

UNIVERSITY OF MINNESOTA



ABSTRACTS

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CENTER FOR
TRANSPORTATION STUDIES

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Translating Mixed-Method Research into a TV Documentary Educating Mature Drivers

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Older adults represent an ever-increasing proportion of our driving public, and, although mature drivers are often more cautious, there comes a time when they may realize that their driving is becoming unsafe and that they need to make a decision about cessation. The mixed-method program of research that I have led over the last several years in both rural and urban Minnesota to try to better understand that process of cessation has led to the identification of both qualitative themes and quantitative results. They include the finding that this driving cessation process is often haphazard with a common lack of awareness of resources available. In spite of this, seniors overwhelmingly value playing an active role in that decision. Many seniors were unaware of the alternative transportation options available to them or, if aware, often did not know how to utilize them. Those and other findings led to the decision to develop and lead a partnership for the creation of a solution-oriented public TV documentary. The focus of the documentary was to provide mature drivers and their families with the information on how to drive safely as long as possible, and with the tools for an autonomous and a smooth transition to alternative community mobility options. The main objective of the presentation will be to describe the key findings of our mixed-method research and illustrate the way in which they informed the prioritization of topics for the documentary. I will conclude by briefly describing how the documentary is being used in educational outreach efforts.

The Effectiveness of Changeable Message Signs and the Aging Population

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Three large-scale studies, using a STISIM driving simulator, were conducted to investigate the effectiveness of various changeable message sign messages in influencing driver behavior. Each of the three studies had 120 experimental participants, all licensed drivers from the following three age groups: 18-24, 32-47, and 55-65. The presentation will focus on the findings related to the driving performance (e.g., speed and compliance) of the older driver group in the context of the other two driving groups.

Lessons Learned from eWorkPlace, A State-sponsored Telework Initiative in the Twin Cities

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In 2007, the Minnesota Department of Transportation and the Twin Cities Metropolitan Council applied and was selected as one of the Urban Partnership Agreement's (UPA) Urban Partners. As an Urban Partner, the Twin Cities works with the United States Department of Transportation to demonstrate a combination of strategies, including tolling, transit, telework, and technology and operations, that have a combined track record of effectiveness in reducing traffic congestion.

eWorkPlace addresses the telework component of the UPA agreement by promoting increased use of telework and flexible work scheduling, with the ultimate goal of reducing peak period commuting by shifting some commuting travel to off peak hours. Allowing commuters to work from home via a computer and electronic link to the office on regularly scheduled workdays at least once a week can help to eliminate some peak-period commuting congestion. Other benefits of telework include an increase in employee productivity, an increase in employee happiness, a decrease in overhead costs for the employer and a decrease in vehicle emissions.

Utilizing market research to determine the benefits and barriers of telework from the viewpoints of employees and employers, a marketing and communications plan was developed to build program awareness, credibility, and interest through an effective media campaign that included a strong focus on social networking sites as well as other traditional media sources. Continuous monitoring of the effectiveness of the media campaign has helped to create recommendations for specific media buys in order to target the desired audience.

Working in collaboration with the Downtown Minneapolis Transportation Management Organization, St. Paul Smart Trips, 494 Commuter Services, Anoka County Transportation Management Organization, and Culture Rx, eWorkPlace has managed to recruit a wide variety of employers who are dedicated to starting or expanding their telework programs. All employers enter an agreement to fully participate in the initiative by identifying a goal for the number of participating employees, and therefore, receive a suite of implementation resources, including telework consulting services and IT consulting services.

Employers are also required to participate in the evaluation measures of the eWorkPlace initiative through Commute Tool, a personalized online tracking tool that measure vehicles miles traveled, emissions, travel diary behavior and attitudinal questions relating to telework. This data is analyzed to properly assess the effectiveness of eWorkPlace in terms of mitigating congestion by looking at the travel behavior of the participants as well as the environmental savings and the cost benefits to the employer. The findings from eWorkPlace will be documented in order to educate future telework initiatives.

Smart Trips Summit-U: Encouraging Biking and Walking through Individualized Social Marketing

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In 2008, St. Paul Smart Trips completed a pilot program in the Summit-U neighborhood of St. Paul, Minnesota using individualized social marketing techniques to encourage residents to use more sustainable forms of transportation. The program mailed newsletters to all 7,100 neighborhood households, offering them the opportunity to order a customized Smart Trips Kit, which included information and incentives related to transportation options. The purpose of the program was to increase biking, walking and transit trips in the neighborhood and decrease overall vehicle miles traveled (VMT).

A before and after, test and control phone survey was conducted from a random sample of 300 neighborhood residents, as well as a random sample of 300 residents of a control neighborhood in St. Paul. Respondents were asked to report all of the trips they took on the previous day, including trip purpose and mode used.

Approximately 8.6 percent of households ordered a Smart Trips Kit. Biking and walking trips, as recorded by the phone survey, increased 33 percent when compared to the control. This increase in walking and biking trips amounts to nearly one additional trip each week by foot or bike for every Summit-U resident. Vehicle miles traveled declined by approximately 20 percent, however, a similar decline was recorded in the control and there was no statistically significant difference between the two. We suggest that this was likely due to the dramatic increase in gas prices during the summer of 2008. The program cost approximately 10 dollars per adult resident to administer, including the cost of the phone survey.

Individualized social marketing has shown promise as a method of encouraging alternatives to driving, but little evaluation has been done. We hope our findings and program model could be used by other jurisdictions and organizations as a cost-effective way to change residents' travel behavior.

Transportation Programs at Mayo Clinic

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Mary Ann will share the journey with the Transportation Program at Mayo Clinic Rochester. She will share the process for engaging staff, and addressing the needs of patients and visitors. She will also discuss the unique transportation challenges faced in rural Minnesota. The overview will include processes and key messages used in the communication to staff to encourage their engagement.

Future of High Speed Passenger Rail in Minnesota and the Midwest

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As High Speed Rail in the U.S. follows the lead of other industrialized countries and other regions in the country, the Midwest has significant plans and potential for developing a network of corridors that will tie together much of middle America. We will look at current plans, timelines, and phases for development of this comprehensive system surrounding the Chicago Hub, and look at how the complementary system proposed for Minnesota ties into the concepts and operations of the Midwest Initiative. The presentation will look at current state-run passenger services and state plans, and how these will turn into a high-speed system. The Mid West Regional Rail Initiative (MWRRI) and AMTRAK's long-range phased plans will be included. Local technology choices, freight system operations and expansion, and interstate compacts and coordination will be a few of the topics discussed during this overview of what lies in store for our region.

US High Speed Rail - The New Holy Grail

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The Obama Administration's focus on multimodal, sustainable transportation investments has lead to intense interest in improving the nation's passenger rail network. In addition to traditional inter-city passenger rail service, typically offered by Amtrak, the Administration is focusing on developing a network of high-speed rail corridors throughout the country.

This presentation will describe the efforts currently underway to define, develop, and implement high speed rail in the US. It will address:

- How high speed rail is defined
- Goals for a national system
- The national map of feasible high speed rail corridors, and the advantages offered by connections between cities bracketing each corridor
- Coordination with the freight railroads, who own and operate most of the nation's rail system
- Evaluation criteria used by the Federal Railroad Administration to rate potential projects for funding
- Funding provisions, including the types, or "tracks" of projects funded under the first grants announced Winter 2009-2010
- Next steps toward making a national high speed rail network a reality

Potential speakers for this session may include multi-stakeholder working to identify and prepare projects for implementation, including representatives from the Federal Railroad Administration, State Departments of Transportation, Class 1 railroads, and private sector parties.

Future of High Speed Passenger Rail in Minnesota and the Midwest

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High Speed Rail services in America will require strong federal, state, local government and private railroad partnerships to build and operate. Nine midwest states have been planning the development of the Midwest Regional Rail initiative, a Chicago Hub service since the mid 1990's. Now that the federal government has established the first sustainable passenger rail development program in 40 years, the Midwest plan is being implemented. The presentation will look at the current federal program and how the Midwest Regional Rail Initiative is positioned to access federal funding to develop the system over the next decade.

Metropolitan Highway System Investment Study

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In 2008, Metro District and the Metropolitan Council completed the “Principal Arterial (PA) Study” to answer questions related to future mobility needs in the region. One of the key conclusions of the study was that “building our way out of congestion” is not a feasible approach and would cost at least \$40 billion.

The current Transportation Policy Plan (TPP) and Mn/DOT’s Metro District Investment Plans indicate the region will receive \$900 million over the next 20 years for mobility investments. Traditional project design standards and practices call for projects to be designed to eliminate congestion for a 20-year forecast horizon. The PA Study concluded that a lower-cost/high-benefit approach may be an effective way to address specific problems, and that pricing can help manage demand and provide an alternative to congestion in some corridors.

The policy direction recorded below is taken from the Council TPP and the Mn/DOT State Plan. These policies have provided the basis for the investment principles that have, and will continue to be used, to develop project recommendations for the MHSIS 50-year vision. They will also provide direction as the 50-year vision is refined and projects are prioritized to produce the 20- year fiscally-constrained plans.

Policy direction

- There are, and will continue to be, fiscal constraints for Mn/DOT and the Council.
- Building our way out of congestion is not feasible; few if any projects should be undertaken with this objective.
- A balanced approach toward investments is needed, which includes:
 - o Preservation
 - o Safety
 - o Mobility
 - § Advanced Traffic Management (ATM)
 - § Lower cost/high benefit (CMSP)
 - § Strategic Capacity Enhancements; Managed and General Purpose Lanes
 - o Regional & Community Improvement Projects (RCIP’s)
- Develop plans that result in a multimodal highway system.
- Strive to integrate CMSP projects with preservation projects.
 - o When possible, integrate preservation elements into all system improvements
- Operational techniques, including pricing, provide effective tools to manage the highway facilities, manage demand and provide alternatives to congestion.
- Major projects will be reassessed to determine if the critical preservation, safety and mobility elements can be addressed with a lower-cost/high benefit solution.

Congestion and Safety Management in the Twin Cities: What Does the Future Hold?

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STUDY OBJECTIVE

Highway congestion in the Twin Cities Metropolitan Area (TCMA) has been growing over past decades and is expected to continue grow as the regions' population increases over time. While congestion is a natural outcome of continued economic growth, it can result in negative safety, economic, and quality of life impacts to all travelers. It affects multiple travel modes including automobiles, trucks, and transit, and it affects multiple jurisdictions as users find alternate routes to avoid major delays (i.e., use of local routes which impacts pedestrians and bicyclists).

The Twin Cities Congestion Management Safety Plan focuses on gaining a better understanding of the concepts of "managed corridors" and "flexible design" as they relate to project development and corridor management. It also focuses on identifying practical strategies and tools that should be implemented, further developed and/or researched to keep Minnesota on the cutting edge of limiting impacts of congestion on system users.

METHODOLOGY/APPROACH

This year long study was undertaken by Mn/DOT, in cooperation and consultation with its transportation partners. The purpose of study was to clearly define the congestion and safety problems in the TCMA, and to identify a range of relevant congestion management strategies and tools, as well as the potential for application of those tools in the region. The study sets the context for evaluating congestion and safety management tools. Study activities were guided by a project management team in consultation with a Working Committee composed of senior staff from Mn/DOT, the Metropolitan Council, and FHWA; a Technical Committee which comprised a range of transportation professionals representing stakeholder agencies throughout region; and a Policy Committee composed of state, county, and city policy-makers.

FINDINGS/RESULTS

The study resulted in eleven key recommendations and a number of action items to be carried forward for implementation. The Plan acknowledges that the Twin Cities region has taken a balanced approach to transportation. It has made investments in strategic highway capacity expansions, in bus, BRT, LRT and commuter rail, and it has invested in operational improvements through ramp meters, Freeway Incident Response Safety Teams, cameras, electronic message signs, and the Regional Transportation Management Center. While this balanced approach is expected to continue, there is a general feeling that future improvements will need to be more efficient in the delivery of travel and safety benefits to users (more benefits for less cost). This will require tighter scoping of projects and greater innovation.

POTENTIAL APPLICATIONS

This Plan continues the previous efforts to explore options that bring more value to transportation system users (increased movement and safety for dollars invested as well as choice), and it begins to broaden the conversation about managing the system to include local partners and other modes. Sharing the results of this study and ongoing work that relates to the Metropolitan Highway System Investment Study will be beneficial to all public officials and stakeholders.

Innovative Techniques for Delivering the Twin Cities' Urban Partnership Agreement on Schedule and Under Budget

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In August 2007, the Twin Cities was one of five communities nationwide to receive an award from a competitive pool of \$1 billion through an Urban Partnership Agreement (UPA) with the U.S. Department of Transportation (USDOT) to implement and deploy innovative tolling, transit, technology and telecommuting projects to reduce traffic congestion by 15 to 20 percent along I-35W, Cedar Avenue and in downtown Minneapolis.

