Nearly two hundred persons attended the 12th Annual Roadway Management Conference on March 22-24, 2004, at the University of Delaware’s Newark campus. The Delaware Technology Transfer Centers in Delaware, Maryland, Pennsylvania, Virginia, and West Virginia sponsored the conference that attracted participants from all of these states and others as far away as Texas. The conference is one of the few in the nation that draws transportation officials from all levels of government: local, state, and federal. The Delaware T2 Center is a unit of the Delaware Center for Transportation.

A key theme this year was transportation safety. The conference began with an address by A. George Ostensen, Associate Administrator for Safety, at the Federal Highway Administration (FHWA). Mr. Ostensen, who spent two tours in Delaware with FHWA earlier in his career, is responsible for all FHWA traffic safety programs that reduce fatalities, personal injuries, and property damage. He pointed out accidents are primarily caused by three factors: driver failure, vehicle failure, and poor highway design. Government, the private sector, and the driving public must commit themselves to an all-out effort to overcome all of these shortcomings. If not, we have little hope of reducing the carnage of annual fatalities which now numbers about 43,000.

There were 21 different sessions at the conference. Those that specifically addressed safety included:

- A mock trial involving a work zone fatal accident
- Eliminating vehicle intrusions into work zones
- Chainsaw safety
- Homeland security issues affecting transportation agencies
- Red light running
- Roadway safety best practices
- Intersection safety

Other sessions covered a variety of topics including:

- Better communications
- Innovative equipment purchasing techniques
- Preventing highway flooding
- Email etiquette
- Pavement reclaiming and recycling
- Successful public meetings
- Winter maintenance strategies

A new feature this year was a bus tour to active and recently completed highway projects in the Wilmington area. Four buses went on a round robin tour of the River Front Walk, the I-95 bridge over the Brandywine Creek, the US 202 improvement project at Blue Ball, and video inspection of underground drainage facilities at Society Memorial Bridge.
MESSAGE FROM THE DIRECTOR

During our November 2003 Transportation Education and Research Forum, we received support from 15 different private organizations. In our March 2004 Roadway Management Conference, that number went up to 27. This, I believe, is an excellent indication of the private sectors’ realization of all the benefits that they can draw by participating in many different activities that DCT sponsors. We continue to explore these areas of mutual cooperation and hope to attract even more support from the private sector in the future.

DISTINGUISHED SPEAKER SERIES

NASA Planners Discuss Security and Facilities Planning
NASA’s Goddard Space Flight Center in Greenbelt, Maryland is home to the Nation’s largest concentration of earth and space science research. Maximizing this research means creating an environment that promotes open, timely peer interactions both within and beyond the boundaries of the site. At the same time, it means providing a safe and secure workplace for the laboratory’s entire workforce. In a post-9/11 world, balancing openness with security is an ever more complex challenge. On Monday, April 12, 2004, Kim Toufectis and Walter Daly, NASA’s chief architects and facilities planners, presented a two-hour lecture/discussion to about 150 U of D students and faculty, as well as to engineers and planners from the Delaware Department of Transportation. They discussed financial and other issues related to creating and maintaining the right environment for cutting-edge research and development. At Goddard, planners assembled a team to make a compelling link between their plans for the institution and the objectives of the mission leadership and other stakeholders. The presentation reviewed the process and introduced some new tools, and a new model that can be adapted to the needs of many research institutions.

Kim Toufectis and Walter Daly of NASA's Goddard Space Flight Center in Greenbelt, Maryland, speaking on “Contemporary Issues in Facilities Planning and Homeland Security,” at the University of Delaware

Our Distinguished Guest Speaker Series featured two lead architects and planners from NASA. Kim Toufectis and Walter Daly of NASA’s Goddard Space Flight Center presented an excellent talk on integrating security in the facilities planning process. Their talk attracted many students and faculty from UD as well as engineers and planners from DelDOT.

The Principle Investigator (PI) / Project Manager (PM) Showcase that we sponsored in Dover during May 2004 proved to be practically feasible and much more efficient in terms of providing access to all individuals who are interested in seeing and learning about our on-going projects. We have decided to continue the sponsorship of the showcase for the foreseeable future.

We are featuring a new section in our newsletter entitled “Research Pays Off”. Because the value of conducting research projects in transportation may not always be apparent to everyone, this new section describes the success stories that many transportation agencies have had after conducting research in a particular transportation field.

And finally, our non-thesis Masters degree program in Transportation Engineering is ready to accept students. Students can register for the program either full-time or part-time. Three areas of concentration, namely, Traffic and ITS, Planning, and Construction and Materials are offered. The program officially begins in Fall 2004. For more information, please call the Center at 302-831-1446.

VISITING TRAFFIC ENGINEERING PROFESSOR TO SPEND A YEAR AT DCT

Dr. Abishai (Avi) Polus of the Israel Institute of Technology (Technion) will be a visiting professor at DCT during the 2004-2005 academic year. Professor Polus, who finished his Ph.D. degree in Transportation Engineering at Northwestern University in 1975, has been highly active in the fields of highway capacity, geometric design, simulation and roadway design consistency. The author of more than sixty peer-reviewed journal articles, he will bring a wealth of knowledge and experience that will not only contribute to the research mission, but will also be a major participant in many different teaching and educational activities of the center. Currently, Professor Polus is scheduled to conduct a research project for DelDOT dealing with the environmental effects of roundabouts as compared to regular signalized intersections. He will also teach courses in Advanced Traffic Engineering, Intelligent Transportation Systems, Operational Effects of Geometrics, and Highway Capacity.

