TECHNICAL QUARTERLY

"AN EXCHANGE OF IDEAS"

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METCON: TXDOT METRIC CONVERSION UTILITY

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THE METRIC CONVERSION TASK

As the deadline for compliance with the federal metrication mandate approaches, the Texas Department of Transportation (TxDOT) must convert an enormous number of standard drawings for use in highway projects. Also, TxDOT personnel must convert some existing projects incorporating English units into metric units. The task might overwhelm TxDOT designers and engineering design technicians if no assistance or tools were available.

The Engineering Development Section of the Information Systems Division has responded to the need by developing an application to convert existing English annotation to metric in department maintained or created MicroStation graphic files. The new application saves design technicians the drudgery of visually perusing graphics files for values that require conversion and individually performing the necessary calculations (Fig. 1). The application, named METCON, combines speed with a friendly graphical user interface. METCON is an MDL (MicroStation Development Language) application that runs within the context of a MicroStation work session. It works on any IBM/clone PC or Hewlett-Packard workstation that has MicroStation installed.

CAD technicians or computer operators are this article's intended audience. Please pass this information on to any CAD technician you know who does not regularly receive the ***Technical Quarterly***.

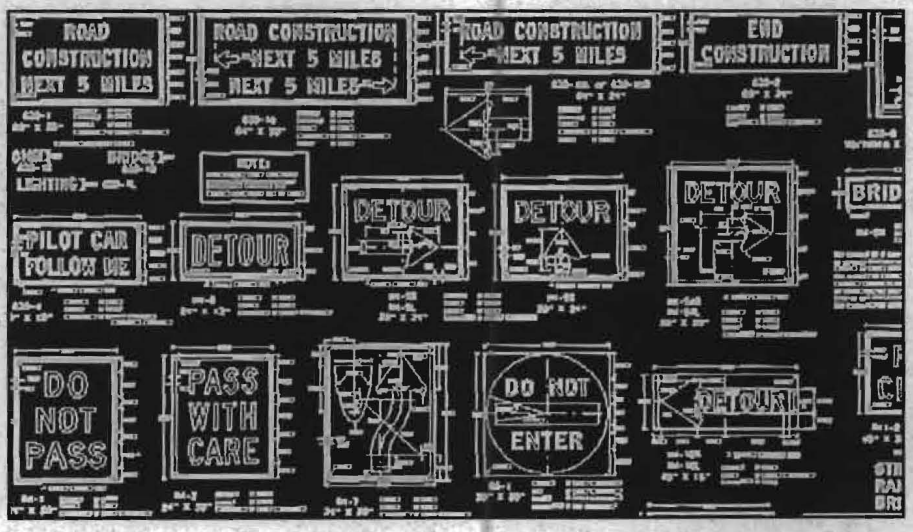

FIG. 1: A portion of a standard sign sheet created in MicroStation requiring conversion to metric. Each sign has many values (represented here by gray blocks) associated with it.

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METCON CAN HELP

METCON does not solve all your metrication tasks, but it does take the pain out of converting dimension text and other values on existing drawings. You view the drawing using MicroStation, select the value or values that require conversion (Fig. 2), and let METCON do the rest. Not only does METCON reduce completion time, it also reduces the possibility of errors as well.

WHAT METCON DOES

Once you have selected text on the drawing for conversion, METCON converts it to metric form if the English annotation conforms to one of five predefined formats (Table 1).

TABLE 1: METCON's five predefined formats.

FORMAT	EXAMPLE
FF'-II x/y"	15'-10 3/4"
II x/y"	0 3/4"
x/y"	3/4"
FF.ddd'	5.896'
FF'	15'

LEGEND
FF — value in feet
II — value in inches
x/y — fraction notation
ddd — decimal fraction

A value matching one of the formats can even be embedded within a line of text. For example, the description:

"The 2'-6 3/4" diameter pipe"

could be converted to:

"The 781 mm diameter pipe."

Of course, you don't want to create accuracy greater than your original values. Refer to TxDOT's ***Metric Guide*** for details on correct conversion.

The newly created text for the metric values can either replace the English text or exist together with the English text. The two lines of text can occupy the same area on the drawing so that you can display or hide either level to create an English or a metric drawing from the same graphics file.

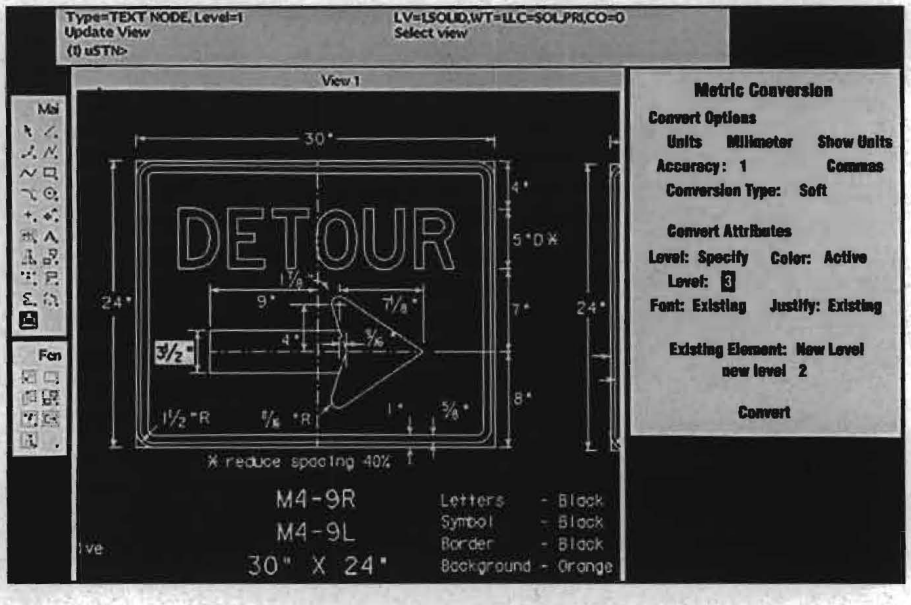

FIG. 2: Selecting values for conversion.

STANDARDS FOR FLEXIBLE VIEWING

Since METCON can control the graphic attributes of the new metric text and even alter graphic attributes of the original English text, it is possible to incorporate statewide conventions for graphic attributes of English and metric text. The proposed standard is to assign graphic level 2 to English values and graphic level 3 to metric values. The base drawing would remain on any other graphic level or levels. If TxDOT adopts statewide conventions, people reviewing files they had not created will not have to hunt for the unit system they need, since they can turn on or off the visibility for all text associated with a specified unit system using graphic level as a key.

HOW METCON WORKS

When you activate METCON, the screen displays a single dialog box that comprises METCON's graphical user interface (GUI). The GUI (Fig. 3) allows much flexibility by letting you apply your own preferences to the output results. The dialog box items are divided into three groups: *Convert Options, Convert Attributes,* and *Existing Text Disposition.* The dialog box items are described here by group:

Convert Options

All parameters that control the conversion and appearance of the numeric value itself are grouped as "Convert Options."

- **Units** [Option Button] options are:
  - Meter
  - Millimeter
- **Show unit** [Toggle Button] states are:
  - In — unit annotation "m" or "mm" will appear in text
  - Out — unit annotation will not appear in text
- **Accuracy** [Option Button] options are:
  - 0.001 (3 decimal places)
  - 0.01 (2 decimal places)
  - 0.1 (1 decimal place)
  - 1 (No decimal places)
  - 10 (Round to nearest 10)
  - 100 (Round to nearest 100)
  - 1000 (Round to nearest 1000)

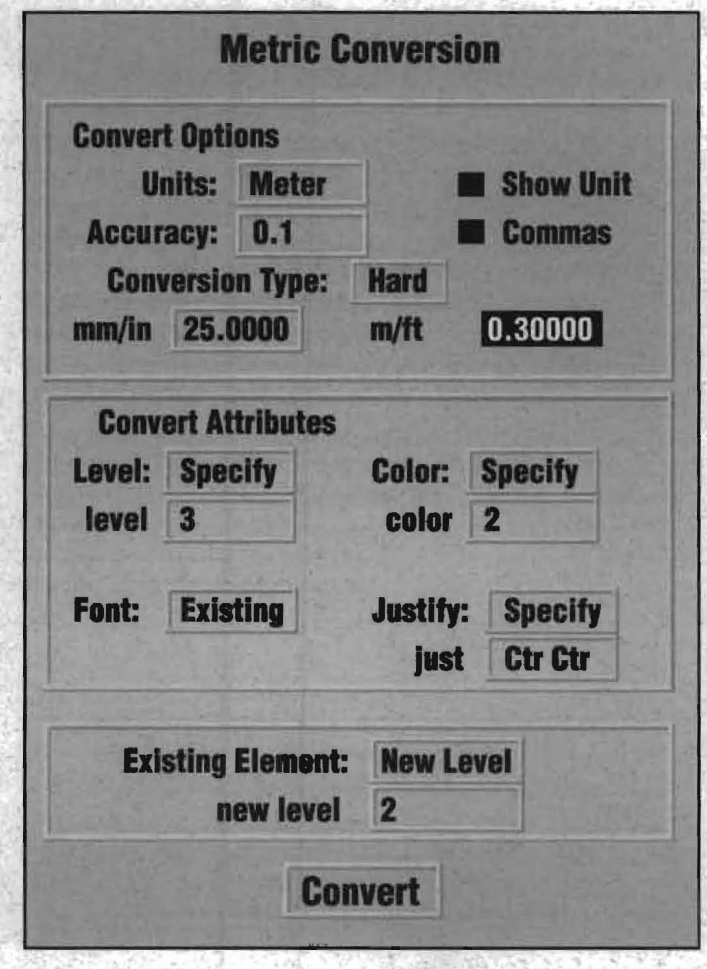

FIG. 3: Close-up of the METCON dialog box.

- **Commas** [Toggle Button] states are:
  - In — comma will separate groups of three digits
  - Out — no commas will appear in text
- **Conversion Type** [Option Button] options are:
  - Soft — use predefined conversion factors
  - Hard — use user-defined conversion factors
- **mm/in** [Text Item] visible only for "hard" conversion type (millimeters-to-inches hard conversion factor)
- **m/ft** [Text Item] visible only for "hard" conversion type (meters-to-feet hard conversion factor)

Convert Attributes

All parameters that control the MicroStation graphic attribute values of the new metric text are grouped as "Convert Attributes." The option buttons for Level, Color, Font, and Justify all have the same three options:

- **Existing** — keep the attribute value of the English text
- **Active** — use the active MicroStation attribute value
- **Specify** — use user-defined attribute value

Existing Element

This group contains items dealing with the disposition of the original English text.