With the \$133.3 million in federal funding came an ambitious project delivery schedule with strict milestone attainment requirements. The state legislature was required to provide the local match and enabling legislation within 90 days of the start of the 2008 Legislative Session. The Minnesota Department of Transportation (Mn/DOT) was required to complete most of the roadway-related projects on or before September 30, 2009. The Metropolitan Council (the Council) was required to complete most of the transit projects on or before December 31, 2009.

Since August 2007, the five UPA and the three Congestion Reduction Demonstration (CRD) awarded communities have forfeited over \$579 million in federal for failing to meet their committed milestones and schedule. Unlike most of the other awarded communities, the Twin Cities, for the most part, has successfully met all of their original schedule and milestone requirements, and has done so under budget, while delivering the most complicated of programs nationwide with five lead agencies implementing 24 different, unique and difficult projects using over 12 different funding sources.

So how was this feat accomplished? Definitely not by employing the typical project development and delivery approaches used by Mn/DOT, the Council, and the other lead implementing agencies. The successful delivery of the Twin Cities' UPA required deviations in typical procedural, process, contracting, design, construction and staging activities that introduced a higher degree of risk and challenged public acceptable.

Soil Modulus Testing and Full Depth Reclamation

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Full depth reclamation (FDR) is a recycling technique in which the existing asphalt pavement section and all or a predetermined portion of the underlying aggregate are uniformly crushed and blended to produce a well compacted base course. Full depth reclamation has been proposed as a viable alternative in road rehabilitation, where asphalt and aggregate resources are conserved, and material and transportation costs are reduced. The objective of the research was to determine the deformation characteristics of base material produced from recycled asphalt pavement (RAP) and aggregate. Various samples with different ratios of RAP and aggregate base were mixed (% RAP/aggregate): 0/100, 25/75, 50/50, 75/25. Sieve analyses were performed, and it was found that as % RAP increased the fine contents decreased. Laboratory compaction testing and field monitoring indicated that gyratory compacted specimens were closer to the densities measured in the field.

Cyclic triaxial tests were conducted to evaluate recoverable and permanent deformation behavior from virgin loading to 5000 cycles. The specimens with RAP exhibited at least two times greater permanent deformation than the 100% aggregate material, and a steady state condition was reached after approximately 1000 cycles. As % RAP increased, more permanent deformation occurred. The Young's modulus (Esecant) increased as the number of cycles increased. Initially, Esecant was larger for the 100% aggregate specimens, but after approximately 100 cycles the 25% aggregate – 75% RAP specimens had the highest Esecant.

PG Binder Selection in Minnesota

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Minnesota's performance-based asphalt binder selection is based on climatic conditions, the application specified and known field performance. Hot Mix asphalt pavement performance at MnROAD and other test sections have shown improved durability to rutting, structural cracking and low-temperature cracking with certain asphalt binders. Cutting-edge research at the University of Minnesota has provided much needed information in the area of low temperature pavement cracking which is the #1 distress on Minnesota roads. This research and information from field test sections will improve and enhance the material selection process so that pavement engineers have the information needed to select the proper asphalt binder for a given application to build long-lasting roads.

Implements of Husbandry

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This presentation will provide an update on the ongoing pooled fund Effects of Husbandry “Farm Equipment” on Pavement Performance study sponsored by the Local Road Research Board, the Minnesota, Iowa, and Illinois department of transportation, and industry. The objective of this project is to evaluate the effect of heavy farm equipment on performance of low volume roads. Two instrumented test sections were constructed at the MnROAD test facilities and several series of tests with various types of agricultural equipment were conducted. A test section that replicates a typical 7-ton road has exhibited significant structural failure whereas another test section replicating a typical 10-ton road has not shown any type of deterioration. Some results of a preliminary data analysis will be presented.

An Update on Strategic Safety Planning for Minnesota Counties

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Minnesota's Strategic Highway Safety Plan (SHSP) identified specific goals and objectives for moving the State Towards Zero Deaths. A key interim goal is to reduce the number of traffic related fatalities below 400 by 2010 and a key objective toward that end involves increasing the level of participation of local highway agencies in the Highway Safety Improvement Program.

Reaching out to local highway agencies is supported by the facts that in Minnesota, more than one-half of traffic fatalities are on the local system and local facilities have the highest crash and fatality rates. In response to these facts, Mn/DOT engaged the counties in the development of the SHSP and revised the approach to managing the State's HSIP – dedicating almost one-half of the safety funds for projects on the local system and actively encouraging counties to develop safety projects consistent with the priorities in the SHSP.

However, even though many Minnesota counties have a long tradition of supporting safety initiatives at the local level, they had never previously conducted county wide safety planning or developed low-cost safety projects for their capital improvement program. As a result, the counties faced significant challenges in taking their initial steps participating in the HSIP process – they had no experience either conducting system wide crash analysis or linking crash causation with a mitigation strategy at a specific location on their system. To address this lack of experience, Mn/DOT began an outreach program primarily consisting of providing the counties with a new electronic crash records system and training relative to the HSIP solicitation process. Initial feedback from the county engineers suggested that these efforts, while necessary were not sufficient to generate safety projects across the county highway system with the desired quality and consistency with SHSP objectives. In response, Mn/DOT has undertaken a project that is unprecedented in scope among the states – partnering with every county in Minnesota and funding the preparation of Road Safety Plans for the local system of roads across the entire state.

Mn/DOT selected a team managed by CH2M HILL to apply the safety planning process, prepare the safety plans and identify a unique set of infrastructure based safety projects for each county. By the time of the Research Conference, the plans for the first set of twenty-one counties will be nearing completion and details about the planning process, the results of the crash analysis and an overview of the at-risk locations along the county system will be provided.

Summary of Rural Safety Policy Improvement Index Project

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This presentation will discuss the Rural Safety Policy Improvement Index (RSPII) project. It will include a discussion of the results from Phase I of this project. This phase of the project included an evaluation of the feasibility of a RSPII and the identification of some policy-related safety measures that could have an impact on rural roadway safety if they were introduced or improved. The calculation and magnitude of the potential rural roadway safety impacts connected to six policy-related safety improvements will then be described. These improvements include automated speed enforcement, primary seat belt laws, sobriety checkpoints, graduate licensing programs, universal motorcycle helmet laws, and the use of ignition interlocks. The challenges to the implementation of these policies within the rural environment will also be noted.

Rural ITS Safety Solution Systems

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Objective

Develop low-cost, readily deployable, low maintenance systems that can be used by government agencies to improve safety on rural roads and at non-signalized rural intersections.

Methodology

To meet this objective, three systems as described below are being designed and tested.

The Driver Behavior Evaluation System (DBES) represents an unobtrusive method to monitor driver behavior. It is intended to be used to collect traffic volume and speed profile data on approaches to intersections and curves. This data will assist the regulating authority in evaluating problem locations and developing the appropriate improvement.

The Stop Sign Warning System will provide active real-time supplemental warning to drivers approaching a stop sign at too high a rate of speed.

The Curve Warning System is similar to the Stop Sign Warning System by providing active real-time supplemental warning to drivers approaching a curve at too high a rate of speed.

Findings

At the time of this abstract, the Concept of Operations and the System Requirements have been written for these systems. The systems will be designed and testing will be underway by the dates of the conference.

Potential Applications

These systems are intended for use with relatively low volume (rural) traffic conditions. The speed information gathered will have greater accuracy than that collected by traditional road tubes.

The Critical Role of Public Outreach and Education in the Successful Implementation of Pricing Projects

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When new transportation concepts are introduced, they are often met with skepticism and outright opposition by stakeholders, policy-makers and the public at-large. Recent experiences with pricing projects have demonstrated that, before new concepts are proposed formally, it is critical that an ongoing process of public education and outreach be undertaken. Outreach and education (O&E) can take many forms, from informal meetings, discussion groups, meetings with civic groups and focus groups, to formal market research and multiple forms of mass media communication.

This presentation will answer questions such as:

- Why does O&E play a critical role?
- What are the consequences of ignoring the O&E process?
- What lessons have we learned from successful implementation of pricing projects?
- How can we apply these lessons learned to be more successful in the future?

Lessons are drawn from five U.S. projects, including Minnesota's MnPASS, and seven projects in European countries.

Ombudsman's Office Resolves Issues and Rebuilds Trust

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The Mn/DOT Ombudsman's Office was created by Transportation Commissioner Tom Sorel in the latter half of 2008 to review complaints about Mn/DOT decisions and decision-making process in an effort to rebuild trust. To date, over 110 issues impacting Mn/DOT's external partners, constituents, and members of the public have been handled by staff, falling primarily into the categories of noise mitigation, access, MnPASS, consultant contracting, property damage, and project communications. Resolution is often achieved through one-on-one and group discussions with complainants and Mn/DOT staff and other vested interests. The Ombudsman's Office continues to expand its mission by establishing a 1-800 intake line, hiring independent third parties to mediate disputes, establishing training for conflict resolution specialists throughout Mn/DOT districts, teaming with Hear Every Voice and External Partnering initiatives and other exciting groundbreaking items for a state DOT.

**Planning Participation Case Study:
Successes, Challenges, and Lessons Learned in Land Use Planning Efforts
Adjacent to an LRT Station**

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After the Hiawatha Light Rail Transit (LRT) line opened in 2004, Metro Transit acquired several properties and portions of properties along the rail alignment that could function as right-of-way or provide space for executing necessary LRT operations. One of the properties included in a deed from the Minnesota Department of Transportation (Mn/DOT) was the former Hiawatha Dry Cleaners Building site located at the northwest corner of Old Hiawatha Avenue and East 50th Street near the 50th Street/ Minnehaha Park LRT station. During construction of the Hiawatha line, this site was chosen as the most appropriate location for constructing an electrical substation to support the operations of the 50th Street/Minnehaha Park station.

Acquisition of this property for LRT operations was accompanied by a variety of challenges, some of which included a deteriorating and structurally unsound building, potentially contaminated soils, and a lack of developer or business-owner interest in investing in repair of the building for commercial use. These challenges were further confounded by local viewpoints that the building is symbolic of Nokomis East Neighborhood history, as the Hiawatha Dry Cleaners was one of the first commercial establishments in the neighborhood. Moreover, the building itself is architecturally characteristic of an early-1900's South Minneapolis commercial building, lending itself to communicating the architectural history of the neighborhood. Due to the reasons mentioned above, there has been a strong community desire to rehabilitate the structure for reuse; however, building disrepair and a lack of private interest and public funds have not been favorable for this purpose. Metro Transit made the decision to demolish the building in November 2009 as a result of these conditions with the hope of partnering with the neighborhood to identify a mutually-desired outcome that will serve the community in a positive manner.

This community outreach project is focused on establishing a partnership with the Nokomis East Neighborhood through a series of workshops, visioning, and design exercises to identify a safe and desired alternative for the site after the building is demolished. Recognizing that this particular site acts as a Gateway into the Nokomis East Neighborhood, there has been interest in using the site to construct a neighborhood open-space amenity, potentially in the form of a community garden, pocket park, a native landscape garden, or a public gathering space. A majority of the public participation work will be completed between January and March 2010; therefore, results, findings, and lessons learned have not yet been identified. The CTS Conference presentation will focus on the approach used to build the partnership between residents and Metro Transit, successes and challenges associated with the outreach efforts, and lessons learned. The information and experience gleaned from this case study will be important in continuing Metro Transit's outreach efforts with other communities impacted by major transit investments in the future. As the Twin Cities expands its network of LRT infrastructure, it will be increasingly important to learn from previous work with local communities and external agencies in addressing multiple stakeholder needs and desires, and in building lasting partnerships with local communities impacted by major transit investments.

Partnering with Mn/DOT for Complete Streets

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The Minnesota Department of Transportation (Mn/DOT) is committed to partnering with a broad coalition to build upon the Department's approach to Context Sensitive Solutions (CSS) in developing and implementing a Mn/DOT "Complete Streets" policy.

While the presentation overviews and highlights the philosophy, principles, and benefits of CSS as an overarching umbrella for addressing and implementing Complete Streets, the focus of the presentation is toward understanding considerations of critical importance when seeking to plan, implement, operate, maintain, and sustain Complete Streets successfully within the context of urban or community environments.

Complete Streets are planned, designed and operated to enable safe access and movement for all users (motorists, transit users, pedestrians, bicyclists ...) of all ages and abilities. Approximately one-third of the US population cannot or does not drive a car and thousands of pedestrians and bicyclists are killed and tens of thousands of pedestrians and bicyclists are injured on US roads annually. Complete Streets does not mean "all modes on all roads" or that "one size fits all". A goal of Complete Streets is to develop a balanced transportation system and networks that integrate all modes via planning inclusive of each mode and across all jurisdictions. A goal of Complete Streets is to better integrate transportation and land use planning and development to make them more mutually supportive, rather than in conflict, with one another. A goal of Complete Streets is to consider and apply broadly informed flexibility in decision-making and design to better balance competing objectives, within existing constraints, while seeking to optimize benefit to cost ratios and return upon investments. Complete Streets benefits range from improved safety and mobility for all users to improved public and environmental health to increased consumer savings, economic activity and property values to improved quality of life through more livable and sustainable transportation, communities, commerce and growth.

