LOCAL ROAD RESEARCH BOARD
MAKING A DIFFERENCE
LRRB Funding

• Legislatively funded (1959)
• Up to 1/2% of State Aid allocation devoted to local road research…currently at $3M
• Research Process:

Research

Mn/DOT
MnROAD
U of M
MnSCU
Consultants
Outstate Universities

Communication

RIC

Training

LTAP

Minnesota Cities & Counties

MAKING A DIFFERENCE
LRRB Members

Bruce Hasbargen (Chair), Beltrami County
Mitch Rasmussen, MnDOT State Aid
Lyndon Robjent, Carver County
Kaye Bieniek, Olmsted County
Tim Stahl, Jackson County
Steve Koehler, City of New Ulm
John Powell, City of Savage
Tom Ravn, MnDOT OCIC
Linda Taylor, MnDOT Research Services
Laurie McGinnis, U of M – CTS

RIC Members

Jeff Hulsether (Chair), City of Brainerd
Dave Robley (Vice Chair), Douglas County
Mike Flaagan, Pennington County
Guy Kohlnhofer, Dodge County
Tim Stahl, Jackson County
Klayton Eckles, City of Woodbury
Merle Earley, MnDOT District 4
Ted Schoenecker, MnDOT State Aid Division
Jim Grothaus, U of M – CTS
Hafiz Munir, MnDOT Research Services
LRRB/RIC Project Selection Process

Development of Proposals and Research Ideas/Needs

Develop Ideas into Proposals

LRRB Review and/or RIC Review

Develop a Technical Advisory Panel

LRRB & RIC Product Review

Complete

Strengths

• Locals empowered to manage their own program
• RIC has on-staff contractor
• LRRB can fund and initiate a contract at anytime
• Ability to leverage by partnering with MnDOT
LRRB Annual Program:

In addition to funding research specifically for MN cities and counties, the LRRB also supports:

- MnDOT Library
- MnROAD
- Local Technical Assistance Program (LTAP)
  - Circuit Trainer Assistance Program (CTAP)
  - MN Maintenance Expo
  - OPERA
Highlight New LRRB Projects

- OPERA Projects
- Pedestrian Crossings: Uncontrolled Locations
- Impact of Heavy Vehicles on Local Roads
- Colored Concrete Deterioration
- Traffic Sign Maintenance & Management

Online Course
Potentials New Signs for MUTCD
Potentials New Signs for MUTCD
Potentials New Signs for MUTCD

WARNING
FASTEN BRASTRAPS AND
REMOVE DENTURES
VERY BUMPY ROAD
Potentials New Signs for MUTCD
Potentials New Signs for MUTCD

If you hit this sign, you will hit that bridge.
Potentials New Signs for MUTCD
Potentials New Signs for MUTCD
Potentials New Signs for MUTCD
Potentials New Signs for MUTCD

EXTREME FIRE HAZARD DON'T EVEN FART IN THE FOREST
Potentials New Signs for MUTCD
Potentials New Signs for MUTCD
OPERA: Operational Research Assistance

- Funded by LRRB ($70k annually)
- Administered by LTAP
- Encourages maintenance staff to get involved in operational/"hands-on" research.
- Funds projects up to $10,000
  - Easy application process
  - Simple final report process
- [http://www.mnltap.umn.edu/about/programs/opera/](http://www.mnltap.umn.edu/about/programs/opera/)
- Project Examples:
  - Back-up Sensor Technology for Snowplows
  - In-pavement LED Pedestrian Crossing
  - Chip Seal over Gravel Roads
Pedestrian Crossings: Uncontrolled Locations

What is it?
Report, Guidebook and Worksheets

What is the goal?
To help locals evaluate their uncontrolled pedestrian crossings and determine appropriate treatment options
11-Step Process:
1. Field Data Review *(Worksheet)*
2. Safety Review
3. Stopping Sight Distance
4. HCM LOS Analysis *(Worksheet)*
5. Ped Sight Distance
6. Review O-D and Alt Routes
7. Access Spacing/Func. Class
8. Speed and Ped Use
9. FHWA Safety Guidance
10. School Crossings
11. Treatment Options
### Pedestrian Crossings: Uncontrolled Locations - Field Data Worksheets

**Uncontrolled Pedestrian Crossing Data Collection Worksheet**

**Location:**
- **City:** [City Name]
- **State:** [State]
- **Scenario:** [Scenario]
- **Agency:** [Agency]
- **Project:** [Project]
- **ID:** [ID]

**Date:** [Date]

**The first step in understanding the pedestrian needs at a potential crossing location is completing a review of the location and adjacent facilities.**

#### Genesee

- **Crossing Length:** Measure the crossing distance from curb to curb. Fill in Crossing 1 distance if there is no median. If there is a median at the crossing location, fill in Crossing 1 and 2 distances.