Dr. Abishai (Avi) Polus, Professor of Civil and Environmental Engineering at the Israel Institute of Technology (Technion)
Thus the purpose of the training program is to help citizens learn how to go about doing the work necessary to evaluate a road and compile a nomination. The most important tasks in completing a nomination are 1) learning the history of the road 2) conducting an inventory of intrinsic qualities found along the road, 3) determining the primary intrinsic quality for which the road merits designation, and 4) learning what stories the road has to tell.

The project started with an examination of best practices for the nomination process in other states with scenic highway programs and in the National Byways program. The team then developed and tested methods for each step in the nomination process for incorporation into the training program. Emphasis is placed on ways of giving citizens a head start in preparing their applications. These include providing instructions for generating and printing most of the maps they will need from Datamil, as well as assembling a “How-to Guide for Researching the Roads of Delaware.” A directory to libraries and research collections in Delaware that have materials on Delaware roads and highways, the research guide also contains a bibliography of sources on Delaware roads and an index to historic maps showing Delaware roads from the eighteenth century to the present.

The education program, “The Discovery Process of Learning the Stories of Scenic and Historic Highways in Delaware,” consists of workshop-based training together with a manual offered to local residents interested in nominating a road as a scenic or historic highway. Starting with concepts of scenic and historic highways, along with history of roads in Delaware, the training course and manual emphasize the methods for nominating a highway including organizing citizens’ groups, laying out the study area, surveying, documenting and evaluating the road’s intrinsic qualities and concluding with how to prepare an application.

The most difficult part of the nomination process is identifying and evaluating a road’s intrinsic qualities and what stories they tell about the road. To do this, an intrinsic quality resource survey is conducted of all the properties and view sheds along a road to determine their intrinsic qualities and those qualities that best characterize the road. It is difficult because it is not just a one-time survey with clipboard and pencil, but a much longer process of coming to know the road, and traveling it several times before the study team and community can arrive at a consensus, not only about the primary intrinsic qualities, but what they mean and how to interpret their significance. This comes down, then, to the community deciding what story it wants to tell about itself and about Delaware using the road.
FALL 2004 OPPORTUNITIES

DelDOT relies on the DCT to manage and sponsor much of its educational and training needs. This is particularly true for the “hard skills” otherwise labeled technology. The list below shows the names of the hard skills courses that the University will offer during the Fall 2004 semester.

This list is provided as a guide. For more information about a particular course, see the Fall 2004 Educational Opportunities for the Transportation Community, a DCT booklet mailed to all newsletter recipients. Also refer to the Fall ’04 Undergraduate and Graduate Registration Booklet and the Fall 2004 Professional and Continuing Studies Bulletin available in print or at www.udel.edu.

Construction
- Pavement Analysis and Design
- Deep Foundations
- Introduction to Bridge Design
- Advanced Concrete Design
- Introduction to Land Surveying
- Load and Resistance Factor Design
- Earth Retaining Structures
- LRFD for Substructures
- Mechanically Stabilized Earth Walls & Reinforced Soil Slopes

Environmental Engineering
- Introduction to Environmental Engineering
- Environmental Engineering Processes
- Fluid Mechanics
- Solid Waste Management
- Water and Wastewater Engineering
- Water Resources Engineering
- Chemical Aspects of Environmental Engineering
- Contaminant Transport & Separation in Environmental Systems
- Eutrophication and Sediment Flux Modeling
- Land and Water Management
- Storm Water Management
- Waste Water Treatment Systems
- Admiralty and Maritime Law
- Politics and the Environment
- Regional Watershed Management
- Energy Policy and Administration

Geotechnical Engineering
- Soil Mechanics
- Soil Mechanics Lab
- Deep Foundations
- Earth Retaining Structures
- LRFD for Substructures
- Mechanically Stabilized Earth Walls & Reinforced Soil Slopes

Government Policy
- Solid Waste Management
- Introduction to Public Policy
- Public Administration
- Local Economic Development: Policy & Practice
- Regional Watershed Management
- Planning Theory and Urban Policy
- Energy Policy and Administration
- GIS in Public Policy
- Case Studies in State & Local Management
- Admiralty and Maritime Law
- Environmental Values, Movements and Policy
- Seminar in Public Administration
- Political Economy of the Environment
- Taxation and Fiscal Policies
- Economics in Public and Nonprofit Sectors
- Organization and Management in Public & Nonprofit Sectors

Licensing Review Courses
- Fundamentals of Engineering (FE) Review Course
- Professional Engineer (PE) Licensing Review Course

Management & Leadership
- Financial Reporting and Analysis
- Data Analysis & Quality Management
- Understanding People in Organizations
- Marketing Management
- Introduction to Public Relations
- Public Relations Writing
- Oral Communications in Business
- Financial Management
- Introduction to Public Policy
- Public Administration
- Conflict Resolution
- Community Development Theory, Concepts and Practice
- Case Studies in State and Local Management
- Topics in Logistic Regression
- Myers Briggs & Personal Development
- Civic Engagement
- Enterprise Systems in Public and Nonprofit Sectors
- Information Technology in the Public and Nonprofit Sectors
- Technology Planning for Government and Nonprofit Organizations
- Seminar in Public Administration
- Public Management Statistics

