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DELAWARE HOSTS 2004 ROADWAY MANAGEMENT CONFERENCE



A. George Ostensen, Associate Administrator for Safety, FHWA, addresses attendees at the 2004 Roadway Management Conference.

Transportation 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:

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

- 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



A mock trial involving a work zone fatal accident.

202 improvement project at Blue Ball, and video inspection of underground drainage facilities at Society

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MESSAGE FROM THE DIRECTOR



Ardashir Faghri, 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



Kim Toufectis (standing, foreground) and Walter Daly (standing behind podium) from the NASA Goddard Space Flight Center in Greenbelt, Maryland, speaking on "Contemporary Issues in Facilities Planning and Homeland Security," at the University of Delaware

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,

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 UID 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.

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 leads NASA's Goddard Space Flight Center's Facilities Planning Office. He currently serves full-time as a representative of Goddard and the Earth Science Enterprise on NASA's Agency-wide Real Property Mission Analysis (RPMA) Team. He holds a Masters degree in Architecture from Rice University and is a registered architect.

Walter Daly is presently the Lead Architect and Master Planner for the Parsons contract at NASA's Goddard Space Flight Center. He is responsible for the administration and management of the Architectural Department of Parsons, and supervises a staff of architects, designers and planners. He holds a Masters degree in Architecture from Tulane University.

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)

Story continued from cover



RMC participants take a bus tour to recently completed I-95 bridge over the Brandywine Creek.

Hill Road in Claymont. DelDOT or consultant project staff were stationed at all the locations to explain projects in detail and to answer questions.

Pennsylvania will host the next Roadway Management

Conference in March 2005 at Hershey.

We wish to thank the following organizations for participating in and sponsoring the 2004 Roadway Management Conference:

- ACF Environmental, Richmond, VA
- Asphalt Paving Systems, Hammonton, NJ
- Asphalt Zipper, Inc., Pleasant Grove, UT
- Atlas Flasher and Supply Co., Inc., Bellmawr, NJ
- ATSSA, Fredericksburg, VA

- Bulk Storage, Inc., Beecher, IL
- CIMLINE, Inc., Plymouth, MN
- DeAngelo Brothers, Inc., Hazelton, PA
- Dome Corporation of North America, Montclair, NJ
- Dow Corning/SSI, Tulsa, OK
- E. J. Breneman, West Lawn, PA
- Flint Trading, Inc., Thomasville, NC
- J & J Truck Bodies and Trailers, Somerset, PA
- Kercher Engineering, Inc., Newark, DE
- Lane Enterprises, Inc., North East, MD
- Lanescan Safety Products, West Chester, PA
- M. H. Corbin, Inc., Plain City, OH
- Maccaferri, Inc., Williamsport, MD
- MACTEC Engineering and Consulting, Inc., Beltsville, MD
- McDonald Safety Equipment, Inc., Newport, DE
- Recon Construction Services, Inc., York, PA
- Reed Systems, Ltd., Ellenville, NY
- Russell Standard Corporation, Mars, PA
- Slurry Pavers, Inc., Glen Allen, VA
- Snow Equipment Sales, Inc., Dayton, OH
- Street Print, Midlothian, VA
- Tensar Earth Technologies, Inc., Atlanta, GA

LETTING SCENIC AND HISTORIC ROADS IN DELAWARE TELL THEIR STORY



David Ames (left), Director of the Center of the Historic Architecture and Design, Principal Investigator, and Eric Gollanek (right), graduate student in Art History, working on the project, "Letting Scenic Roads in Delaware Tell Their Story."

The Center for Historic Architecture and Design (CHAD) in conjunction with the Delaware Department of Transportation is currently developing a training program to teach citizens how to prepare nominations of prospective roads and highways to the state's scenic and historic highway program. The project manager is

David Petrosky from DelDOT with David Ames, Center for Historic Architecture and Design as principal investigator. A team of research assistants at CHAD are also working on the project, including Eric Gollanek, David Amott, Amardeep Dhanju, and Kathyne Larrivee.

Delaware's Scenic and Historic Highways program began in 2000, with Kennett Pike (Rt 52) becoming the state's first scenic highway in 2002. A scenic and historic highway is one that goes through an area with scenic, historic, natural, cultural, recreational, and archeological "intrinsic" qualities. DelDOT sees this as a community-based effort in which a road must be nominated by community members and supported by their local sponsors for inclusion in the Scenic and Historic Highway program. The nomination requires maps, a description of what the traveler will see and photographs of the road and views from the road. But most importantly, to qualify as a scenic and historic highway, a road must exhibit at least one outstanding "intrinsic" quality visible from the road.

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.

EDUCATION

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

Finance 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

T²

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.

FALL 2004

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

ORES-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 effort 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

intellectual capital. Because of this, an organization's training can affect its value. Bassi and Van Buren (1999) found training as a percentage of payroll to be significantly correlated with the market-to-book value of publicly traded companies. Where the average U.S. employer spent about 0.9% of payroll on education and training (Bassi, et al., 1996), training magazine's top 100 companies [in terms of training] averaged 4% with Pfizer ranking first at 14%.

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 for employee training. 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.

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DCT AND NHI EXPLORE PARTNERSHIP AGREEMENT

The National Highway Institute (NHI) is the training arm of the Federal Highway Administration. Its catalog includes more than 130 courses in areas such as Structures, Construction and Maintenance, Pavements, Intelligent Transportation Systems, Planning, and the Environment. In 2003 the NHI held 560 training sessions for 13,600 participants throughout the United States.