The presentation briefly describes and illustrates the following:

- Origins of Complete Streets (problems, policies, legal requirements and advocacy groups)
- Expected public benefits from implementing Complete Streets
- Current status of Complete Streets legislation, policy, and guidance nationally and locally
- Mn/DOT's partnering approach to Complete Streets
- Case studies and comparisons in addressing Complete Streets challenges and opportunities

Northstar Commuter Rail Update

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Northstar is Minnesota's first commuter rail line in the 21st century. It began service in November 2009 after twelve years of intense community and political advocacy. Project partners are the Northstar Corridor Development Authority (NCDA) including county rail authorities of Anoka, Hennepin and Sherburne, Met Council, Minnesota Department of Transportation (MnDOT), Minnesota Twins and the Federal Transit Administration.

The presentation will address project development, implementation and operation challenges and opportunities in making Northstar a reality.

“Rock-On” – A New Life for the Rock Island Swing Bridge

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Background

Built in 1895, the Rock Island Swing Bridge was a two-level structure that carried rail traffic on the upper deck and vehicle traffic on the lower deck. In 1982, the Rock Island Railroad closed the bridge and the renamed “JAR Bridge” began operations as a privately owned toll facility for vehicle traffic only. In August 1999, the bridge was closed by Mn/DOT due to failure of structural members and through tax forfeiture ownership was turned over to the State of Minnesota. In December 2001, the United States Coast Guard determined the structure was a hazard to navigation. Since that time, the bridge had functioned as an informal fishing and river viewing access area for local residents. In November 2008, a portion of the east bridge approach collapsed which led Washington and Dakota Counties to pursue demolition for safety purposes.

Concurrent with the demolition process, the City was pursuing a vision to convert a portion of the bridge into a recreational pier. The pier would be a key element of the Dakota County Mississippi River Regional Trail Corridor which follows the Mississippi River, connecting Harriet Island Regional Park in St. Paul to the Spring Lake Park Reserve in Hastings. The recreational pier would also serve as a key amenity for a major community park being developed by the City adjacent to the bridge site.

In spring 2009, with demolition activities underway, Inver Grove Heights secured \$1.3 million in Transportation Enhancement (TE) American Recovery and Reinvestment Act (ARRA) funds to rehabilitate the remaining bridge elements and construct the recreational pier. Following the award of the ARRA funds, the Minnesota Legislature passed legislation that placed a moratorium on further demolition of the structure. The moratorium provided an opportunity for the City to address a broad range of challenges including addressing federal Section 106 requirements, securing environmental approvals, and resolving ownership issues. Facing a seemingly impossible schedule, the City successfully completed the required studies and secured all approvals in advance of the November 13, 2009 ARRA funding deadline. Through the course of the process the project was the subject of several newspaper articles which featured the challenges of the process and the City’s efforts to make the recreational pier vision a reality.

Presentation

The presentation will touch on the history of the bridge and the unique developments which led up to the City securing the federal stimulus funding. In addition, the substantial challenges faced by the City will be set in context and the efforts that led to securing the approvals for this very unique project will be highlighted.

It is proposed to be an interactive presentation which will include representatives from the City of Inver Grove Heights and SEH Inc., who was retained by the City to assist with the feasibility assessment, design, environmental documentation, and permitting.

Roadway Improvement Project Cost Allocation

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STUDY OBJECTIVE

The purpose of the cost allocation analysis is to allocate future public improvement costs related to future build conditions in an area to the appropriate existing and future redevelopments/developments. While the future redevelopments and developments use up the available excess capacity of the existing intersection and roadway system, the existing developments in the area use a percentage of its initial capacity contributing to the capacity constraints and subsequent need for improvements. This initial capacity usage is taken into account when allocating future improvement costs.

METHODOLOGY/APPROACH

The proposal is to assess a portion of the total cost of a project to the benefiting parcels on an area basis. Each parcel in the immediate vicinity, benefiting from the proposed improvements, is assumed to be one assessment unit.

The approach consists of the following two key components:

- Public Involvement – The governing agency should meet with the affected property owners to discuss the project purpose and need, as well as to present the property assessment methodology. Comments and concerns are compiled and considered as part of the cost allocation development process.
- Cost Allocation – Costs are allocated to the appropriate parcel based on future land use projections. Existing uses are taken into account that fall within the affected area. A cost per square foot is determined for each respective land use type based on the impact these potential land uses have or will have on the adjacent roadway network, resulting in the need for the proposed improvement. The parcels may be prorated based on their potential to develop due to the respective municipality utility staging plans. This will impact the ability of these areas to develop, subsequently impacting their property value.

FINDINGS/RESULTS

The cost allocation process is based on vehicular trip generation forecasts, associated impacts to the adjacent roadway network, and property development/redevelopment projections. This allows the municipality to assess the affected parcels for future roadway impacts they will contribute to as a result of their potential redevelopment.

POTENTIAL APPLICATIONS

This project has application for all communities that may face large costs for roadway infrastructure improvements that are either due to current area development or future development/redevelopment.

POLICY IMPLICATIONS

Policy-makers can use the methodology outlined to prepare similar cost allocation assessments for small or large area developments as a condition of approval or typical property assessment policy.

Bus Staging and Layover Space in Downtown Minneapolis

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Downtown Minneapolis depends on a strong, reliable transit network. To deliver on-time transit service to meet growing demand for transit, buses require layover and staging space on the perimeter of the downtown core. However, land in this area is also prime for residential development, increasing pressure on the transit system to build expensive, enclosed off-street garages for bus layovers.

Metro Transit completed a study in late 2009 and early 2010 to estimate future demand for bus layover needs and to identify potential new locations for layover facilities. The study is the first comprehensive look at layover needs for the entire downtown area.

With a projected need to simultaneously park up to 75 buses in some parts of downtown during afternoon peak periods, solutions to the layover problem require significant financial resources, major changes to operating procedures, and strong intergovernmental partnerships.

This presentation will focus on study results and outcomes, including projected shortfalls, planning for new locations, and innovative transit facility and operations strategies to meet the challenge of placing a critical piece of transit infrastructure in a dense urban area.

Unsaturated Soil Mechanics Implementation During Pavement Construction Quality Assurance

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Pavement foundations are constructed using compaction techniques that create unique soil structures and these soils are typically in an unsaturated condition with their strength and stiffness greatly influenced by soil suction. Several design and maintenance measures are also undertaken to maintain unsaturated conditions in order to achieve favorable long term engineering properties such as high shear strength and stiffness. However, the ability to quantify “favorable” has been elusive and is only now practical using newly developed performance related in situ test equipment and procedures.

Minnesota’s new flexible pavement design method (MnPAVE) is a mechanistic-empirical method that uses powerful mechanistic calculations to optimize flexible pavement design. Material properties have previously been based largely on empirical tests and experience because Minnesota’s traditional pavement design method preceded the development of modern soil mechanics and unsaturated soil science. Recent studies on a range of unsaturated soil specimens have shown that the soil water characteristic curve (SWCC), shear strength, and stiffness vary greatly due to suction. Therefore pavement design and construction quality assurance testing are changing in Minnesota and unsaturated soil mechanics is being implemented using new performance related construction testing and specifications.

Moduli and deflection target values (TVs) for the unbound pavement foundation materials have been proposed for use during pavement design. These TVs are determined using the plastic limit (PL) for cohesive soils and the grading number for granular materials. The PL has been found to be a reasonably accurate predictor of the SWCC and therefore a family of SWCCs has been defined based on the PL. TVs are then verified during the construction of the unbound pavement foundation using the light weight deflectometer (LWD). Laboratory resilient modulus testing, with soil suction measurement, was also used to supplement TV development.

FWD User Tools for Local Roads

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The Minnesota Department of Transportation Office of State Aid has teamed with the Minnesota County Engineers to conduct a 2-year Falling Weight Deflectometer data collection project on Minnesota County Roads. The project started in May, 2009 and will be completed by May, 2011, with the data collection completed by November, 2010. The project includes collection of FWD data on approximately 9000 miles of County Roads, the collection of pavement segment, structure and traffic information which was provided by the counties, and compiling the data into a format that will be used by a data analysis tool being developed by Dr. Jim Wilde at Minnesota State University, Mankato. The final product of the two projects will be a data analysis tool supplied to each county with all of their pavement data included, which will allow the County Engineer to determine the spring load rating of each pavement tested. The tool will also allow the user to update traffic, structure, and subgrade information as it changes or better data becomes available, and to evaluate the effects of increased traffic volumes on the performance of a given roadway.

A Novel Nondestructive Method for QC/QA of Concrete Pavements

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Non-destructive testing (NDT) can be applied to evaluate the extent of pavement damage and has been proven to improve decision-making process in pavement maintenance and rehabilitation. A recently developed ultrasonic tomography device (MIRA) offers a great potential for high accuracy measurements of such parameters as concrete and asphalt thicknesses, reinforcement location, debonding between the layers, level of compaction, presence of honeycombing, delamination, etc. This new device, MIRA, utilizes 40 (10x4 array) “touch and go” transmitting and receiving dry point contact transducers to apply the same analysis principles that have been successful in medical and metal applications to concrete. The multiple sensor pairs in each scan allows for the required redundancy of information to evaluate heterogeneous mediums such as concrete or asphalt. This presentation discusses some of the field implementation of MIRA for reinforcement location, thickness determination, material property characterization, as well as concrete pavement transverse joint deterioration and delamination. Analysis techniques developed at the University of Minnesota to increase the productivity are also discussed.

Non-Intrusive Technologies Phase III

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The use of non-intrusive technologies for traffic detection has become a widespread alternative to conventional roadway-based detection methods. This increase in use has been accompanied by a wide variety of sensors and sensor manufacturers. Many of these sensors are new to the market or represent a substantial change from earlier versions of the product. Mn/DOT is leading a pooled fund study conducting field tests of the latest generation of non-intrusive traffic sensors (TPF-5(171)).

The project is evaluating the extent to which non-intrusive technology sensors offer advantages in safety, data collection, data quality and cost-effectiveness. Emphasis is being placed on the performance of sidefire sensors in congested urban locations; conditions in which traditional methods are most difficult to deploy. These sites have traditionally been challenging for non-intrusive sensors due to limited right-of-way, slow-moving vehicles and occlusion. The non-intrusive technologies to be evaluated include radar, infrared, magnetometer and video sensors. Piezoelectric sensors and inductive loop detectors will be used as a baseline to determine axle spacing and magnetic length of the vehicles.

The project involves extensive field work to properly install, calibrate and evaluate the sensors' capabilities. Field evaluations are being conducted at Mn/DOT's test facility on I-394 in Minneapolis and another site to be selected. The study is focusing on both sensor accuracy and subjective factors such as maintenance and ease of implementation. For sensor accuracy, the collection of volume, speed, and both length-based and axle-based vehicle classification is of primary concern. The sensors will be tested in both varying traffic congestion conditions and several weather conditions, such as rain and snow. A Final Report documenting the project's findings will be published in December 2010.

User Perceptions of Fee Lane Concepts in Minnesota

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Conversion of high-occupancy vehicle (HOV) lanes to high-occupancy toll (HOT) lanes has become a relatively common managed lanes technique now employed in cities across the U.S. However, conversion of existing general purpose lanes to toll lanes or HOT lane operations has not yet won public support as the perception persists that these “free” lanes have already been paid for and such conversions are a take-away. Focus groups were held to understand what policies, conditions, designs and operational characteristics could be considered that may satisfy concerns about general purpose lane adaptations to optional toll lanes or FEE Lanes. FEE Lanes envision all users, except transit, paying a toll during peak-periods, with the lane reverting back to “free” operation outside of the peaks. Three configurations of FEE lanes were presented and a toll credit system was offered as a means to compensate users who may view the conversion as a take-away.

Participants liked what they have already seen work, which is one priced lane on I-394 MnPASS, but were also concerned about user safety and equity. The credit system, which attempts to address user equity, was a source of confusion for many focus group participants. Although some participants seemed to like the idea of getting the credits to use in FEE lanes, there were numerous concerns about logistics of credit management and distribution. These findings highlight the need for increased education and marketing about road pricing options which can assist in building support for a variety of pricing options, such as FEE lanes.

