Local Road Safety Peer Exchange
Minnesota Sinusoidal Rumble Strips and Other Traffic Safety Considerations

Victor Lund, PE, Traffic Engineer
St. Louis County, Minnesota
October 11, 2018
Overview

• Prioritization of Safety Strategies
• Development of the Minnesota Sinusoidal Rumble Strip
• Implementation and Public Relations Considerations
Prioritization of Safety Strategies

• Where do you invest safety projects?
• The reality...
  – Most serious crashes occur on the rural highway system.
  – However, serious crashes are infrequent and widely dispersed.
• Think about this...
  – In greater Minnesota, 50 percent of severe road departure crashes occur on curves but 75 percent of curves have had no crashes in a previous 5-year period.
  – There is no such thing as “Dead Man’s Curve”
• How do you prioritize locations with a low density of serious crashes?
## Crash Density by Jurisdictional Class

<table>
<thead>
<tr>
<th>Roadway Jurisdiction</th>
<th>Miles</th>
<th>Total Crashes*</th>
<th>Fatal Crashes*</th>
<th>Total Crash Density**</th>
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</table>

*2015 Crash Data

**crashes/mile/year

Data Source: 2015 Minnesota Motor Vehicle Crash Facts
What is the Systemic Approach?

- What it is not...
  - Road safety audits
  - Worst first
  - Specific site safety improvement (e.g. turn lane) based upon an engineering study

- What it is...
  - Result of a planning process
  - Safety improvements based upon risk factors
  - Proactive deployment of low cost safety strategies over entire at-risk system
What is the Systemic Approach?

- **Approach**
  - Traditional: Crashes = Risk, No Crashes = No Risk
  - Systemic: No Crashes ≠ No Risk

- Recognized that ~50% of serious crashes occur on the local road system (county roads)

- **Focus**
  - Segments
  - Intersections
  - Curves
Doctors have been doing this for a long time...

- Think about how doctors provide care to their patients...
- Inquire about your
  - Family health history
  - Personal health history
  - Diet/behavior
- Use this information to assess your risk to develop certain diseases
- Proactively work to treat these risk factors before major issues develop later in life
43% of serious cross-centerline crashes occur on roads with an ADT > 1,000 vehicles per day. This ADT range constitutes only 10% of county road mileage.

*Serious crashes defined as a fatal or incapacitating injury crash.
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<th>Rank</th>
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<th>#</th>
<th>Intersection Description</th>
<th>Skew</th>
<th>On/Near Curve</th>
<th>Development</th>
<th>RR Xing</th>
<th>Previous STOP (&gt;5mi)</th>
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Source: St. Louis County Road Safety Plan
**Effectiveness of Safety Strategies**

- Decisions to implement a strategy should always consider effectiveness.
- National Cooperative Highway Research Program (NCHRP) produces reports documenting effectiveness of various traffic safety strategies.

### Proven
- Supported by rigorous academic studies
- High confidence in effecting a change

### Tried
- Some evaluations
- Conflicting experience and results
- May effect a change

### Experimental
- New idea
- Limited to no formal evaluation completed
- Limited deployments
- Unknown if it will effect a change
Tangible Results

Minnesota Fatality Rates By System

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Fatality Rate [Crashes Per 100 Million Vehicle Miles]

*Projection via linear interpolation

25% reduction in fatality rate from 2011 to 2014 on the County System.

Source: Howard Preston, CH2M, Author of MN CRSP
Minnesota Sinusoidal Rumble Strips

• Rumble strips are a highly effective safety strategy, but they have elicited complaints from adjacent residents

• MnDOT and LRRB completed two studies\textsuperscript{1,2} on the noise evaluation of alternative rumble strip designs

• First study evaluated various designs\textsuperscript{1}
  – California Design (14” center-to-center, 1/32” – 5/8” depth, 8” wide)
  – Pennsylvania Design (24” center-to-center, 1/8” – 1/2” depth, 8” wide)
  – Minnesota Design (12” center-to-center, 3/8” – 1/2” depth, 16” wide)

• Second study objective was to determine the optimal sinusoidal rumble strip design\textsuperscript{2}

1. Terhaar, E, Braslau, D, February 2015, *Rumble Strip Noise Evaluation*, Minnesota Department of Transportation
Comparison of Rumble Strip Cross-Sections

Source: Terhaar, E, Braslau, D, February 2015, Rumble Strip Noise Evaluation, Minnesota Department of Transportation
Sinusoidal Rumble Strip Noise Evaluation

Exterior Decibel Levels at 50 Feet

Exterior sound of Mumble Strip is ~10 dB lower than the Minnesota Rumble Strip at 50 feet away for a car driving at 60 mph.