The DCT and the T² Center annually sponsor several NHI courses for DelDOT, local governments, and university students. Selecting the courses to schedule was based on a perceived need, but was not always tied into a long-range strategic plan. DelDOT is developing comprehensive training plans for each of its major divisions. It has identified numerous NHI courses that can meet its needs – courses that need to be predictably scheduled

over a period of several years. New NHI courses must also be scheduled in a timely manner.

The DCT and DelDOT realized that we must work more closely with the NHI than we have in the past. As a first step, the DCT invited the NHI to meet with DelDOT, the FHWA Delaware office, the DCT, and Engineering Outreach in the College of Engineering. At this meeting we all agreed that we should develop a partnership agreement that will result in a more systematic and predictable scheduling of NHI courses in Delaware.

The DCT has prepared a draft partnership agreement that all of the parties have approved in principle. The agreement will bind DelDOT, the NHI, and the DCT to closely work together to select, schedule, and evaluate transportation training in Delaware taught by the NHI and others. Delaware will be one of only a handful of states to have such an agreement with the NHI.

We intend to sign the agreement in late July or early August 2004. Our next issue of this newsletter will include a description of this agreement.

UNIVERSITY OF DELAWARE HOSTS CUBE TRAINING



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

About fifteen years ago DelDOT purchased Tranplan, then a new and sophisticated travel forecasting model. Tranplan became one of the most popular travel forecasting systems used by state and local transportation agencies. Now, in 2004, DelDOT has upgraded to Cube, Tranplan's successor.

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.

Fifteen persons attended this course including three from DelDOT, one from DelDOT's major planning consultant, and one UD Civil Engineering graduate student. New Jersey DOT and New Jersey Transit sent staff members, as did the Metropolitan Planning Organizations in Baltimore, MD and Toledo, OH.

The course was intended for analysts who generally apply models made by others to test scenarios of various transportation facilities. Course modules included:

- Interlocution to travel demand forecasting methodology
- Introduction to developing a travel model in Cube
- Using Cube Graphics for network development and editing
- Use of ArcGIS with Cube
- Preparing scenarios for testing
- Transit system coding, assignment, and analysis
- Evaluating, comparing, reporting, and presenting results

In exchange for providing training facilities, the University received a complete package of Cube software that it will use to train undergraduate and graduate students for many years. This is another example of how the University constantly revises its curriculum to provide DelDOT and others with excellently prepared engineers and planners.

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 program, 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.



(front to back) Andrea Chavez, Justin Ross, and Jimmy Chan walking on the catwalk underneath the Delaware Memorial Bridge.

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 history 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."



(clockwise from top) Peter Quinn, Julia West, Geoff Burrell, Lynne Starek, Adrienne Johnston, Kevin Bott, and Taronne Tabucchi standing on one of the towers of the Delaware Memorial Bridge. Quinn, West, and Johnston are all graduate students assisting with the NSF-REU program.

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 compose 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 catwalk 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 maintenance." This excursion gave the students a larger perspective on the general design of bridges that might not otherwise have been obtained in the classroom.

Research

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 T² Program, University of Delaware

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

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

Project Manager: David Petrosky, DelDOT, Division of Planning

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 Faghri, Dept. of Civil and Environmental Engineering

Project Manager: Dan Lacombe, 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

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

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

Principal Investigator: Shinya Kikuchi, Department of Civil and Environmental Engineering

Project Manager: Dave Gula, Delaware Transit Corporation

ITS Lab Operations and Maintenance

Principal Investigator: Shinya Kikuchi, Department of Civil and Environmental Engineering

Project Manager: Gene Donaldson, Traffic Management Center

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-fledge 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

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.



Sandi Wolfe, DCT Secretary, and Larry Klepner, T² Program Coordinator, at the Transportation Research Showcase.

Publications

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

Research Pays Off

"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/m³ as compared with a typical soil density of

2.0 Mg/m³. 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

Of all 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 paid the normal "low-bid" price to purchase the tires, and MDEP paid the cost of shredding the tires in the specified stockpile. By using tire shreds from this source, 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.

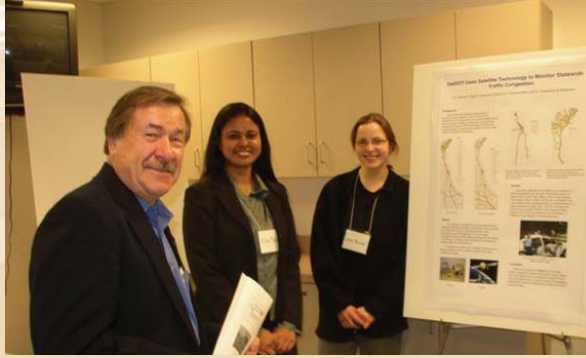
Altogether, this project used 1.2 million tires, and MDOT has used 1.1 million tires on other projects. Cumulative savings from these projects have more than returned the money invested in the University of Maine's tire shred research.

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, Department of Civil and Environmental Engineering, University of Maine, 5711 Boardman Hall, Orono, Maine 04469-5711 (telephone 207-581-2176, e-mail dana.humphrey@umit.maine.edu).

EDITOR'S NOTE: Appreciation is expressed to Stephen Maher and G. P. Jayaprakash for their efforts in developing this article.

DCT SPONSORS ITS FIRST TRANSPORTATION RESEARCH SHOWCASE



Representative Roger Roy (R-20) talking with graduate students Shilpa Mallem (left) and Laura Berzina (right) at the 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.



Dr. Ardashir Faghri (center) conversing with visitors at the Transportation Research Showcase.

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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.