UNIVERSITY OF MINNESOTA

CENTER FOR TRANSPORTATION STUDIES

M I N N E S O T A

TECHNOLOGY
EXCHANGE

A Newsletter of the Minnesota Technology Transfer (T^2) Program, Local Technical Assistance Program (LTAP)

July-September 1997 Vol. 5, No. 3

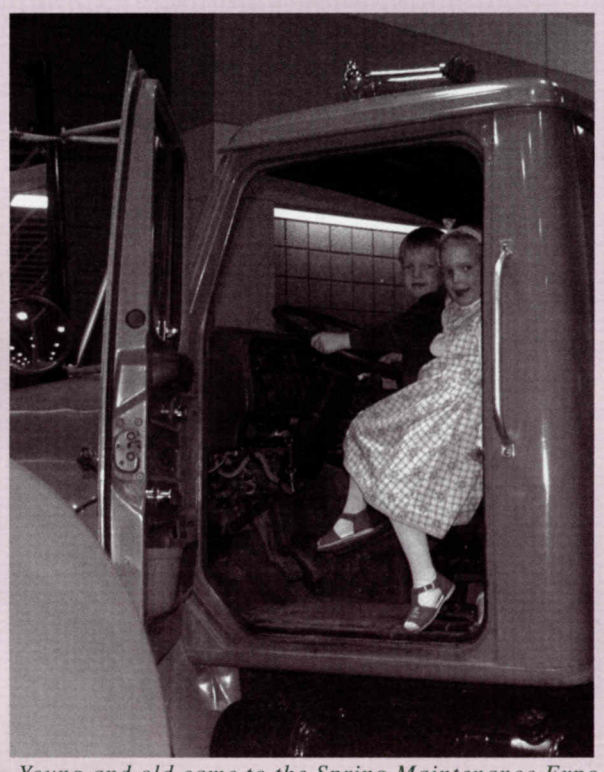
Spring Maintenance Expo: In a Word, Wow!

Patching potholes, filling cracks, and removing graffiti—these are just three of the topics that drew a record crowd of over 600 persons to the Minnesota Spring Maintenance Conference in St. Cloud. Held on April 9-10, the event was designed for city, county, and state maintenance operators and supervisors along with transportation and research implementation personnel.

Expo sponsors were Mn/DOT, the Minnesota Local Road Research Board (LRRB), the Minnesota Street Superintendents' Association, the Minnesota Public Works Association, and the Minnesota Technology Transfer (T^2) Program.

The expo followed a similar event last October that focused on winter maintenance issues. The fall expo had evolved from the old Mn/DOT "Snowfighter Roadeo" into a much larger event where maintenance workers from cities and counties could also share their experiences. *(Ed. note: The Second Annual Fall Maintenance Expo and Snow Roadeo will be held on October 1-2, 1997, at the Anoka County Fairgrounds. Details to come.)*

The spring expo featured over 60 concurrent session presentations covering maintenance innovations in Minnesota. Topics included pavement maintenance, bridge and concrete maintenance, safety, traffic and sign management, roadside management, gravel roads, maintenance management systems, and human relations.



Young and old came to the Spring Maintenance Expo in St. Cloud.

The range of speakers was just as impressive. For example, **Paul Keranen** of Mn/DOT Maintenance Operations gave the opening comments, and LRRB chair **Michael Sheehan** and Mn/DOT commissioner **James Denn** gave the welcoming address. **Cheri Trenda,** director of the T^2 Program, and **Tom Struve** and **Dave Hutton,** members of the T^2 Steering Committee, moderated sessions. Presenters included **Kathy Baker** and **Ken Nelson** of Mn/DOT, who reviewed activities of the Circuit Training and Assistance Program (formerly known as the Circuit Rider Van Program), and **Walter Leu,** a member of the LRRB.

To get a taste for what you may have missed, please turn to pages 4-5 of this *Exchange*. The Q&A section on page 2 also has information from the Expo.

T^2 Steering Committee Sets Workshop Fees, Directions

During its annual spring meeting, the Minnesota T^2 Program Steering Committee, chaired by **Pat Murphy** of Mn/DOT State Aid, discussed the need to provide local agency personnel with more advanced information on T^2 training plans to enable necessary agency planning and budgeting for employee attendance. As a result, this *Exchange* contains information *(see page 6)* to help you communicate with and prepare budget/training plans for your local board or council members.

Workshop information reflects the Steering Committee's categorization of all current and potential T^2 workshop topics. The primary purpose of the workshop categories is to extend T^2 resources and meet as many local agency training needs as possible.

Category A: T^2 Base Program Workshops, includes topics that are part of the ongoing, base T^2 workshops that are subsidized to keep registration fees to a minimum. **Category B: T^2 Special Program Workshops,** includes topics that are not part of the base T^2 program, but are offered depending on the availability of special program funds. Last, **Category C: Nonsubsidized T^2 Workshops,** includes topics that have been requested by local agency personnel but are not subsidized; therefore, registration fees must cover all associated course expenses.

Finally, training topics for the 1998-99 T^2 Program were selected from a variety of feedback sources including T^2 surveys during the annual city and county engineer meetings, T^2 course evaluations and course catalog feedback forms, T^2 Steering Committee directions, LRRB research implementation activities, and direct requests from you or your staff.

Many of you have requested courses that reflect general management/supervisory topics such as conflict resolution, public speaking, coaching/team building, etc. Because quality training programs for these topics are generally available through a variety of vendors, the T^2 Program will not be offering these courses. However, many of these topics are presented during annual city, county, and township meetings, and T^2 will be involved in supporting and sponsoring these special presentations.

The T^2 Steering Committee, training staff, and I hope that this information is helpful to you in planning for your 1998-99 training activities. The 1998 T^2 workshop catalog—including details of program content, dates, and locations offered—will be mailed to you later this year.

If you have questions or further suggestions, please contact me at (612) 625-5829, or Lori Graven at (612) 625-9023. We look forward to working with you on our new T^2 training initiatives.

—Cheri Trenda

T^2 Welcomes New Program Coordinator

The Center for Transportation Studies welcomes **R. Benjamin Gribbon** as the new education and technology transfer (T^2) coordinator. Gribbon, selected by a panel representing the University, LRRB, and Mn/DOT, joins us from the Mn/DOT Office of Transit.

At Mn/DOT, Gribbon served as a project manager and grants administrator, working with the Metropolitan Council, city governments, and rural transit systems. He recently created a new cooperative purchasing process for transit vehicles by working closely with transit systems, vendors, vehicle manufacturers, and Mn/DOT shop supervisors. The process resulted in improved specifications, purchasing power, value, and responsiveness from manufacturers.

Gribbon says he especially expects to enjoy his new role as T^2 coordinator, based on his experience as research faculty at Florida's Center for Urban Transportation Research (CUTR). At CUTR, Gribbon provided technical assistance to transit systems statewide. In addition to research responsibilities, he managed the Statewide Maintenance Training Program: coordinating statewide training events and maintenance workshops, evaluating courses and trainers, and sharing maintenance

Gribbon *continued on page 3*

HIGHLIGHTS

And the Winners Are...Your Colleagues!

