University of Minnesota
Center for Transportation Studies
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CTS Research E-News brings you the latest research project milestones, published reports, and seminar coverage.

In this issue:

Policy & Planning

- U of M researchers and CTS edit 'Access to Destinations' book
- 2006 Oberstar Forum to focus on role of non-motorized transportation

Intelligent Transportation Systems

- Searching for the ideal ramp metering system
- New civil engineering professor to focus on traffic operations, modeling

Transportation Infrastructure

- Wooden bridges to benefit from high-tech structural scrutiny

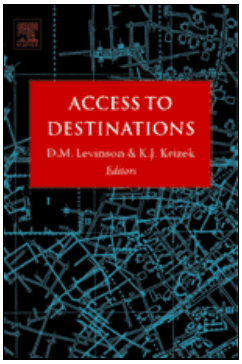
Transit & Alternative Modes

- National transit news

Upcoming Events

Policy & Planning

U of M researchers and CTS edit 'Access to Destinations' book



A new book that broadens our understanding of the concept of accessibility is now available. *Access to Destinations* is a 414-page collection of 17 research papers plus an introductory chapter by the editors: Associate Professor **David Levinson** (Department of Civil Engineering) and Assistant Professor **Kevin Krizek** (Humphrey Institute of Public Affairs).

The papers resulted from the CTS "Access to Destinations" Conference held at the University of Minnesota in November 2004. The conference was funded by University of Minnesota President Robert Bruininks' 21st Century Interdisciplinary Conference Series as well as CTS. Levinson and Krizek helped plan and moderate the conference.

The book is an up-to-date account of the science and policy of accessibility. The wide-ranging papers cover transit, network growth, definitions, modeling, and more.

"This is a lively, readable, and intellectually rich exploration of accessibility, the most important characteristic of cities and their transportation systems," writes Professor **Martin Wachs** in his review. "The contributors explore many aspects of accessibility and the loss of accessibility that comes with congestion. The result is fascinating, because their approaches are so different, yet complementary. [The book is] of equal interest to planners, engineers, and urbanists of all backgrounds." Wachs, of the University of California, Berkeley, was the CTS luncheon speaker in spring 2004.

Accessibility and mobility are distinctly different concepts, writes Professor **Susan Handy** of the University of California, Davis, in her chapter. Mobility is the ability to get from one place to another; accessibility is the ability to get what one needs, through travel if necessary.

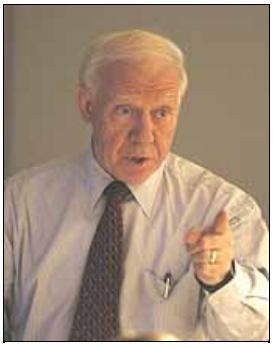
It is possible, she explains, to have good accessibility with poor mobility. For example, a community with severe congestion but where residents live within a short distance of destinations has poor mobility but may still have good accessibility. On the flip side, a community may have good mobility but poor accessibility: a smaller city may have ample roads and low levels of congestion but relatively few or inadequate destinations for shopping or other activities.

Published by Elsevier Ltd., the book was copyedited and produced by CTS editor **Peter Park Nelson**. It may be ordered online.

The CTS Access to Destinations interdisciplinary research program is another outcome of the 2004 conference. Five research projects are under way with funding from various sponsors, and CTS is developing an outreach program with a grant from the McKnight Foundation.

2006 Oberstar Forum to focus on role of non-motorized transportation

The fifth Oberstar Forum is scheduled for April 10, 2006, at Coffman Memorial Union on the Minneapolis campus of the University of Minnesota. The forum is hosted by CTS. The 2006 Oberstar Forum will explore the value of integrating non-motorized transportation such as bicycling and walking into communities. SAFETEA-LU has provided substantial federal funding to advance and evaluate walking and biking systems.



An afternoon panel discussion on implications for research will feature researchers **Kevin Krizek** and **Gary Barnes** of the University's Hubert H. Humphrey Institute of Public Affairs, and **Ann Forsyth** of the Metropolitan Design Center. Krizek is the head of the recently established Active Communities/Transportation Research Group, focusing on land use policies and programs related to how communities incorporate active modes of transportation.

The featured speaker of this year's forum is **Berthold Tillmann**, the mayor of Münster, Germany. Münster looks like the medieval village it once was but features a highly effective transportation network to allow quick and easy access to work, shopping, entertainment, and schools. Münster boasts of a daily mode share of bicycling approaching 40 percent and recently received a global "Most Livable Community" award.

The forum will explore several key aspects of investing in bicycling and walking, including:

the integration of the design of non-motorized facilities into the community and transportation network

- the value of increased accessibility on economic activity, livability, and community identity
- recreation and health benefits and safety concerns
- the role of local, state, and federal government and the impacts of geography and culture

U.S. Representative **James Oberstar** of Minnesota will present an overview of the non-motorized transportation provisions in the national SAFETY-LU package of transportation legislation.