The Urban Partnership Agreement Successes and Lessons Learned So Far

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New MnPASS Express Lanes on I-35W now provide new options for commuters traveling between the southern suburbs and downtown Minneapolis. Opened on September 30th, 2009, the new MnPASS lanes allow express travel for single occupant vehicles willing to pay a modest fee to use the high occupancy vehicle (HOV) lanes that were originally only available to transit, carpoolers and motorcycles. In addition to the MnPASS Express Lanes, overhead signs in all lanes along the corridor advise motorists of blocking incidents or congestion downstream. On the north end of the corridor, the overhead signs in the far left lane notify motorists when the shoulder lane is open to MnPASS users, transit and carpoolers.

Expansion of the MnPASS lanes to I-35W was part of the Urban Partnership Agreement (UPA) project which provided \$183.5 million in federal and local funding to improve traffic flow on the I-35W corridor north and south of downtown. When completed in 2010, the UPA initiative will provide more transportation choices and reduce congestion on I-35W through the use of congestion pricing, expanded transit service, innovative technology, and telecommuting.

This is the first phase of the I-35W MnPASS Express lanes which include two segments; from Highway 13 in Burnsville to I-494 in both directions and a dynamic shoulder lane section on northbound from 46th St to Downtown Minneapolis. Upon completion of the Crosstown project in late 2010, the I-35W MnPASS Express lane from I-494 to 46th Street will be opened.

This presentation will review the successes and lessons learned so far for the Minnesota Department of Transportation's portion of the UPA initiative which includes the MnPASS lanes, dynamic shoulder section, and overhead signs known as intelligent lane control signals (ILCS). Although additional analysis still needs to be performed, operators of the system are able to share their experience and observations on the effectiveness of the ILCS on motorist's behavior, the changes in traffic conditions along the corridor, and the number of customers MnPASS has attracted to date.

A Safer Way Home: The Minnesota SafeRide Resource Guide

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Communities have long struggled with the negative impacts of impaired driving. Some communities have responded by developing transportation alternatives to give drivers another way home after an evening out drinking. Safe ride programs are one approach to preventing impaired driving. In a CTS project funded by the MN DPS/OTS entitled *A Safer Way Home: The Minnesota SafeRide Resource Guide*, four safe ride programs from different areas of Minnesota are profiled. Each program developed independently of the others, has different levels of business and community involvement, and has unique aspects that contribute to programmatic success. Communities considering a safe ride program can consult these cases studies and gain insight into the type of program that might fit well in their own community. The final section of the *Guide* offers assistance to community leaders, businesses or individuals interested in creating a safe ride program in their own community. Step-by-step suggestions for creating a successful program culled from research, other successful programs and best practices are outlined for consideration.

Itasca County Area Transportation Study

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The State and Local Policy Program, in conjunction with Humphrey Institute Professor Yingling Fan and Center for Transportation Studies Assistant Director for Education and Outreach Gina Baas, have conducted a study evaluating the cost and ease of implementing a variety of options for people to travel within and outside Itasca County, Minnesota.

The county presents a challenge to transportation planners, as it is the 3rd largest in the state by land area, but one of the smallest in terms of population. To gain an understanding of the key transportation needs, we held a series of focus groups, listening sessions, and one-on-one interviews, and also conducted background research that included demographic analysis, mapping of the “mis-match” between the location of jobs and where the workers lived, and a national scan of best practices in providing rural transportation.

This work resulted in a number of recommendations that fall into five functional categories:

- Policy and Administrative changes
- Communications, Education and Outreach changes
- Opportunities for Coordination and Cooperation
- Operations, Maintenance and/or Service Improvements
- Cost Sharing or Saving Opportunities

Substantively, the recommendations range from bike routes and use of public transportation, to raising awareness of bus service linking Itasca County to Duluth and launching an online carpool service. We ranked them by estimated cost and ease of implementation, and offered to let the Itasca County stakeholders choose which to act upon. This presentation will include both an overview of the presentations and additional information about follow-on activities.

Project Management Peer Review

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Mn/DOT's Office of Project Scope and Cost Management will present an overview of the *Project Management Peer Review* conducted with CTS in October 2009. This presentation will focus on the peer review process itself and the value of utilizing other state DOT peers to provide an objective viewpoint and to assist in benchmarking where Mn/DOT is with project management. This presentation will also concentrate on the findings and results of the peer review and how Mn/DOT is taking the results of the peer review and going forward on implementation as part of a *change management* process. The presentation on the project management peer review will be in conjunction with a presentation, also by the Office of Project Scope and Cost Management, on the continuing implementation of Cost Estimating and Cost Management and will highlight the interdependency between these two areas, such as cost and scope management, risk management and performance measures.

Minnesota Department of Transportation Change Management

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The Minnesota Department of Transportation (Mn/DOT) will host a session on the continued implementation of its Cost Estimating/Cost Management efforts that have been developing for roughly three years. Presenters will concentrate on the following:

1. The impacts of project management and project management plans on the CE/CM effort. Included will be discussion of the fall 2009 Project Management Peer Review. (Mn/DOT is asking to host a session on the Project Management Peer Review)
2. Cost Risk Assessment Value Engineering (CRAVE) Workshops established to help define project risk and validate cost estimates
3. Mn/DOT's continued effort on implementation of CE/CM: development of performance measures, a tracking system, risk, and tool development.

Effects of the American Recovery and Reinvestment Act (ARRA) on Minnesota

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Program description

A description of how Mn/DOT developed its ARRA program with its partners to achieve the dual goals of infrastructure improvement and job creation. The program principles, development process; project type and statewide distribution of funds will be described.

Program status

The goal of ARRA was to get projects out quickly to stimulate the economy. All funds from 2009 ARRA legislation had to be authorized by March 2, 2010. Where is Minnesota in delivering the program of ARRA projects? The status of project lettings; construction and spending; job creation will be presented.

Lessons learned

The ARRA required unprecedented reporting and program delivery speed. Multi-modal investments were encouraged and new focus areas included economically distressed counties; and participation of disadvantaged businesses. What has MnDOT learned from this experience? How will these learnings apply to future infrastructure funding?

Temporal and Spatial Variation in Non-motorized Traffic: Some Exploratory Analyses

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Transportation planners and managers need information about variation in non-motorized traffic to improve management of transportation systems. Little information about use of non-motorized infrastructure historically has been available to inform decisions related to either management of existing infrastructure or investment in new infrastructure. This paper reports preliminary findings from a project to monitor non-motorized traffic on multi-use trails in the Twin Cities Metropolitan area. Archival data and new traffic counts collected using infrared monitors are summarized. Descriptive statistics, including monthly traffic ratios, weekend-weekday traffic ratios, and peak hour traffic proportions are presented. Traffic counts are correlated with neighborhood and other factors and compared with comparable statistics from the City of Indianapolis. Examples of how statistics can be used to inform transportation planning are presented.

Counting Bicyclists and Pedestrians

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Objective: The objective of this research is threefold: 1) To understand the relative importance of various streets and trails for bicyclists and pedestrians, 2) To understand the load that bicyclists and pedestrians carry on various streets, in comparison to motor vehicle occupants and transit riders, and 3) To measure the effects of bicycling and pedestrian improvements made to streets.

Methodology: Most counts were conducted in September of 2007, 2008, and 2009 with human field observations where counters manually tabulated the number of bicyclists and pedestrians. In each location, an imaginary screen line was drawn across a street (including the sidewalks and/or bike paths). All bicyclists and pedestrians crossing that line were counted. At most locations, 2 hours worth of data was collected in the afternoon rush period, between 4:00 and 6:00 pm on a Tuesday, Wednesday, or Thursday. Twenty-four hour estimates were drawn by assuming that 20% of all bicycle traffic and 18% of all pedestrian traffic occurs from 4:00 to 6:00 pm. In other locations, 6 to 20 hours worth of data was collected throughout the day, and extrapolations were drawn from those time periods.

Findings: So far approximately 150 locations have been counted in Minneapolis. The busiest location for biking is 15th Avenue SE north of 5th Street with an estimated 3,570 bicyclists per day. The busiest location for walking is Washington Avenue SE west of Union Street with an estimated 21,740 pedestrians per day. East River Parkway north of Franklin Avenue carries the highest bicyclist mode share (17%). Washington Avenue SE west of Union Street carries the highest pedestrian mode share (32%).

Policy Implications: The number and proportion of bicyclists and pedestrians on a street can influence project design when improvements are being planned. Counts also allow engineers to better understand crash rates for non-motorized users, as the raw number of bicycle or pedestrian crashes may not translate directly to safety problems.

Analyzing Bicycle-Motorist Crashes in Minneapolis

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Objective and Methodology

The objective of this research is to analyze bicycle-motorist crashes from 2006-2009. Crash analyses conducted by other cities were reviewed to develop the methodology. Crashes were organized by factors, including turning movements, failure to yield, cyclist position on the roadway or sidewalk, available bicycle facilities, location, age, gender, date, and time of day. The crash analysis was conducted using State of Minnesota accident reports available through the Minneapolis Police Department. Research is currently underway and will be completed in Winter 2010.

Potential Applications/Policy Implications

The results of bicycle crash analysis can help the Non-Motorized Transportation Pilot Program, the City of Minneapolis, and the public to assess the effectiveness of current bicycle planning. By identifying common crash types and locations, this research helps determine which intersections and roadways might be improved with infrastructure changes, education, and enforcement.

Rubblization: A Cost-Effective Option

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The first reported use of rubblization and Hot Mix Asphalt (HMA) overlay occurred in 1986 on a New York State Department of Transportation (DOT) project. Since then 7,000 lane-miles of concrete pavement have been rubblized in the United States. Many state, county and local agencies regularly specify this solution for concrete pavements at the end of their service lives. For example, the Wisconsin DOT has let an average of 100 lane-miles per year over the past five years.

Rubblization and HMA overlay has become very popular in many places. All types and thicknesses of concrete pavement can be rubblized. The process is very cost effective especially when compared to full-depth reconstruction. Construction can proceed quickly while minimizing the impact on through traffic, and excellent long-term pavement performance is being achieved. Also, the rubblization and HMA overlay process is environmentally friendly because all of the existing pavement structure is reused without having to remove and haul it off-site.

As agency needs have increased dramatically without available revenues keeping pace, cost effectiveness has become an increasingly important consideration. The rubblization and HMA overlay process requires significantly less raw materials than full-depth reconstruction and is much less likely to require expensive subgrade correction.

The success of a rubblization project is best measured by the long-term pavement performance of the HMA overlay. Several recent studies have found that excellent performance is being achieved. In-depth studies have analyzed pavement performance in Illinois, Michigan, and Wisconsin and have found that pavement performance is meeting or exceeding initial design assumptions and expectations. Several Minnesota agencies have used rubblization and HMA overlay as a rehabilitation technique since 1999 with great success.

Recently, the general public has become much more aware of environmental impacts and sustainability concepts and all levels of government are responding with new requirements for transportation planning, project design and construction activities. The rubblization and HMA overlay process has been achieving these goals for years. This presentation would help answer common questions including:

- What is the proper HMA overlay design over a rubblized concrete pavement?
- What level of subgrade support is required?
- Can urban pavements with underground utilities and curb and gutter be rubblized?
- How are overhead structures with minimum clearance issues handled?

This presentation would also cover the best management practices and specifications of rubblization.

PCC Mix Designs Using Recycled Concrete Pavements

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State departments of transportation began using recycled concrete aggregate (RCA) as aggregate in portland cement concrete pavement in the United States in the late 1970s. Although RCA is rarely used in current U.S. rigid pavement slabs, the impetus for its continued use remains the same: a lack of landfill space, a shortage of nearby quality natural aggregates, or both. However, as American pavement engineers and researchers place a greater emphasis on sustainable, reusable roadways, the status quo for RCA in American roadways should be reconsidered along with these new priorities. This study proposes to revisit the use of recycled concrete as aggregate in rigid pavement slabs by using overlooked research to address the concerns that prevented the wide-scale adoption of recycled concrete as an aggregate in pavement slabs by state departments of transportation. Experiences encountered in countries (mostly restricted to Europe) where the use of RCA in rigid pavement is more common are also described. New opportunities for the use of RCA as a structural component in pavement concretes are detailed.

Recycled Unbound Base Pooled Fund Study

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The objective of this project is to characterize the properties of recycled concrete (RCA) and asphalt (RAP) as unbound base without being treated or stabilized, to assess how RCA and RAP behave in the field, and to determine how pavements can be designed using RCA and RAP. Issues to be considered include variability in material properties, purity of material, and how to identify and control material quality. This project includes examination of existing information, laboratory studies, and evaluation of data from MnROAD test sections. Anticipated results from this project include a suite of tests and/or protocols that may be used to identify the critical characteristics of these recycled materials, as well as optimum design criteria and best construction practices needed for a durable base that meets the properties proposed for layer design. Test sections were constructed using recycled materials in the granular base layers at the MnROAD test facility. One test section includes 100% RAP, another 100% RCA, a third one a 50/50 blend of RCA/natural aggregate, and a fourth one only natural aggregate (Class 5) as control. The material properties are monitored during construction and throughout the pavement life by MNDOT, especially the variation with changing seasons and moisture regimes in order to determine their effects on pavement performance.