Source: Terhaar, E, Braslau, D, February 2015, Rumble Strip Noise Evaluation, Minnesota Department of Transportation
Sinusoidal Rumble Strip Noise Evaluation

Interior Decibel Levels

Interior sound of Mumble Strip is ~4 dB higher than the Minnesota Rumble Strip for a car driving at 60 mph.

Source: Terhaar, E, Braslau, D, February 2015, Rumble Strip Noise Evaluation, Minnesota Department of Transportation
Comparison of Rumble Strips

Minnesota Rumble Strip

Sinusoidal Strip

Video: https://youtu.be/W3-uPGB1nmM

Source: Terhaar, E, Braslau, D, February 2015, Rumble Strip Noise Evaluation, Minnesota Department of Transportation
Optimized Sinusoidal Rumble Strip

Figure Source: MnDOT Technical Memorandum 17-08-T-02

(i) Depth tolerance is ±1/16" along the sinusoidal wave.
St. Louis County
Sinusoidal Rumble Strip Project

• The project treated ~65 centerline miles
• Project included the following items (actual 2018 unit prices)
  – Milled Sinusoidal Rumble Strips → $0.25/LIN FT
  – Fog Seal → $0.10/LIN FT
  – Centerline Striping → $0.54/LIN FT (averaged)
  – Total Cost = $0.89/LIN FT or $4,700/mile
• Applied wet-reflective paint in the rumble strip
• Applied ground-in wet-reflective paint in the gaps
• Maintained gaps at all public road intersections
When safety strategies crash...
Rumble stripes make highway driving more dangerous

I loved the Sept. 12 story, “Rumble stripe grumbles.” It’s good to know motorists are not the only ones annoyed by the stripes.

Before the stripes you could drive Minnesota Highway 23 without too much worry about oncoming traffic. Now about one third of all oncoming cars are in your lane to make sure they don’t hit the stripes. This causes you to cross the stripes and listen to the annoying sound and feel the shudder of them.

Back when I was a kid we had to travel Minnesota Highway 169, which had an up-swinging curb on the right side of that highway. I was relieved to see that they have implemented the rumble stripe, calling it a safety feature. (Ha-ha.) I believe winter driving will be a real picnic with having to constantly swing to the right over the stripes to avoid head-on collisions.

 Hats off to St. Louis County Commissioner Mike Forsman of Ely! I hope he will stay strong and not be bullied by bureaucratic red tape. I’m sure he will be at the top of the safety chain come winter when rollovers skyrocket as people swerve to the right to avoid head-on collisions. We may all have to move to his county to get around the high cost of auto insurance.

When safety strategies crash...

Rumble stripes unpopular in other Minnesota counties, too

St. Louis County isn’t the only one dealing with complaints about the new federal rumble stripe guidelines. Curves and Whiskey County Commissioner Barry Rowan said he received the same complaints when they started installing it in 2008. Curves and Whiskey County had to pay $4,000 to replace the stripes in two months after they were grouted out.

In Wright County, left-over rumble was in place but removed the day it was put in. Decision came from the county home office, according to County Engineer Dave Coon. “You can’t predict the future,” he said. “It’s a real pain and we have to live with it.”

When safety strategies crash...

‘Singing highway’ legend growing

On behalf of the Greater Polo/LakeLand Area Tourism Board, I would like to invite Range residents to experience our newest tourist attraction, County Highway No. 4, otherwise known as the “Singing Highway.”

Recently, a crude but recognizable rendition of the National Anthem was played out by the drivers of a Mack logging truck, a Coupe DeVille, a Jeep Wrangler and a Toyota Prius; as time goes on, the tunes are sure to get even better.

This new attraction was brought to you by the St. Louis County Highway Department, specifically Jim (Buzz) Foslis, engineer, and Victor here’s your rumble strip sign. Lund, maintenance supervisor.

Make your next Sunday drive a memorable experience, and cruise the “Singing Highway.”
Public Relations Lessons Learned

• Interact (communicate, educate, etc.) with your elected officials
• Public can become very concerned about residual effects of safety treatments – especially noise!
• Inequitable distribution of benefits
• “Measure twice, cut once.”
• Remember our role as engineers...
Contact Information

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Resources

• *Rumble Strips and Stripes on Rural Trunk Highways*, MnDOT Technical Memorandum No. 17-08-T-02, August 2017, [https://techmemos.dot.state.mn.us/techmemo.aspx](https://techmemos.dot.state.mn.us/techmemo.aspx)


• FHWA Proven Safety Countermeasures, [https://safety.fhwa.dot.gov/provencountermeasures/](https://safety.fhwa.dot.gov/provencountermeasures/)

• Rumble Strips: Saving Lives (video), Minnesota LRRB, [https://youtu.be/Ukd6zEqdx2Q](https://youtu.be/Ukd6zEqdx2Q)