The Existing Element [Option Button] has these choices:

- **No change** — do nothing to the original text
- **New level** — move the existing text to a specified level
- **Delete** — delete the existing text

FUTURE ENHANCEMENTS

Currently, METCON performs conversion on values as you select them one at a time. One requested feature is to allow values within a defined fence to be converted all at once.

AVAILABILITY

The Information Systems Division will distribute the METCON utility to automation administrators of all districts and divisions with MicroStation capabilities. Contact your local automation administrator to get a copy loaded on your PC or HP workstation.

NEW CONTRACT TIME DETERMINATION SYSTEM (CTDS) IS NOW MANDATORY FOR ALL CONSTRUCTION PROJECTS

by **Kelly West**
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BACKGROUND

A 1991 Federal Highway Administration (FHWA) mandate calls for all state departments of transportation to have a formal method of establishing contract completion time for federally funded highway construction projects. In the past, Texas Department of Transportation (TxDOT) districts have relied, as have most states, on the experience of their senior engineers to set contract duration, with most of the scheduling based on simple prediction techniques, standard production rate bar charts, and rules of thumb. However, more sophisticated, computerized methods exist. If a project is not completed on time, the contractor can use critical path programs to show what they believe to be an unreasonable time estimate or to suggest that TxDOT contributed to a major delay. Thus TxDOT schedulers must now formally document how they logically and reasonably calculate time for individual construction contracts.

THE NEW CONTRACT DETERMINATION SYSTEM (CTDS)

To meet the FHWA requirements, TxDOT Administrative Circular 17-93 makes mandatory the use of a new Contract Time Determination System (CTDS) for all projects let since December 1993. CTDS produces a worksheet (with both manual and computerized versions) that shows a rational procedure for determining contract duration and project completion dates. Before going to contract, all projects must have a CTDS worksheet turned in to the Design Division for review [Ref. 1].

Because construction contractors must produce *detailed* schedules that encompass many specific work activities and can vary according to job and contractor, TxDOT needs only to establish a reasonable time to allow for the contract. Therefore, Texas Transportation Institute (TTI) researchers Donn Hancher, Frank McFarland, and Rifat Alabay, who developed the new CTDS under Study 0-1262, worked toward a *conceptual* system, rather than a detailed job schedule [Ref. 2].

Development of the System

Researchers first had to select a project classification system. Classification places the construction contract into a highway project category. For example, are you widening a freeway, replacing a bridge, or simply laying a seal coat? For departmental ease of use, the researchers modified TxDOT's design project management system. This system allows fourteen categories of highway projects. The miscellaneous category was eliminated for the CTDS, giving it a total of thirteen project categories.

An important part of the programming involved relating major work items in a category to each other correctly. For example, if a freeway is being widened, one of the major work items will be the right-of-way preparation, which will involve such activities as clearing the site, removing old pavement, excavating the earth, excavating the rock, and embankment. Each one of these activities must be complete or partially complete before other work items can be started, so for each work activity, researchers assigned a percentage of the preceding activity that must be finished before beginning the next step. For instance, in the category "Widen Freeway," a detour set-up must be 100 percent complete before right-of-way preparation can begin.

To calculate base production rates for each major work item in the CTDS, the study team used production rate data collected from the TxDOT districts. Production rates for construction are difficult to standardize. Because of the many varying environmental conditions that can effect a construction project, every work item in the contract can have a wide variation of possible work times. Therefore, this system allows districts to substitute their own data for the standard rates or to use project-specific adjustments. For this conceptual CTDS, these adjustments are based on five common work condition factors that affect most construction projects — location, traffic conditions, complexity, soil conditions, and quantity of work. The user can also modify the condition factors if the defaults do not seem appropriate for a specific job item that needs adjustment.

Researchers selected the basic scheduling technique by asking, "Which is better — a table or curve based on time versus cost, a bar chart with or without production rates, the more sophisticated and detailed critical path method, or simply the judgment of senior personnel?" After the research team analyzed district and DOT questionnaire data, they selected bar charts because TxDOT engineers are familiar with this format and training would be faster and easier.

Finally, for the computerized system, Design Division has adjusted the system so that it operates on any PC with Lotus 1-2-3, version 2 or 3.

Using the Basic Conceptual Scheduling Procedure (CTDS)

The procedures are the same for manual and computer systems except for steps five and six. Figure 1 shows the basic steps. Schedulers must first examine any available information about the specific project, such as design drawings, specifica-

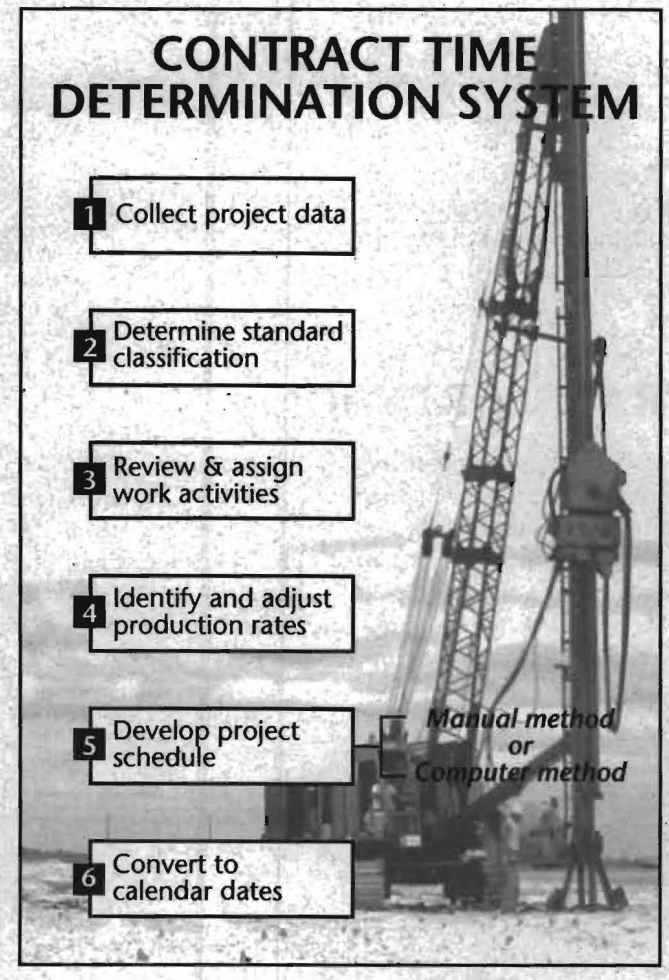


FIG.1 : The steps of CTDS.

tions, quantity take-offs, construction site conditions, etc. This step is important because details and special conditions might effect the overall project duration.

Following the second step — selection of a project classification from TxDOT's already established thirteen highway project categories — the scheduler will have a standard schedule with pre-established work activities and production rates. He or she must then determine if there are any work activities that need to be added or removed for the particular project. If special activities are added, the scheduler must include appropriate sequencing relationships and overlap information. If the project requires phasing, work activities should be identified for each phase of the project and the phases linked sequentially as they are to be built in the field.

The last step before the actual scheduling is to check the standard production rates for the work activities. Here the scheduler must draw from experience in deciding whether or not the rates are realistic for the particular project being estimated. If the scheduler is not satisfied with any of the standard production rates, he or she may substitute preferred rates or use the five correction factors.

The last two steps of the basic procedure — developing the project schedule and converting to calendar dates — can be done manually or with the computer system developed. TTI research report 1262-1F contains detailed instructions and documentation of both the manual and computerized process. The computerized system should be more convenient for most projects.

Having obtained an estimate for the total project duration, the scheduler should check the number of working days assigned to see if the total appears reasonable. Depending on the project conditions and constraints, it might be feasible to reduce or add more time to allow for contingencies. With a particularly large project, the scheduler should break it into phases, should do a separate worksheet for each phase, and should consult experienced personnel to make sure the total time estimate is feasible. If the time allowed appears short, this should be noted, checked, and emphasized in the bid documents before going out for bids, so the bidders can plan accordingly.

Once the final schedule has been determined, a bar chart or CPM diagram will be produced for the project files and for use by the project management team. Contractors should not be given the conceptual schedule, since it is only for setting a feasible contract time, but should be required to submit their own detailed construction schedule for the project.

IMPLEMENTATION OF THE AUTOMATED CTDS

Design Division (DES) has trained twenty requesting districts in the manual use of the new CTDS. On March 9, 1994, DES sent the automated procedure, requiring only a PC and Lotus 1-2-3, to all districts. According to Dr. Khali Persad, P.E., Design Engineer and Research Project Director in charge of training, response from the districts has been positive.

Running the computerized version will be self-explanatory and should not require further training of a scheduler familiar with Lotus and the manual CTDS. The user has only to identify project conditions and input project classification; the program gives the list of default work items. Then, after inputting the work quantities for each item, Lotus automatically calculates the production

rates, the duration of each work item, and the total contract duration. If the scheduler is not fully satisfied with the final numbers on the work sheet, he or she can customize the project duration by changing the default production rates. Finally, Lotus will automatically draw up the bar chart.

Design Division will continue to monitor the success of the automated CTDS. Users are encouraged to offer suggestions for improvement and general comments so that revisions and adjustments can continue to upgrade the quality of TxDOT's contract time determination system. Address your comments and questions to Dr. Khali Persad, P.E., Design Engineer in the Design Division (512) 416-2597.

REFERENCES

1. Dr. Khali Persad, P.E. Texas Department of Transportation, Design Division. Telephone Interview. March 30, 1994.

2. Donn E. Hancher, William F. McFarland, and Rifat T. Alabay. ***Construction Contract Time Determination,*** TTI Research Report 1262-1F. Texas Transportation Institute: The Texas A&M University System, November 1992.

CLIENT TRANSPORTATION

by **Tina Janek,** Director
Office of Client Transportation
Health & Human Services Commission

Ask anyone in rural Texas what the greatest human service need is and they are likely to reply in one word: transportation.

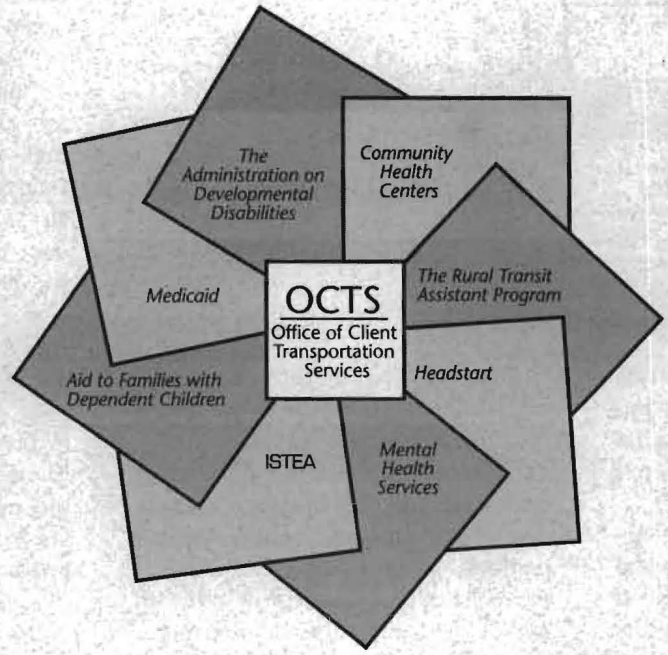
Where population is sparse and public transit limited, a visit to a doctor or a food stamp renewal can pose major problems. Big cities can be just as daunting for those who are elderly or have disabilities.