Large-Scale Model Experiments (LSME) replicating field-scale conditions were conducted to determine the plastic deformation and resilient modulus characteristics of all base materials used in test sections. When compared to conventional base course, RAP and RCA experienced higher and smaller plastic deformations, respectively. The blended RCA experienced plastic deformations that were smaller than those experienced by conventional base material, but greater than those experienced by pure RCA. An increase in layer thickness decreased the amount of plastic strain experienced by each of the materials. The summary resilient modulus (SRM) of RCA was 24% to 77% greater than that of Class 5, while the SRM of RAP was 18 to 33% greater. The SRM of the blended RCA/Class 5 was 17% to 29% greater than that of Class 5, which was comparable in magnitude to the SRM of RAP. An increase in layer thickness increased the SRM of each of the materials. The resilient modulus of each material was also determined by bench-scale testing in accordance with NCHRP 1-28a, as well as by field-scale tests incorporating falling weight deflectometer. The resilient moduli determined from each test method was normalized to the low-strain (maximum) modulus and plotted as a function of shear strain amplitude for each material. The resulting plots suggest a backbone curve, which describes the dependence of resilient modulus on stress-strain conditions and scalability of the laboratory modulus to the field.

A total of fifteen recycled materials were collected for characterization and testing from across the USA. The type and amount of impurities present in these materials were identified and the allowable limits for impurities are being investigated. Compaction characteristics and resilient moduli of these samples were also determined and predictive equations were derived.

Rural Road Safety and Maintenance Roadway Safety Workshops

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The Minnesota Local Road Research Board (LRRB) and Mn/DOT's State Aid for Local Transportation (SALT) have been instrumental in helping engineering stakeholders address safety concerns. In 2008, the LRRB funded the development and delivery of a workshop focusing on Rural Road Safety Solutions. SRF lead the development of curricula for eight workshops that were presented throughout the state. The workshops were targeted at Minnesota city and county engineers and were developed in a "train-the-trainer" format. Attendees left with an understanding of the many tools and technologies available for the assessment and improvement of safety on rural roads. A key message of the training was that a safety "revolution" is afoot in Minnesota and those responsible for roadways can make a difference through low-cost prevention strategies. However, early on in the process it was noted that this "culture of safety" needed to involve the city and county maintenance forces as well. Therefore, the LRRB has funded the development of a similar, but shorter, workshop for maintenance professionals that highlight grassroots efforts that maintenance professionals can "look for" and "do" on a daily basis to make our roadways safer.

Local Agency maintenance forces are in the best position to be the "eyes and ears" for Local Agencies when it comes to identifying situations, that when addressed, could greatly improve safety for the traveling public. A few areas where low cost maintenance safety solutions might be implemented through proactive engagement by Local Maintenance forces include: gravel shoulders (lane shoulder drop-off), right-of-way obstructions including approaches, mailboxes and utilities, striping and signing, guardrails, mowing, sweeping, patching, drainage, etc.

Both of these workshops will be available in the future from the MN Local Technical Assistance Program (LTAP). <http://www.mnltap.umn.edu/>

Minnesota Local Agency Pavement Marking Practices

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Good pavement markings provide critical elements to: guide drivers on correct road paths; compliment road signs to inform and warn drivers; and improve night driving conditions. The key factor in determining marking quality is its presence (a measure of how much marking is remaining on the road) during the day and retroreflectivity (the ability of markings to reflect light and thus be visible to the driver) during nighttime. Presence and retroreflectivity are based on the markings used (typically with paint, epoxy or thermoplastic), type and quality of beads, and how are they applied, as well as how they degrade over time. This presentation will address the findings of a Local Road Research Board project which reviewed existing pavement marking practices by local agencies in Minnesota in terms of material selection, installation, specifications, and contracting procedures. The results are being used to provide guidance for maintaining good pavement markings thereby saving money and increasing road safety.

Minnesota Toolkit – Information for Local Agencies to Meet FHWA's Sign Retroreflectivity Requirements

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Traffic signs present important information to drivers at all times, both day and night. To be at their most effective, their visibility must be maintained. Previously, the Manual on Uniform Traffic Control Devices (MUTCD) did not specify minimum retroreflectivity levels. The new standard in Section 2A.09 requires that agencies maintain traffic signs to a minimum level of retroreflectivity (outlined in Table 2A-3 of the MUTCD). The Federal Highway Administration (FHWA) believes that this proposed change will promote safety while providing sufficient flexibility for agencies to choose a maintenance method that best matches their specific conditions. To assist with conforming to these requirements, FHWA has put together several helpful tools including workshops and a very detailed web site:
http://safety.fhwa.dot.gov/roadway_dept/retro/index.htm

However, these tools and website are only helpful to those that know about the requirements and also have access to the internet. Many of Minnesota's small cities and townships are not aware of the requirements and would not know what to do to meet them. Therefore, SRF is working with the MN Local Road Research Board (LRRB) and Mn/DOT's State Aid for Local Transportation (SALT) to develop a "Sign Retroreflectivity – A Minnesota Toolkit" that will help educate local agencies on the retroreflectivity requirements, resources available to them and a summary of the various assessment and maintenance methods they can use. In addition, this toolkit will provide examples of existing agency sign inventories, policies and signing agreements with other agencies.

As a follow-up to the Minnesota Toolkit, the LRRB has funded the development of a manual and training course titled *Minnesota's Best Practices for Traffic Sign Maintenance and Management* which provides an overview of the new provisions of the MUTCD, summarizes the alternative methods for sign maintenance that have been identified, and then focuses on a potentially powerful strategy – reducing your sign maintenance costs by substantially reducing the number of signs along your system of roadways.

The Minnesota toolkit and the Best Practices Manual are expected to be final in early 2010 and will be available on the LRRB's website at <http://www.lrrb.org> as well as the State Aid Traffic Safety website: http://www.dot.state.mn.us/stateaid/sa_traffic_safety.html

Snow Rendering for Interactive Snowplow Simulation – Improving Driver Ability to Avoid Collisions When Following a Snowplow

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Our ability to perceive motion in general and optical expansion in particular is crucial for safe driving. Expansion indicates that we are approaching the car ahead of us. In previous work by Yonas and Zimmerman, two situations were found that interfere directly with our perception of the expansion motion that alerts drivers that collision is imminent: fog and blowing snow. The effect can vary depending on how these situations interact with the colors of the snowplow vehicle and the color of the surrounding road environment, but in general what is created is a dangerous low-luminance contrast situation. In a low-luminance contrast situation the contrast between foreground and background luminance is minimized. Luminance can be thought of as the amount of light intensity, but not color that comes from a surface.

Our ongoing research efforts are focused on building a virtual environment simulation tool to help answer questions related to how humans behave when faced with these low-luminance contrast winter driving scenarios. The overall goal of this research tact is to create safer winter driving conditions by applying information about human perception to the design and configuration of snowplow lighting.

In particular, we are conducting experiments with different snowplow lighting configurations in both low-luminance contrast and high-luminance contrast within the virtual environment simulation. Additionally, one of our objectives is to provide more effective simulations of low-luminance contrast situations (e.g. fog or blowing snow) that can be used to advance prior experiments, ideally creating safer winter driving conditions by applying our knowledge.

Our talk will focus on describing the problem area while presenting some of our results investigating snowplow lighting configurations. We will also cover some of our work for improving our winter snow model.

A Generational Checklist for Communicating Research

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This presentation will take a case-study approach to communicating your research across three generational cohorts: Baby Boomers, Generation X and the Millennial Generation. The presenter will analyze three existing reports for generational messages, plus two research reports supplied by the audience. So bring your research with you, and we will analyze it in during the presentation. We will discuss technology issues, but we will also dig deeper into the psychology of generational messaging.

Collaborative Information Services between Minnesota Public Agencies

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The Minnesota Transportation Libraries program -- a collaborative effort of the Minnesota Department of Transportation, the Center for Transportation Studies at the University of Minnesota, and the Minnesota Local Road Research Board -- is intended to use traditional and emerging technologies to make the world's transportation-related information resources readily accessible throughout Minnesota. Information professionals representing these three associations collect, organize, and disseminate information about Minnesota's transportation programs and resources. Skilled in transportation research practices and usage of core resources, these professionals assist constituents in navigating, interpreting, and evaluating online and print resources and engage in and investigate emerging information practices and tools. This presentation will discuss how transportation researchers can utilize emerging technologies, standard print and electronic resources, and local professionals for their information needs.

The Evolution of Social Media Policy in a State Agency

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There are many resources which identify the benefits of using social media as a communication tool, but very few government entities have developed a detailed policy to manage it. Typically, the government entities just say “no” to its use or they allow it to creep into the environment by default. This presentation will explore some of the issues that were considered in creating a social media policy in the Minnesota Department of Transportation. The presentation will cover legal, security, and information quality concerns.

Should the Fuel Tax be Replaced?

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While there is a growing consensus among many transportation leaders that the fuel tax is no longer a good way of financing the transportation system, there is by no means a public understanding of why this is so. The public assumes that the taxes they are paying at the pump are paying for the system and that whatever problems there are with the system are simply a matter of waste and inefficiency.

This research project examines the fuel tax on the basis of tax and public policy principles:

- Equity and fairness – all users pay and benefit
- Efficiency and livability – mode shift from auto to transit, peak to off-peak, full truckloads
- Revenue adequacy and sustainability – full recovery of transportation costs
- Environmental sustainability – polluters pay
- Feasibility – privacy, security, implementation & operating costs

The research seek to answer the question of whether the fuel tax in fact should be retained or replaced with a system based on vehicle-miles traveled. What are the options for replacing the fuel tax and is there a better approach for a user-based system of financing transportation?

Sustainable Transportation Funding Options for Minnesota

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This study considers the long-term sustainability of current funding sources for state trunk highways, Greater Minnesota transit and Twin Cities metropolitan area transit. The current funding structure is discussed along with forecast trends that are likely to impact the level of revenue generated. In particular, the effects of improved vehicle fuel economy and increased use of alternative fuels are considered, along with broader economic trends such as inflation and volatility in fuel and construction prices. Several possible funding sources are evaluated, including modifications to existing sources, such as adjusting rates or indexing, and adding new sources such as mileage-based fees. Economic, administrative and environmental criteria are used to determine the viability of new sources, and possible transitions to a new transportation funding structure are presented.

Mn/DOT Quantitative Survey on Public Perceptions of Mileage-Based User Fees

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The Minnesota Department of Transportation (Mn/DOT) has completed the third phase of market research into public attitudes and awareness regarding mileage-based user fees (MBUF). The first two phases of research, already completed, involved gathering qualitative data from experts and the general public on mileage-based fees. This final phase is intended to quantify our understanding of public perceptions regarding MBUF concepts. Public knowledge and acceptance of these initiatives will be a critical factor in the development of mileage-based user fee policies.

Mn/DOT has three main goals for this phase of research:

- Assess reactions to informational pieces the Minnesota public respondents will see and determine whether the materials aid respondents in adequately understanding transportation issues and funding scenarios
- Gauge the reaction to written concept(s) of the mileage-based user fee funding initiative, which will charge a user fee according to the number of miles driven per year, keeping attuned to potential unintended consequences
- Quantify the barriers to this concept which Mn/DOT heard qualitatively and identify potential solutions that would aid the public in acceptance of the models as presented, or perhaps enhance or remove features in the concept(s)

This session will report on the findings of this research and risks associated with the MBUF concept.

ITS and Privacy: Suggestions for Peaceful Coexistence

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This research addresses significant legal questions related to electronic communication as it is used in intelligent transportation systems (ITS) technologies. With an emphasis on locational privacy, the research focuses on technologies that require participation of all users of a transportation facility, require the collection of information identifying the user, and have the potential to sanction the user if the data collected indicates they violated the terms of a private agreement and/or the law. The research team began by looking at the history of transportation technologies that have faced legal, usually civil liberties-related, challenges regarding their implementation. After gathering information about ITS applications that currently (or are likely to in the future) incur a high level of scrutiny, a legal analysis was completed to show why such scrutiny is necessary. Technologies examined include those used to collect a Vehicle Miles Travelled road user fee and those used to enforce Graduated Driver License provisions.

The research results in suggestions for how the purposes of these technologies can be achieved with minimal intrusion, ensuring that stringent legal tests are met. Developers of ITS applications are provided with the information needed to maximize the potential usefulness of their technologies without compromising consumer's privacy. Along with specific application, the underlying concepts presented will generally stretch to any field which uses information transmitted by means of electronic communication as well. The suggested methods for employing the technologies discussed here may be used for a variety of equipment, including both radio frequency identification and global positioning systems.