The *Exchange* is pleased to pass on the following award announcements. Our congratulations to all.

At its annual meeting last March, the National Association of County Engineers (NACE) selected **Doug Weiszhaar** as Rural County Engineer of the Year. Weiszhaar, county engineer in Stearns County, has been a county engineer / assistant engineer for the past 21 years. A NACE member for 16 years, Weiszhaar also is a member of the Minnesota County Engineers Association and was president in 1995. He is a member of Minnesota Counties, the Minnesota Transportation Alliance, and the Mn/DOT Advisory Committee. He chaired the CTS Infrastructure Council from 1990-97.

In addition, **Duane Blanck** (Crow Wing County) was installed as NACE president-elect, and **Don Wisniewski** (Washington County) was elected and installed as the north central regional vice president.

At its spring meeting, the Minnesota Public Works Association presented its Hugo G. Erickson Award to **Ron Rudrud** of the city of Bloomington. Rudrud is a member of the T² Steering Committee.

Kathy Baker of Mn/DOT received a plaque at the Spring Maintenance Expo honoring her commitment to innovation and statewide technology transfer. Baker is one of the instructors for the Circuit Training Assistance Program, or CTAP (formerly the Circuit Rider Van Program) and has been a contributor to the *Exchange*.

And last but not least, Wright County was a 1996 recipient of the "Excellence in Storage Award" issued by the Salt Institute. **Wayne Fingalson,** Wright County engineer, deserves kudos for his role in earning the award.

Minnesota T² Says Good-bye to Martikainen

Paivi Martikainen of Mn/DOT Maintenance Operations Research returned to her home of Finland in May. For the last three years the T² Program was one of the many beneficiaries of Martikainen's energy and ingenuity. She was particularly valued for her contributions to the Circuit Rider Van Program.

After spending the summer in Finland, she and her family (including her two adorable children shown in the cover photo on page 1) will move to Saudi Arabia where her husband is employed.

M I N N E S O T A
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The Minnesota Technology Transfer (T²) Program is part of the Federal Highway Administration's Local Technical Assistance Program (LTAP). LTAP is a nationwide effort designed to foster and improve information exchange among local practitioners and state and national transportation agencies. Minnesota's T² Program is administered by the Center for Transportation Studies at the University of Minnesota, and cosponsored by the Minnesota Local Road Research Board and the Minnesota Department of Transportation.

Technology Exchange is published quarterly. For free subscriptions, mailing list changes, or extra copies of the *Exchange,* contact Circulation at the address or phone number shown.

The *Exchange* welcomes contributions and suggestions from its readers. Submit articles, news items, and other comments to Pamela Snopl, editor, at the address or number below.

Minnesota Technology Transfer (T²) / LTAP Program
Center for Transportation Studies
University of Minnesota
200 Transportation and Safety Building
511 Washington Avenue S.E.
Minneapolis, MN 55455
Phone: (612) 626-1077
Fax: (612) 625-6381
E-mail: snopl001@tc.umn.edu
Web: http://www.umn.edu/cts/T2/t2.html

Q & A: Work Zone Safety

Our subject this issue is work zone safety. Roberta Dwyer, Mn/DOT tort claims engineer, is our source. Dwyer developed Part VI of the *Manual on Uniform Traffic Control Devices,* including the *Field Manual.* She presented this information at the Spring Maintenance Expo.

Q

You worked on Part VI of the *Minnesota Manual on Uniform Traffic Control Devices* (MN MUTCD). Could you tell us some of the things included in this section?

A

Part VI consists of 11 sections covering areas including general concepts of work zone traffic control, device specifications, speed limits in work zones, pedestrian and worker safety, flagger operations, long-term traffic control, and short-term traffic control (the *Field Manual*).

Q

The MN MUTCD is currently being revised. What do you think are some of the biggest changes?

A

The MN MUTCD is continually being revised by the Minnesota Committee on Uniform Traffic Control Devices. This group—consisting of Mn/DOT traffic engineers; rural, city, and county engineers; and consultants—meets every six weeks to review areas of concern. These changes are continually being incorporated and are published annually in January.

Since the revised Part VI was published, major changes include:

- New provisions for speed limits in work zones.
- Revised layouts for the use of mobile operations for nighttime operations.
- New standards for variable message signs.

Major changes in the *Field Manual* from the previous Part VI include:

- Higher mounting height of signs in work zones.
- Quality standards for devices.
- Numerous additional layouts including moving and nighttime operations.
- Interim pavement markings.

The next edition of the *Field Manual,* to be published in January, 1998, will include metric units.

Q

Could you briefly describe the revisions of the interim pavement marking specifications?

A

On high-volume (greater than 1500 average daily traffic), two-lane, two-way roads and multilane undivided roads, centerline markings including no passing zones are to be installed prior to opening the roadway to traffic. This requirement may be met with the use of paint, pavement tape, or temporary raised pavement markers. Signs alone do not fulfill the requirements of interim pavement makings except on low-volume roads (less than 1500 ADT). Full requirements may be found in Section 6F-73 of the MN MUTCD and Mn/DOT Technical Memorandum.

Q

What is Mn/DOT doing to get the word out about the revisions included in the new manual?

A

All holders of the MN MUTCD automatically receive the updated version. Mn/DOT has worked with various organizations such as the American Traffic Safety Services Association (ATSSA), the North Central section of the Institute of Transportation Engineers (NCITE), Associated General Contractors (AGC), the Minnesota Asphalt Pavement Association (MAPA), and county engineers to notify affected parties of these changes.

Q

How do you think work zone safety has improved in the last ten years?

A

Work zones have become standardized through the uniform use of the *Field Manual* and its predecessor, *Appendix B.* Quality standards for devices have improved the visibility of devices used. Technological advances such as variable message signs, highway advisory radio, and high visibility materials have improved motorist information.

Q

What area(s) still need improvement?

A

Work is needed on speed control in work zones. Positive barriers that are quickly installed to separate workers from vehicles need to be developed. New methods of delivering complex information to the driver will be required in the future.

Q

When will the revised manual be available and how can a person get a copy of it?

A

Part VI of the MN MUTCD and the *Field Manual* with an errata sheet are currently available from Mn/DOT Map Sales, (612) 296-2216. Quantities of up to 25 *Field Manuals* may be ordered at no charge. Metric and revised *Field Manuals* in English units will be available in January of 1998. Comments, concerns, and questions regarding Part VI can be directed to the Office of Traffic Engineering, (612) 582-1030.