That was the why the Legislature in 1991 created the Office of Client Transportation Services in the Governor's Office. Staff came on board and the Office started to operate in October, 1992, and in 1993, the office was moved to the Health and Human Services Commission.

The office, headed by Tina Janek, is well underway in preparing a statewide plan to coordinate the many transportation programs that help Texans get the health care and other services they need.

There are a number of federal programs which fund transportation for the needy. The federal Intermodal Surface Transportation Efficiency Act (ISTEA) provides capital funds to private, nonprofit organizations who transport the elderly and persons with disabilities. The Rural Transit Assistance Program, funded through ISTEA, provides training, technical assistance and support for nonurban transit. The act also provides planning funds, training funds and capital funds for bus purchase and replacement.

A number of other federal programs either provide transportation



or reimburse clients. Head Start, Medicaid, the Administration on Aging, the Administration on Developmental Disabilities, Aid to Families with Dependent Children, Community Health Centers and block grants for community services and alcohol, drug abuse and mental health services are on this list.

Because of its size, Texas is a big participant in all these grant programs, but until now, there has been neither a real assessment of all the needs nor coordination among the many programs.

The Health and Human Services Commission created the agency Transportation Coordinating Council to accomplish this. The Council has members from major health and human service agencies as well as the Texas Department of Transportation.

"Our first step is to compile information on the programs we now operate," Janek said. "And one of the problems we're addressing is that agencies collect data in different ways.

The Council has committees looking at the legislative mandates on client transportation. They include:

- collecting data on client transportation needs, services and expenditures
- creating a statewide coordination plan
- establishing standards of reporting and accounting

Meanwhile, the Office of Client Transportation Office is looking at new ways to pull in more federal dollars and stretch existing resources, perhaps by pooling resources to purchase equipment and insurance.

"We been very fortunate to have the close cooperation of the Texas Department of Transportation," Janek said. "They're very interested in providing better services to those who need them."

The office plans to have a draft state plan prepared in the fall and a complete report for the 74th Legislature.

THE TEXAS QUALITY INITIATIVE: TEXAS TRANSPORTATION INDUSTRY'S PRIDE AND CONTINUOUS CHALLENGE

by **Annie Dadian-Williams**, P.E.
Partnering Section
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Texas Department of Transportation

BACKGROUND

We have to work together to build a better world — this idea has been growing in the national consciousness over the last five years. In the transportation industry, a group of public and private entities formulated the idea of "partnerships in quality" and created a National Quality Initiative (NQI). In 1991, the American Association of State Highway and Transportation Officials (AASHTO) formed a National Quality Initiative Steering Committee. Membership included the Federal Highway Administration (FHWA), and six industry organizations:

- American Road and Transportation Builders Association (ARTBA)
- Associated General Contractors of America (AGC)
- American Concrete Pavement Association (ACPA)
- National Asphalt Pavement Association (NAPA)
- American Consulting Engineers Council (ACEC) National Ready Mixed Concrete Association (NRMCA).

In 1993, the American Public Works Association (APWA) joined the NQI Steering Committee.

National Objectives

The objective of promoting a national initiative is to foster cooperation among all individuals in constructing and maintaining transportation infrastructure.

The mission of the Steering Committee is to solidify this partnership and the commitment to quality through policy development, training, and technical support. The first four items on the agenda included:

1) the drafting of a "National Policy on the Quality of Highways;"
2) the sponsoring of a one-day "National Quality Seminar" for top management in the transportation industry;
3) supporting a series of four regional seminars on quality; and
4) conducting a series of technical support activities.

The document, "National Policy on the Quality of Highways," was drafted jointly by the members of the National Quality Initiative Steering Committee for the purpose of establishing a partnership among highway stakeholders in the public and private sectors. The policy document calls for a commitment to quality products, information, and services through the cooperative efforts of transportation professionals in the areas of product construction and maintenance; research and technology; flexibility and responsibility; assurances; incentives; and quality management systems. On November 10, 1992, at the National Quality Seminar, "Partnership for Quality," this document was signed by representatives of the original eight organizations involved in its creation. In addition to the signing of this document, this event was the official launching of the "partnership in quality" philosophy in the highway community.

To ensure that the industry carries on with this initiative nationally, The National Quality Initiative Steering Committee's goal was that a committee also be formed in each state to work toward holding state-level seminars, promote continuous quality improvement, and carry on the effort to promote meaningful and measurable improvement in quality.

TEXAS' EFFORTS

The Texas Quality Initiative Steering Committee has been formed with members representing the Texas Department of Transportation (TXDOT), Federal Highway Administration (FHWA), Associated General Contractors of America (AGC), Texas Hot Mix Asphalt Pavement Association (THMAPA), Texas Aggregates and Concrete Association (TACA), Texas Chapter: American Concrete Pavement Association (TACPA), Consulting Engineers Council of Texas (CEC), Texas Public Works Association (TPWA), Center for Transportation Research (CTR), and Texas Transportation Institute (TTI).

The Texas Quality Initiative Steering Committee is fortunate to have the following members:

- B. F. (Bob) Templeton (TxDOT)
- William C. Jones (FHWA)
- John R. Weisman (AGC)
- Charles W. Smoot (THMAPA)
- Bob R. Beard (TACA)
- John D. Roberts (TACPA)
- Ken King (CEC)
- Larry D. Hertel (TPWA)
- B. Frank McCullough (CTR)
- Herbert H. Richardson (TTI)

In addition, Annie S. Dadian-Williams (TxDOT) and Pat O'Neil (FHWA) serve as support for this committee. The members of this committee have established a firm partnership dedicated to fulfilling the goals of the National Steering Committee. Together they developed a mission, scope and theme.

Mission

The Texas Quality (TQI) Steering Committee's Mission is to challenge the Texas Transportation industry to a stronger commitment to internal and external customer satisfaction

through: promotion of the partnering concept, mutual trust, continuous quality improvement, sensitivity to the environment, encouragement of innovation and value engineering, and joint ownership of the quality initiative, while optimizing resources and services.

Scope

To involve transportation industry & user participants that contribute to the conception, design and construction of transportation facilities, and to provide proper direction necessary to assure fulfillment of the mission.

Theme

Quality: The Texas Transportation Industry Pride and Continuous Challenge.

The first goal of the Texas Quality Initiative Steering Committee is to hold statewide conferences in Texas. These seminars will educate and promote quality within Texas.

TABLE 1: Information on "Quality Initiative" seminars.

DATE	CITY	HOTEL
January 3-4	San Antonio	Wyndham
January 17-18	Houston	Houston Medallion
January 24-25	Odessa	Holiday Inn
January 31/ February 1	Dallas	Doubletree

The topic of quality is not new to the highway industry. The Texas transportation industry has always been committed to delivering highway products which reflect quality in materials, design, construction and maintenance. The commitment to "Quality" is ongoing. There is always room for improvement. "Quality is a journey, not a destination"

The Texas Quality Initiative Conferences will be held in 1995 at the locations shown in Table 1.

The Texas Quality Steering Committee takes great pride in the sponsorship of these conferences and is firmly committed to continuous quality improvement in Texas as a united highway industry.

REFERENCE

U. S. Department of Transportation, Federal Highway Administration. ***Quality Improvement Resource Guide.*** Publication No. FHWA-SA-94-002, October 1993.

PUBLIC CONCERNS AND FACTS ABOUT TRAFFIC SAFETY ALONG THE TEXAS/MEXICO BORDER REGION

by **Rafael F. Pezo,** Ph.D.
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ABSTRACT

With NAFTA, trade will increase between the United States and Mexico. This increase in commerce will lead to an increase in traffic that could create problems in terms of highway safety, especially along the Texas/Mexico border. The highway system already transports 70 percent of Texas/Mexico freight. Maintaining a high level of safety is of great concern because traffic-related accidents bring consequences (i.e., fatalities, injuries, congestion, insurance rate increases) that are major public problems with economic, social and political implications. To put into perspective the present driving conditions of the border and to identify the areas that need attention and improvement, the Texas Department of Transportation contracted with the Center for Geotechnical and Highway Materials Research of the University of Texas at El Paso to survey the border population. The research team prepared a questionnaire to determine the public's main concerns about traffic safety and distributed it throughout the Texas/Mexico border region. The team received a total of 724 responses. They drew conclusions from these responses and also reviewed and compared accident data from the different border communities of Texas. The majority of respondents feel that the present driving conditions along the border region are average. However, the results also indicate that concerns over the likelihood of colliding with a truck or colliding with an insured motorist in some border areas are justifiable.

CHARACTERISTICS OF POPULATION SURVEYED

Figure 1 is the English version of the traffic safety questionnaire. Researchers distributed both English and Spanish versions along the border region in shopping malls, ports of entry, university campuses, parks, and truck stops.

The population surveyed represented a wide variety of people with different backgrounds, ages, genders, nationalities and geographic localities within the border region. Out of the 724 responses, 51.5 percent were from the El Paso/Cd. Juarez area, 2.2 percent came from the Del Rio/Cd. Acuña/Eagle Pass/Piedras Negras areas, and 46.3 percent were from the Rio Grande Valley areas.

In regard to their language proficiency, 53.1 percent claimed to be bilingual, 26.9 percent claimed to understand only English, and 20.0

percent claimed to understand only Spanish. Additionally, 35.1 percent claimed to be directly involved in the trucking industry, while 64.9 percent were not. Texas licensees comprised 52.9 percent of those surveyed, 29.0 percent were Mexican licensees and 10.6 percent had a U.S. license from states other than Texas. The remaining 7.5 percent of those surveyed had no drivers' license.

FINDINGS FROM QUESTIONNAIRE

Researchers entered the responses into a database using SAS, the Statistical Analysis Software [Ref. 4] using unique binary code to identify each response. They also used SAS to analyze the database. In general, the analysis consisted of tabulating the responses and comparing them based on the different characteristics of the population surveyed.

The majority was pro–NAFTA. Bilinguals and those who only understand Spanish were much more in favor of NAFTA than those who only understand English. Those in the trucking industry were more skeptical about NAFTA than those individuals not in the trucking industry.

In regard to public concerns, researchers made several interesting findings. The majority felt that the present driving conditions along the border region are average (56 percent). Only 5.7 percent felt that conditions are safe.

