Session # 23: Replacing Raised Pavement Markers with Painted Rumble Stripes

Tuesday March 6, 2011

Presented By:

Dana Plattner - INDOT
Mike Prather - INDOT
Stuart Mitkey - INDOT
SR28 TEST CORRIDOR RESULTS
Early Pilot Study in Frankfort Indiana

State Road 28
Alternatives to Raised Pavement Markers

STUDY AREA

SITE VISIT: SEPTEMBER 29, 2010
Retroreflectivity
Measure of Low Light Visibility

Retroreflectivity = \frac{\text{millacandelas}}{(\text{lumen} \times \text{meter}^2)}

Measure of light returned to light emitted
Physics of Retroreflectivity

From Headlights

To Driver

Exposed Surface of Glass Bead

Refracted

Reflected

Painted Line

16mil (.016in)

Road Surface

4in
Painted Rumble Strip Study Area

Site Visit: October 21, 2010
October 21, 2010: Painting Day

<table>
<thead>
<tr>
<th>Paint Application Rate</th>
<th>Glass Beads Application Rate</th>
<th>Element Application Rate</th>
<th>Paint Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I Glass Beads</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 gal/mile</td>
<td>104 lbs/mile</td>
<td>N/A</td>
<td>16 mil</td>
</tr>
<tr>
<td>Element Blend</td>
<td></td>
<td>84 lbs/mile</td>
<td>20 mil</td>
</tr>
</tbody>
</table>
Two Assessment Techniques

Qualitative:
Empirical Video & Photography

Quantitative:
Retroreflectivity

[Graph showing retroreflectivity vs. distance]
Dry Day Images
Dry Night Images
Wet Night Images

Painted Rumble Visible

Painted Line Not Visible

Painted Rumble Visible

Painted Line Less Visible
December 2, 2010: Site 1 – Glass Beads (WET)
Site 1 – Glass Beads (Yellow)
Site 1 – Glass Beads (White)
December 2, 2010: Site 2 – Element Blend (WET)

Site 2 – Element Blend (Yellow)

Site 2 – Element Blend (White)
February 17, 2011: Site 1 – Glass Beads (DRY)
Site 1 – Glass Beads (Yellow)
Site 1 – Glass Beads (White)
February 17, 2011: Site 2 – Element Blend (DRY)

Site 2 – Element Blend (Yellow)  
Site 2 – Element Blend (White)
April 27, 2011: Site 1 – Glass Beads (WET)
Site 1 – Glass Beads (Yellow)
Site 1 – Glass Beads (White)
April 27, 2011: Site 2 – Element Blend (WET)

Site 2 – Element Blend (Yellow)

Site 2 – Element Blend (White)
Coring for Photographic Analysis

NOVEMBER 3, 2010
Sites 1 and 2

6” CORES WERE TAKEN
- 3 Yellow Study Area 1
- 3 White Study Area 1
- 3 Yellow Study Area 2
- 3 White Study Area 2

Mark Cores with Direction/Station/Date/Study Area
Line Pre-Winter

345 Beads Total

i, ii - glass beads
Line Post-Winter

149 Beads Total

iii- glass bead
iv- missing bead
Rumble Bottom Post-Winter

244 Beads Total

v- glass bead
vi- missing bead
June 2011 – Dry Retro Data Collection
July 2011 – Wet Retro Data Collection
Post-Win White Glass

Retroreflectivity vs Distance (Feet)

- FHWA
- Rumble Top
- Rumble Bottom
- Line

STUDY AREA #1
Glass Beads
MM 54
MM 52
MM 53
Post-Winter Yellow Glass Beads

STUDY AREA #1

Glass Beads

MM 54
MM 52
MM 53

Retroreflectivity vs Distance (Feet)