- **Crossing 1:** [Distance]
- **Crossing 2:** [Distance]

- **Width:** Effective crosswalk width
  - [Width]

- **ASAP Compliant Median Available (minimum 4 ft. wide):**
  - [Yes/No]

- **Curb Ramps Available:**
  - [Yes/No]

- **ASAP Compliant Curb Ramps Available (at least 4 ft. wide):**
  - [Yes/No]

- **Speed:** Posted or RST speed limit
  - [Speed]

- **Grade:**
  - [Grade]

- **Is the crossing within a horizontal or vertical curve?**
  - [Yes/No]

- **Equations to calculate the following are located on the next page.**

- **Traffic on Approach:** Measure traffic volume in 15-minute intervals on the roadway approaching.

<table>
<thead>
<tr>
<th>AM Peak Traffic Volume</th>
<th>PM Peak Traffic Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hourly</td>
<td>Hourly</td>
</tr>
<tr>
<td>0-5 min:</td>
<td>0-5 min:</td>
</tr>
<tr>
<td>5-15 min:</td>
<td>5-15 min:</td>
</tr>
<tr>
<td>15-25 min:</td>
<td>15-25 min:</td>
</tr>
<tr>
<td>25-35 min:</td>
<td>25-35 min:</td>
</tr>
<tr>
<td>35+ min:</td>
<td>35+ min:</td>
</tr>
</tbody>
</table>

#### Traffic and Pedestrian Data

- **Pedestrian Volume:**
  - [Volume]

#### Additional Data Collection

- **Lighting:**
  - Is street lighting present and is there a crosswalk location? [Yes/No]

- **Crosswalk Pavement Markings:**
  - Is the crosswalk currently marked? [Yes/No]

- **What is the condition of the markings?**
  - [Condition]

- **Are the markings clearly defined?**
  - [Yes/No]

- **Do they need replacement?**
  - [Yes/No]

- **What is the crosswalk marking pattern?**
  - [Pattern]

- **Currently marked by crosswalk:**
  - [Yes/No]

- **Currently marked by the advance of crosswalk:**
  - [Yes/No]

- **Distance to Nearest Marked Crosswalk:**
  - [Distance]

#### Sight Distance Calculations

- **Sight Distance:**
  - [Distance]

**Notes:**

---

**Sight Distance Calculations:**

- **Baking Sight Distance:**
  - [Distance]

- **Pedestrian Sight Distance:**
  - [Distance]

- **L = design speed, m**
  - [Design Speed]

- **r = sight distance, ft**
  - [Distance]

- **C = calculation of sighted and not discernible, ft**
  - [Calculation]

---

**MAKING A DIFFERENCE**
Pedestrian Crossings: Uncontrolled Locations - HCM LOS Worksheets

Uncontrolled Pedestrian Crossing Level of Service Evaluation Worksheet

Crossing Location: _____________________________ Date: __________
City: _____________________________ State: _____________________________ Reviewer(s): _____________________________ Agency: _____________________________

Step 1: Identify Two-Stage Crossings

If there is a median available for a two-stage crossing? [ ] Yes [ ] No
If yes, does the median separate the AAM requirements (6 ft, 5 ft, 4 ft) for the two stages? [ ] Yes [ ] No
If yes, do pedestrians treat this as a two-stage crossing location? [ ] Yes [ ] No
Pedestrian use judgment to determine whether the available headway is sufficient for a safe crossing.