When driving in their own country, drivers with a Texas license were strongly concerned about foreign drivers, their insurance and driving habits, and the condition of foreign-owned vehicles. Mexican drivers in Mexico were concerned about foreign drivers' knowledge of local signage and laws. When driving in a foreign country, law enforcement was, by far, the main concern of drivers with a Texas license and/or those involved in the trucking industry; whereas safety standards and signage were the main concerns of those with a Mexican license. When driving in a foreign country, the majority would like to receive a set of regulations and guidelines for driving in that foreign country. Drivers with a Mexican license, in particular, were receptive to this suggestion.

ASSESSING TRAFFIC SAFETY ALONG THE BORDER REGION

As a means of assessing the present conditions of traffic safety along the border region, researchers examined Texas border communities' accident statistics such as traffic-related accidents, fatalities, and injuries. Specifically, researchers made the following reviews and comparisons:

- Review of the accident rates of the southern counties of Texas.
- Review of accident statistics of the four major border cities (Brownsville, McAllen, Laredo, and El Paso) of Texas.
- Comparison of characteristics of drivers involved in accidents at

FIGURE 1: English version questionnaire.

UTEP PROJECT 1984 SURVEY — Taken By: ____ Date: ____

№ 1017

1. Sex: Male ____ Female ____

2. Age: ____ ____ ____ ____ ____ ____ ____
   15-19 20-29 30-39 40-49 50-59 60-69 70+

3. Level of education:
   Grade School ____ High School ____ College ____ Other ____

4. Do you understand: English ____ Spanish ____ Both ____

5. Are you in the trucking industry? Yes ____ No ____
   If so, are you? Management ____ Labor ____
   Where is your work base? ____

6. In what state was your drivers license issued? ____

7. In what area do you do most of your driving?
   Border Region ____ Mexican Interior ____
   U.S. Interior ____ All of the above ____

8. Which of the following best describes present driving conditions along the border region?
   Safe ____ Average ____ Dangerous ____

9. Are you pro NAFTA (North American Free Trade Agreement)?
   Yes ____ No ____
   Yes, but with certain reservations ____ Undecided ____

10. Once NAFTA is implemented what concerns you most about driving in YOUR country?

	Concerned	Undecided	Don't Care
A. Foreign drivers (Insurance, driving habits)	____	____	____
B. License requirements for foreign drivers	____	____	____
C. Foreign drivers knowledge of local signage and laws	____	____	____
D. Condition of foreign owned vehicles	____	____	____
E. Excessive weight of commercial vehicles	____	____	____

   F. Other; specify ____
   From the above choices (A-F), what concerns you most? ____

11. Once NAFTA is implemented what concerns you most about driving in a FOREIGN country?

	Concerned	Undecided	Don't Care
A. Local drivers (Insurance, driving habits)	____	____	____
B. Safety standards (road conditions, emergency lanes)	____	____	____
C. Signage (reflectivity, condition, lack of, location)	____	____	____
D. Law enforcement	____	____	____
E. Travel Accommodations (rest areas, parking, motels)	____	____	____

   F. Other; specify ____
   From the above choices (A-F), what concerns you most? ____

12. When entering a foreign country would you like to receive a set of regulations and guidelines for driving in that foreign country?
   Yes No Don't Care

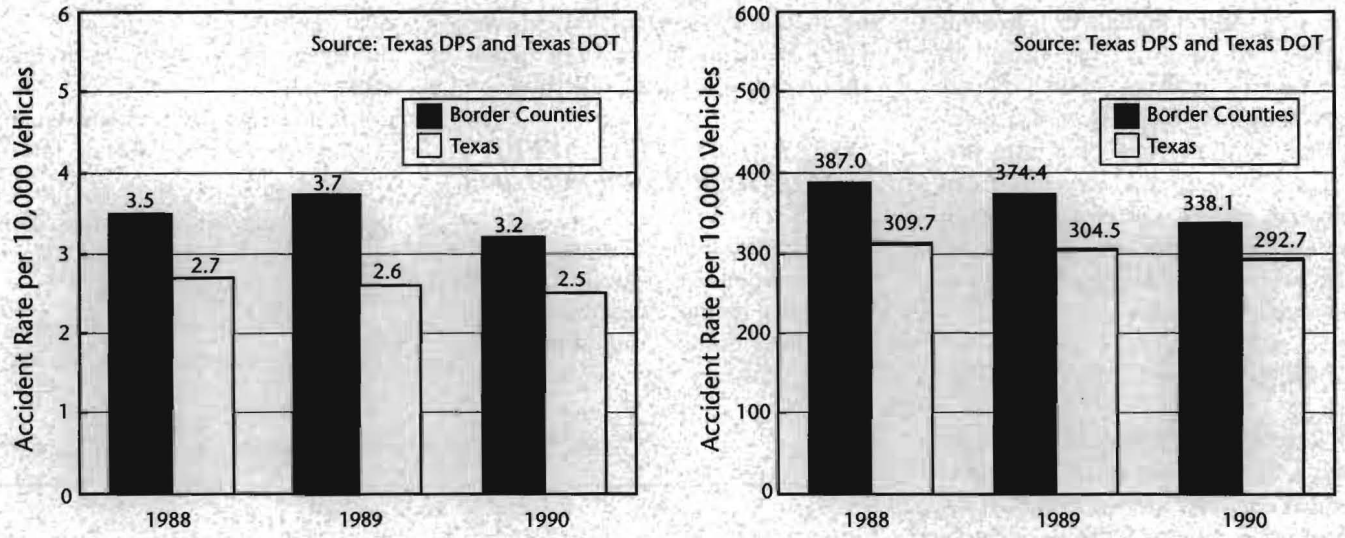

FIG. 2: Comparison of accident rates of the border counties with those of the entire state of Texas for the years 1988, 1989, and 1990.

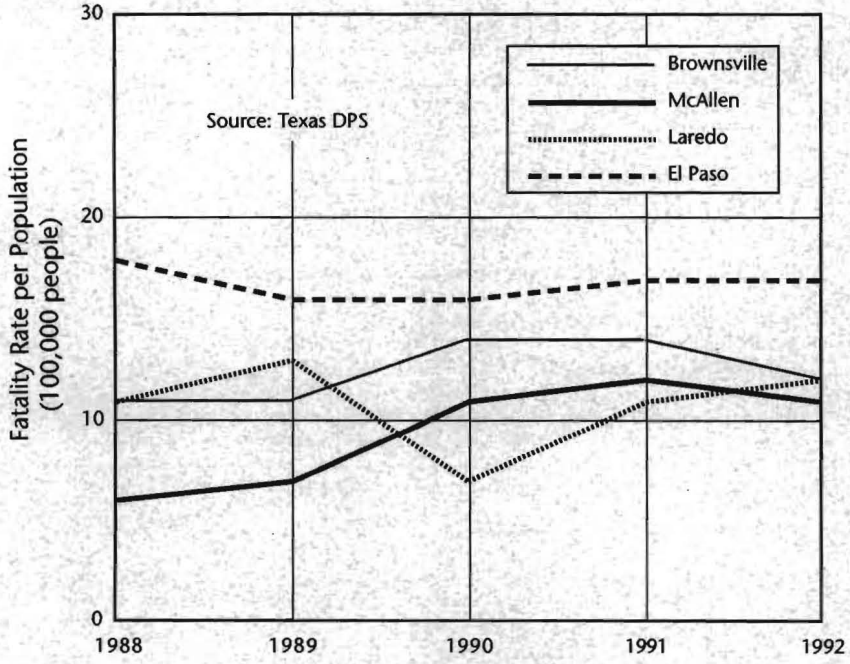

FIG. 3: Comparison of fatality rate per population for the cities of Brownsville, McAllen, Laredo and El Paso for 1988, 1989, 1990, 1991 and 1992.

two highway sections; one on the Texas border and the other in the interior of Texas.

Data Collection

The annual reports of the Texas DPS for the years 1988 through 1992 yielded the necessary Texas accident records [Ref. 5]. The researchers also reviewed and compared accident records of the 14 southern border counties of Texas with statewide records. TxDOT's Ken Carey and Jim Taylor provided the number of registered vehicles for the southern border counties of Texas and driver characteristics. The researchers obtained population figures for the U.S. from the Bureau of the Census.

Accident Rates and Statistics

The review of accident records turned up several important findings. The border counties of Texas had higher accident and fatality rates per 10,000 registered vehicles than the entire state of Texas. Figure 2 data shows that the Texas border has more traffic-safety related problems than any other region in the state. In 1990 border counties had an accident rate of 338.1, while the whole state had 292.7. In 1989 border counties had a fatality rate of 3.7, while the whole state had only 2.6 (which is similar to the U.S. rate of 2.6). This clearly puts into perspective the conditions at the border region as compared to the entire state of Texas.

Figure 3 presents the trends of the fatality rates per population of these cities. These figures indicate that El Paso has the lowest level of traffic safety of the four major border cities of Texas.

ACCIDENT RECORDS OF TWO SELECTED SECTIONS OF IH-35

Researchers performed a case study in an attempt to compare in-depth the characteristics of vehicles and drivers involved in traffic-related accidents occurring at the border region and in the interior of Texas. For

Continued on page 19...

GETTING THE LEAD OUT: STUDY 1315 SAVES MONEY AND THE ENVIRONMENT

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THE PROBLEM

Lead-based paints have been used on structural steel buildings and bridges for many years because of their effectiveness against corrosion and because they require little surface preparation before application. However, with time, even lead-based paint deteriorates and must be removed before repainting. Ten coats or more of paint are not uncommon on structures built in the 30s and 40s (Fig. 1). The records don't always indicate what type of paint was used for each coat.

The most common method of removal is by abrasive blasting. Some advantages of abrasive blasting are that it is efficient, cost-effective and provides a clean, roughened surface for the new coating application. Unfortunately, blasting produces byproducts that may contain contaminants such as lead, chromium, and cadmium from the old paint system.

These heavy metals pose environmental concerns both during sandblasting and afterward when disposed in a landfill. Vegetation, animals, and humans can assimilate abrasive blasting byproducts with serious results. Lead and other contaminants in blast waste that are put into a landfill can leach into the ground water, be taken up by plants and passed on to anything that eats the plants. These contaminants also can be absorbed directly by breathing the particles or eating or drinking something the particles have landed on.

Once in the body, all inorganic forms of lead tend to act in a similar manner, and can damage the blood, brain, kidneys, liver, and reproductive organs. Lead can cause anemia, coma, mental retardation, birth defects, and even death. These serious health problems have triggered recent environmental regulations concerning abrasive blasting of lead-based paints, along with the disposal of the blasting by-products. On a different front, landfill space, even for nonhazardous industrial byproducts, is limited by the LandBan Act of 1990 [Ref. 1].