Economics in Public and Nonprofit Sectors
- Organization & Management in Public and Nonprofit Sectors
- Human Resources Management in the Public and Nonprofit Sectors

Roadway Capacity & Design
- Urban Transportation Planning

Structural Engineering
- Statics
- Structural Analysis
- Building Design
- Probability-based Design
- Pavement Analysis and Design
- Introduction to Bridge Design
- Deep Foundations
- Advanced Concrete Design
- Coastal Structures
- Technology & Computer-aided Drafting
- Statics & Structure of Materials
- Composite Materials Structures
- Theory & Practice of Historic Preservation Planning
- Load & Resistance Factor Design
- Earth Retaining Structures
- LRFD for Substructures
- Mechanically Stabilized Earth Walls & Reinforced Soil Slopes

Traffic Engineering
- Traffic Network Simulation and Modeling

Transportation & Land Use Planning
- Urban Transportation Planning
- Land and Water Management
- Intro to Land Surveying
- Storm Water Management
- Regional Watershed Management
- Planning Theory and Urban Policy
- Theory and Practice of Historic Preservation Planning
- Context Sensitive Design

Other
- Elementary Statistics
- Urban Communities
- Introduction to GIS
- Documentation of Historic Structures
- Info Technology in the Public & Nonprofit Sectors
- Research Methods and Data Analysis

Certificate Programs
- Graduate Certificate in Composite Materials
- Geotechnical Engineering
- Maintenance Engineering
Delaware T² Center
Events Calendar

July 31-August 4, 2004
National T² Meeting, Bernalillo, NM
Annual gathering of 58 T² Centers to discuss best practices, technology emphasis areas, and other issues.

August 23-24, 2004
Peer Exchange, Newark, DE
Representatives from the Mississippi, Maryland, and West Virginia T² Centers and the Federal Highway Administration will participate in a peer exchange of our Center. The issue will be, “Selecting Technologies for Education and Deployment.”

October 5-8, 2004
NHI Course 135041, HEC-RAS, River Analysis System, Dover, DE
A 3.5 day course providing an overview and hands-on experience with a computer program for the design of bridges.

Fall 2004
Tort Liability, Dover, DE
A one-day course covering current transportation liability issues taught by Mark McNulty, Esq., Delaware DOT, and Dr. Ronald Eck, University of West Virginia.

Fall 2004
Critical Lane Analysis
A one-day course on the analytic process for intersection design and traffic signal timing. We intend to present this course more than once depending on demand.

Fall 2004 and Beyond
A Series of Traffic Engineering Workshops
Numerous one-day workshops focusing on the fundamentals of traffic engineering for engineers and higher level technicians. About 12-15 sessions will be offered initially.

Non-Thesis Masters Degree Program in Transportation Engineering
Offered for full-time as well as part-time students
3 concentrations: Traffic and ITS, Planning, Construction and Materials
Traffic Engineering and Intelligent Transportation Systems Core Courses
- CIEG-667 Advanced Traffic Engineering
- CIEG-652 Transportation Facilities Planning and Design
- CIEG-867 Traffic Flow Theory, or, Traffic Network Simulation & Modeling
- CIEG-667 Intelligent Transportation Systems
Transportation Planning Engineering Core Courses
- CIEG-654 Urban Transportation Planning
- CIEG-652 Transportation Facilities Planning and Design
- RES-601 or 602 Survey of Operations Research
- UAPP-601 Measuring and Defining Planning Problems
- UAPP-827 Program and Project Evaluation

Pavement and Highway Materials Engineering Core Courses
- CIEG-667 Pavement Analysis and Design
- CIEG-667 Civil Infrastructure Systems
- CIEG-652 Transportation Facilities Planning and Design
- CIEG-620 or 622 Soil Mechanics or Earth Structures Engineering
- CIEG-667 Advanced Construction Engineering and Management
Please call Kathy Werrell at 302-831-4863, or Wanda Taylor at 302-831-1446 for more information.

Note: The following article is reprinted with the permission of the California T² Center located at the University of California, Berkeley.

The Value of Training
Summary by Steve Muench, Ph.D. PE, of a chapter in his Ph.D. dissertation, University of Washington, 2004. For more information please contact <stmuench@u.washington.edu>.
c. Steve Muench 2004
Knowledge is a vital organizational asset. This is the essential unstated assumption associated with almost all training discussions. While American corporations spend in excess of $50 billion annually on training (Galvin, 2002) and numerous authors espouse the virtue and necessity of training, few make an effect to actually show its value. This short paper highlights the fundamental premise for continued and even increased support for training: it is an investment in a valuable commodity that produces high returns.

Knowledge is Valuable
Today, in the information age, organizations are routinely valued not on their physical but rather their intellectual capital. Edvinsson and Malone (1997) define intellectual capital as “the possession of the knowledge, applied experience, organizational technology, customer relationships and professional skills that provide [an organization] with a competitive edge in the market.” Bassi and Van Buren (1999) point out that “intellectual capital is the only source of competitive advantage within a growing number of industries.” For instance, the $296 billion market value of Microsoft in June 2004 far exceeds the value of its physical assets. To be sure, much of this value is based on speculation, but much is also based on Microsoft’s intellectual capital—what it knows. Training is one of the chief methods of maintaining and improving
Training is an Investment

General accounting standards classify training as an expense. However, training is really an investment: an organization typically invests up-front to train its employees (in the form of enrollment fees, travel expenses and opportunity cost of the employee’s time) and, in return, expects future returns (in the form of increased knowledge, skills and productivity). As with any other investment, if the returns outweigh the investment, training is a worthwhile endeavor.