Crossing 1
L = critical length of approach
C = critical length of crossing
Tc1 = time to cross
Tc2 = time to cross

Crossing 2
L = critical length of approach
C = critical length of crossing
Tc1 = time to cross
Tc2 = time to cross

Step 2: Determine Critical Headway

Pedestrian crossing observed. The spatial distribution of pedestrians should be computed:

1. Use field observations or estimate pedestrian size using equations:
   \[ N_p = \frac{Q_n}{V_p} \]
   where: Np = total number of pedestrians in crossing location
   Vp = total pedestrian flow rate (ped/s)
   Qn = vehicular flow rate across crossing (veh/s)

2. Compute spatial distribution:
   \[ N_p = \frac{Q_n}{V_p} \]
   where: Np = total number of pedestrians in crossing location
   Vp = total pedestrian flow rate (ped/s)
   Qn = vehicular flow rate across crossing (veh/s)

3. Compute critical headway:
   \[ t_c = \frac{N_p}{V_p} \]
   where: t_c = critical headway
   Np = total number of pedestrians in crossing location
   Vp = total pedestrian flow rate (ped/s)

Step 3: Estimate Delay Reduction due to Yielding Vehicles

Step 4: Estimate Probability of a Delayed Crossing

Probability that a pedestrian will not incur any crossing delay is equal to the likelihood that a pedestrian will experience a gap greater than or equal to the critical headway immediately upon arrival at the intersection.

Step 5: Calculate Average Delay to Wait for Adequate Gap

Average delay for a pedestrian who crosses an uncontrolled intersection (e.g., any pedestrian experiencing random delay)

Step 6: Calculate Average Delay to Wait for Adequate Gap

Average delay for a pedestrian who crosses an uncontrolled intersection (e.g., any pedestrian experiencing random delay)

When a pedestrian arrives at a crossing and finds it inadequate, that pedestrian is delayed until one of two situations occurs: (a) gap greater than the critical headway is available, or (b) motor vehicles yield and allow the pedestrian to cross. While motorists are legally required to stop for crossing pedestrians at all intersections, at all marked crossings, motorist yield rates actually vary considerably.

Some crossing universities use pedestrian crossing rates measured on the same page.

Average pedestrian delay

\[ d_p = \frac{1}{n} \sum (k - 0.5)(n - 0.5)P(n) \]

where: d_p = average pedestrian delay (s)

Average pedestrian delay

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\[ d_p = \frac{1}{n} \sum (k - 0.5)(n - 0.5)P(n) \]

where: d_p = average pedestrian delay (s)

Summary

LOS: A. 0-5 Usually no conflicting traffic
B. 5-10 Occasionally some delay due to conflicting traffic
C. 10-20 Delay noticeable to pedestrians, but not inconveniencing
D. 20-30 Delay noticeable, delaying some degree of marking
E. 30-45 Delay approaches tolerable level, high chance of marking
F. >45 Delay exceeds tolerance level, high chance of marking

Los Angeles County Metropolitan Transportation Authority

HCM Evaluation Worksheet

Page 7 of 9

Making A Difference
Pedestrian Crossings: Uncontrolled Locations - Potential Treatments

1. Signing and Marking Treatments

- Crossing Warning Sign
- High-Visibility Crosswalk Markings
2. Uncontrolled Crossing Treatments

- Overhead Flashing Signal Beacons
- Center Median with Refuge Island
- Rapid Rectangular Flashing Beacons
3. Traffic Calming Treatments
4. High-level Treatments
(High cost, high speed, high volume)
# Pedestrian Crossings: Uncontrolled Locations - Potential Treatments