The Texas Department of Transportation (TxDOT) needed a way to stabilize spent bridge blast material so that it passed the Environmental Protection Agency (EPA)'s toxicity leaching criteria and, at the same time, to make a usable product out of the same material without moving the spent blast material from the construction site. Joe Raska, P.E., TxDOT's research project director at the start of this study, invited the Texas Water Commission, the Department of Health and the Air Control Board to have representatives on the technical advisory panel for the research project [Ref. 2]. He hoped by including the other agencies that dealt with air and water pollution to gain swift implementation of any desirable results.

FINDING A STABLE SOLUTION

TxDOT contracted Study 0-1315, Solidification/Stabilization of Contaminated Spent Blasting Media in Portland Cement and Mortars, with the Center for Transportation Research. Drs. Ramon Carrasquillo, David Fowler, and Raymond Loehr were the principal investigators. The objectives of the study were to develop mix designs that reduced the leachable levels of lead, chromium, and cadmium below the maximum allowed by the EPA and still produce an end product of sufficient strength and durability to be useful as filler for dolphins protecting bridge piers or riprap or sidewalks.

Developing such a mix design is not as easy as it might appear. Blast contaminants can react with portland cement in ways that cause problems. Lead, for instance, is a set retarder. It can also lower strengths. Aluminum, while not considered toxic, is present in many paints. It reacts with portland cement to form hydrogen gas resulting in lower strengths and

FIG. 1: Taking samples from a failing paint system to test for heavy metals.

FIG. 2: The Rainbow Bridge soon after completion in 1937. Complex truss work over open water poses a challenge to cost-effective, environmentally responsible rehabilitation.

FIGURE 3: Enclosing the Rainbow Bridge for sandblasting.

more permeability. More permeable mortar is less durable and more likely to leach.

TxDOT selected the Rainbow Bridge near Port Arthur, Texas, as the repainting test case (Fig. 2). This large steel truss bridge was scheduled for major rehabilitation that included repainting. An estimated 3000 barrels of blast waste would be generated. Texas has no hazardous waste landfill and would have to truck the blast waste overland to Arkansas or Louisiana. The cost of landfill disposal of this waste was estimated at $300 to $500 *a barrel.* Clearly, if the researchers could make solidification/stabilization (S/S) work, TxDOT could realize a huge cost saving for the citizens of Texas and be environmentally responsible at the same time.

THE PROJECT

The contractor on the Rainbow Bridge Project elected to enclose the bridge and to use a vacuum blast system which collected the spent blast media immediately (Fig. 3). After collecting the spent material, researchers designed and tested over 160 concrete mixes The mix designs for the spent material contained either blast slag, sand, dust, or a combination of the three. Test variables included [Ref. 1]:

- water/cement ratio
- cement content
- amount of fly ash
- amount of silica fume
- dosage of superplasticizer
- dosage of calcium nitrite as an accelerator
- spent material type, composition, and amount
- strength gain over time
- leaching of lead chromium, and cadmium according to the toxicity characteristic leaching procedure (TCLP) required by the EPA
- permeability

Researchers performed the TCLP on both crushed and monolithic samples of the design batches to ensure that the material was truly stable chemically and that the contaminants were not merely encapsulated. They found that they were able to bind the lead and other contaminants chemically so that the crushed sample did not leach any more than the monolithic ones (Table 1).

Test Results

Lab tests and field trials of the different designs indicate:

TABLE 1: Rainbow Bridge TCLP leaching results.

BLOCK#	LEAD, mg/L	CHROMIUM, mg/L	CADMIUM,mg/L
1	0.06	2.27	0.20
2	0.07	0.70	0.21
3	0.07	0.49	0.20
EPA Limit	5.00	5.00	1.00

- successful formulation of an S/S system depends on knowing the composition of all raw materials;
- lower W/C ratios inhibit leaching while elevating compressive strength;
- regardless of the admixtures used, leaching tended to decrease with an increase in compressive strength; and
- the best performance was obtained when the majority of the dry components were mixed prior to the addition of any liquid components.

[Ref. 3]

IMPLEMENTATION

EPA regulations required the waste be processed on site. Table 2 gives the recommended proportions for recycling the Rainbow Bridge spent abrasive. This mix produced approximately 50,000 12-by-12-by-6-inch concrete blocks, used in the protective dolphins for the bridge [Ref. 3]. This mix incorporated about three 55-gallon drum of spent blast material per cubic yard of mix. The approximate cost per cubic yard of this mix was $90 (Fig. 4). Through rough estimation, the project saved approximately $800,000.00 by eliminating the need to dispose of hazardous material [Ref. 2].

TABLE 2: Recommended mix proportions for Rainbow Bridge spent abrasive recycling.

MATERIAL	AMOUNT
Cement	320 kg (705 lbf)
W/C ratio	0.35
Superplastisizer	13.7 ml/kg (21 oz./cwt)
Spent Blasting Sand	499 kg (1100 lbf)

During the 1993 construction season, the researchers developed S/S mixes for four bridges on IH 35 in Austin, the Montopolis Bridge (also in Austin District), a bridge on US 87 in the Amarillo District, a bridge in the Tyler District, and a Galveston ferryboat (Houston District).

Guidelines

A general users' guide is in the works. Remember that each job is unique — the sandblasting byproduct

FIG.4: On the job at Rainbow. Left to right from top: barrels of blast waste awaiting S/S treatments; adding blast waste to specially designed mix; pouring the S/S mix (note worker's protective gear); and forming the 12-by-12-by-6-inch blocks.

will be different each time; the cement ingredients will vary in composition, and sandblasting technology itself is rapidly evolving new methods and new equipment. With those cautions in mind, the following are some of the preliminary guidelines [Ref. 1]:

1. Establish job requirements and environmental limits to be met by S/S material in terms of compressive strength, setting time, and TCLP leaching.
2. Characterize all raw materials using the TCLP and Total Constituent Analysis.
3. Determine trial mix proportions with the aid of Research Report 1315-1, Solidification/Stabilization of Contaminated Spent Blasting Media in Portland Concretes and Mortars.
4. Make a trial batch. Ensure that the proper mixing sequence is used and that adequate mixing is achieved.
5. Test the trial batch for compressive strength and TCLP leachability.
6. Determine whether the trial batch meets the requirements of the specific application.
7. If needed, change the mix design to adjust for strength, set time, and leaching requirements.
8. Repeat steps 5 through 8 until you get a successful S/S system.
9. Ensure that the same materials and job conditions exist in both the trial batches and the field application.
10. Use the proper mixing sequence and ensure adequate mixing during the field application of the S/S system.

WRAP-UP

Current research project director Art Barrow, P.E., has noted that the researchers have developed the expertise to determine S/S mix designs quickly and correctly [Ref. 2]. They worked closely with both TxDOT inspectors and the contractor on the Rainbow Bridge project. The researchers are assisting TxDOT officials in the development of standard specifications.

Having other agencies with environmental regulatory concerns on the technical panel was very helpful. For instance, since the Texas Water Commission was part of the panel and was well pleased with the early results, the Water Commission waived the need for the project to get special permission for each job site. All the research team has to do is let the Water Commission know where the S/S job is to take place. Waiving of special permission speeded up the implementation on new sites.

Most importantly, the immediate implementation of the research results has saved the state hundreds of thousands of dollars, as well as spared the environment the potential introduction of lead and other heavy metals from blast waste. Project 1315 is a great success on several counts: cost-effectiveness, environmental soundness, and rapid implementation.

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1. Garner, A. G., R. C. Loehr, R. L Carrasquillo and D. W. Fowler. ***Solidification/Stabilization of Contaminated Spent Blasting Media in Portland Concretes and Mortars*** CTR 0-1315-1. Austin: Center for Transportation Research, The University of Texas, March 1993.

2. Research and Technology Transfer Office, Texas Department of Transportation. *1993 and 1994 Semiannual Reports for Study 0-1315.* File CTR-0-1315.

3. Salt, B. K., A. G. Garner, R. C. Loehr, D. W. Fowler and R. L Carrasquillo. Recycling "Contaminated Spent Blasting Abrasives in Portland Cement Mortars." Paper presented in at ***Recovery and Effective Reuse of Discarded Materials and Byproducts for Construction of Highway Facilities***. Denver, 19-22 Oct. 1993. Sponsored by FHWA and EPA.

AUTOMATIC ANALYSIS OF PAVEMENT DISTRESS DATA WILL IMPROVE RATER SAFETY, PRODUCTIVITY

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INTRODUCTION

TxDOT's Pavement Management Information System (PMIS) requires accurate pavement distress data. Pavement rating teams usually collect this data manually. Manual collection of pavement distress data is not possible in heavy, fast-moving urban traffic because of the danger to pavement rater teams. In these cases, districts often use a multipurpose road survey vehicle that collects pavement video footage at highway speeds. The crew brings the video tape back to the office for data reduction. Then, a number of trained technicians review it frame by frame, counting and classifying the different types of recorded distress visually. This manual interpretation of videotaped pavement distress data is labor intensive, repetitious, and very tedious.

Anything repetitious and tedious is usually a good candidate for automation. TxDOT has been working on automated interpretation of pavement surface condition videos for seven years. Finally, computing power, video, and digital image-processing technology have advanced sufficiently (and the price of these technologies has dropped) that a fully automated interpretation system for the processing of pavement surface condition video is becoming practical

PROJECT GOALS

In Study 0-1189, Automatic Photo

Interpretation System for the ARAN, Texas Transportation Institute (TTI) researchers Paul Chan, Robert Lytton, Ashok Rao, and Lan Li developed and tested a prototype for a comprehensive image-processing system and accompanying automatic crack evaluation software for both asphalt concrete pavement (ACP) and continuously reinforced concrete pavement (CRCP). As implementation of the system into the PMIS continues under Study 7-1965, Implementation of Automatic Surface Distress Data Collection Procedures for PMIS, TTI researchers update and improve the automatic data interpretation hardware with more advanced video technology and more field testing. "We want to determine application ranges for the entire system: where it should and should not be used; where it is most successful; what type of distress data is best evaluated manually and what can be accurately done with the automated interpretation," says Paul Chan, the project's principal investigator.

COLLECTING DISTRESS DATA

Pavement surface distress video collected for automatic interpretation requires sharp, shadow-free images in order for the computer and the image processor to digitize the photo frames accurately and efficiently. Variations in natural light, shadows (usually from trees, passing vehicles, bridges and the survey vehicle itself), and poor resolution can distort crack images and confuse the processing. So researchers built a prototype video collection system with the following components:

- an enclosed trailer, open at the bottom, with a rubber skirt to block out sunlight
- two black-and-white, low light, highly sensitive, electronically shuttered cameras that can acquire clear images even indoors
- L-shaped rows of halogen lights surrounding each camera

In the current trailer setup, the cameras and lights are suspended on a cross-beam about 4 feet above the pavement surface. This arrangement allows for a clear image at 50 mph. The Study 7-1965 will continue to investigate different data collection setups to find the most cost-effective and efficient system for collecting "noiseless" footage. For example, using a strobe light with the low light camera may eliminate the need for a trailer. Whatever the video collection method, once a high-quality tape of the pavement is completed, it is ready for automatic evaluation in the lab.