Training is also an investment from the employee’s perspective. Training increases skills and knowledge, which can lead to better pay or promotion. So who benefits most from the training investment: the employee with increased wages and/or promotion, or the employer with increased productivity? Loewenstein and Spletzer (1998) researched this question and concluded, “the effect of an hour of training on productivity growth is about five times as large as the effect on wage growth.” Therefore, employers “reap almost all the returns to company training” (Bartel, 2000) This may be oversimplifying because employees generally view training as either a gift from the employer or at least a sign of commitment on the part of the employee, which is important to job satisfaction (Barrett and O’Connell, 2001).

In sum, both the employee and employer benefit from the training investment. The question now shifts to one of measurement: do the returns on training outweigh the investment?

Training Return on Investment (ROI)

When calculated using sound methodology, training has been shown to provide significant return on investment: on the order of 5 to 200 percent. The problem is that methods used to quantify training ROI can often be suspect or even outright self-promotion. Furthermore, it is often very difficult to quantify the effects of training. For instance, one effect of training can be increased job satisfaction, which is difficult if not impossible to quantify. Intuitively we know this is important in retaining good employees; however it will not show up on a ROI calculation.

In 2000, Bartel provided one of the best objective looks at the value of training to the employer. She looked at 10 large data set surveys and 16 individual case studies in an attempt to determine the employer’s return on investment. She found the following:

Methods using large data sets to compare many different organizations estimated training ROI from 7 to 50 percent.

Individual case studies estimated training ROI from 100 to 5900 percent. Bartel believes the high ROIs in this category are based on faulty methodology. Her in-depth analysis of two well-constructed internal case studies revealed a 100 to 200 percent ROI.

Therefore, even the most conservative estimate puts training’s ROI at 7 percent—an acceptable rate of return by most standards. Additionally, although it is not appropriate to generalize based on the results of two case studies, it can be said that based on Bartel’s in-depth analysis of two well-constructed internal case studies, training’s ROI can be much higher: approaching 100 to 200 percent.

Summary

Training is a valuable commodity that, if viewed as an investment rather than an expense, can produce high returns. While it is true that training costs money and uses valuable employee time and resources, studies tend to show training provides a positive return on investment—sometimes in the neighborhood of several hundred percent. Therefore, although training might seem like a luxury expense in tight financial times, it is, in fact, one of the most sure and sound investments available.

References


Training Course at UD. Ken Vaughn, from Citilabs, Inc., presenting Cube
Delaware Memorial Bridge.

Among Cube’s major advantages is that it is fully GIS compatible.

Mike DuRoss at DelDOT asked the T2 Center and the Engineering
Outreach Program to facilitate Cube training for its planning staff and
others in the Mid-Atlantic Region. This training took place on June 7-
11, 2004, at the University of Delaware’s main campus in Newark.

Student Researchers
Climb Up and Down the Delaware Memorial Bridge

By RuthAnn Eng

Editor’s Note: The University of Delaware Center for Innovative Bridge
Engineering is home to the National Science Foundation Research
Experiences for Undergraduates (NSF-REU) in Bridge Engineering pro-
gram, a summer research program for engineering students from colleges
and universities throughout the United States. RuthAnn Eng, an English
major at the University of Delaware, is one of 12 students participating
in the 2004 program. The following article documents her impressions of
a field trip to the Delaware Memorial Bridge.

For travelers between New Castle, Delaware, and Pennsville, New Jersey,
the Delaware Memorial Bridge is a familiar sight. This distance makes
this bridge the world’s longest twin suspension bridge, and on June 30,
the REU students toured the structure and enjoyed the view from the top
of the tower.

John Jones, the Director of Engineering and Maintenance, explained
that the Delaware River and Bay Authority (DRBA), the agency that
maintains the Delaware Memorial Bridge, is controlled cooperatively by
Delaware and New Jersey. The agency hires a summer intern from the University of Delaware and
one from Rowan University, and they both accompanied the group for
the day’s activities.

Joe Volk, the Senior Engineer for the bridge, spoke briefly about the his-
tory of the Delaware Memorial Bridge, and how the DRBA has worked
to establish higher standards of customer service and security. He was
very knowledgeable about the history and the future of the projects with
the bridge; and he said cheerfully, “I want to bring you down to the
bridge because that’s where the fun is.”

The anchorage
Volk was accompanied by electrical engineer Kenny
Simpson, and the REU students divided into two groups
for an extensive tour of the bridge. Volk led his groups
down into the anchorage, which looks deceptively small
from the outside. The small groups of cables that com-
pose the main suspension cable are stored and secured
inside the anchorage, and the entire structure is accessible
through a series of stairways.

Climbing down into the
main structure made some of the students nervous at times, particularly
in the partial darkness and steep steps, but the experience turned out to
be very informative. Justin said, “It was an unexpected part of the trip
that turned out to be the most interesting and educational.”

