Evaluation of Centerline Rumble Strip Impacts on Short-Term Pavement Performance

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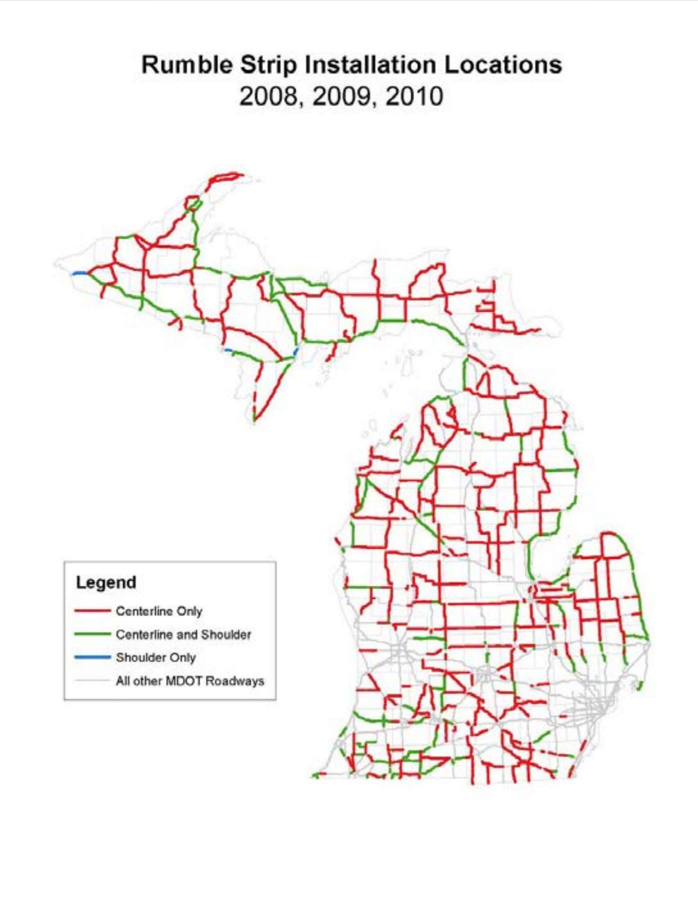
Overview

- Introduction
- Potential Pavement Quality Concerns
- Prior Research
- Study Design
- Results
- Maintenance/Design Strategies

Introduction:
Michigan Rumble Strip Program

- Statewide installation program covering 5700 miles of high-speed, rural non-freeways
- 3-year installation period (2008-2010)
- Short-term evaluation examined safety impacts, along with other concerns:
  - Bicyclists
  - Noise
  - Pavement quality



Introduction:
Potential Pavement Quality Concerns

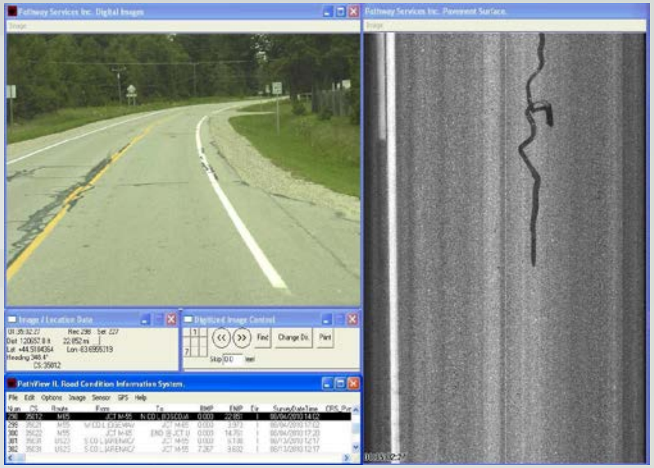
- Rumble strips are generally milled into existing pavement surface
- Milling process may cause several detrimental conditions:
  - effective pavement surface thickness is reduced in the milled areas
  - milled areas may allow moisture to infiltrate the pavement surface
  - milled indentation may allow for water to pool and freeze
- Little published research exists pertaining to pavement deterioration associated with rumble strips