Assessing Elements of a Low Carbon Transportation Fuel Standard for Minnesota

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Researchers will investigate and develop a modeling analytical framework to compare the economic and environmental implications of various low carbon fuel standards (LCFS) for vehicles operated on Minnesota public roads. The research team will then submit a report with recommended parameters and methods for analyzing LCFSs that measure progress in reducing greenhouse gas emissions on a life-cycle basis as well as the economic and environmental impacts on each transportation fuel and production pathway. These metrics will be compared to the state's current policies.

Travel Demand Management: Planning, Environment, Pricing, Sustainability

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Presentation Objective

The objective of the presentation is to share innovative best practices for Travel Demand Management (TDM) strategies in Minnesota as well as throughout the United States and world. The panel will consist of two presentations – (1) Twin Cities TDM strategic planning efforts and (2) international experience with road pricing strategies.

Importance of TDM as Part of a Sustainable Transportation System

Efficient demand-side management is critical to create a sustainable transportation system and ensuring continued functionality of a capacity-constrained system. Thus, travel demand management (TDM) is an imperative key to the development of a sustainable transportation system. By focusing on the transportation system's ability to move people, rather than vehicles, TDM strategies increase the overall efficiency of the system. TDM increases the number of people moved by increasing the number of people each vehicle carries, shifting trips to off-peak times, and eliminating or shifting trips to other modes that use less of the region's limited transportation infrastructure.

Twin Cities TDM Strategic Plan

The Metropolitan Council is in the process of developing a regional strategic transportation demand management plan (TDMSP) for the Twin Cities region. Innovative strategies and performance measures are being developed for the plan. The strategies and performance measures will be used to facilitate the effective use of CMAQ funding.

The TDMSP documents the current TDM environment in the Twin Cities, which includes an inventory of regional TDM activities and compares these activities to national and international best practices. The TDMSP will culminate with recommended implementation strategies including administrative structure, funding sources, and policy measures to better gauge the impact of TDM initiatives and to increase overall TDM effectiveness.

Road Pricing

Broad application of variable road pricing in the U.S. has been limited due to political, technical, and institutional issues. However, variable charges have been used successfully by many U.S. industries, including hospitality, air travel, utilities, and telecommunications. In addition, road pricing has been instituted on a broader basis in other countries, notably Singapore, Germany, the UK, and Sweden, and to a limited degree in the U.S. through the implementation of High Occupancy Toll (HOT) lanes. The application of road pricing has been employed to reduce congestion, which has positive environmental effects, and to generate new revenues for transportation.

In December 2009, a team comprised of representatives from the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA); the Georgia, Minnesota, Virginia, and Washington State Departments of Transportation; the Port Authority of New York and New Jersey; and SRF Consulting visited with representatives from Sweden, the UK, Singapore, Germany, the Czech Republic, and the Netherlands. The purpose of the scan was to identify new ideas and practical, workable models for integrating road pricing approaches into state, local, and regional policies, programs, and practices. The team identified nine major findings that are intended to inform the U.S. road pricing research agenda and assist U.S. practitioners to more effectively implement road pricing as a transportation demand management tool.

Addressing Climate Change in Environmental Impact Analysis

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The proposed presentation discusses the different approaches being taken by local governments, states, and governmental agencies to incorporate climate change into project-level environmental review processes. The study provides an overview of policies that are currently in place or being developed.

Currently, there is no federal requirement under the National Environmental Policy Act for the inclusion of greenhouse gas emissions in the environmental review process for federal agency projects. However, some states, local governments, and government agencies are beginning to consider the potential climate change impacts of construction and development projects under state environmental laws. This has been spurred by increased awareness of climate change and a rise in lawsuits challenging the validity of environmental assessments that excluded greenhouse gas emissions. The policies are not widespread, but increasingly, governments are considering ways to include greenhouse gas analysis in environmental review.

The research assesses the different ways in which these policies are being structured, and the varying ways in which they are implemented. The research addresses the types of policies being used (statutes, rules, guidelines), the ways in which these policies impact the existing environmental review process, and the varying methods used to analyze greenhouse gas emissions.

Vibration Inspection Techniques to Rapidly Assess the Health of Rural Bridges

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Current timber bridge inspection procedures used in Minnesota and across the United States are mostly limited to visual inspection of the wood components. Use of advanced techniques like stress wave timing, moisture meters, resistance drills will significantly improve the reliability of the inspections but these inspection techniques are time consuming.

The objective of this project was to conduct vibration testing of dowel laminated timber bridge systems to better understand the potential for using vibration testing to assess the structural health and condition of bridges in Minnesota. A second key objective was to improve and automate the vibration testing system that is currently being used. This research showed that the forced vibration system developed is an effective tool for conducting forced vibration tests of timber bridges and that there is a noted increase in frequency during each successive stage of construction. A reliable means for assessing the peak frequencies and an identification of the mode still needs to be developed for this system to use the vibration response to predict the EI product for use in load ratings. Each bridge has a unique set of vibration characteristics that were identified using the automated system. These characteristics showed peaks in amplitude as the frequency of the vibration was increased from 0 - 35 Hz during testing. It is believed that monitoring of the characteristic vibration response for each bridge would be a means of identifying changes in structural health over time due to wood decay, accidents, vandalism, or lack of maintenance.

FHWA Long-Term Bridge Performance Program

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With the passage of the Safe, Accountable, Flexible, Efficient Transportation Equity Act (SAFETEA-LU), the Federal Highway Administration (FHWA) Office of Infrastructure, Research and Development (R&D), initiated the Long-Term Bridge Performance (LTBP) program. The LTBP program is an ambitious 20+ year research effort that is strategic in nature with specific short- and long-term goals. The program will include detailed inspection, periodic monitoring, evaluation and testing, and possibly forensic investigation of representative samples of bridges throughout the United States to capture and document their performance. The program will result in a high-quality, quantitative database, which will lead to the development of improved life-cycle cost and performance models, better understanding of bridge deterioration, improved effectiveness of maintenance and repair strategies, provide support for improved design methods and bridge preservation practices, and facilitate development of the next generation of bridges and bridge management tools.

The objectives of the LTBP program are; 1- Developing a strategic road-map, 2- Identifying bridge performance indicators and specific data to be collected through collaboration with stakeholders; 3- Establishing an open architecture, scalable, and extensible data management and data analysis infrastructure; 4- Developing protocols for data sampling and collection, and quality assurance; and 5- Developing a methodology and rationale for sampling bridges from the National Bridge Inventory database to determine the type, numbers, and locations of bridges to be inspected, monitored, evaluated, and instrumented.

In September 2009, the pilot study phase of the LTBP program got underway with the objectives of validating protocols for data collection and management and ensures that all of the components needed to achieve the long-term objectives of the LTBP program are specified before commencing work on large population of bridges nationwide. The LTBP pilot phase will include a total of 7 bridges having a good representation of the many environmental conditions experienced throughout the United States. The States participating in the pilot study are California, Florida, Minnesota, New Jersey, New York, Utah and Virginia.

This presentation will provide an overview of the objectives of the LTBP program and highlights its current activities with special focus on the Minnesota Pilot Bridge.

I-35W St. Anthony Falls Bridge Structural Monitoring

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The St. Anthony Falls Bridge was constructed to replace the steel truss bridge that collapsed on August 1, 2007. The replacement bridge featured a “smart bridge” system. This system included instrumentation for monitoring the structural behavior of the bridge. The University of Minnesota is responsible for the collection and interpretation of the data gathered by the system. To aid in the analysis of the bridge, finite element models were created. Prior to opening the bridge to traffic, truck load tests were conducted to provide data for calibrating the model. The models will be used to gain a better understanding of the behavior of concrete box girder bridges in Minnesota, and for establishing a long-term monitoring plan for the instrumented bridge. This presentation describes the instrumentation in the St. Anthony Falls Bridge, the construction and calibration of the finite element models, the behavior of the bridge with respect to the truck load tests and thermal effects, and the plan for long-term monitoring.

Wakota Bridge Thermal Stress Monitoring Program

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This presentation describes a monitoring program developed to study the effects of temperature variations on the forces in the structure of Wakota Bridge. The Wakota Bridge, also known as the Minnesota Department of Transportation (Mn/DOT) Bridge 82855, carries the eastbound lanes of trunk highway 494 over the Mississippi River, as well as the Union Pacific Railroad (milepoint 347.56) and Verderosa Avenue. It is a post-tensioned segmental concrete bridge for which temperature changes are expected to affect the magnitude of the moments at the base of the piers. The intent of the monitoring program is to use field observations to verify and/or modify current procedures in the AASHTO LRFD Specifications. The instrumentation described here includes (1) instruments installed in Piers 2 and 4 of the Wakota Bridge, as well as (2) the strain gauges installed in Spans 3 and 4 of the superstructure. This presentation addresses the placement of the sensors and the data acquisition equipment, as well as an overview of the analysis of post-tensioned segmental concrete bridges for thermal effects.

Improving Transportation Safety through Accident Investigation

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The National Transportation Safety Board is a small Federal agency charged by its authorizing statute with determining the probable cause of accidents in all transportation modes, and with making recommendations to prevent their recurrence. The Board is also charged with conducting safety research to identify and correct transportation safety risks. In meeting these responsibilities it is essential that accident investigations be pursued to a depth and with a technical rigor that can distinguish the truly one-off rare event from systemic conditions that pose continuing risks to the transportation system. Equally important is resolution of accident causation to a degree that permits the identification of appropriate corrective actions.

This presentation will review the Board's approach to discovering the probable cause of transportation accidents, with examples that include: the I35W bridge collapse in Minneapolis, MN on August 1, 2007; the Chatsworth, CA collision between a Metrolink passenger train and a Union Pacific freight train on September 12, 2008; a rural motorcoach accident near Mexican Hat, UT on January 6, 2008; and the crash of a commuter airliner near Buffalo, NY on February 12, 2009.

These investigations have revealed catastrophic failures in various aspects of the transportation system, and have generated safety recommendations intended to correct these flaws and prevent future accidents. The presentation will also discuss the development and validation of such safety remedies.

Center for Excellence in Rural Safety Research and Outreach Activities

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In 2005 the Center for Excellence in Rural Safety (CERS) was created at the University of Minnesota. This presentation will define the rural roadway safety problem in Minnesota and/or the country. It will introduce the attendees to the rural roadway safety activities being completed by the Center for Excellence in Rural Safety (CERS) at the University of Minnesota. Two CERS projects will be summarized briefly. The Rural Safety Policy Improvement Index (RSPII) project will be complete and attempts to quantify the rural roadway safety improvements that might occur throughout the United States if changes were made to six policy-related safety improvements (e.g., seat belt laws). The capabilities of SafeRoadMaps (Version 2) will also be discussed. This is a web-based tool that allows users to search for the location of roadway fatalities and acquire some information about their characteristics. Improvements to the national rural safety clearinghouse being completed for the United States Department of Transportation will also be noted.

New Methodologies to Identify Candidates for Safety Investment

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FHWA has implemented a policy change to the Highway Safety Improvement Program (HSIP) that revised the objective of the program from reducing highway crashes in general, to specifically emphasizing the prevention of severe crashes (fatal + serious injury). This change in emphasis – from all crashes to severe crashes – presents a new challenge to the professionals managing safety programs. The random, widely distributed nature of severe crashes makes it difficult to identify specific at-risk locations. For example, in Minnesota approximately 33% of fatal crashes (190 per year) involve a single vehicle running off the road, 75% of these (145 per year) are in rural areas and 62% of these are on the local system. However, this system is made up of over 45,000 miles of two-lane highways, which results in a density of 0.002 fatal road departure crashes per mile. This statistic begs two questions: are all of these miles equally at-risk and if not, how can the most at-risk locations for severe crashes be identified as candidates for safety investment.

One of the key challenges associated with recent safety planning efforts relates to the fact that analytical processes for identifying candidates for safety investments in rural areas – rural intersections and rural highway segments on both the state and local systems – are neither well developed nor are the basic processes understood by safety analysts. Most previous efforts to refine analytical processes have focused on improving the statistical methods for identifying high crash locations. However, most of the rural locations where most severe crashes occur have had few or no crashes during a typical three to five year study period.

The key point is that the mature analytical systems that safety professionals are familiar with are primarily focused on finding locations with unusually high numbers of crashes, which most often are not the locations where the majority of severe crashes are actually occurring. As a result, new methodologies and analytical techniques are required.

In an effort to develop these new methodologies, Mn/DOT has recently completed research studies of three components of the state's rural highway system – STOP controlled rural intersections, two-lane highway segments and horizontal curves. The research resulted in the identification of analytical processes for identifying and prioritizing at-risk locations that would be candidates for the proactive deployment of low cost safety strategies. Initial applications of the new processes successfully identified at-risk locations and resulted in the development of low cost safety projects on both the state and county systems that were selected for HSIP funding.