HOW THE INTERPRETATION SYSTEM WORKS

The process begins when the trained rater places the video tape into a professional-quality, slow-playback, dynamic tracking VCR. The VCR is interfaced to a host workstation computer system and to an image processing unit through a time base corrector that provides the synchronization signal to the slow-playback video (Fig. 1).

The program developed for the system's computer evaluates four cracking distress types for ACP — longitudinal, transverse, alligator, and block cracking. For CRCP, it looks at spalling and transverse cracking. After determining if cracks are present, the program classifies the crack according to type, and then determines the percentage or number of cracks for a PMIS segment.

The image processor recognizes pavement distresses by first converting the video image to pixels, the basic unit of information in a digitized image, and then analyzing the gray level (intensity) of square blocks sized at 48 pixels each. In an image, the cracks on pavement show as the dark pixels. The program assigns these blocks a higher gray level value than the lighter pixel blocks, usually pavement background. The program's crack detection scheme locates pixels with higher than average gray levels and plots a histogram for each row of 48 pixels. The program looks at the shape of the histogram to determine the presence of a crack in that block. It then produces an edge map that it uses to compute the extent and orientation of these pixels, thus determining the crack type and severity. TTI Research report 1189-2F discusses technical details

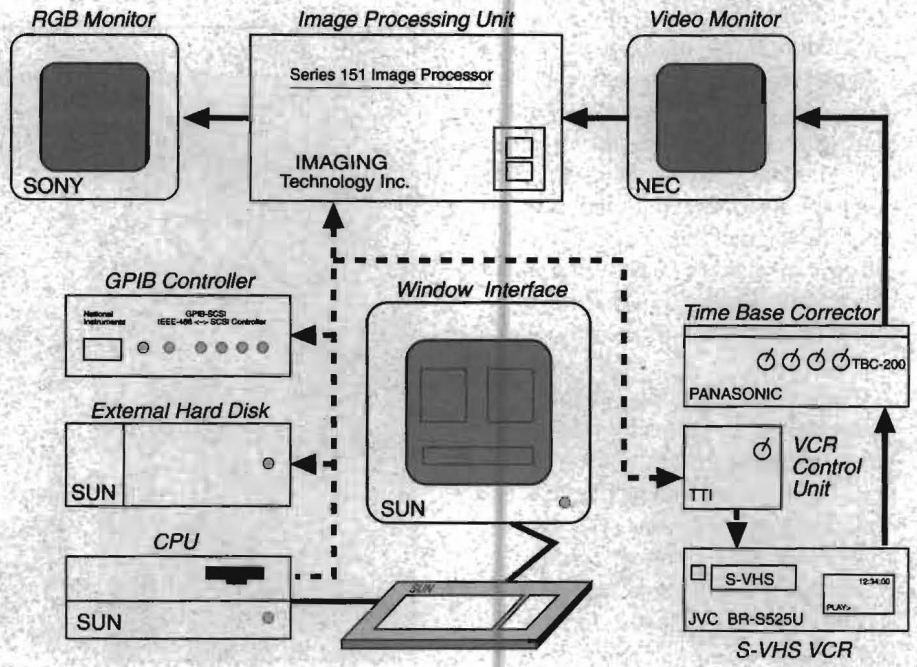

Figure 1: Video image-processing system configuration.

of the software development, the processes behind image analysis, image features, extraction, and the image classification rules.

Despite the sophisticated and detailed computations going on within the system, the actual output is relatively simple and user friendly.

FIELD TEST RESULTS

Researchers tested the program on SH 6 near Navasota for ACP and on US 59 for CRCP to evaluate the collected video data, processing methods, and classification rules. The results were over 70 percent accurate, consistent and reliable, even in noisy images such as sealcoat surfaces or "stained" images such as oil spots. In fact, detecting transverse cracks in one section, the computer had a 90 percent accuracy rate, and the visual PMIS number matched the computer number at 3. For the CRCP footage, the initial 0.5 mile results show that the accuracy of spalled and transverse cracks is over 70 percent. (See Figs. 2 & 3.)

IMPLEMENTATION

Researchers are now working toward increasing processing speed of the program by using a sampling scheme to prevent unnecessary analysis of large amounts of video. During data collection, the operator will indicate pavement type, rate noncracking distresses, and flag areas where cracking is present. This rating can also be a postprocessing operation if necessary. This information is then passed to the automated workstation.

The system will only sample ACP areas where no cracking distresses were indicated and rate areas where cracking distresses were flagged. For concrete pavement, the systems will analyze all the pavement for spalled cracks and will determine average crack spacing. The programmers are building options into the processing software so the operator can audit the system and, if necessary, override the computed results. The system will also

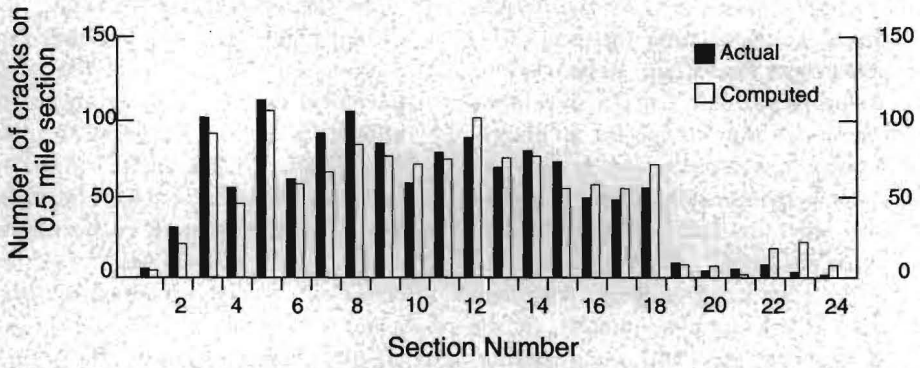

FIGURE 2: Transverse cracking counts, visual versus computer evaluation.

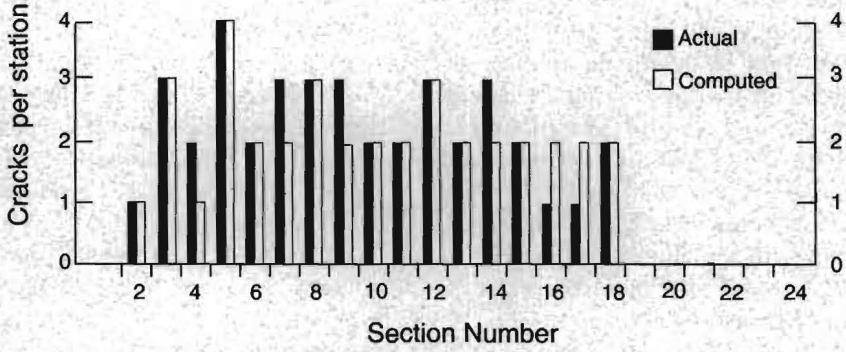

FIGURE 3: TxDOT PMIS rating of transverse cracking.

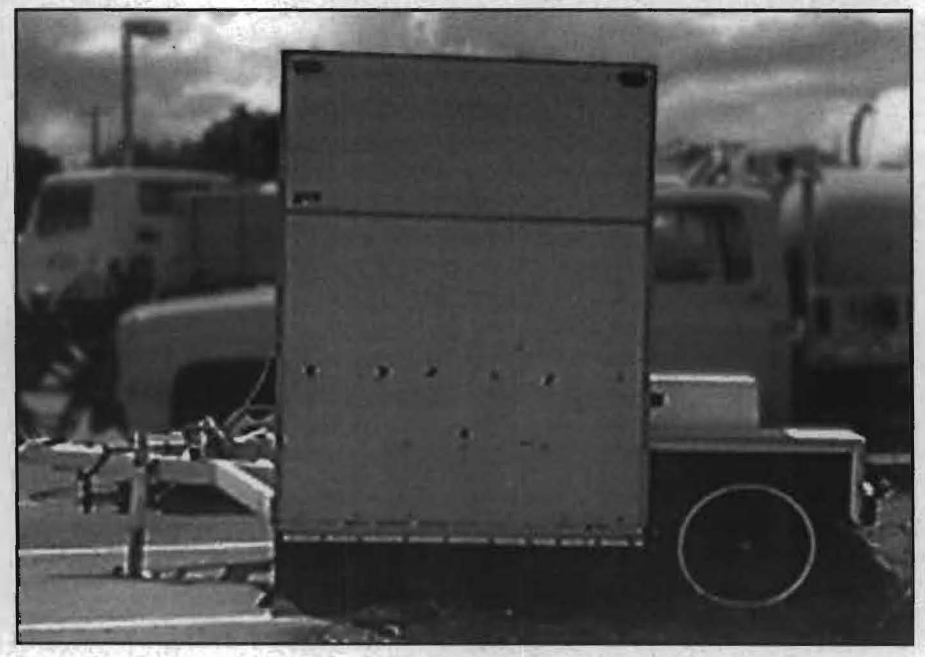

FIGURE 4: The enclosed trailer as it appears currently.

flag areas where it had trouble identifying cracking distresses.

Researchers are planning to conduct field tests (Fig. 4) over a three-month period (summer 1994). In the fall of 1994, the Design Division (DES) Pavement Section hopes to start initial implementation by automatically rating CRCP data collected in the urban areas. This initial implementation will identify areas that need refinement. One known area that needs further investigation is artificial lighting. The Research Project Director for studies 0-1189 and 7-1965, David Fink, says, "We still want to investigate strobe lights because strobes will allow us to examine the entire 12 feet of pavement rather that the 8.5 feet allowed by the trailer." If the automated system proves viable, DES hopes to implement the system statewide by using regional centers to collect and reduce the data for a group of districts.

SUMMARY

Hardware and software prices are coming down, and video technology advances every day. These rapidly developing technologies make automatic interpretation of pavement distress data easier and more practical. Reliable automatic distress interpretation will relieve trained pavement raters of watching mile after eye-glazing mile of pavement videos and will use their expertise where it counts most — to correct or override the program on questionable or extremely difficult pavement sections. The Texas Department of Transportation's PMIS data will increase in accuracy and consistency by using automated interpretation to handle the tedious, repetitious parts of distress analysis, leaving the human rating experts fresh for the interpretation of complex pavement distress.

SHRP CORNER

Technical Quarterly is starting an article series featuring Strategic Highway Research products and developments to aid in the implementation and spread of these excellent technologies. Look for the "SHRP Corner" logo in each issue.