Volk challenged the students even further by leading them out onto
the catwalk underneath the bridge. With the vehicles roaring overhead and
steel beams shaking visibly, it was difficult to forget how high the cat-
walk was above the water. Walking underneath the bridge revealed its
internal structure that would not be apparent to a passenger simply
driving over it, and Volk was very helpful in pointing out the major
structural elements.

The tower
Simpson took the groups down to the pier at the foot of one of the
towers, and then straight up to the top of the tower for a fantastic view
of Delaware, New Jersey, and Pennsylvania. In pairs, everyone took a 4-
minute ride in a tiny elevator to the top of the tower, which gave them
an idea of what engineers might experience during an inspection of this
bridge.

Taronne thought that the trip to the Delaware Memorial Bridge was the
highlight of her summer so far. She says, “Seeing both the anchorage
and the tower gave me a greater appreciation of how a bridge needs to
be designed so that it can be accessible for inspection and main-
tenance.” This excursion gave the students a larger perspective on the gen-
eral design of bridges that might not otherwise have been obtained in
the classroom.
The Delaware Center for Transportation has been gearing up for another exciting year of Research for the Delaware Department of Transportation. In January 2004 we met with DelDOT’s Research Committee to identify and prioritize the most important transportation problems facing DelDOT. On July 1, 2004, the Project Investigators started research for DelDOT on the following projects:

**Active Adult (55+) Community/Trip Generation Rates**
What are the trip generation characteristics of "active adult" (55+) communities?

Principal Investigator: Dave Racca, Center for Applied Demography and Survey Research
Problem proposed by: Ralph Reeb, Division of Planning

**Evaluation of Roundabouts vs. Unsignalized and Signalized Intersections in Delaware**
Many fully-controlled (signalized) intersections, causing vehicles to stop and start, result in greater emissions (decreased air quality) than would be the case if the intersections were a roundabout instead. Which intersections would be appropriate for roundabouts? What impact would roundabouts have in DE? Need a model to identify intersections for roundabouts.

Principal Investigator: Ardeshir Faghri, Department of Civil and Environmental Engineering
Problem proposed by: Dan Lacombe, Division of Planning

**Characterization of SR-1 Concrete Test**
Prioritization of concrete used for SR-1 pavement (shrinkage & modulus evaluations).

Principal Investigator: Danny Richardson, Department of Civil and Environmental Engineering
Problem proposed by: Wayne Kling, Division of Materials and Research

**Hot Mix – Skid and Noise**
Evaluation of skid and noise, another surface texture characteristic of DelDOT superpave HMA mixtures (and possibly compare to DelDOT SMA and open-graded HMA mixtures). Conducting tests for Delaware using our materials vs. other states.

Principal Investigator: Nii Attoh-Okine, Department of Civil and Environmental Engineering
Problem proposed by: Wayne Kling, Division of Materials and Research

**Transit Accident Study**
Correlation of work hours and accident rates and existing resources. Determine if there are more accidents as a result of progressive hours of operator drive time.

Principal Investigator: Douglas Tuttle, Institute of Public Policy
Problem proposed by: Ray Miller, Delaware Transit Corporation

**Bike Path Adjacent To Residential Areas – Property Value/Desirability**
Quantify that bike paths can increase real estate values. Economic benefits of bike paths/trails adjacent to residential properties.

Principal Investigator: Dave Racca, Center for Applied Demography and Survey Research
Problem proposed by: Dan LaCombe, Division of Planning

**Succession Planning**
Transfer of institutional knowledge to the next generation of DelDOT professionals: Retirement/Succession planning; evaluate pros/cons of increased use of consultants vs. in house expertise; work force assessment (present & future); what are other state DOT’s doing to address this issue? Develop aggressive plan.

Principal Investigator: James Flynn, School of Urban Affairs
Problem proposed by: Rosemary Samick, FHWA

**Durability of Thin Overlays**
What do you replace it with on a new structure? Compare to more traditional ways.

Principal Investigator: Nii Attoh-Okine, Department of Civil and Environmental Engineering
Problem proposed by: Larry Klepner, DCT T’ Program, University of Delaware

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**The current active research projects include:**
As each project is completed, an abstract will be available on the DCT website: http://www.ce.udel.edu/dct.

**A Study of the Traffic Monitoring and Data Program in Delaware**
This project will review the traffic monitoring and data program of the Delaware Department of Transportation. Specific recommendations and subsequent monitoring of the implementation of those recommendations will follow this review.

Principal Investigator: Ardeshir Faghri, Department of Civil and Environmental Engineering
Project Manager: Tyrone Crittenden, Division of Planning

**Evaluation of the Potential of Retention Ponds and Sand Filters to Produce Nuisance Mosquitoes and West Nile Virus Vectors**
Principal Investigator: Jack Gingrich, Department of Entomology and Wildlife Ecology
Project Manager: Maryanne Walsh, Division of Field Services

**Commercial Vehicle Information System and Network (CVISN) for Delaware/I-95 Corridor Coalition**
The I-95 Corridor Coalition is moving forward with a corridor project to implement a Commercial Vehicle Operation (CVO) Commercial Vehicle Information Systems and Networks (CVISN) in neighboring states. This project will determine the best practices in the states that are implementing CVISN, and frame a CVISN implementation program in the Delaware model. It will recommend an incremental approach and identify what current practices within DelDOT, Motor Fuel, Public Safety, and the Delaware Code may need changes or revisions, and identify the cost to implement a program, as well as the cost savings to the State and the trucking companies.