For more information on the Oberstar Forum, including coverage and proceedings from previous years, visit the Oberstar Forum web pages. Registration for the Oberstar Forum is available online.

Intelligent Transportation Systems

Searching for the Ideal Ramp Metering System

Many residents of the Minneapolis-St. Paul area will recall their dismay when in October 2000 the state legislature mandated a six-week shutdown of all ramp meters in order to study their effectiveness. Eventually, evaluations were completed and ramp meters were turned back on, but with modifications. The old Zone system focused on the flow of freeway traffic, resulting in unacceptably long wait times for drivers on entrance ramps. Therefore, a new system was calibrated to take into account both the freeway flow and ramp delays.

Panos Michalopoulos, assisted by **John Hourdos** and **Wuping Xin** from the civil engineering department, evaluated this newer metering system, Stratified Zone Ramp Metering (implemented in 2002-2003). The team of researchers used computer simulations, testing several measures of effectiveness in separate comparisons with the previous Zone metering system and with no control strategy. They organized the measures of effectiveness into three categories: freeway performance, ramp delay, and system performance (ramps and freeways).

When compared to the previous Zone metering system, the newer system indeed achieved its goal of reducing delays and long queues on freeway ramps. However, the quality of freeway flow was sacrificed as shown by an increase in freeway delays, number of stops, and increased fluctuations of freeway speed and density.

In comparison with no control strategy, Stratified successfully increases freeway efficiency and safety. Nevertheless, system delay, fuel consumption, and pollutant emissions are measures that may either improve or worsen when weighed against no control strategy. Factors such as freeway geometry and demand patterns can cause inconsistent results.

Much of the team's study detailed the underlying algorithm used for the Stratified Ramp Metering system. Taking into account the weaknesses in the Stratified Ramp Metering method, they intend to explore improved algorithms that will factor in traffic patterns. The researchers advocate using tools such as the microsimulator to test metering strategies before they are put in place.

For a detailed description of the Minnesota Stratified Zone Metering strategy, the algorithm, and measures of effectiveness used for the study, see *Evaluation and Improvement of the Stratified Ramp Metering Algorithm through Microscopic Simulation—Phase II* online.

Adaptive modeling may improve evacuation traffic control

By their very nature as extreme events, emergency evacuations resist traditional network evaluation methods because standard assumptions about network use patterns do not apply. Traffic during evacuations is dominated by movement to "safe zones" and fraught with unpredictable behavior by frustrated and panicked motorists. However, emergency situations do provide the authority for strict centralized control of the traffic system, using signals and traffic control officers on the ground to direct vehicles as needed.

Henry Liu, who joined the civil engineering faculty as an assistant professor in 2005, will add to the department's expertise in modeling and managing complex traffic systems under scenarios of recurring congestion and emergency response/evacuation. Liu received his Ph.D. in 2000 from the University of Wisconsin at Madison. Before joining the University of Minnesota, Liu was an assistant professor in the department of civil and environmental engineering of the University of Utah, and a postdoctoral researcher with the PATH program at the University of California at Berkeley.

Among Liu's research interests is the development of adaptive feedback control approaches to evacuation traffic management. At an Advanced Transportation Technologies Seminar sponsored by the ITS Institute in fall 2005, Liu argued that evacuation efforts often run into problems despite elaborate scenario-based planning efforts carried out in advance, because planning can't predict all possible scenarios. Instead of scenario planning, Liu therefore decided to focus on real-time traffic management, or, as he put it, "how can we respond to this specific disaster, now."

These characteristics led Liu to develop an adaptive control approach to evacuation traffic management. Adaptive traffic control systems, which use current traffic data to change their control behavior in response to changing conditions, offer the ability to compensate for disruptions by rerouting traffic along optimal routes. A reference model of the road network and a traffic simulation engine calculate the overall system

objective using current data.

Liu has created a stripped-down simulated version of this system (without origin-destination estimation and resource allocation modules) on a simplified road network containing only a few nodes and links. For each node (intersection) in the network, the system calculates the optimal turning percentage to achieve a desired performance measure, such as lowest total travel time or minimum number of "victim vehicles" (vehicles unable to clear the network before a deadline). The system uses a "rolling horizon" approach to estimate traffic flow characteristics every two minutes and update its control strategy accordingly.

Liu has also developed several plug-in modules to enhance the functionality of the widely used PARAMICS microscopic traffic simulation software.