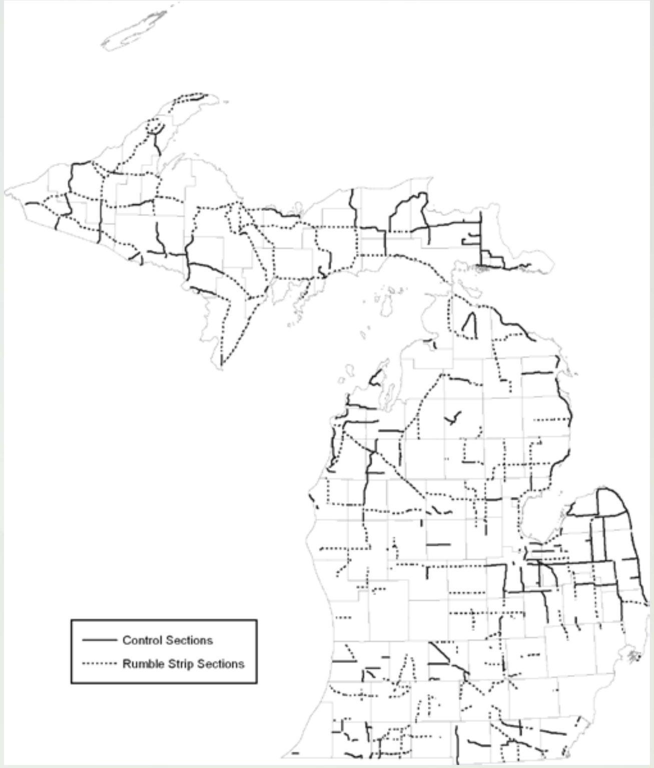
Prior Research

- 2001 - Colorado DOT evaluated distresses in rumble strips; after 5 years, no detrimental impact found
- 2004 – National survey showed 62.5% of states found no adverse effects; 8.3% experienced some problems (remainder unsure)
- 2008 – Minnesota study found that grinding in rumble strips could be problematic on HMA pavement surfaces

Field Evaluation of Pavement Condition

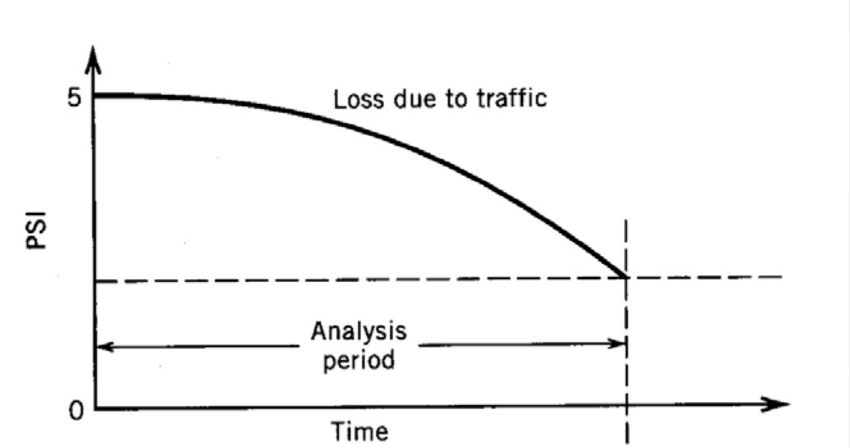
- Visual reviews of pavement imagery data from biennial survey
- Random sample of segments along high-speed (55 mph), two-lane rural highways throughout Michigan

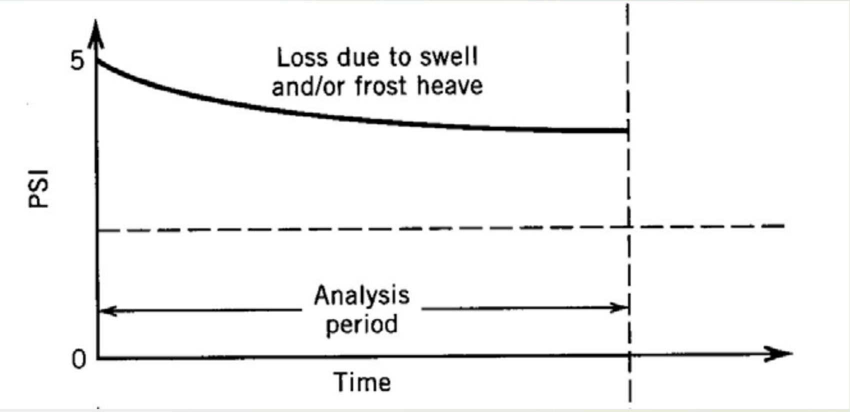




Pavement Deterioration

- All pavements deteriorate over time, with rate of deterioration affected by:
  - Traffic load
  - Temperature
  - Moisture
  - Pavement age