Meet Your T² Staffers

On page 1 we introduced Ben Gribbon, the latest addition to our T² staff. We thought you also might like to meet the rest of the T² staff, to help you connect the names with the faces. So below, from left to right, are:

R. Benjamin Gribbon (program coordinator) and Cheri Trenda (program director); Laura Dale Bischof (librarian), Jennie Read (student support), and C.J. Melco (database manager); Catherine Ploetz, Lori Graven, and Bev Ringsak (program coordinators for workshops and other events); Cristyn Kowal (associate editor), Pamela Snopl (seated, senior editor), and Pat Rouse (designer)

Gribbon

from page 1

solutions.

He also advised the Rural Transit Assistance Program in Florida and Massachusetts, where he analyzed training needs, taught workshops, and helped to establish statewide training networks. He has trained hundreds of drivers and managers in a variety of public transportation issues.

Gribbon has also conducted research and training as a consultant. He coauthored several technical assistance documents for the U.S. Department of Transportation, and worked with the Volpe Transportation Systems Center in Cambridge.

CTS and Minnesota T² welcome Gribbon's broad expertise in transportation, while he looks forward to applying his experience in training and technical assistance to Minnesota's T² Program. Please join us in welcoming Ben to our program.

[Gribbon's phone number is 612-625-8373.]

Russian Transportation Officials Visit Minnesota T²

Last March seven transportation officials from Russia visited Minnesota to learn about technology transfer programs. The visit was part of a three-week tour—including stops in five states and Washington, D.C.—by representatives of Russia's Federal Highway Department, Regional Highway Construction Directorate, "Roads of Russia" Directorate, Moscow T3 Center, and the U.S. FHWA Moscow mission.

The purpose of this visit was to help the Russians model a system of transportation technology transfer and training (or "T3") similar to the U.S. version. They visited different LTAP centers and transportation research centers to learn about management and processes of technology transfer. They also observed structures of different LTAP centers, their functions and requirements, and unique features of each state and center.

In Minnesota **Merritt Linzie** of Mn/DOT coordinated tours of several local sites including the Traffic Management Center in Minneapolis, the Minnesota Road Research Project near Monticello, and Cortec Corporation, as well as a formal reception and dinner. **Cheri Trenda,** director of Minnesota T², and **Robert Johns** and **Lowell Benson** represented CTS at this dinner.

In addition, Minnesota T² hosted a morning session with the Russians to share administrative and management aspects of running a T² center. Trenda, **C.J. Melco** (databases), **Pamela Snopl** (publications), **Dave Lynch** (budgets), and **Lori Graven** (workshops) joined **Paivi Martikainen** (then with the Circuit Training and Assistance Program) in this discussion.

The visit was coordinated by the Federal Highway Administration's Office of International Programs, which has an ongoing cooperative effort between the United States and Russia.

LRRB UPDATE

Putting Research Into Practice: The History of the RIC

by Bob Witty

The LRRB Research Implementation Committee (RIC), previously known as Local Road Research Board Investigation 645, began in 1974. The Local Road Research Board (LRRB) at that time recognized a need for communicating research. Investigation 645 was thus established as an ongoing project, the focus of which is to put research into practice.

An advisory committee was established and appointed by the chair of the LRRB. The committee started with two county engineers, two city engineers, one Mn/DOT State Aid engineer, and two Mn/DOT staff engineers from the Office of Research and Development. Currently the RIC has ten voting members and three ex-officio members. Voting members are:

- four county engineers
- two city engineers
- one assistant State Aid engineer
- one District State Aid engineer
- one Mn/DOT technology development engineer
- one Mn/DOT research operations engineer

The ex-officio members are:

- one Mn/DOT research implementation coordinator
- one Mn/DOT research services engineer
- one representative from Minnesota T²

Early on the RIC, through consultant support, conducted research implementation with the express purpose of making new research and new concepts more usable by local and state agencies. The RIC began conducting surveys of city and county engineers to determine subjects of interest. Many subjects and research activities have been covered and various methods—including workshops, seminars, slides, videos, and written reports—have been used to get information out to local agencies.

The RIC, left to right, standing: Roger Olson, Mark Maloney, Bob Witty (chair), Dick Hansen, Cheri Trenda, Dave Johnson, Wayne Fingalson, Roger Gustafson. Seated: Micky Ruiz, Lou Tasa, Julie Skallman, Steve Lunde, Mike Marti. Not pictured: Larry Read, Lowell Odland

Early work by the RIC was much like the work being done today. Earlier projects involving research in pavement management, load effect on pavements, and pavement recycling provided timely, valuable information to local government engineers by way of workshops and slide/tape programs. Later projects are doing the same but generally use more videos as the end product. In fact, the "Load Effect on Pavements" project, which was originally a slide/tape presentation, was redone as a video. It has had wide use in presentations to the public, law enforcement, and local government officials.

The award-winning video titled "Weather and Loads: The Effect They Have on Roads" was presented at the 1991 International Conference on Low-Volume Roads by Mike Marti, Braun Intertec. Copies of the video were requested by people from Maine to Louisiana, and as far away as Kenya, Africa. The video also earned the NACE Technical Innovation of the Year Award in 1993.

Other subjects often keep coming back as technology changes and more becomes known; an example is the subject of geotextiles, for which the first report was written as a *Research Implementation Series* (RIS) in 1985. Since then six additional RIS reports have been written for geotextiles and another project is in progress which will result in a computer program in disk format as an end product.

The *Research Implementation Series* is a series of short reports on a variety of subjects from bituminous pavements to guardrails, herbicides, soybean oil (soapstock) to waste products used in construction. Typically the short reports in the RIS are from 2 to 20 pages and are meant to provide resource information. To date there are 21 reports in the RIS.

The work of the Research Implementation Committee is important. The work provides local government engineers with the latest technology and information on a wide variety of subjects; and it provides training for employees and educational tools for elected officials and the general public.

[For more information contact Witty, Martin County highway engineer and chair of the RIC, at (507) 235-3347.]

T E C H N O L O G Y E X C H A N G E

MAINTENANCE EXPO

Sights and Stories from the Spring Maintenance Expo

MAINTENANCE EXPO

Virtually every topic at the Spring Maintenance Expo would be a great match for the readers of the *Exchange*. Of course, we can't fit everything into this issue, but these two pages give you a pretty good sampling of the sessions and activities. Rest assured that future issues of the *Exchange* will cover more of the topics that your colleagues shared in St. Cloud.

Improving Service Levels on Aggregate Surfaced Roads

by Walter Leu

Drainage, Drainage, Drainage

You've probably heard the old saying that the three most important factors in selling real estate are location, location, location. When it comes to gravel roads, you could say something similar—the three most important factors in a good gravel road are:

- Drainage: have an adequate crown on the road surface.
- Drainage: eliminate standing water in ditches.
- Drainage: have an adequate approach and centerline culverts.

The general idea is to eliminate as much of the subsurface moisture as possible. Too much subsurface moisture is our enemy and has killed many a gravel road. It is the cause of frost heaves, soft roadbeds, and frost boils.