## Table 2: Signing and Marking Treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Recommended Locations</th>
<th>Staged Pedestrian Yield Rate</th>
<th>Unstaged Pedestrian Yield Rate</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crosswalk Markings Only</td>
<td>* Inexpensive * Helps define a crossing location * Indicates to drivers that crossing location is present</td>
<td>* Very little effect at night * Speeds increase over time * Not shown to reduce crashes</td>
<td>* Not usually recommended alone * Low-volume and low-speed roadways * Where justified</td>
<td>NR</td>
<td>NR</td>
<td>$500–$2,000</td>
</tr>
<tr>
<td>Warning Signs</td>
<td>* Inexpensive * Helps define a crossing location * Warning to drivers that crossing location is present</td>
<td>* Tend to be ignored unless pedestrians use the crossing consistently * Proven to be ineffective at reducing crashes at uncontrolled intersections</td>
<td>* Where unexpected entries into the road by pedestrians may occur * At or before the crossing location * With or without a marked crosswalk</td>
<td>NR</td>
<td>NR</td>
<td>$300–$1,200</td>
</tr>
<tr>
<td>Overhead Warning Signs</td>
<td>* May decrease vehicle speed</td>
<td>* Requires overhead structure * Tend to be ignored unless pedestrians use the crossing consistently</td>
<td>* Multilane roadways * Midblock crossing locations * Usually coupled with other measures such as RRFBs or beacons</td>
<td>NR</td>
<td>NR</td>
<td>$60,000–$75,000</td>
</tr>
<tr>
<td>Colored Concrete/Brick Pavers</td>
<td>* Inexpensive * Warning to drivers that crossing location is present * May decrease vehicle speed</td>
<td>* Can be expensive * Not shown to reduce crashes</td>
<td>* Downtown/urban conditions * Traffic signal locations * In conjunction with pavement markings</td>
<td>NR</td>
<td>NR</td>
<td>$10,000–$75,000</td>
</tr>
<tr>
<td>Crosswalk Markings and Signs</td>
<td>* Inexpensive * Warning to drivers that crossing location is present * May decrease vehicle speed</td>
<td>* Make snow removal more difficult * Need consistent maintenance and replacement due to vehicle hits</td>
<td>* Where justified</td>
<td>7%</td>
<td>7%</td>
<td>$800–$3,200</td>
</tr>
</tbody>
</table>
Pedestrian Crossings: Uncontrolled Locations

http://www.mnltap.umn.edu/publications/handbooks/
http://www.cts.umn.edu/Publications/ResearchReports/reportdetail.html?id=2368
Recent Project: Impact of Heavy Vehicles on Local Roads

What Was the Need?

- Heavy trucks cause roads to deteriorate quickly
- Challenging for engineers to quantify the effects
Recent Project: Impact of Heavy Vehicles on Local Roads

What Was the Goal?

- Create a tool to calculate the impact of heavy vehicles beyond what was planned in the original pavement design.
Recent Project:
Impact of Heavy Vehicles on Local Roads

What Was Developed?

• Continuation of an LRRB’s project:
  *Managing Interaction Between Local Authorities and Major Traffic Generators*

• Expanded the excel spreadsheet tool to:
  – calculates the pavement design life (in ESALs) consumed by the unanticipated vehicles
  – calculates the additional bituminous/costs required if the heavy truck traffic had been predicted when the pavement was designed
**When to use?**

- Conduct analyses for:
  - a single street segment
  - entire road network
- Impacts reported in:
  - financial terms
  - ESALs consumed
  - additional bituminous material required
- Compare current situation vs. the impact of potential changes in heavy traffic levels
Recent Project:
Impact of Heavy Vehicles on Local Roads

Where to Access?  LRRB.org
Recent Project: Colored Concrete Deterioration

What is the problem?

• Across Minnesota, an estimated 45 colored concrete projects have experienced early deterioration – microcracking

• Some communities are experiencing this as soon as 2-5 years after construction
Recent Project: Colored Concrete Deterioration

What was done?
• Study conducted to determine the unique properties of the concrete that may be causing the issues and to develop recommendations for future projects and repairs.
• Vadnais Heights and Centerville torn up their colored concrete and participated in this study.
Recent Project: Colored Concrete Deterioration

What was found?

- Researchers determined that the colored concrete mixtures have likely been too porous for Minnesota winters, allowing deicing chemicals to leach in and damage the pavement.
- Crosswalks most affected.
Recent Project:
Colored Concrete Deterioration

Recommendations:

- Use a denser concrete mixture (less water)
- Alternative streetscaping ideas such as concrete stains, pavers, or colored high friction surface treatments.
- Repair based on MnDOT’s concrete pavement rehab guidelines, considering cause and extent of damage.
Recent Project:
Colored Concrete Deterioration

Full report at:
www.lrrb.org
Recent Project: Traffic Sign Maintenance & Management Online Course

What is it?
Online training course for maintenance staff to learn the basics of traffic sign maintenance and management.