FHWA  Rumble Top EB  Rumble Bottom EB  Line EB
Post-Win
Yellow Glass Beads

STUDY AREA #1
Glass Beads
MM 54
MM 52
MM 53

Retroreflectivity
Distance (Feet)
FHWA Rumble Top WB Rumble Bottom WB Line WB

Distance (Feet)
Post-Winter
White Element Blend
Post-Winter
Yellow Element Blend

STUDY AREA #2
Element Blend
MM 52
MM 53
MM 54

- FWHA
- Rumble Top EB
- Rumble Bottom EB
- Line EB
Post-Winter
Yellow Element Blend

Retroreflectivity vs. Distance (Feet)

FHWA Rumble Top WB
Rumble Bottom WB
Line WB

STUDY AREA #2
Element Blend
MM 54
MM 52
MM 53
<table>
<thead>
<tr>
<th>Condition</th>
<th>Glass Beads</th>
<th>Element Blend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Rumble Stripe</td>
<td>127</td>
<td>191</td>
</tr>
<tr>
<td>Dry Painted Line</td>
<td>16</td>
<td>148</td>
</tr>
<tr>
<td>Wet Rumble Stripe</td>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>Wet Painted Line</td>
<td>300</td>
<td>400</td>
</tr>
</tbody>
</table>

FHWA recommended replacement threshold for dry pavement.
Yellow Post-Winter Results

FHWA recommended replacement threshold for dry pavement

In direction of application

Against direction of application

Retroreflectivity

<table>
<thead>
<tr>
<th>Condition</th>
<th>Retroreflectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Rumble Stripe</td>
<td>77</td>
</tr>
<tr>
<td>Dry Painted Line</td>
<td>44</td>
</tr>
<tr>
<td>Wet Rumble Stripe</td>
<td>14</td>
</tr>
<tr>
<td>Wet Painted Line</td>
<td>12</td>
</tr>
<tr>
<td>Dry Rumble Stripe</td>
<td>188</td>
</tr>
<tr>
<td>Dry Painted Line</td>
<td>129</td>
</tr>
<tr>
<td>Wet Rumble Stripe</td>
<td>151</td>
</tr>
<tr>
<td>Wet Painted Line</td>
<td>148</td>
</tr>
</tbody>
</table>

Glass Beads

Element Blend
• Edgeline Rumble Stripes are promising
  – Retroreflectivity (Emperical Video, Numerical Retro)
  – Cost
• Ongoing Studies on SR 38 and 120
  – Next slides
CLRS RETRO RESULTS
SR38 & SR120
SR 38 Antioch to Kirklin, Indiana
Section 1

Co Rd 300 E
Measurement 1: Rumble Top

South

Center of Measurement Area
Measurement 2: Rumble Bottom

Center of Measurement Area
Measurement 3: Rumble Top

South

Center of Measurement Area
Measurement 4: Rumble Bottom

Center of Measurement Area

South
Measurement 5: Line (Control)
Schematic: Eastbound

Repeat at 40’ intervals (or to match skip pattern).
Section 1 Eastbound

Painted Eastbound

Retroreflectivity vs Measurement Location #

Co Rd 450 E
Co Rd 300 E

Section 1

Rumble Top (Long) Rumble Bottom 1 Rumble Top (Short) Rumble Bottom 2
SR120 - Elkhart Indiana

Section 1

Section 2
Section 1 Eastbound
Section 1 Westb
Section 2 Eastbound
Section 2 Westb
Schematic: Eastbound

Repeat at 40’ intervals (or to match skip pattern). Repeat for westbound.
Section 1 Eastbound

Retroreflectivity Measurement Location #
Rumble Top (Long) Rumble Bottom 1 Rumble Top (Short) Rumble Bottom 2

Painted Westbound
SPECIAL THANKS TO:

Tom Brennan, Purdue University
Alex Davis, Purdue University
Gannon Grimmer, Purdue University
Alex Hainen, Purdue University
Steve Remias, Purdue University
Paul Michael, INDOT
Randy Morris, INDOT
Professor Darcy Bullock, Purdue University
SR28 Questions