavements with crumb rubber modifier (CRM) through the development of materials and construction specifications, mixture design and testing procedures, binder testing procedures, and quality control and construction guidelines.

Upon completion of this study, a final report documenting all research results will recommend specifications, test protocols, and guidelines. Study results are now ready for field testing.

The researcher requires experimental sites for evaluating the following: (1) effects of rubber on plant production, laydown, and compaction operations; (2) short-term pavement performance; (3) quality control; and (4) cost. Districts interested in providing sites should call Ms. Cindy Estakhri at (409) 845-9551.

The research team has developed a laboratory experiment plan. They have collected asphalt, aggregate, and rubber materials for fabrication of asphalt-concrete samples in the laboratory, with AAMAS now evaluating preliminary mixture designs. The project started in September 1992 and will terminate in August 1994.

Area 2 —
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Researcher:
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Guidelines Will Improve Accuracy of Traffic Data Collection

The effectiveness of the department's computerized traffic management system (CTMS) depends on information obtained from vehicle detectors. This information includes incident detection, ramp metering rate selection, wrong-way vehicle detection, and traffic-responsive pattern selection. Currently, TxDOT has no established guidelines for selecting optimal placement and installation methods for these detectors. For example, it is often either impossible or undesirable to place the detector units close to the detector loops, or to place the detector units in the same cabinet that houses the department's local control unit (LCU).

The objective of Project 0-1392, *Effective Detector Placement for Computerized Traffic Management,* is to conduct engineering design studies in accordance with on-going TxDOT traffic data collection and planning efforts to develop guidelines for the effective placement and installation of detectors. These guidelines will include:

- The most effective placement of trap and nontrap detector stations on the freeway and HOV lane;
- The most effective placement of detectors on entrance and exit ramps, including metered entrance ramps;
- The most effective distance between the two detectors of a trap pair of detectors;
- The most effective placement of system detectors for an arterial street control system;
- The most effective placement of system detectors for a frontage road control system;
- Detector response time needed for different applications;
- Number of turns of the wire in the loop for different cable lead lengths and required response times;
- Different types of lead-in cables and their effect on response time and cable lead lengths; and
- Effective distance from detector unit to local control unit.

The project, which runs from September 1993 through August 1994, will significantly improve the accuracy and reliability of the department's computerized traffic data collection operations.

Area 3 —
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Border Truck Traffic Impacts Studied

Study 0-1317, *Impact of a U.S.-Mexico Free Trade Agreement on Texas Highways,* is examining how NAFTA-generated traffic will impact the Texas highway system. The study will provide TxDOT with an accurate accounting of costs related to the maintenance and future expansion of existing road systems. In addition, the study will estimate revenue the state receives from transportation fees and gasoline taxes.

Using data gathered from TxDOT weigh-in-motion (WIM) sites in Laredo and El Paso, the researchers will forecast truck traffic. They will also predict highway costs based on the relationship between the volume of U.S.-Mexico trade and truck traffic. Finally, the project team will provide informed assumptions about the weight and condition of the Mexican truck fleet.

TxDOT can use the study results to plan accurately for future roadway construction projects and to estimate their associated costs. The study runs from September 1992 to August 1994.

Area 1 —
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Focus on Research

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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