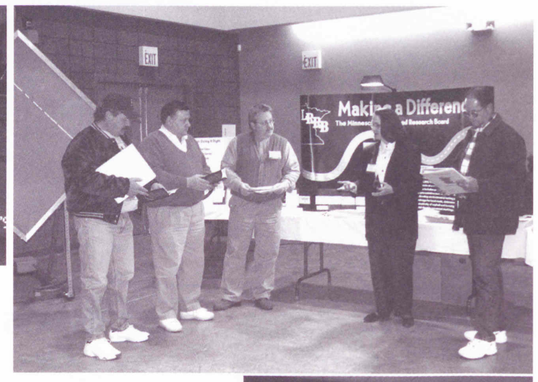
Structures and Standards

The Minnesota Local Road Research Board (LRRB) has developed a guide for *Low-Volume Aggregate Surfaced Roads* (publication 92-1).

This guide helps you decide how thick your gravel base should be to adequately handle the traffic you expect. Thickness is based on the soil type, traffic counts, and type of gravel base available.

It's important to understand the difference between an ideal situation and reality. The charts show the ideal thickness of gravel; the reality is that most highway departments can't afford to put down that much gravel. So, when your road fails in the spring you'll know why.

More gravel is no substitute for a poor subgrade or poor drainage. If drainage can't be improved, then consider using a pre-sewn fabric and capping with a minimum of 6 inches of gravel, preferably 8 to 12 inches. Use a Mn/DOT Type V geotextile and have your supplier sew two 12-foot to 14-foot pieces together so that it covers the roadway. This should cost about $0.50 to $0.70 per square yard or about $10,000.00 per mile, plus the cost of gravel. This is expensive—that's why we try to drain the water first.



Above: Expo presenters Don Theisen (Washington County) and Walter Leu. Right: Micky Ruiz of Mn/DOT and Dave Hutton of Savage (third from left) discuss the LRRB with Expo participants.

Lake of the Woods Geotextile Project

Lake of the Woods County constructed a geotextile project on a nine-mile section of road at the Northwest Angle. The total cost was $450,000. This project was a complete success. A typical section includes:

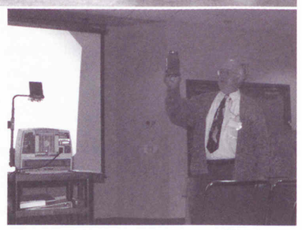
- subgrade preparation
- woven geotextile pre-sewn at 30-feet wide, 300 psi grab strength, both directions
- Eight inches of pit run (Class 2)
- Three inches of Class 5, mod. (minimum 8 percent on #200)
- calcium chloride application once per year at 16-foot width, at 1,500 gallons per mile

We are now trying a soil stabilizer, EMC Squared® from Soil Stabilization Products Company, Inc. It is designed to reduce moisture infiltration, frost heave susceptibility, rutting, washboarding, unraveling, gravel loss, and dusting for a wide range of soil and aggregate materials used as running surfaces on unpaved roads. It requires no safety precautions and is nonflammable, nonhazardous, and acceptable for environmentally sensitive areas. *(For a product brochure, call 800-523-9992.)* We are treating five miles of road this year and are currently testing its effectiveness.

[If you would like more information about this project, please call Walter Leu, county engineer in Lake of the Woods County, (218) 634-1767.]

Dad's Recipe for Gravel Roads

by Dick Larson



Dick Larson

Let me tell you a tale about "Dad's Recipe" for gravel roads. It was developed from the experiences of myself—county engineer for Mille Lacs County for the last 20 years—and my father.

The story starts with my dad's contracting experience back in 1928. It seems that a large boulder had to be removed from the center of a township road. The public was tired of driving around the boulder. Dynamite was used to remove it. My father emphasized the need to remove the boulder to satisfy the public, and to use caution working around dynamite. His advice was: "satisfy the public, use caution working around dynamite, and don't take unnecessary risks."

The story developed into the first two rules for road gravel. First, get rid of the big rocks in your gravel. The public does not like the larger 3/4-inch size stone allowed in Class 5. They do not like to drive on large stones or around larger rocks. Second, don't take unnecessary risks; instead, follow past experience—use specifications developed by the state over many years of use. Making changes to gravel specifications is like playing with dynamite. Make only those minor modifications that you feel comfortable making.

The state specification for granular material using the English specification is contained in the 1989 blue book, *Standard Specification for Construction.* For most areas of the state, where aggregate is not quarried, the only specifications that require both fines and crushed material are Class 6 and the old standby Class 5. Most road authorities are familiar with Class 5.

I added an additional rule to my dad's recipe: Make sure there is some clay in the fines portion of the gravel, perhaps 2 to 3 percent. When using the Class 5 specification, test the material for the amount of clay in it. The amount of fines—which can be either silt or clay—allowed in Class 5 is from 3 to 10 percent. Typically, clay is needed to glue the material together.

The state specification does not include a test to determine the amount of clay in the gravel. Commercial testing of fines could detect the clay content, or a field test could be done, as follows:

Add a spoon of Calgon to a quart of water. In a second jar, place two cups of dry fine sand size material from your road (use a window screen to separate out the fine sand). Add the water mix to the sand and shake. The material will settle out in layers of sand, silt, and clay. The sand settles in less than a minute. The silt takes about an hour, and the clay may take several days. Compare the thickness of the layers to get an idea of the amount of clay and silt in your gravel. When you find a gravel material that works well on your roads, use this test to obtain more of it.

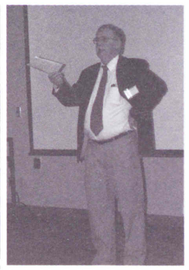
And thus ends the tale of "Dad's Recipe."

[Larson is county engineer with Mille Lacs County.]

Dad's Recipe for Gravel Roads

25%	3/8 - 3/4	Medium stone
20%	#4 - 3/8	Small stones
17%	#10 - #4	Coarse sand
18%	#40 - #10	Sand
10%	#200 - #40	Find sand
10%	Fines*	Binder

**Portion should be clay.*



Left: Mn/DOT's Ken Nelson discusses van training. Above: Paul Keranen. Right: Wayne Fingalson

Merrill Evans, Rod Gilbert, and Rick Trocke preview new maintenance equipment.

The Path to Good Signing

by Bruce Jacoby

The first step to good signing is: "To manage what you've got, you have to know what you have." It's often difficult for some agencies to develop a systematic method of sign replacement—or in other words, a system for asset management.

Asset Management

Asset management is the 90's buzzword. What is a signing asset? What did it cost your agency to install that stop sign? The post, brackets, bolts, survey, equipment, labor, locates, aluminum, reflective sheeting, and printing?

Some examples at work: There are agencies in the Midwest that, if a natural disaster struck, could tell you within hours how much it would cost to sign, rebuild, and repair everything. The city of Maplewood a number of years ago wrote a program that could tell you within a few dollars the total cost to resign their city.

Types of Management Tools

What sign inventory tools are available for an agency? Here's a sample:

- Logbook—a paper record of each sign and its complete history for a township or small city. A great place to start.
- Photo log—expensive, but not complete.
- Video log—excellent, but limited to daytime condition.
- Computer—higher cost but greatest advantage, especially with some of the software that's available.