STATUS OF WORK-ZONE SAFETY DEVICES

Many highway workers and motorist are injured or killed each year in highway work zones. Conflicting requirements for road repair and the need to maintain traffic flow contribute to the potential for work zone incidents. The SHRP work-zone safety devices are intended to address these conflicting needs in work zones. The devices inform motorist of impending maintenance operations, warn and protect workers against errant vehicles. A description of the SHRP work zone devices is as follows:

- **Salt Spreader Truck-mounted Attenuator (TMA)** protects a slow-moving plow or salt-spreader truck from rear-end collisions.
- **Portable Crash Cushion** is a tilt-bed trailer fitted with sand-filled barrels positioned in advance of a work zone, allowing protection to be provided quickly where needed.
- **Intrusion Alarms** (ultrasonic, infrared, microwave or pneumatic) sound loud sirens warning workers of errant vehicles entering the work zone, thus giving workers time to get out of harm's way.
- **Portable Rumble Strip** warns drivers when they are approaching a highway work zone or flagger station.
- **Direction Indicator Barricade** helps guide motorists in the proper direction of travel through a lane closure in a work zone.
- **Opposing Traffic Lane Divider** helps motorists safely stay in designated travel lanes through work zones.
- **Flashing STOP/SLOW Paddle** gets the drivers attention by flashing a maximum of two high intensity lamps mounted on the stop side of the paddle.
- **All-Terrain Sign Stands** can be used on steep slopes lacking flat shoulders.
- **Remotely Driven Vehicle** protects maintenance crews in front of it by serving as a shadow vehicle and protects the driver of the errant vehicle with a truck-mounted crash attenuator.

These SHRP prototype devices were developed and tested on a closed track. It is the Federal Highway Administration's goal to stimulate the implementation of SHRP concepts through field testing and evaluation of available devices. The SHRP devices are being refined and improved. Similar devices stimulated by the SHRP concepts are currently being developed and manufactured. In an effort to generate the widest trial use and evaluation, the Federal Highway Administration has identified a number of SHRP concept device manufacturer/distributors (next page); however, this does not constitute an endorsement of any product or device.

TABLE 1: SHRP concept device manufacturers/distributors.

SHRP CONCEPTS	STATUS	MANUFACTURER/DISTRIBUTOR	COST Est.
Salt Spreader TMA Attachment (3021)	Implemented	Energy Absorption, Inco. Chicago, IL 60601 (312) 467-6750, Jim Crowley	*Attachment* $3820 *Complete System* $7350
Portable Crash Cushion (3014)	Pending (Plan available)	ENSCO, Inc Springfield, VA 22151 (703) 321-9000, Dale Stout	$30,000 $35,000
UltraSonic Alarm	Pending		$3,500 $4,000
Infrared Intrusion Alarm (3010)	Available	ASTI Transportation Systems Highway Sensors & Systems Newark, DE 19702 (302) 328-3220, Frank Simko	$3,000
Microwave Intrusion Alarm (3010)	Available	Traffic Management Systems Corp. St. Louis, MO 63122 1-800-274-0966, Jack Toman	$1,990
Pneumatic Tube Intrusion Alarm (3010)	Available	Safe-Lite Systems Newtown, PA 18940 (215) 968-9296, George King	$100
Portable Rumble Strip (3015)	Available	Poly Enterprises Monrovia, CA 91016 (818) 358-5115, Al Provence	$60
Direction Indicator Barricade (3012)	Available	WLI Industries, Inc Villa Park, IL 60181 1-800-323-2462, Dan Donovan	$80
Opposing Traffic Lane Divider (3011)	Available	Impact Recovery System San Antonio, TX 78212 (210) 736-4251, Israel Ramirez	
Opposing Traffic Lane Divider (3011)	Available	FlexStake, Inc. Ft. Myers, FL 33912 1-800-348-9839, Tim Maloney (703) 360-5145, Mary Obermeyer	$75
Opposing Traffic Lane Divider (3011)	Available	Flasher Handling Corporation De Pew, NY 14043 1-800-451-9636, George Giotis	$50
Flashing STOP/SLOW Paddle (3016)	Available	Graham-Migletz Enterprises, Inc. Independence, MO 64050 (816) 254-1788, Jerry Graham	$400
Flashing STOP/SLOW Paddle (3016)	Available	Columbia Safety Sign Corporation Woodland, WA 98674 (206) 225-7688, John Valdez	$95
Flashing STOP/SLOW Paddle (3016)	Available	A/C Enterprise Vancouver, WA 98661 (206) 695-4050, Monte Arehart	$175
All Terraine Sign & Stand (3017)	Available	Napoleon Fabricators, Inc 25 1nterstate Dr. Napoleon, OH 43545 (419) 592-4465, Greg Westhoven	$500
Remotely Driven Vehicle (3013)	Plans available	ENSCO, Inc Springfield, VA 22151 (703) 321-9000, Dale Stout	$70,000 $76,000

Public Concerns and Facts about Traffic Safety ...

continued from page 10.

this purpose, they reviewed 1992 accident records of two selected sections of IH-35: a 22.4-km (14-mile) section north of Laredo, and a 27.2-km (17-mile) section south of Dallas.

The Dallas and Laredo sections of IH-35 (Table 1) had a comparable number of accidents as well as the vehicle over accident ratio, as well as the length of the selected sections. Thus, the researchers believe that the comparison of vehicle and driver characteristics involved in traffic-related accidents at these two sections is justified.

The study revealed that in the Laredo section, passenger cars were involved in 53 percent of the accidents; while in the Dallas section, this figure was 15 percent higher. Also, in the Laredo section, a greater percentage of trucks (45 percent) was involved in accidents as compared to that of the Dallas section (32 percent). This fact can be interpreted as: "If one is involved in a traffic accident, the chances of colliding with a truck are much higher in the Laredo section than in the Dallas section." This increased risk of colliding with a truck is clearly a cause for concern at the border region.

At the Laredo section, only 74 percent of all drivers involved in accidents had proof of insurance, whereas at the Dallas section, 99 percent of all drivers showed a proof of insurance. This data can be interpreted as: "If one is involved in a traffic accident, the chances of the other driver not carrying proof of insurance are 1 out of 4 in the Laredo area, as compared to 1 out of a 100 in the Dallas area." This evidence clearly shows the difference in traffic safety conditions in the two areas of Texas.

Out of those drivers with a Texas license involved in accidents at the Laredo section, only 77.8 percent had insurance. In the Dallas section, of the Texas licensees involved in accidents, 99 percent had insurance. This data can be interpreted as: "If one is involved in a traffic accident in the Laredo area with a driver who happens to have a Texas license, the chances of that driver having proof of insurance are roughly 3 out of 4; but if the same accident occurs in the Dallas area, the chances are

TABLE 1: Comparison of 1992 accident records of IH-35 sections.

DESCRIPTION	SECTION NORTH OF LAREDO	SECTION SOUTH OF DALLAS
Number of Accidents	499	562
Number of Vehicles Involved	986	1,135
Ratio Vehicles/Accident	1.98	2.02
Length of Section	22.4 kms (14 miles)	27.2 kms (17 miles)
Types of Vehicles Involved		
Passenger cars, passenger and trailer,	53%	68%
Trucks, buses, road equipment	45%	32%
Others (motorcycle, unknown vehicles)	2%	-
Characteristics of Drivers Involved		
All Drivers	74.0% with insurance 22.0% w/o insurance 4.0% not shown	99.0% with insurance 0.0% w/o insurance 1.0% not shown
With Texas License	80.0% 77.8% with insurance 22.0% w/o insurance 0.2% not shown	86.0% 98.7% with insurance 0.0% w/o insurance 1.3% not shown
With Mexican License	12.0% 66.0% with insurance 32.0% w/o insurance 2.9% not shown	-
With Others	8.0%	14.0

much higher, 99 out of a 100." In addition, out of those drivers with a Mexican license involved in accidents at the Laredo section, only 66 percent carried proof of insurance. This data can be interpreted as: "If one is involved in a traffic accident in the Laredo area with a driver who happens to have a Mexican license, the chances of that driver having proof of insurance are roughly 2 out of 3." Again, these conditions are clearly causes for major public concern.

SUMMARY

The questionnaire revealed that:

- The majority of respondents felt traffic safety along the border is average. Only 5.7 felt conditions are safe.
- Most Texas licensees worried about law enforcement when driving in a foreign country and the driving habits and insurance of foreign drivers in the U.S.
- Most Mexican licensees worried about foreign drivers' understanding of Mexican signage and laws. When driving in the U.S., signage and safety standards worried them most.
- Nearly 87 percent of respondents said they would welcome a set of regulations and guidelines given at the border for driving in the respective foreign country.

The examination of border traffic accident rates and statistics indicated several traffic-related issues of concern.

- The border counties of Texas had higher accident and fatality rates per 10,000 registered vehicles than the entire state of Texas, i.e., the Texas border has more traffic-safety related problems than any other region in the state.
- The city of El Paso has, by far, the highest fatality rate per population as compared to the other major border cities of Texas (Brownsville, McAllen and Laredo).
- Based on the accident records of two selected sections of IH-35, one north of Laredo and the other south of Dallas, drivers in the Laredo area (border region) have a greater risk of being involved with an uninsured driver or a heavy vehicle than those in the Dallas area of IH-35 (Texas interior).

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HARRIS COUNTY SOLVES ROADSIDE DRAINAGE PROBLEMS

Shortly after taking office as County Commissioner in Texas' Harris County, Steve Radack was faced with a challenge. The obstacle before him was in maintaining good, open drainage over 800 mi. of roadside ditches throughout Precinct Three. Approximately 500 mi. of ditches ran through residential areas, where standing water could potentially create vast breeding grounds for the Culex mosquito. While wanting to alleviate this problem, Commissioner Radack also wanted to use existing crews and equipment in the most efficient and economical manner.

Precinct Three staff analyzed the job process and noted that there was time lost between the field engineering crews determining the proper grade and setting the necessary grade stakes, and then after each cut, checking to see if the grade was cut accurately. Using this method under the best circumstances only allowed for the cleaning of approximately 600 to 800 ft. of ditch per day.

Precinct Three normally had three excavating crews working on ditching operations. Each crew consisted

of a Gradall 660 telescopic excavator, three tandem axle trucks to haul the spoil material, and the time and labor of five crewmen. An engineering crew would go through the process of setting the engineering stakes every 50 ft. along the ditch for the excavating crews. then, the Gradall crew would use a stringline and plumbob to determine the correct slope for the water in the ditch to establish a proper flow.

THE BEST METHOD

Seeking to improve this process entailed a great deal of discussion about what would be the most effective and efficient method. In reviewing the bottom line and the potential options, the Precinct Three staff recommended a new approach to the job. Radack so much that he soon approved the purchase of three Spectra-Physics Laserplane machine control systems to be incorporated into the existing excavating fleet.