Summary Data from Study Sections

		Rumble Strip Sections		Control Sections	
Factor	**Classification**	**Miles**	**Percent**	**Miles**	**Percent**
Region	Upper Peninsula	131	47.6%	58	31.9%
	Northern Lower Peninsula	85	30.9%	69	37.9%
	Southern Lower Peninsula	59	21.5%	55	30.2%
	Total	275	100.0%	182	100.0%
AADT	Under 4,000	165	60.0%	109	59.9%
	Over 4,000	110	40.0%	73	40.1%
	Total	275	100.0%	182	100.0%
Pavement Age	2 yrs old	28	10.2%	26	14.3%
	3 yrs old	43	15.6%	36	19.8%
	4 to 5 yrs old	105	38.2%	64	35.2%
	6+ yrs old	99	36.0%	56	30.8%
	Total	275	100.0%	182	100.0%

Pavement Distress Quantification

- Pavement distress quantified using metrics such as:
  - Quantity (i..e, frequency)
  - Extent (i.e., length)
  - Severity (i.e., width/size)

Crack Propagation Examination

- Changes in number of cracks intersecting centerline compared before and after rumble strip installation
- Rate of crack propagation compared between segments where rumble strips were installed and comparable control segments

Marginal Rates of Crack Propagation (i.e., increases) Over Two-Year Period

Factor	Factor Level/Group	Mean	Std. Dev.
Rumble Strip Presence	Control Section (w/o Rumble Strips)	3.92	0.30
	Rumble Strip Section	4.11	0.26
AADT	Less than 4,000	3.63	0.27
	More than 4,000*	4.41	0.31
Geographic Region	Upper Peninsula	3.60	0.33
	Northern Lower Peninsula	3.75	0.33
	Southern Lower Peninsula*	4.71	0.38
Pavement Age (Second Year)	2 yrs old*	4.87	0.54
	3 yrs old*	4.96	0.44
	4 to 5 yrs old	3.37	0.31
	6+ yrs old	2.88	0.33

*indicates propagation rates that are significantly higher at 95-percent confidence

Results

- Rumble strips did not significantly impact rate of crack propagation when controlling for other relevant factors
- Road segments with more than 4,000 vehicles per day showed 21.5 percent higher distress rate compared to lower volume segments
- Southernmost region of Michigan experienced higher rates of crack propagation than northern parts of the state (Weather? Traffic composition? Construction/Maintenance Practices?)

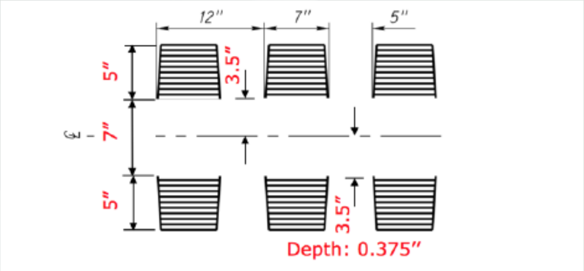
Maintenance

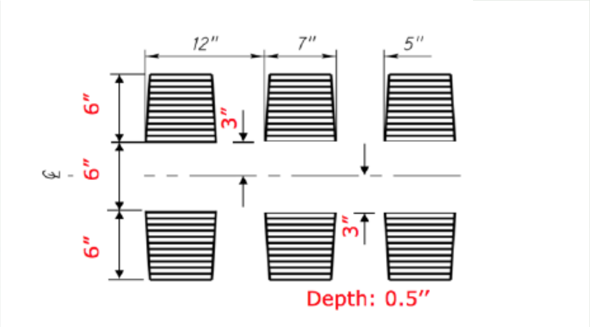
- Cutting into an asphalt joint could expedite deterioration
  - MDOT adopted joint density specification to ensure soundness of centerline pavement
- Chip seal
  - Rumble strips maintain functionality w/single chip seal
  - Double chip seal reduced effectiveness
  - MDOT updated Special Provisions, for double chip seal only top layer crosses the rumble strips
- Microsurfacing treatments found to nullify rumble strips
  - MDOT updated Special Provision, rumble strips should be filled in prior to surface treatment