Transportation Infrastructure

Wooden bridges to benefit from high-tech structural scrutiny

Although you may have to drive a few miles off the highway to find one, timber bridges remain an important part of the road network in many rural areas. **Brian Brashaw** of the UMD Natural Resources Research Institute estimates that there are approximately 80,000 bridges containing structural timber elements in use across the United States today, with about half that number constructed entirely of wood. In Minnesota, about 4,000 bridges include timber elements. Understanding the maintenance needs of these bridges is important to ensuring safe and reliable transportation service on many low-volume roads.

At an Advanced Transportation Technologies Seminar on December 6, 2005, Brashaw presented research carried out by his team and collaborators to develop nondestructive testing methods for assessing the structural health of timber bridges.

Brashaw noted that many of the timber bridges currently in service on rural roads were originally constructed in the 1950s and 1960s and have reached the point in their life cycle where significant repair or replacement may be required. Rapid and reliable techniques for evaluating these bridges, he said, will help engineers manage them more effectively.

As part of its work, the research team has developed educational programs that use short courses and hands-on assistance to help local personnel learn how new techniques for evaluating their timber bridge inventory. The team recently put together a short course for officials in hurricane-ravaged New Orleans to help assess damage to homes and other structures that had been flooded.

Many of the techniques explored by Brashaw and his collaborators have been used for years in the timber industry to assess the quality of wood materials. One of the simplest techniques is resistance drilling, in which a special tool charts the resistance of a wood beam to drilling with a small-diameter bit. The degree of resistance can provide a good indication of wood quality within the beam, which is often not visible during external inspection. This type of testing is very "user-friendly" for inspection personnel, and the results are easy to interpret.

Stress wave timing, another technique investigated by the research team, involves sending a pulse of sound waves—created by an ultrasound generator or, more simply, by striking a transducer with a small hammer—into a structural element and measuring the time needed for the pulse to reach the other side. Because sound waves travel more quickly through dense material than through the air gaps in decayed or damaged wood, stress wave timing can indicate the internal quality of a specimen without drilling.

While resistance drilling and stress wave timing can show the internal condition of a beam or piling at a certain point, other techniques exist for evaluating the overall health of a structural member. Brashaw's team used forced vibration testing—in which a bridge is induced to vibrate and readings are taken at various points using a recording oscilloscope—to evaluate bridges in the laboratory and in the field. A small variable-speed motor mounted firmly to the bridge and attached to an eccentric-loaded weight proved capable of generating a surprising amount of vibration power for this purpose.

Interpreting data from forced vibration testing depends on understanding how different types of structures vibrate. Brashaw's team initially focused its efforts on bridges in which a solid deck rests on long beams or stringers. Future work, Brashaw said, would seek to understand the behavior of so-called slab-span bridges, in which beams are attached to each other side-by-side to form a single rigid structure. Work by the mathematics and statistics department, he noted, has been critical to the team's ability to identify the source of errors in forced vibration data and interpret the results correctly.

Support from NATSRL has made it possible for the researchers to focus on improving their equipment and developing a prototype automated system so bridge inspection personnel can use forced vibration testing easily in the field. By automating the system, Brashaw explained, the researchers hope to create a tool that can be used to routinely check the health of timber bridges. Another future direction is to extend the forced vibration method to bridges that combine steel girders with wooden structural elements.

Transit & Alternative Modes

National Transit News

TCRP research publications available online

The federal Transit Cooperative Research Program (TCRP), administered by the Transportation Research Board, provides practical transit research to address technical and operational issues. TCRP emphasizes putting research results into the hands of organizations and individuals that can use them to solve problems. TRCP publications may be viewed at www4.trb.org/trb/onlinepubs.nsf/web/crp.

Recent TCRP publications include:

- *Public Transportation Security, Volume 10 -- Hazard and Security Plan Workshop: Instructor Guide* (TCRP Report 86, Vol. 10)
- *TCRP Annual Report of Progress 2005* (PDF)

Upcoming Events

Here are selected events related to transportation research. Visit the CTS Web site, www.cts.umn.edu/events, for more comprehensive event information. You may also subscribe to e-mail event announcements using our subscription form.

March 2, 2006
CTS Transportation Career Expo, Minneapolis. Contact Mindy Carlson, 612-625-1813, carlson@cts.umn.edu.

April 17, 2006
Information Session: Graduate Certificate in Transportation Studies. 6-7 p.m. at 215 Humphrey Institute, 301 19th Ave. S., Minneapolis.

May 24, 2006
CTS Spring Luncheon with Thomas DeCoster, Saint Paul RiverCentre. Contact Julie Grazier, 612-624-3044, conferences5@cce.umn.edu.

May 24-25, 2006
17th Annual CTS Transportation Research Conference, Saint Paul RiverCentre. Contact Julie Grazier, 612-624-3044, conferences5@cce.umn.edu.