Replacement Systems

What system for replacement of signing do you now use? The best system some agencies have is the **complaint system**. This is the system where the mayor, chief of police, county commissioner, or citizen demands replacement, because they were unable to react to a sign or someone else complained to them. This system is a "firefight" approach. The cost is usually high emotionally, leading to ulcers, migraines, and potential job loss.

Another system is the **legal system**. This may offer what appears to be a bargain. Do not replace, maintain, or use the right product in the right place. This system, when it strikes, is the most expensive. A $1,000,000 judgment could sign the average county or DOT district numerous times over, not to mention the impact on a city or township. This appears to be signing at the lowest price, but results in the highest cost to an agency. When you add time, people, and financial resources, you have quickly lost your bargain.

A **visual evaluation** system is a means of finding bad signing of your road fast. You drive your entire system during the day and replace all the signs that appear cracked, faded, or peeling. Then, the following year a nighttime evaluation is conducted. This is when your budget needs to be its biggest. This combined system is a good place to start, but this still leads to major peaks and valleys in your agency's signing budget.

A good method is the **series system**. This is a program where signs are replaced by criticality. The first year regulatory signs are replaced, the next year imminent warning signs, then potential warning signs, and you continue to replace all the different series of signs. The down side is that there are major peaks and valleys in replacement due to more signs in the particular series.

A **sign maintenance management** system is a guaranteed method to keep your budget consistent and your workforce efficient. This is a process where an agency divides itself into 2, 4, 6, 7, or even 14 maintenance districts. The number is determined by the longevity of the reflective materials and the rate that deficient signs need to be replaced.

The city of St. Paul has had an excellent program in place for years. They replace 1/14 of the city's signs each year. This is based on the tested life of the retroreflective sheeting they are using.

Retroreflectivity

The type of retroreflective product is not the primary focus of this story. The basic ingredient to a quality sign program is the following: signing that commands attention both day and night for all drivers, signing that offers a safety buffer during a July thunderstorm or January blizzard, and signing that provides years of service. If you have all these things to keep your signs serving the community, you've got it all!

Want to Learn More?

To learn more about durable signing, sign maintenance management, software, electronic sign fabrication, sign refurbishing technologies, and other transportation topics, plan on attending the Fifth Annual American Transportation Safety Services Association Transportation "How To" on April 14-16, 1998, in Fargo, N.D. Call **John Jackels** of Mn/DOT at (612) 582-1390, or **Bruce Jacoby** of 3M at (800) 949-2194, for details.

[Jacoby is senior account representative with 3M's Traffic Control Division.]

Bridge Inspection Tips

by Steve Kavanagh

Inspecting concrete bridges is an important part of a bridge maintenance routine. Following are descriptions of bridge deck deterioration indicators and inspection locations and procedures. Also included are some of Mn/DOT's PONTIS tools for concrete deck management.

Deterioration Indicators

The inspection of concrete decks for cracks, spalls, and other defects is primarily a visual activity. Some of the visual indicators are:

- Concrete discoloration. Darkened concrete indicates water saturation. Efflorescence is a white deposit on concrete caused by crystallization of soluble salts brought to the surface by moisture in the concrete surface.
- Scaling. The gradual deterioration of a concrete surface due to the failure of the cement paste caused by chemical attack or freeze/thaw cycles.
- Spalling. Circular or oval depression in the concrete caused by a separation of a portion of the surface concrete revealing a fracture parallel with or slightly inclined to the surface. This is often caused by rust buildup on deck rerods as the rust expands; these can be found both on top and below the deck.

In addition to visual inspection, hammers and chain drags can be used to detect areas of delamination. Also, core samples can be taken from the deck and sent to a laboratory to determine the extent of any chloride contamination.

Inspection Locations and Procedures

Both the top and bottom surfaces of concrete decks should be inspected for cracking, scaling, spalling, corroding reinforcement, chloride contamination, delamination, and full or partial depth failures. The primary locations for concrete deck inspection include:

- Areas exposed to traffic—examine for wear, scaling, delamination, and spalls.
- Areas exposed to drainage—investigate for general deterioration of the concrete.
- Bearing and shear areas where the concrete deck is supported—check for spalls and crushing.
- Shear key joints between precast deck panels—inspect for cracks and other signs of independent action.
- Top of the slab over the supports—examine for flexure cracks.
- Bottom of the slab between the supports—check for flexure cracks.
- Top and bottom of the slab in negative moment regions of the superstructure—check for transverse flexure cracks.
- Stay-in-place forms—investigate for deterioration and corrosion of the forms, often indicating contamination of the concrete deck; these forms can retain moisture and chlorides that penetrate full-depth cracks in the deck.
- Anchorage zones of precast slab tie rods—check for deteriorating grout pockets or loose lock-off devices; if a previous inspection report is available, this should be used by the inspector so that the progression of any deterioration can be noted.

PONTIS Inspection Program

Mn/DOT issues annual bridge inspection reports through the PONTIS program. For more information regarding Mn/DOT's PONTIS program, contact Paul Kivisto at (612) 582-1194.

The inspection reports include:

- Deck and slab conditions. This report will list all of your bridges in deterioration beyond condition 2 (on a scale of 1 to 5), with the square unit of deterioration. Decks are graded by the percent of deterioration; condition 1 is defined as no repaired areas; condition 5 is more than 25 percent repaired areas.
- Deck cracking smart flag conditions. This report addresses deck cracking. Once a deck begins to show other distress more significant than cracking (spalling/delamination), the status of this smart flag is probably not important. Only decks in condition 2 or worse will be listed in your final PONTIS summary.
- Underdeck smart flag conditions. This addresses deck distresses through visual inspections of the deck soffit (under surface). It is extremely valuable when the top surface of the deck is covered with an overlay. PONTIS indicates distressed areas such as water saturation, spalls, map cracking, and patched areas.

[Kavanagh is bridge maintenance supervisor with Mn/DOT in St. Cloud.]

WORKSHOPS & TRAINING

Superintendents Tour Hutchinson Facility

As part of the Maintenance Superintendents Conference (Districts 3 & 8) on April 16, McLeod County hosted a tour of the Hutchinson Area Transportation Services (HATS) facility. This facility is the joint highway maintenance building constructed and operated by McLeod County, Mn/DOT, and the city of Hutchinson.

Dave Randt, McLeod County maintenance superintendent, organized the agenda and led the tour. **Rick Kjonaas,** county engineer with McLeod County and a T² Steering Committee member, described the work of the joint powers board that manages the facility.

The board has one appointee from McLeod County (Kjonaas), two from Hutchinson (John Rodeberg and Ken Merrill), and one from Mn/DOT (Jack Kipacek). The board meets monthly to set budgets and policies, hear from agencies and employee groups, and resolve issues or problems for the continuing success of the partnership. Two part-time employees are now paid by the board, which receives funding periodically from all three agencies.