Minnesota Statewide Comprehensive Freight and Passenger Rail Plan

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The 2008 Session of the Minnesota Legislature mandated the Mn/DOT prepare and submit a Comprehensive Statewide Freight and Passenger Rail Plan to the relevant legislative committees. The intent is to develop policy and finance guidance for rail initiatives and investments in the state, and to be included in the State Transportation Plan upon completion.

The scope of the plan will address the following areas:

- Develop an overall vision for effective utilization of the state's rail network and its future development.
- More clearly define private and public sector roles, including the State of Minnesota's, and the integration of those roles into the planning, coordination, and use of rail in the state's transportation system.
- Identify priority rail corridors, programs, and projects that will offer effective improvements or expansion for passenger travel in and out of Minnesota.
- Enhance freight access to markets and efficient, competitive services to rail customers, as well as improvements to overall freight flows and logistics.
- Develop practical and usable performance measures and investment guidelines for public development of rail assets and services.

The approach to Plan development will revolve around several strategies in order to insure comprehensive investigations and consensus of stakeholders in the Plan directions and policies. Mn/DOT will proactively and consistently engage its partners and all concerned parties in the planning process during an eighteen month span of activities. Key aspects of the suggested approach will involve these concepts:

- Establish a Policy and Steering Committee representing concerned stakeholders including public officials, industry representatives for carriers, shippers, and travelers, and the general public, to provide active and ongoing input, review, and direction to the planning team.
- Organize and implement a dual-track but integrated study process that recognizes the distinct characteristics of freight transportation, passenger transportation, and their points of intersection over such issues as capacity, safety, infrastructure use and compensation, and commingling of services. Each track will support its own technical advisory committee and outreach program to stakeholders, while providing key joint forums and shared information to each other to reinforce coordination and inform project management and the Steering Committee.
- Recognize and maintain the goal of developing both an overall vision for a future system through a transparent and consensus-building process, and implementing practical and complementary strategies and projects that will systematically and productively advance the Plan.

The Plan is scheduled to be completed by December 2010

Summary: The Minnesota DOT has completed the first Minnesota Comprehensive Statewide Freight and Passenger Rail Plan effective Dec. 31, 2009. Included in the research and findings are currently relevant recommendations for Minnesota to build high speed passenger rail connections between the Twin Cities and Chicago, tying into the federally designated Chicago Hub network (the Mid-West Regional Rail Initiative or MWRI) and linking all major Regional Trade Centers to the Twin Cities in this state and Wisconsin. The presentation will discuss current technology, federal initiatives, local project status, costs, effectiveness, timelines, and future enhancements.

Freight Performance Analysis on I-94/I-90 from the Twin Cities to Chicago

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One of the key measures of freight performance on interstate highways in the United States is travel time reliability. The Federal Highway Administration (FHWA) has established a partnership with the American Transportation Research Institute (ATRI) to measure average travel rates for over 25 freight-significant corridors since 2002. Currently, the developed Freight Performance Measure (FPM) system from ATRI has the capability to derive average truck travel speed and travel time on all national highways.

I-94/90 is a key freight corridor for goods transportation between Minneapolis and Chicago in the Upper Midwest. There are increasing volumes of freight being shipped to Chicago then sent by air through O'Hare rather than being sent by air through the MSP airport. The Minnesota Department of Transportation (Mn/DOT) freight office is interested in using the FPM data to study the growing freight activities along I-94/90 from the Twin Cities to Chicago. This project utilizes the truck location data obtained from ATRI to study the freight activities along I-94/90. This report documents the analysis results of heavy trucks (mostly class 8 trucks over 20,000 lbs.) traveling along the I-94/90 corridor. Truck location data collected by private data providers from May 2008 to April 2009 were obtained from ATRI. General traffic data along the corridor were also acquired from corresponding state DOTs for comparison.

Data analysis methodology and data processing procedures were developed. Travel Time Index (TTI), defined as the peak travel time over the free flow travel time, is proposed to measure the level of congestion and Buffer Time Index (BTI), defined as the ratio of the difference between the 95th percentile and average travel time divided by the average travel time, is used to measure the travel time reliability along the freight corridor. Truck speed, speed variation, truck volume variation, distribution of destinations, stop location, and rest duration derived from each individual trip were processed and analyzed using statistical software in this study.

An Assessment of the Impact of Competition on Rail Rates for Agricultural Shipments – An Empirical Study of Minnesota Rail Rates on Soybean, Corn & Wheat Shipments

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Minnesota is the 7th largest agricultural exporting state in the U.S. Its total agricultural exports in 2008 were \$5.46 billion. Soybeans, corn and wheat account for 72% of total agricultural commodity exports. As the agricultural exports grow, many shippers' and farmers' associations in Minnesota have expressed concerns about incrementally higher rail rates and relatively lower service levels because of lack of competition or tight capacity. They have regularly called for improvements in current rail freight transportation services. A 2008 survey among ethanol producers in Minnesota also found concerns on rail capacity, service quality and rates and the impact of rail transportation on the sustainable development of the ethanol industry.

As a result of the concerns brought forth from various groups regarding railroad service and re-regulation, the Minnesota Department of Agriculture (MDA), with assistance from the Minnesota Department of Transportation (Mn/DOT), proposed to do an analysis of rate competition among railroads and its impacts on rail rates in Minnesota for major agricultural shipments, namely soybean, corn and wheat, using the Surface Transportation Board (STB) Rail Waybill Sample. This analysis confirmed the speculation on the pricing strategy of railroads on corn, wheat and soybean shipments – that the less competition there is among railroads and between railroads and water transportation the higher the shipping rates that will be paid by corn, wheat, and soybean shippers. The analysis substantiated that the presence of additional rail competition and the availability of water transport nearby lowers corn and wheat rail rates. Additionally, the results showed that the effects of inter-railroad competition may vary with the extent of water competition.

Northern and Western Minnesota Regional Freight Studies (Districts 1, 2, 4 & 8)

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The Northern and Western Minnesota Freight Studies are a multimodal transportation planning effort. The studies were sponsored by the Minnesota Department of Transportation (Mn/DOT). The purpose of the studies was to provide a better understanding of freight demands on the regional transportation infrastructure and to provide a framework that addressed key state freight planning goals.

Methods

The study approach consisted of the following unique study methods:

- Stakeholder Input: The study team established regional steering committees utilizing members from various agencies and locales throughout the state, and conducted four regional freight forums to solicit ideas for freight improvements. The study team also conducted interviews with local, regional, and national shippers to obtain freight information and shipment needs.
- Freight Trends and Issues: Commodity flows, mode of transportation, and supply chains for commodities were calculated to determine the major import and export commodities.
- Inventory of Critical Freight Facilities: An inventory of critical freight facilities was conducted to ascertain where freight facilities were strongest and what freight facilities needed improvement.

Techniques

Innovative techniques were used in the analysis of freight facilities and trends including:

- GIS Analysis of Critical Freight Inventory Characteristics: A designated tiered truck network was created to assist transportation officials in planning freight routes. The study team also assessed the regional freight network using the 2030 State Transportation Plan performance thresholds that were overlaid on the tiered truck network to determine routes most suitable for freight movements. Measures included roadways with shoulders less than six feet, roadways with AADT over 11,200, ride quality index, proximity to freight generators, and HCADT.
- ITS Opportunities for Freight Safety and Information Strategies: Technology-related solutions were developed to address safety and freight information issues which included 511 enhancements, rest area parking availability, wildlife warning systems, intersection/entry warning systems, real time alternate route planning, dynamic messaging signs, and truck priority at signalized intersections.

Recommendations

The study team provided noteworthy recommendations, policy implications, and possible future projects for each region that will improve operating efficiencies, upgrade multimodal infrastructure, encourage public/private investments, and provide regulatory initiatives such as:

- Quick Start Projects: Quick start projects were developed for immediate implementation as well as for programming into the TIP/STIP process for future funding.
- Super Haul Corridor Routes: An analysis was conducted to determine routes for oversized freight movements with the expectation of creating an official map for shippers and haulers.
- Regional Truck Size: Policies were developed to improve regional truck size and weight uniformity between counties and between states in the Upper Midwest.
- Port and Intermodal: Recommendations for expanding operations at the Port of Duluth, as well as for intermodal facilities along rail lines were developed.

Mining Bus Location, Passenger Count and Fare Collection Database for Intelligent Transit Applications

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We develop a methodological data processing framework to process massive transit data including vehicle location, passenger count and electronic fare transactions. The developed data analysis methodology can allow a number of applications such as transit route performance measurement to support decision making for transit planning and operation. We obtained one month of vehicle location and passenger count data collected in 2008 from Metro Transit. All data were loaded to a commercial SQL database server for data pre-processing and analysis. There are about 30% of the buses equipped with APC counters for collecting ridership information (boarding and alighting counts) at stop level. Bus TP time analyses at time points for nearside and far-side stops, and for early and late buses are considered separately. Link travel time between two consecutive time points is also analyzed. Statistical model based on the empirical data was developed for link travel time estimation. A time point based dwell time model and route-based simulation for route productivity, run time and recovery time analysis as well as scheduling planning and reliability analysis was developed.

In order to investigate the access behavior of transit user, we also obtained a dataset of over 20,000 U-Pass and MetroPass users from University of Minnesota, Parking and Transportation Services (PTS) in 2008. The MetroPass holders are transit users working at University of Minnesota. Addresses of MetroPass users were geocoded to 2005 Twin Cities Metro street map using GIS software to compute the traveling network distance from each registered address to corresponding locations of all tap-on transactions.

Examples of route performance analysis on route 10 and 16 have demonstrated the capability of the data analysis methodology. We would like to further our effort by enhancing the current data processing system to compare performance measure from user's perspective. One area is to focus on the development of a robust route-based transit model that can provide decision support on optimizing performance based on schedule reliability and route productivity. For example, a route-based transit simulation model will allow transit agency to evaluate different schedule, stop consolidation, and other strategies. However, additional data, such as door opening/closing status and rear vs. front door alighting information, from the APC-equipped vehicles are required to enhance the TP time model. External parameters such as arterial traffic condition or weather information, when available, can potentially be integrated to provide informative decision support for transit dispatchers.

Transit Cost-Effectiveness: The C.E.I. Demystified

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For over 25 years the Federal Transit Administration (and its predecessor, the Urban Mass Transportation Administration) has worked to develop and apply a fair measure of cost-effectiveness to use in evaluating the worthiness of major transit projects for federal funding. The current Cost Effectiveness Index (CEI) increasingly shows up in the media and in policy discussions as various transit corridors strive to meet its strict thresholds. This research describes the past and current definitions of the CEI, and shows how the various factors that go into the CEI affect its outcomes in a test application. It considers how this transit measure of benefits versus costs compares to the techniques used in highway projects and the potential to meld the two processes.

Among the early struggles with the transit CEI were the measures of “benefit”. Initial indices considered only new transit riders. More recently the CEI has taken advantage of improvements in general transit modeling techniques to create a newer measure of user benefit. This research considers the conditions under which one or the other would favor various types of projects.

In addition to estimation of user benefits, the CEI has provided opportunities to improve potential projects by assessing trade-offs between other factors and measures used to compare alternatives. This research explores some of those conditions.

Impacts of the Hiawatha Light Rail Line on Commercial and Industrial Property Values in Minneapolis

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This paper analyzes the property value impacts of the Minneapolis Hiawatha Light Rail Transit (LRT) Line in terms of the accessibility effect of proximity to an LRT station. To recover the value-added of the line on sales prices for commercial and industrial properties, we utilized a linear hedonic pricing function using data predating construction and postdating completion of the line. We found that the LRT line produced positive price premium to local communities and the premium extends to about 0.9 miles from LRT stations. The findings provide evidence for transit agencies in justifying transitway investment, as well as addressing the concerns of local developers and lenders regarding LRT's economic benefits.

Can Light-Rail Transit Improve Job Access for the Working Poor?

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Public transportation plays an important role in addressing poverty, unemployment and equal-opportunity goals. Increasingly often, entry-level job opportunities are located away from low-income populations. However, low-income individuals often do not have access to vehicles for commuting, or struggle to pay rising gas prices. These factors make low-income individuals more transit-dependent now than ever before.

This study aims to uncover whether the recently opened Hiawatha Light Rail Line in the Twin Cities, MN effectively connect low-income individuals with suitable job opportunities. The Hiawatha LRT runs between downtown Minneapolis with the Twin Cities' southern suburbs.

Construction on the Hiawatha line began in 2001 and was completed in 2004. The study also examines whether households and employers have relocated to take advantage of benefits provided by the new transit corridor.