In the process of events, a Spectra Physics Model 1145 gradable transmitter was set up in the ditch that was to be cut. This unit allowed the grading crew to program the optimum percent of slope for the designated ditch. The laser then transmitted a 360 degree plane of harmless infrared laser light at the designated grade.

Next, on the boom of the Gradall, a 3-ft. rigid mast was bolted directly over the bucket, and a Spectra-Physics Gradio laser receiver was mounted on the mast. The Gradio receiver performed two functions. The receiver maintained two arrays of photo cells that sensed the laser beam as it rotated at the preset grade and depth of cut. The receiver could then determine if the excavator bucket was too high, low, or on grade, within 0.02 ft. It then transmitted this grade information by use of radio waves to a Gradio 3-lite display mounted in the operator's cab. In this manner, the Gradall operator could determine the proper depth of cut and grade without the use of grade stakes. The method saved the crew time and the county money.

"The laser provided each ditching crew with the ability to do their own engineering, thereby allowing the surveyors to increase production."

The machine operators liked the adaptation of the laser technology units to the equipment. One, who has been operating a Gradall for 15 years, for Harris County says his crew has increased production 100%. "We have been able to totally eliminate all stringlines and Ts from the job. In the past we used hand signals to communicate and if a new man joined the crew, our production dropped dramatically until he became acquainted with our methods. Now, with the laser, we can proceed as usual," he said. He also recalled on a recent job where one crew was able to clean 1,400 feet of roadside ditch in only 6 hours.

The laser provided each ditching crew with the ability to do their own engineering, thereby allowing the surveyors to increase production. Commissioner Radack identified these advantages:

1. an increase in production by crews;
2. a savings for the taxpayer not only in dollars, but in the added time it gives to spend on other neighborhood projects; and
3. a quicker response to drainage problems.

Reprinted from ***Better Roads*** *63(Oct. 1993):27.*

CDM'S NEW VEGETATION MANAGEMENT NEWSLETTER

Have you seen Construction and Maintenance Division's ***TxDOT Vegetation Management Newsletter?*** Here's an excerpt on pesticide operation from the March 1994 issue.

The use of any pesticide, in this day and age, is receiving more and more attention, scrutiny and debate within the general population. The use of herbicides for noxious weeds is one of the tools the department uses in managing over 700,000 acres of vegetated right-of-way.

However, the "safest" chemical in the world will do nothing but damage if applied incorrectly. That's why the herbicide certification training schools stress proper application techniques regardless of the chemicals or equipment being used.

The best way to help insure continued availability of herbicides as one of the alternatives within our "vegetation management toolbag" is to see that the chemicals are applied correctly and at the correct rates.

We should do it for a number of reasons, but I tend to agree with the oatmeal guy when he says, "...it's the right thing to do."

When it comes to *rate of application,* some of the following comparisons might be useful:

"One pound per acre is roughly equal to one teaspoon of sugar spread evenly over 5,000 5-inch cereal bowls."

"Two ounces per acre is roughly equal to a teaspoon of sugar spread over 40,000 bowls of cereal."

Since most toxicological information which talk about chemical residue within our food or water supply are expressed in **parts per million (ppm) or parts per billion (ppb),** the following comparisons might be useful:

"One part per million is roughly equal to one ounce of salt in 62,500 pounds of sugar."

"One part per billion is roughly equal to one inch in 16,000 miles."

If you'd like to recieve ***TxDOT Vegetation Management Newsletter,*** call Paul Northcutt (512) 416-3091.

COMPRESSING DATA FREES DISK SPACE

by **Larry Mendenhall**
Editor
Technology News
Iowa Transportation Center

There are only two kinds of hard drives — ones that are empty and ones that are full.

That may be an exaggeration. But hard disk space — like nature — abhors a vacuum. For example, here at *Technology News,* an external hard disk of 170 megs was flashing "Cannot Save File, Disk Full" messages after being connected for only two months.

Shrinking hard disk space can be avoided by either buying additional storage devices or doing a better job of managing your current disk space. For space-hogging applications like those that use a lot of graphic files, it's likely that buying additional storage space will be your best option for two reasons. One, there are a variety of devices available, and two, prices for these devices are relatively low.

If you don't use space-greedy software but your disk is full anyway, chances are that some thorough spring cleaning is the way to go. The space that can be recovered by deleting unnecessary files and transferring little-used files to floppy disks will surprise you (See "Hard Disks Need Maintenance" in the December, 1991, ***Technology News***). Once that's done and you still need more space, you may want to consider using compression software.

Compression software uses either one of two tactics to shrink file sizes and free more space on your disk. Driver-level compression programs store data on disk more efficiently and file-level compression programs reduce redundant sections of code. Either method will increase the free space available by about 50 percent, depending on the types of files being compressed. Both types will also decompress files when they are needed.

Driver-level compression saves space by writing information to the disk differently than DOS. A hard disk is divided into sectors which actually store the information. Each sector can hold 512 characters. If you created a file of 512 characters it would fit neatly in one sector, sector one. If that file, however, contained 513 characters then the extra character would be placed on the next sector, sector two, leaving room for 511 characters. That isn't a problem until the next file is saved. DOS skips to sector three to write the file, wasting the space left over on sector two. Driver level compression makes use of the free space left over on sector two.

Disk-level drivers work in the background. That is, the computer operator is generally unaware of the compression and decompression process. These programs have been developed to the point where the computer operator shouldn't perceive a slow down in his or her operations.

Compressing data at the file level employs a different tactic. A file-level compression program searches a file for redundant characters. For example, it would look at a file and determine how often the character "e" appears. Instead of writing the code for "e" each time, the program writes it once and then places a marker in each place where "e" appears.

File compression software requires a more active role by the computer operator. To use this type of program, the operator must mark files that he or she wants to compress and tell the program which directory to store it in. The time required to do this depends on the size of the file. While this may not be as convenient as driver-level programs, it is convenient if only certain files need to be compressed. Some users compress only their data files and leave application and system software files uncompressed.

Programs using both methods are reliable. A drawback to compression programs is that disk recovery, optimization, and virus scanning programs don't work with compressed data. In fact, using these tools on compressed files may even destroy your data. Compression software stores data in a proprietary manner that renders disk recovery and disk optimization software such as Norton Utilities useless. Similarly, virus detection software does not scan compressed data and must be turned off when compression software is installed. Some compression programs solve this problem for the user by including disk optimization software.

Even if you decide not to compress your entire hard drive it will still be handy to have a compression program. If you backup your hard disk to floppies (we all backup our hard drives, right?) or use floppies to transfer files from one location to another, then you can use compression software to be able to fit more files or bigger files onto your disks. At ***Technology News*** compression software reduced a 52-megabyte directory enough to fit on just nine high-density floppy disks.

Excerpted from Microtechnology, ***Technology News*** *(August 1993):4.*

WHEN PLANNING TO USE A VIDEO

If you're going to be conducting a training session and want to use a video, these suggestions might help:

- **Preview** the video at least twice. Decide which part of the video you will show. It's not always necessary to show the entire tape.
- **Show** a clear link between the content of the video and the training program.
- **Introduce** the video in depth. Don't just turn it on and get out of the way.
- **Prepare** questions and discussion points related to the video.

Source: ***Communications Briefs.*** Louise Brinie, cited in *Creative Training Techniques,* 50 S. 9th St., Minneapolis, MN 55402.

FUNCTIONAL REQUIREMENTS FOR ATMS SIMULATOR BEING DEVELOPED

A critical stage before field implementation of Advanced Traffic Management Systems (ATMS) and other Intelligent Vehicle/Highway Systems (IVHS) component technologies is the ability to test them in a controlled, off-line/on-line environment. The concept of a Traffic Management Laboratory (TML) is an attractive approach for testing, evaluating, and refining different IVHS designs and deployment strategies before actually building the infrastructures for these strategies. Only through the use of these laboratories can researchers ensure the technical soundness of proposed concepts and avoid costly and inconvenient retrofits of discovering technical deficiencies after implementation.

In this regard, FHWA has established a real-time TML. This effort encompasses the design, development, and implementation of an ATMS simulator suitable for developing, testing, evaluating, and calibrating IVHS concepts and technologies. Initially, the ATMS simulator will provide a low-resolution, low-fidelity (LRLF) — (software-based) — testbed based on existing models from the TRAF simulation family. It will eventually evolve into a high-resolution, high-fidelity (HRHF) — (machine-in-loop) — simulator replicating mature IVHS traffic management centers. Some of the functional requirements being considered for the TML include:

- Suitability for developing, testing, evaluating, and calibrating traffic control strategies; incident detection algorithms and management plans; multimodal transportation strategies; and Traffic Management Center hardware configurations and support systems.
- Flexible system and communications architecture to enable the evaluation of the implementation potential of distributed computing and the ability to serve as a mechanism for integrating ATMS with other IVHS components.
- Ability to serve as the main mechanism for testing products from ongoing R&D efforts and to provide a forum from which the social and economic benefits of IVHS can be quantified.

Currently, the functional requirements are being developed. The initial LRLF system implementation will be delivered this summer, and full operation is expected by the end of the year. The HRHF implementation is expected to be completed in 2 years.

Al Santiago, (703) 285-2028.
***FHWA Transporter** (February 1994):4.*

BE SURE HOW YOU ANSWER

When you get a computer message you don't understand, don't respond until you're sure you know what it means.

- Example: The computer says "Disk full ... delete old files?" If you say "yes," you may lose lots of files that you didn't want to lose.
- What to do: If the machine isn't locked up when the question appears, print the screen. If you can't do that, call someone who knows more about the computer than you do. Don't answer the question. Don't turn the machine off.

Answering the question the wrong way could cause much grief.

Source: ***Communication Briefs;*** *Letowt on Computing,* 22 Nostrum Road, Norwalk, CT 06850.

WANT TO KNOW WHAT'S GOING ON?

Curious about research? Implementation? Technology Transfer? Come see the Research and Technology Transfer Office's booths at this year's Transportation Conference in October.

COME ON OUT TO THE ROADEO!

The 1994 State Roadeo will be held at the Austin District, Travis County East Maintenance Section, on September 20, 1994, beginning at 8:30 a.m. Bus transportation will be provided for participants and supervisors from the Radisson Hotel headquarters at 111 East First Street and Congress. We encourage participants, safety coordinators, and supervisors to make their accommodation reservations as soon as possible by calling 1-800-333-3333.

The Accident Prevention Management meeting and Roadeo Awards ceremony will be September 21, 1994, in the main conference room at the Radisson Hotel.

If you have any questions, please feel free to contact Vicki Haydon or Jerral Wyer at (512) 416-3395.

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