Principal Investigator: Bernard Dworsky, Institute of Public Administration
Project Manager: Greg Oliver, DelDOT, Division of Planning

**Letting Scenic and Historic Roads in Delaware Tell Their Story**
A web-based manual to facilitate the identification, designation and management of scenic and historic highways
Data for Trip Generation Models: Trip Attraction Rates for Delaware Condition
Two types of developments create special trip generation circumstances: large commercial shopping complexes, and very compact multi-use developments. The purpose of this project is to have Delaware-specific trip generation rates for these land-uses.

Principal Investigator: Shinya Kikuchi, Dept. of Civil and Environmental Engineering
Project Manager: William Brockenbrough, Division of Project Development

Enhancing Delaware’s Highways: A Natural Vegetation Project
The project will investigate vegetation models conceived to restore Delaware's roadside landscapes to a more natural state reflecting the regional flora.

Principal Investigator: Sue Barton, Department of Plant and Soil Sciences
Project Manager: Chip Rosan, Roadside Environment

Transforming Data into Information: The Development and Demonstration of a Data Model to Support Planning
This project will demonstrate how information can be structured for integration into Oracle Enterprise databases, and how it can be accessed and used to support DelDOT's needs.

Principal Investigator: David Racca, Center for Applied Demography and Survey
Project Manager: Gene Donaldson, Traffic Management Center

Travel Time Measurement & Analysis Using Automated Vehicle Locator (AVL) on Dart Buses
This project will devise a system that provides the travel time in the network using AVL on the DART buses. This will include measuring and analyzing the accuracy of travel time, developing a set of algorithms to translate the measurements to information useful to auto users as well as transit users, and evaluating the effects of this system with respect to the overall performance of DelTrac.

Principal Investigator: Shinya Kikuchi, Department of Civil and Environmental Engineering
Project Manager: Gene Donaldson, Traffic Management Center

Examination and Application TRANSIMS
This project will examine TRANSIMS and how it will match the needs for travel demand analysis in Delaware. It will produce a preliminary user's manual for DelDOT's use.

Principal Investigator: Shinya Kikuchi, Department of Civil and Environmental Engineering
Project Manager: Mike DuRoss, Division of Planning

Treatment of Data for Transit Operations and Planning Decisions
This project will provide a new, more reliable estimate of travel mode choice in Delaware to be used for planning and evaluation of services and assist in the establishment of systems to better judge the consequences of alternative solutions to transportation problems.

Principal Investigator: Shinya Kikuchi, Department of Civil and Environmental Engineering
Project Manager: Dave Gula, Delaware Transit Corporation

ITS Lab Operations and Maintenance
This project will produce a new, more reliable estimate of travel mode choice in Delaware to be used for planning and evaluation of services and assist in the establishment of systems to better judge the consequences of alternative solutions to transportation problems.

Principal Investigator: Shinya Kikuchi, Department of Civil and Environmental Engineering
Project Manager: Gene Donaldson, Traffic Management Center

Surface Treated Roads
DelDOT maintains 1800 lane miles of surface treated pavement. It is along many of these roads that major new development is occurring. Is there a better surface treatment method or inexpensive technology that DelDOT could be using to address this issue?

Principal Investigator: Danny Richardson, Department of Civil and Environmental Engineering
Project Manager: Jennifer Cajthaml, Division of Preconstruction

Subdivision Inter-Connectivity
Various researchers have claimed that providing road connections between large sub-divisions results in fewer and shorter automobile trips and less congestion on the adjacent road system. We need to know how much difference inter-connectivity can/could or does make.

Principal Investigator: Ed O'Donnell, Institute of Public Policy
Project Manager: Ralph Reeb, Division of Planning

GPS/AVL System Evaluation
Determine benefits and productivity improvements of our Automated Vehicle Locator (AVL) System. (A GPS system that identifies location of buses).

Principal Investigator: Dave Racca, Center for Applied Demography and Survey Research
Project Manager: Bill Hickox, Delaware Transit Corporation

Estimating Current Modal Splits
This project will produce a new, more reliable estimate of travel mode choice in Delaware to be used for planning and evaluation of services and assist in the establishment of systems to better judge the consequences of alternative solutions to transportation problems.

Principal Investigator: David Racca, Center for Applied Demography and Survey Research
Project Manager: Michael DuRoss, Division of Planning

HMA Specification Research
Evaluate quality assurance program of DelDOT’s hot mix asphalt acceptance program. Statistical evaluation of test results.

Principal Investigator: Nii Attoh-Okine, Department of Civil and Environmental Engineering
Project Manager: Wayne Kling, Division of Materials and Research

2003-2004 GPS Travel Time and Delay Data Collection and Analysis
This project uses the state-of-the-art equipment in receiving satellite position information for collecting real-time state-wide traffic data. The data is then analyzed and displayed by Geographic Information Systems software.

Principal Investigator: Ardeshir Faghi, Dept. of Civil and Environmental Engineering
Project Manager: Dan Lacombe, Division of Planning

Principal Investigator: David Ames, Center for Historical Architecture and Design

Project Manager: David Petrosky, DelDOT, Division of Planning

Principal Investigator: Shinya Kikuchi, Dept. of Civil and Environmental Engineering

Project Manager: Mike DuRoss, Division of Planning
During the 2003-2004 fiscal year the Delaware Center for Transportation's principal investigators have been busy doing research for specific needs for DelDOT. We have completed and published fifteen project reports. Check our website for an abstract of each report.