The study area includes the seven-county Twin Cities metropolitan region and uses data from several sources including the Longitudinal Employer-Household Dynamics (LEHD) database, the U.S. Census Bureau and Metro Transit. Two complementary analyses are conducted, including a before-and-after accessibility analysis and a before-and-after commuter-flow analysis. Accessibility is defined in this research as a low-wage job reachable within 30 minutes of transit travel, with a maximum of one transfer and a maximum walking distance of one-quarter mile. With the before-and-after accessibility analysis, I found significant increases in transit accessibility to low-wage jobs over the study interval. I also found major accessibility gains occurring not only along the Hiawatha corridor but also along the bus routes (especially the high-frequency routes) that connect with the Hiawatha line. The before-and-after commuter flow analysis shows changes in commuting flows between home and work near the transit system. I found significant relocations of low-wage workers to areas near three Hiawatha LRT stations including Cedar-Riverside, Franklin Avenue, and Lake Street-Midtown, as well as to areas with bus connections to Hiawatha. In addition, I found significant reorientation of low-wage jobs to the Hiawatha station areas in downtown Minneapolis and Bloomington's Mall of America area. Taken together, the analyses in this study show positive evidence on the role of transit in promoting social equity.

Porous Pavement for Storm Water Management

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Urban stormwater management requires the use of best management practices (BMPs) that meet the needs of the watershed where the project is located and the rules and regulations of the local city and watershed management organization. Many of the municipalities and Watershed District in the Twin Cities are now requiring the use of stormwater runoff volume reduction BMPs. For land uses with significant parking areas and vacant land constraints, the use of porous pavement is a cost-effective solution to storing and infiltrating stormwater on-site. The use of porous pavement is also beginning to be used in roadway projects with low traffic volumes and low or no sand use for snow and ice control. This presentation reviews the historical use of porous pavements, alternative types of porous pavements, benefits, examples and past performance.

SAFL Baffle Improves Standard Sump as a Stormwater Treatment BMP

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Standard sumps (manholes) have commonly provided a location for pipe junctions and maintenance access for municipal and highway stormwater drainage systems. These standard sumps may qualify as a best management practice (BMP) to remove suspended sediment from the water column. However, no data on the effectiveness of sediment removal and required associated maintenance schedules of the sumps exist. Such data could justify granting pollution prevention credits for the use of standard or retrofitted sumps to municipalities, counties and government transportation agencies.

Two full scale standard sumps were tested in a laboratory setting to determine whether they remove suspended sediment from stormwater runoff. The sumps evaluated had a simple flow through design with a one percent drop from the inlet to outlet. One sump had a 4ft diameter and 15 inch diameter inlet and outlet pipes, and was tested for either 4ft or 2ft depth. The other sump had a 6ft diameter, 24 inch diameter inlet and outlet pipes, and was tested for 6ft or 3ft depth.

Sediment removal (deposition) efficiencies were determined under low flow conditions, and sediment resuspension rates in the sumps were measured under high flow conditions for all sump configurations. In the low flow removal efficiency tests sediment of specific size and concentration was fed into the influent pipe. At the conclusion of the test the sediments removed by the sump were collected, dried and weighed. In the high flow condition tests a commercially available sand gradation (e.g. F110 with a median diameter of 110 μm) was placed inside the sump and the amount of sediment remaining after the sump had been flushed by high flows for a period of time was determined. The sumps did remove suspended sediment at low flows, but at high flows the washout was substantial.

A flow-through baffle, named the SAFL Baffle, was designed and tested as a possible retrofit to the sump. Multiple configurations with varying percent open area and different angles of attack were evaluated in a scale model. An optimum configuration was then constructed at the prototype scale and evaluated for both removal efficiency and sediment retention. Results obtained with the retrofit indicate that, with the right baffle dimensions and porosity, scouring of sediment from the sump at high flows can be nearly completely eliminated, and removal efficiency can be significantly increased for low flows and/or larger particle sizes.

Removal efficiency functions have been developed for standard sumps and sumps retrofitted with the porous baffle. The data collected show that standard sumps retrofitted with the SAFL Baffle can be successfully used as stormwater treatment BMPs.

Porous Pavement in the City of Robbinsdale's Residential Streets

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The Shingle Creek Watershed Management Commission along with the cities of Robbinsdale and Plymouth received a Federal Section 319 grant to evaluate if a porous asphalt street surface requires less salt to maintain a safe winter stopping distance. The Minnesota Pollution Control Agency is administering the grant.

The Shingle Creek watershed is a 43 square mile basin in northwest Hennepin County extending from Plymouth to Minneapolis. Shingle Creek is impaired for excess chloride and a Total Maximum Daily Load study showed that a 71% reduction is needed to remove it from the impairment list. 90% of the chloride loading is attributed to road salt application and this study is an effort to find a physical method to reduce the need to salt streets.

In October 2009 test and control sections were installed at 41st and Abbott and 41st and Zenith in Robbinsdale. The 150ft test section consisted of 4" porous asphalt, 1" choker course 13" of ballast rock. The control was the traditional Robbinsdale street section comprised of 1 ½" wear and 2 ½" asphalt base, 8" aggregate and 12" select granular. Similar instrumentation was installed in each section consisting of a pressure transducer to record subsurface water levels, a thermocouple tree to record temperature at eight elevations, an automatic water quality sampler to obtain subsurface overflows and pole mounted closed circuit cameras to capture photos at set intervals. The nearby Crystal Airport weather station is used for precipitation and air temperature data. The University of Minnesota, St. Paul campus weather station is used for thermal heating data. Pavement condition is also being monitored by observation to note loss of material due to aging, freeze-thaw cycles, wheel turning and plowing.

The asphalt specification was prepared with significant assistance from the Minnesota Department of Transportation and the Minnesota Asphalt Pavement Association. Two components were watched closely, the addition of cellulose fiber as an added binder and placement with an air temperature above 50°F to prevent asphalt drain down.

After one winter of monitoring it appears that the porous section is slightly warmer at 18" below the surface but the surface gets colder faster compared to the control. It has been observed that once the porous pavement warms sufficiently to melt snow and ice the melted water doesn't refreeze at the surface but drops through the pavement. It is being investigated if this is just from sunlight warming the pavement or if there is a chimney effect allowing warmer air from below grade to assist in snow and ice melting. The site will also be monitored in winter 2010-11.

The porous test section showed almost no loss of material through one winter even though plow scuff marks are plainly visible. No salt was applied to the section and no loss of pore space was observed due to clogging by sand from wheel carry over.

Exploring the Pattern of Clustering Within Minnesota Soil Survey Data Using Self Organizing Maps

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The analysis of soil based on its chemical composition is of great importance for the Minnesota Department of Transportation (MNDOT). For instance, in order to understand the suitability of certain proposed materials for usage as roadway bed or fill material at a particular location, there is a need to analyze the chemistry of the native soils. However, the chemical composition of the soil may be characterized by many metal and non-metal constituents. This makes soil analysis rather complex because of the high dimensionality. For this purpose, we use the Self Organizing Map (SOM) method which provides a mapping from the high dimensional input space onto a 2D space (called a map), such that points close (to each other) in the input space are mapped onto close points in this map. In this report we perform clustering of data samples collected along MNDOT roads and try to explore the pattern of clustering between the different soil samples. The two different soil datasets used are:

- **Metro 2001 Soil Survey data** representing samples collected at different sites along MNDOT roads within the Minneapolis-St. Paul metropolitan area. The purpose of analysis is to understand how the concentration of elements changes with distance from major highways.
- **MN Statewide 2003 Soil Survey data** representing samples collected at different non-road sites throughout the state of Minnesota. The sites are selected so that they represent the statewide geomorphologic units. The purpose of this analysis is to explore the pattern of clustering based on the geomorphologic units and the provenance of the glacial sediments.

Metro 2001 Soil Survey data

The soil samples from sites near the road tend to cluster together and the soil samples corresponding to sites far away from the road form a different cluster. Further, we also observe that the soil samples that are far from the road tend to cluster more with the background samples than the soil samples that are nearer to the road.

MN Statewide 2003 Soil Survey data

SOM clustering of soil samples generally does not show any correspondence between clusters and geomorphologic units. However, we observe a good pattern of clustering of the soil samples based on the soil composition (viz, Lacustrine, Till and Outwash), particularly when we use only the rock-forming metals (Al, Fe, Mg, Ca, Na, K, Mn) for clustering. We further observe that the soil samples that have northeast as their provenance of the glacial sediments seem to form a different cluster than the soil samples which have north/northwest as their provenance. We further extend our analysis to capture the pattern of clustering taking only the elements that are of regulatory interest (viz, As, Cr, Cu, Pb, Ni, W, Zn). We find a good pattern of clustering for chromium (mostly geographic), which indicates a high concentration of chromium for the Northeast region of Minnesota.

The clustering of the soil samples based on their distance from the roads could be a result of the enrichment of some elements due to proximity to the road. The anomalies that were not due to provenance can be attributed to disturbance of the soil. Further, the results can also help the state agencies determine the background concentration of metals in soil and the potential occurrence of metals in surface water and ground water. Moreover, for chromium the regional variation should be taken into account while comparing the background soil samples. Thus SOM provides a useful means to analyze the high dimensional soil survey data and derive useful results from it.

Spatial Analysis of Crash Data in the State of Iowa

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The purpose of the study is to find out the differences between urban and rural area in the State of Iowa, in terms of the relationship between crash rates and demography or road infrastructure. We will use the crash data across the State of Iowa in 1990 and 2000 from Iowa DOT, and relate the data to census 1990 and 2000 data at block group level, as well as the road infrastructure data from Iowa DOT. The analysis will use the Spatial Regression models which include Spatial Autoregressive Model (SAR) and Spatial Error Model (SEM), instead of the Ordinary Least Square regression. The Spatial Regression models will modify the crash data employing Moran's Index to correct the spatial autocorrelation of the crash rates between neighboring block groups, in order to acquire a more reliable result of the relationship between crash rates and the explanatory variables. Two models will be built using rural and urban crashes data separately with other environmental impacts controlled, and if the crash rates changed differently over years between urban and rural areas, environmental justice issues can be identified for future policy notice.

Likelihood of Modal Switch: Can Travel Habit Change?

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Households and individuals are attracted to the automobile for its representation of prosperity and independence. However, dependency on the automobile fostered multiple implications such as urban sprawl and negative effects on health and the environment. In most cities, driving is perceived as a necessary means to get from one point to another. Although cities possess a highly regarded bus system, most individuals and households remain dependent on automobile use even when unnecessary. To help solve automobile dependency, the city ought to review land use patterns and promote new ways of urban and transportation planning through dense, mixed-use environments. Nevertheless, the pressing question will be if cities were to make transit-oriented changes in regards to development, would the residents respond accordingly? In order to investigate the answer to this question, this research developed different hypothetical scenarios and gathered residents' reaction. Using statistical models, the study examines the mode switching behavior of the respondents in response to the predefined land use and transportation interventions. The data set used for the analysis is acquired from the online survey of St. Cloud City residents' travel behavior. The analysis result reflected that if dense and mixed developments were implemented, there is an indication of switching from car use to walking and biking. This study also identified public transportation-related persuading factors that cause residents to shift from car use to public transportation. The result showed that people traveling greater distances everyday reflected a likelihood of decreasing their car use if land use and transportation services are improved. This can indicate that there is an expected shift in mode choice contingent upon a well-designed and efficient multi-modal transportation system. One interesting facet of the results involved the respondent's willingness to reduce car use if a park-n-ride system is offered. This proves to be interesting because perhaps park-n-rides increase the willingness to use mass transit. Findings in this study provide insight to a number of actions that would encourage residents to choose an alternative mode of transportation. If policies were put in place, it seems likely a large percentage would switch. Based on the outcome in this research, the study can be further extended as experimental analysis of travel awareness programs.

Summer-Winter Mode Choice Behavior of University Students

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A growing student population has resulted in increased demand for automobile use on campus. Students' intense use of automobiles is the root of traffic problems for universities. In regions where there is heavy winter snow, studying seasonal constraints and modal switch behavior of university students would give local public offices and universities an insight for their transportation planning. Thus, this research aims to analyze student's summer-winter modal switch. i.e., how students change their travel mode choices from summer to winter. There were several factors identified as to have influence on mode choice behavior of students including gender, age, car ownership, land use, attitude etc. The research not only investigates what the mode choice characteristics are of university students; but also examines why students behave the way they do regarding to trip making and how this can be implied on planning and policy. The methodology implemented is a latent variable binomial logit model using a travel behavior survey of St. Cloud State University students. The dependent variable is the mode choice of students in winter and summer. The independent variables are chosen to be the socio-economic background of the students, mode-related variables, land use variable, and attitude variables. The result of the study reflected that there is a slight modal shift from car use in winter to walking and biking in summer. The result also exhibited a likelihood of more bus use in the winter than in summer. The result of the study could be used to formulate policies and programs that encourage, educate and inform students on the benefits of alternative transportation modes. The study suggests that Universities ought to provide awareness programs that encourage students to use public transportation. Besides, the study recommends re-planning a winter public transport provision by improving the public transportation level of services that could ultimately reduce the use of cars by students, so that the environmental and congestion problems would be tackled.