What is the purpose?
• Offers flexibility to complete training when it fits in schedule.
• In class training can be difficult to attend.
• Maintenance workers are retiring rapidly; knowledge is not being transferred.
Recent Project:
Traffic Sign Maintenance & Management Online Course

Module Summary

1. General Overview
2. MN MUTCD
3. Sign Policy
4. Sign Materials
5. Safety
6. Sign Placement
7. Sign Installation
8. Sign Retroreflectivity
9. Sign Maintenance and Management
10. Addressing and Street Name Signs
Recent Project:
Traffic Sign Maintenance & Management Online Course

Modules are made up of a combination of:

• Videos vignettes
• Narrated slides
• Quizzes
• Check your knowledge questions
• Linked resources
Recent Project:
Traffic Sign Maintenance & Management Online Course

Sign Maintenance and Management Training

The development of this course was funded by the Minnesota Local Road Research Board.

Curriculum was developed and compiled by SRF Consulting Group, with the assistance of CH2MHILL, the University of Minnesota, Minnesota Local Technical Assistance (LTAP) program and Minnesota state and local agencies.
Recent Project: Traffic Sign Maintenance & Management Online Course

Menu Notes
- Module 5: Safety
  Safety
  Safety Overview
  MnDOT Road Work Safety Tips
  Work in ROW
  Gopher State One Call (GSOC)
  Worker Visibility
  CYU: Gopher State One Call
  CYU: Performance Class
- Truck Visibility
  Truck Visibility
  MN MUTCD Field Manual
  Field Manual Definitions
  CYU: Field Manual Definition
  CYU: Safety Items
- Sign Maintenance on Rural/Highway
  Sign Maintenance on Rural/Highway
  Sign Maintenance on Urban
  Field Safety Checklist
  End of Module

Module 5: Safety

No lights

Single light

Light bar
Recent Project: Traffic Sign Maintenance & Management Online Course

Registration:

Fee: $65  
Time: 8 hours  
Approx. 5 months to complete

1 Roads Scholar Credit

http://www.mnltap.umn.edu/training/topic/traffic/onlinesign/index.html
New Project:
Full Depth Reclamation (FDR) for Urban and Suburban Street Application

- Started summer 2014
- Technical Liaison: Mark Maloney
- MnDOT Project Coordinator: Farideh Amiri
- Research performed by Department of Civil, Environmental, and Geo- Engineering, U of M
  - PI: Dr. Mihai Marasteanu
  - Co-PI: Dr. Jia-Liang Le
Project Objective:

- Evaluate the advantages and limitations of using FDR for urban and suburban streets and to propose guidelines for implementing FDR as an effective rehabilitation procedure
- Task 2: Perform a survey at the local and national level to identify current practices
  - Survey was sent via email on Monday Jan 26th
  - Responses are due February 10th
  - Your responses are critical in developing guidelines for implementing this promising technology
More Information

• LRRB Website [www.lrrb.org](http://www.lrrb.org)
• LRRB Chair:
  Bruce Hasbargen: Beltrami County Engineer
• RIC Chair:
  Jeff Hulsether: Brainerd City Engineer
## Research and Development spending

<table>
<thead>
<tr>
<th>Company/Agency</th>
<th>Percent of Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft</td>
<td>21%</td>
</tr>
<tr>
<td>Pfizer</td>
<td>15%</td>
</tr>
<tr>
<td>Motorola</td>
<td>10%</td>
</tr>
<tr>
<td>3M</td>
<td>7%</td>
</tr>
<tr>
<td>Boeing/IBM/Honda (each)</td>
<td>5%</td>
</tr>
<tr>
<td>Ford/Toyota</td>
<td>4%</td>
</tr>
<tr>
<td>Caterpillar</td>
<td>2%</td>
</tr>
<tr>
<td>FHWA</td>
<td>~0.5%</td>
</tr>
<tr>
<td>State DOTs</td>
<td>~0.1 – 0.2%*</td>
</tr>
</tbody>
</table>

* - varies but most funds from federal sources
LRRB Meeting Schedule

Four Annual Meetings

• Strategy Meeting (Spring)
• Project Review Meeting (Summer)
• Program Review Meeting (Fall)
• Programming Meeting (Winter)
LRRB Outreach and Marketing

- Newsletters (2/Year)
- Web Updates (6/Year)
- National Publication (1/Year)
- Conference Presentation (up to 5/Year)
- Conference Board/Exhibits (up to 5/Year)
- Coordination Meetings (2/Year)