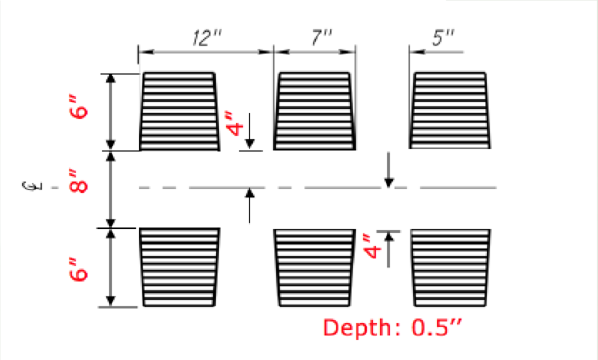
Maintenance

- Crack treatments for longitudinal joints
- Various types of sealants (e.g., fog seal) and rejuvenators.

Recent Design Modifications

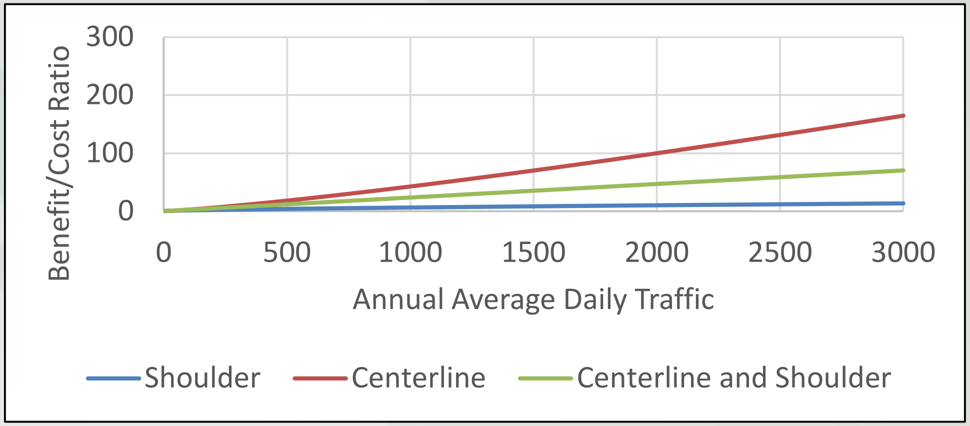


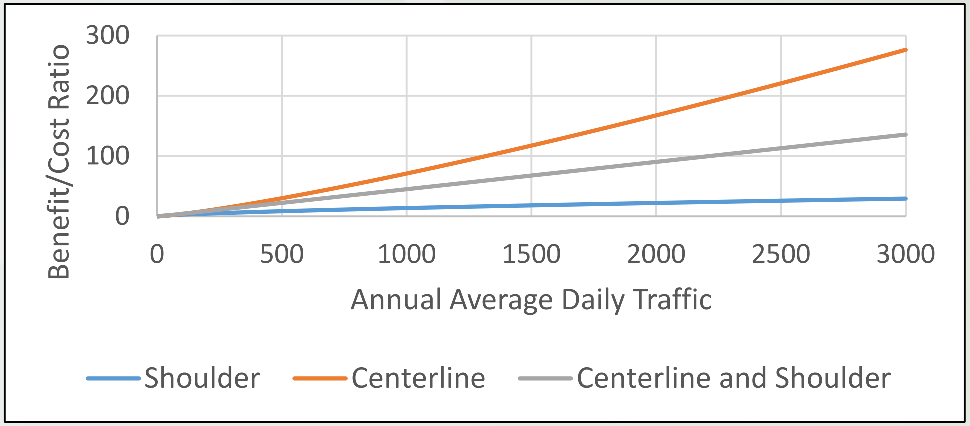




Conclusions

- Rumble strips likely to have some adverse impacts on pavement condition
- Design and maintenance strategies can mitigate the degree of these impacts
- Installation on local systems is strongly justified from an economic standpoint





Thank You!

Questions and comments?

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