**Evaluation of Training Methods**
by Kathleen Werrell in cooperation with
Project Manager, Larry Klepner, T2 Program, University of Delaware

**DART First State Delaware Paratransit Services Study: A Review of Service Characteristics, Policy Implications and Options**
by Douglas Tuttle in cooperation with
Project Manager, Stephen Kingsberry, DTC

**Delaware Department of Transportation Reorganization/Soft Skills Workshop Project**
by Kathy Wian in cooperation with
Project Manager, Carolann Wicks, DelDOT

**ADA Eligibility Process Control Model for DART First State Paratransit**
by Carol R. Denson in cooperation with
Project Manager, Bonnie Hitch, DTC

**An Attempt to Estimate the Resilient Modulus of Construction Materials from Basic Soil Tests**
by Nii Attoh-Okine in cooperation with
Project Manager, Wayne Kling, DelDOT

**Service Life Assessment of Concrete with ASR and Possible Mitigation**
by Nii Attoh-Okine in cooperation with
Project Manager, Jim Pappas, DelDOT

**Factors That Affect and/or Can Alter Mode Choice**
by Edward Ratledge in cooperation with
Project Manager, Dan LaCombe, DelDOT

**Reinforced Multitiered Walls**
by Dov Leshchinsky in cooperation with
Project Manager, Dennis O'Shea, DelDOT

**DESIGN SPEED Selection Recommendations**
by Ardeshir Faghri in cooperation with
Project Manager, Michael Balbierer, DelDOT

**High Performance Concrete for Bridge 8F in Frederica, Delaware**
by Michael J. Chajes in cooperation with
Project Manager, Muhammad Chaudhri, DelDOT

**Second Generation In-Service Bridge Monitoring System**
by Tripp Shenton in cooperation with
Project Manager, Joe Vogel, DelDOT

**Analysis and Testing of a Highly Skewed Bridge**
by Michael J. Chajes in cooperation with
Project Manager, Dennis O’Shea, DelDOT

**Detecting Corrosion in Existing Structures Using Time Domain Reflectometry**
by Robert Hunsperger in cooperation with
Project Manager, Muhammad Chaudhri, DelDOT

**Application of Global Position System (GPS) to Travel Time and Delay Measurements: 2002 Phase**
by Ardeshir Faghri in cooperation with
Project Manager, Dan LaCombe, DelDOT

**Use of HDPE Drainage Pipes by DelDOT**
by Dov Leshchinsky in cooperation with
Project Manager, Jiten Soneji, DelDOT

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**TECHNICAL ASSISTANCE**

The Delaware Center for Transportation also does short-term projects, which include, but not limited to, a literature search on a topic that a full-fledged research is not required, or did not receive high enough priority to be funded. During the 2003-2004 fiscal year the Center did literature searches on the topics listed below. A report of the findings was given to the project manager to look over and decide if that is enough information for their needs, or if they would like the Center to do more research.

**Environmental Friendly Bridge Coatings and Sealants**

**Cross Walks – Materials/ADA**

**Effective Training for Pedestrians**

**GASB 34**

**Pass-By Trips**

**Pavement Marking Materials**

**Better Utilization and Best Practices/Coordination of Existing Resources for Transit**

**Scrap Tires**

**Design of Toll Booth Facilities for Safety**

**Truck Parking Space**

**Best Design for Truncated Domes/ADA**

**Utilities Accommodations**

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**SANDI WOLFE JOINS DCT STAFF**

It is our pleasure to introduce the newest member of our Center, Sandi Wolfe. Sandi is working part-time assisting everyone at the Center. She comes to us with excellent secretarial skills and experience and will be a great asset to the Center as we expand.

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Sandi Wolfe, DCT Secretary, and Larry Klepner, T2 Program Coordinator, at the Transportation Research Showcase.
“Research Pays Off” is a new section in this newsletter. The results of research can provide innovative, cost-effective solutions to important transportation-related problems. In the future, each issue of TranSearch will feature a research project in the US that was solved and implemented as an example of how research is important in transportation. This issue’s article has been reprinted, with permission, from the Transportation Research Board’s website: http://www.4.trb.org/trb/onlinepubs.nsf/web/rpo_intro.

TIRE SHREDS SAVE MONEY FOR MAINE

Dana N. Humphrey, Philip A. Dunn, Jr., and Peter S. Merfeld

Obtaining adequate slope stability of highway embankments constructed on weak foundation soils is a challenging design problem. To address this problem, highway engineers often consider using lightweight fill, such as expanded poly-styrene, shale, wood chips, or tire shreds made from used rubber tires. Nationwide an estimated 800 million tires lie in abandoned stockpiles. In addition, 64 million tires with no productive end use are generated annually. Since approximately 100 tires are required for one cubic meter of compacted tire shred fill, there is a great potential for the use of rubber tire shreds on highway projects.

Problem

The designers of a new interchange for the Maine Turnpike, intended to provide more direct access to the Portland Jetport and surrounding city streets, were faced with weak foundation soils. The site for the 9.8-m-high bridge approach embankments on each side of the turnpike was underlain by up to 12 m of weak marine clay, offering unacceptably low safety factors for slope stability.