The board's guiding principle is that—in resolving any problem or issue—the top priority is to give maximum benefit to the public. Only then does the board develop each agency's role in order to reach a particular outcome, Kjonaas said. To resolve a specific issue, for example, it might take more sacrifice from one agency than the others, but over time the expenses should even out so that all three agencies are satisfied and receive back maximum benefits from the partnership, he said.

A major hope for the project is that as the population of the area expands and public expectations rise, existing crews will be able to meet some of the need through gains in operating efficiency. Kjonaas acknowledged that every street department works with neighboring agencies to some extent, but this project is designed to "push partnering to as a high a level as possible." To date, the results are good: "We very pleased with how it's going so far," he said.

[For information on next year's maintenance superintendents conference, contact any District 3 or District 8 county superintendent or call Rick Kjonaas at (320) 864-3156.]

T² Workshop Categories and Fees

Category A: T² Base Program Courses

The registration fee reflects a course subsidy using Minnesota Local Road Research Board (LRRB) and FHWA Local Technical Assistance Program (LTAP) funds.

Course Fee

$50.00 City/County
$40.00 Township

Courses

- Gravel Road Maintenance
- Methods for Effective Equipment Purchasing/ Cooperative Equipment Purchasing*
- Preventive Equipment Maintenance
- Traffic Signing and Control
- Traffic Engineering Fundamentals
- Tort Liability
- Highway Drainage Design*
- Equipment Management, Replacement Schedules, Financing*

Category B: T² "Special" Program Courses

The registration fee reflects a partial course subsidy using special LRRB or Mn/DOT State Aid funds. Fees vary depending on special funds available.

Courses and Fees

- Mechanic Training—$95.00
- Spring Maintenance Research Expo—$50.00
- Satellite Training Programs (topics to be announced)—$50.00
- Erosion Control (two days)—$150.00
- Management of Roadside Vegetation*—$75.00
- Construction Contract Management*—$75.00
- Pavement Design (asphalt, concrete, gravel)*—$50.00
- Superpave Asphalt Mix Design*—$50.00
- Seal Coat Design, Procedures, and Crack Seal Materials*—$50.00
- Pavement Management/Condition Ratings*—$50.00
- Cost/Benefit Analysis/Performance Measures*—$50.00
- Circuit Training and Assistance Program (C-TAP/ T² Van)—$25.00
- Snow and Ice Control
- Asphalt Maintenance
- Work Zone Safety *
- Management of Roadside Vegetation*

Category C: Nonsubsidized T² Courses (Anticipated Fees, All Courses)

Registration fees cover all associated course costs. Cost is $140 for a one-day course.

Courses

- Advanced Traffic Signal Systems
- Construction of Hot Mix Asphalt
- CADD User Group Sessions
- Internet—Accessing and Use*
- Road/Weather Information Systems (R/WIS)*
- Geographic Information Systems: Introduction to GIS for Local Government
- Address Mapping/Mile Reference Posts (Linear Reference Systems)*
- Political Redistricting with Census Data*
- Facilities Management*
- Parcel Mapping*

* New topics for course development under consideration. Selected 1998-99 course offerings will reflect priority topics depending on funding availability and local agency demand.

Tidbits from the CTS Annual Research Conference

The Center for Transportation Studies held its Eighth Annual Transportation Research Conference on May 13-14 in Minneapolis. Two conference presentations that might be of interest to *Exchange* readers are summarized below.

Recycled Concrete Aggregate *Can* Be Useful in Pavements

Professor Mark Snyder of the University of Minnesota presented the results of an FHWA-funded study on the "Use of Recycled Concrete Aggregate in New Concrete Mixtures."

Recycled concrete aggregate (RCA) is produced by the crushing of original concrete structures. Interest in using RCA has grown due to environmental concerns, dwindling landfill space, disposal costs, and project costs, he said. However, because of some cases of poor performance in the past (including deteriorated midpanel cracks and loss of load transfer), some states have banned the use of RCA in highway pavements. Thus, his study was designed to find the causes of pavement distress due to RCA, develop practical guidelines for RCA mix designs, and identify pavement designs for which RCA is appropriate.

His research team conducted tests at four sites in Minnesota as well as at sites in four other states (all sites were at least seven years old), plus numerous types of laboratory tests. They found that the following factors significantly affect RCA performance:

- The mechanism of breakage/ crushing, which influences the gradation and the workability of the concrete.
- Clinging mortar (from the old concrete mix). This is very important in influencing properties of the new aggregate. The original aggregate type, type of crusher used, and amount of crushing required all influence how much mortar remains.

[Ed. note: A proceedings of the plenary sessions will be available from the Center later this summer by calling (612) 626-1077. This will include the opening panel session on "Road Pricing in the Real World," with a keynote address by Gerald S. Pfeffer, senior vice president with United Infrastructure, and two luncheon presentations: the first by Jose A. Gomez-Ibanez of Harvard University on "Transport Privatization: What's Working and What's Not," and the second by Gloria J. Jeff, associate administrator for policy with the Federal Highway Administration, on "ISTEA II: The Challenge of Managing a 21st Century Transportation System."]

Research indicates that states have modified their RCA mix designs so that the strength of their RCA concrete is the same as, or even slightly higher than, that of conventional concrete. They also found that the elasticity of the RCA concrete was the same as, or slightly lower than, that of conventional concrete, depending on the total mortar contents of the two materials. This has important implications for pavement design—if a reclaimed aggregate has a large amount of clinging mortar, engineers should consider using shorter joint spacings, Snyder said.

In conclusion, Snyder reported that RCA can be used successfully in new concrete mixtures. The performance of RCA concrete can be comparable to that of conventional concrete if reclaimed mortar contents are low. However, reducing reclaimed mortar contents results in more waste and less profit for contractors, who would prefer to maximize recycling efficiency. Overall, Snyder recommends that users "treat RCA as an engineered material and test thoroughly."

Intercity Bus Study Leads to a Call for Proposals

Gerald Weiss, federal programs manager for transit at Mn/DOT, presented findings from the Minnesota Intercity Bus Study. The aim of this study was to learn about the current intercity bus service in Minnesota, its routes, riders and facilities, and then to evaluate and suggest strategies for improving service in rural areas. Key components of the study were a literature review and a rider survey, which was conducted in eight bus stations.

Some findings from the intercity bus ridership survey are:

- Riders in the 18-34 and over 55 age groups constitute the majority of riders.
- Seventy-one percent of trips are social or recreational.
- Workers (41 percent) and students (26 percent) are predominant users.
- Thirty-six percent of trips were to outstate Minnesota, 24 percent to the Twin Cities.
- Top reasons for intercity bus trips are low cost, no car, and convenience.
- Nearly 80 percent of the Minnesota sample live within 20 miles of an intercity bus terminal.
- North and southwest Minnesota are underserved.

The study revealed several areas where rural intercity bus service could be improved, including station facilities, marketing of bus services, and service gaps. The Mn/DOT Office of Transit will be accepting 1998 funding proposals for the development, support, and improvement of intercity bus travel.

For more information on this study or on submitting a proposal, contact Gerald Weiss at (612) 296-1612.

Publications and Videos

Minnesota T² and Mn/DOT Library

Materials available through the **Minnesota Transportation Libraries (MTL)** partnership are described below. For further information contact Laura Dale Bischof, CTS/ Minnesota T², phone (612) 626-1023, fax (612) 625-6381.

Videos

Taking Care of Roadsides (United States Department of Transportation. Ca. 10 minutes. 1997.) This video features state programs that use native grasses and flowers to improve the ecological and aesthetic quality of roadsides. The highlighted programs, often the result of private/public partnerships, not only reduce the maintenance costs of irrigation, mowing, and herbicide, but also help to preserve a region's natural heritage.

Printed Materials

How to Develop and Implement an Integrated Roadside Vegetation Management Program: A Guide for Township, City, County, Parish, State, Turnpike and other Roadside Authorities. (The National Roadside Vegetation Management Association Integrated Roadside Vegetation Management Program Task Force. 1997)

This guide directs roadside authorities in the development and organization of integrated roadside management programs. This volume is useful for local governments considering or currently working on a vegetation plan. Special emphasis is given to plan development and evaluation and consensus building.

Greener Roadsides: An FHWA Quarterly Newsletter for Roadside Decision-Makers (Federal Highway Administration Office of Environment and Planning.) *Greener Roadsides,* a free quarterly newsletter from the FHWA, features roadside management solutions from around the country. The winter 1996 issue is devoted to landscape solutions and topics such as historic preservation, parkway right-of-ways, median planters, and scenic overlooks.

Transportation Research Reports Catalog (Minnesota Department of Transportation, 1996.) The Minnesota Local Road Research Board, with assistance from the Minnesota Department of Transportation and the Minnesota Technology Transfer Program, presents 40 years of transportation research results available in an easy to read format.

The catalog contains short abstracts of research project reports from both Mn/DOT and LRRB, and each report is classified by subject in reverse chronological order. This structure allows a researcher or practitioner to scan the history of research on a certain topic, such as asphalt maintenance or soils, and quickly locate relevant projects and their library location.

1996 Research & Technology Program Highlights. (Federal Highway Administration. 1996.)

This 40-page report highlights the activities and accomplishments of the FHWA's Research and Technology Program during fiscal year 1996. Contents include intelligent transportation systems (ITS); pavements; structures; materials; highway policy, planning, and operations; environment; safety; and freight and motor carriers.

CD-ROMS

PMIS: Noxious and Nuisance Plant Management Information System (U.S. Army Corps of Engineers Waterways Experiment Station. Minimum system requirements: 386/ 25 processor and 500 kb hard disk space.)

Problem land and water plants can spread very quickly, endangering native vegetation and negatively impacting entire ecosystems. This plant management system CD-ROM is an interactive information system that assists nontechnical personnel in the identification and eradication of troublesome vegetation. Users can click on the scientific and common names of a plant, view a series of its images, and receive general information on the plant.

In addition, a step-by-step plant identification system helps users classify unknown plants. Buttons for herbicides, biocontrol agents (insects), and mechanical controls present the standard methods for eliminating a given plant. The CD-ROM also provides a list of contacts and Internet sites for plant management.

Get SHRP with New Publications

Over the years the *Exchange* has told you about the various Strategic Highway Research Program (SHRP) products that might help you do your job. But don't just take our word for it—feel free to check out the following publications that discuss SHRP products and programs.

Focus. (Federal Highway Administration.) If you don't already receive it, the SHRP monthly newsletter, *Focus,* is a great source for information. In addition to articles about various SHRP products, the newsletter also includes an implementation calendar listing regional and national events. To subscribe contact the editor, Kathryn Harrington-Hughes, (202) 347-1414; e-mail 74063.110@compuserve.com.

SHRP Products for Local Governments (Final Report) Executive Summary. (Federal Highway Administration Publication FHWA-SA-97-039.) This report summarizes efforts to deliver 18 products (mostly maintenance related) from SHRP to local governments through the LTAP centers. Over 165 regional or national exhibits/presentations were given during a three-year period, plus many more were completed at the local level by the LTAP centers.

TR News. (Transportation Research Board, Jan.-Feb. 1997.) This issue, titled "Bring Research to Reality: Strategic Highway Research Program," focuses on SHRP's legacy, namely, the more than 100 new devices, tests, and specifications that have been developed. Included in the document are photographs from Blue Earth County's Superpave site. The document, available on loan from Minnesota T², also contains many useful contacts names and numbers.

New Web Sites

LTAP News

LTAP News is now available on the World Wide Web. It currently houses T² center newsletters from all 50 states for the years 1992, 1993, and 1994. Check out *LTAP News* online at www.ltap.org.

NEXTEA Information

The National Economic Crossroads Transportation Efficiency Act (NEXTEA), the name for the reauthorization of ISTEA, is the federal government's six-year, $175 billion transportation funding plan.

The full text of the bill and additional information can be found at www.fhwa.dot.gov/reauthorization.

Street Talk

"Street Talk," an interactive Web site, allows public works directors, street and road superintendents, and city officials to share ideas, announcements, job openings, items for sale, and other options.

The site's address is www.cititech.com/talk.htm. It is provided by CitiTech Systems, Inc., a software company specializing in integrated software for public works and street/road departments.

SHRP Database

The Strategic Highway Research Program (SHRP) Evaluation and Implementation Database, developed by the Washington State Department of Transportation, is full of information accessible by the Web.

The database contains information supplied by state transportation departments, the Federal Highway Administration, the American Association of State Highway and Transportation Officials (AASHTO), and the Transportation Research Board.

The database is a good tool for evaluating and implementing SHRP products. It will allow for easier communication between states and for improved dissemination of SHRP product evaluations. It will also allow technical experts from all states to identify their counterparts at other agencies, as well as share information and experiences with them.

The home page lists the following categories:

- SPS and GPS test sites
- vendor directory
- personnel directory
- product evaluations
- literature
- AASHTO Subcommittee on Materials
- other links
- discussion groups
- calendar

The address is www.wsdot.wa.gov/fossc/OTA/SHRP.

[SHRP and NEXTEA material reprinted with permission from Sammie Jones, editor, LTAP Quarterly Newsletter, *Montana State University.]*

Report Available on ATP Process

University of Minnesota researchers recently completed a study titled *Minnesota's District/ Area Transportation Partnership Process (ATP).* The study was led by **Gary DeCramer,** a senior fellow with the Humphrey Institute and CTS who recently left the University to head the U.S. Department of Agriculture's Rural Development Agency. Also involved in the project were Humphrey Institute students **Wendy Klancher, Mara Krinke,** and **James MacGillis** and co-principal investigator **Robert Johns** of CTS.