Several alternatives for strengthening the foundation soils and stabilizing berms were examined, including ground improvement techniques such as stone columns and deep soil mixing. However, these options were discarded because of their impact on adjacent wetlands and their relatively high cost. For a cost-effective solution, geotechnical designers turned to the results of research conducted since 1990 at the University of Maine on use of tire shreds as lightweight fill. For the Jetport project, information from five projects funded by the Maine Department of Transportation (MDOT) and three projects funded by the New England Transportation Consortium (NETC) was used.

Solution

The studies funded by MDOT and NETC provided information on the engineering and environmental characteristics of tire shreds as lightweight fill for highway embankments and retaining-wall backfill. The study results show that tire shreds have an in-place density of 0.70 to 0.95 Mg/m$^3$ as compared with a typical soil density of 2.0 Mg/m$^3$. It was also found that tire shred layers will be compressed by the weight of any overlying soil, making it necessary to overbuild the initial thickness of tire shred layers. In addition, field research indicated that tire shreds should be covered by at least 0.8 m of soil to provide proper support for an overlying flexible pavement.

A field study has been addressing concerns related to the effect of tire shreds on groundwater quality. The site for this study is on Route 231 in North Yarmouth, Maine. At two locations beneath the shoulder of the road, 3-m2 geomembranelined basins are being used to collect water that has infiltrated through 0.6 m of tire shreds covered by about 1 m of granular soil. A third basin, used as a control, is overlain only by granular soil.

Water quality at the site has been monitored for more than 5 years. Results show that the tire shreds have increased the levels of manganese and iron, but these metals are not a health concern. Concentrations of other metals have been similar to those found in water samples taken from the control section, and all have been well below the primary drinking water standard levels. In addition, samples were taken for volatile and semi-volatile organics on two dates, with no detectable levels found.

In 1995 and 1996, three tire shred fills built elsewhere underwent self-heating reactions. Subsequently, the University of Maine, in conjunction with the Federal Highway Administration and the scrap tire industry, conducted a study on how to limit heating of thick tire shred fills. This study resulted in guidelines now embodied in ASTM D6270-98, Standard Practice for Use of Scrap Tires in Civil Engineering Applications.

Application

For the Portland Jetport Interchange, the designers elected to take a conservative approach, and used 1.8 m of soil between the top of the tire shred layer and the bottom of the flexible pavement. Results of laboratory compressibility tests indicated that the tire shred layers should be overbuilt by about 10 percent of their final thickness. Information from the North Yarmouth study was used to obtain environmental approval for the project.

The Portland Jetport Interchange was the first project to fully implement the newly developed guidelines for limiting the heating of thick tire shred fills. To comply with those guidelines, the designers of the interchange used 300-mm maximum-size tire shreds, less than 1 percent of which were smaller than 4.75 mm. The shreds were placed in two layers, each with a maximum thickness of 3 m, separated by 0.9 m of fine-grained soil. The outsides of the tire shred layers were also covered with fine-grained soil. Temperature measurements taken in the tire shred layers during and after construction showed no evidence of self-heating.

Benefits

All of the lightweight materials considered for providing slope stability, tire shreds were found to be the cheapest. An agreement among the project designer, the Maine Turnpike Authority (MTA), and the Maine Department of Environmental Protection (MDEP) specified that the source of the tires be an abandoned stockpile about 50 km from the project site. Under this agreement, MTA saved $300,000 over the next-cheapest alternative. Since it would have cost MDEP $300,000 more to have these same tires processed for tire-derived fuel, use of tire shreds as lightweight fill on this project saved the state of Maine a total of $600,000.

Altogether, this project used 1.2 million tires, and MDOT has used 1.1 million tires on other projects. Cumulative savings from these projects have more than returned the money invested in the University of Maine’s tire shred research.

In addition, use of tire shreds on the Jetport project did not impact the adjacent wetlands, as would have been the case with the other methods considered. As a final benefit, the results from the University of Maine research and the self-heating reaction study were used to develop an ASTM standard.

For further information contact Dana N. Humphrey, Civil and Environmental Engineering, University of Maine, 5711 Boardman Hall, Orono, Maine 04469-5711 (telephone 207-581-2176, e-mail dana.humphrey@maine.edu).
DCT SPONSORS ITS FIRST TRANSPORTATION RESEARCH SHOWCASE

DCT sponsored its first annual “Transportation Research Showcase” at the Paradee Center in Dover on May 3, 2004. Each Project Investigator and graduate student(s) hosted a poster session for his/her current project(s). Although the rain may have kept some people away, we still had a good attendance at the Showcase. There were visitors from DelDOT, the Delaware Legislature, private industries and the University of Delaware. This will become an annual event. If you missed our first showcase, be sure to watch for our next Transportation Research Showcase in spring 2005.

The posters were divided into six categories: Environmental, Pavement and Materials, Planning, Structures and Bridge, Traffic and ITS, and Transit so that visitors could easily find their particular area of interest. Visitors had an opportunity to converse with the Principal Investigators on a one-to-one basis.

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The mission of the Delaware Center for Transportation is to improve the movement of people, goods, and ideas within, to, and through the State of Delaware, the mid-Atlantic region, the nation, and the world through research, development, and education.