The ATP process was introduced in Minnesota to ensure stakeholder participation in the development of the State Transportation Improvement Program. The ATP process is a new undertaking and is continually evolving. Each of the eight ATPs is required to submit a list of transportation investments for its area. The members of each have developed their own unique process for meeting this requirement.

The ATP report provides a point-in-time representation of the ATP process along with perceptions of the process's strengths and challenges developed through interviews of ATP members and other stakeholders. The report is a documentation, not an evaluation, of the process. There are two volumes to the report: Volume I is the cross-case analysis, and Volume II contains the eight ATP case studies and the perspectives of other stakeholders.

Copies of the report are available from Mn/DOT's Office of Research Administration, 612-282-2274.

Media Watch

You might want to check out the June issue of *American City & County.* It contains a short article about Minnesota cities and counties collaborating on the use of Geographic Information System (GIS) technology.

CALENDAR

If your professional organization meets on a regular basis, let us include the information here. Contact Editor, *Technology Exchange*.

For an up-to-date list of events in Minnesota and nationwide, please see the CTS/T² events web page: **http://www.umn.edu/cts/Events/calendar.html**

DATE	EVENT	LOCATION	CONTACT
Aug. 10-14	Eighth International Conference on Asphalt Pavements	Seattle, Wash.	Univ. of Washington, (206) 543-5539
Aug. 20	Work Zone Safety and the New MUTCD Teleconference	Various	American Public Works Association, (800) 472-6100
Aug. 24-27	Rural Advanced Technology and Transportation Systems Int. Conference	Big Sky, Mont.	Western Trans. Inst., (406) 994-6114
Sept. 3-4	Minnesota Transportation Alliance 104th Annual Meeting	Thunderbird Hotel, Bloomington	Bev Ringsak, (612) 625-6689
Sept. 14-18	American Public Works Association International Congress & Exhibition	Convention Center, Minneapolis	Rick Person, (612) 266-6122
Sept. 23-25	1997 Right-of-Way Professionals Conference	Conference Center, Breezy Point	Betty Moore, (612) 282-2450
Oct. 1-2	Second Annual Fall Maintenance Expo and Snow Roadeo	Anoka County, Minn., Fairgrounds	Bev Ringsak, (612) 625-6689
Oct. 5-8	American Society of Civil Engineers 1997 Annual Convention & Exposition, "Innovative Civil Engineering for Sustainable Development"	Convention Center, Minneapolis	(800) 548-2723
Oct. 20-21	23rd Annual Minnesota Public Transit Conference	Marriott Hotel, Bloomington	Mn/DOT's Office of Transit, (612) 296-3379
Oct. 29-31	United States Hot Mix Asphalt Conference	Phoenix, Ariz.	National Asphalt Pavement Association, (301) 731-4748
Nov. 6	"Partners for Roadway Safety Conference"—Third Annual	Ramada Plaza Hotel, Minnetonka	Marv Sohlo, Mn/DOT, (612) 582-1066

T² Passes Peer Review—With Your Help

During the week of June 16-20 a peer review team visited Minnesota to review several programs, as required in the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. Representatives of Mn/DOT (Bob Benke), the Local Road Research Board (Mike Sheehan), the federal government, and others were on the peer review team.

The Minnesota T² Program was one of the programs reviewed. We are pleased to report that the program received very positive reviews. Specifically, the *Exchange* was praised as one of the best LTAP newsletters in the nation, since it provides much original material.

That's where we would like to thank you. As evident in all our *Exchange* issues, many of you—our readers—contribute articles for the newsletter. The peer review is proof that all our efforts are worth it.

Reader Response

Please help the *Exchange* become more effective by filling out this form and returning it to:

Minnesota T² Program, Center for Transportation Studies
200 Transportation and Safety Building, 511 Washington Avenue S.E.
Minneapolis, MN 55455
Fax: (612) 625-6381 E-mail: snopl001@tc.umn.edu

The following is a(n)
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Name _____
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Employment
County_____City_____Township_____Mn/DOT_____Supplier_____
Contractor_____Consultant_____Vendor_____Other____
Address _____
Phone/Fax _____
My suggestion for a local innovation to report on is: _____
My question for the Q & A column is: _____
My idea, comment, or suggestion is: _____
Please send me information on: _____

Want to Become an ATSSA Flagging Instructor?

In concert with AASHTO and the FHWA, the American Traffic Safety Services Association (ATSSA) has developed a training course as part of a national flagger registration program. The program has two main components:

- a flagger training system
- a national database

The goal of the Flagger Registration program is to provide trained and responsible flaggers on the nation's roadways, thus enhancing traffic safety for workers and road users. To provide this service as effectively as possible, the program relies on a "train-the-trainer" approach that utilizes tiers of instruction levels, including master instructors—trained by ATSSA—who train flagger instructors, who train flaggers.

Flagging Instructor Training Course

ATSSA will hold two-day flagging instructor courses next spring in Grand Rapids, Michigan, and Fargo, North Dakota. They are also offering a Worksite Traffic Supervisor workshop next spring in New Brighton.

Classes are limited to not more than 15 students and fill up quickly. To obtain further information, call ATSSA at (540) 898-5449, e-mail general@flagger.com, or see their Web site at www.flagger.com.

ATSSA will consider scheduling additional courses based on demand, so if you are interested in having a course in your area, please notify ATSSA.

National Database

ATSSA has created an easily accessible national database of flagging information. The database is divided into sections, including:

- a list of flagging instructors
- a list of trained flaggers
- rules/regulations of ATSSA programs
- up-to-date federal and state standards and specifications
- job postings and other classifieds
- the latest flagging equipment/gear and the manufacturers and retailers providing it
- other flagging-related news and information
- information on other ATSSA traffic safety products and services.

The flagging database can be accessed by calling (540) 898-5449 or online at www.flagger.com. Some of the information will only be available by password to registered users.

Hydraulic Designing Goes CD-ROM

Since its initial printing in 1985, the FHWA's Hydraulic Design Series Number 5 publication, *Hydraulic Design of Highway Culverts,* has gained widespread use throughout the highway community. The publication is now available on compact disk (CD) in an interactive format with the following features:

- electronic design forms
- equation boxes for obtaining culvert design nomograph solutions in either English or metric units
- the 1995 FHWA videotape *Improved Inlets at Highway Culverts*
- hypertext links to figures, tables, design forms, and many other features

The CD is titled *Hydraulic Design of Highway Culverts* Version 1, publication no. FHWA-SA-96-080. The companion publication, *Installation and User's Guide for Hydraulic Design of Highway Culverts (CD-ROM),* publication no. FHWA-SA-96-081, which describes the CD's installation and features, can also be found on CD.

Microsoft Windows™ version 3.1 or higher is needed to run the CD. Copies of the user's guide can be obtained by calling Pallas, Inc., (801) 755-0002, or visiting the company's Web site at www.pallasinc.com.

[Reprinted with permission from the FHWA's Research and Technology Transporter, *May 1997.]*