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

Tuesday March 6, 2011

Presented By:

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

State Road 28
STUDY AREA

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

Retroreflectivity = millacandelas/(lumen*meter$^2$)
Measure of light returned to light emitted
Physics of Retroreflectivity

From Headlights
To Driver

Exposed Surface of Glass Bead
Refracted
Refracted

Reflected

Painted Line
16mil (.016in)

Road Surface

4in
STATE ROUTE 28

STUDY AREA #1
INDOT MIX (Glass Beads)

STUDY AREA #2
3M (Elements) + INDOT MIX (Glass Beads)

Painted Fall 2010

MM 52

MM 53

Eastbound Only

MM 54
Painted Rumble Strip Study Area

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

<table>
<thead>
<tr>
<th>Type</th>
<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>Glass Beads</td>
<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>22 gal/mile</td>
<td>104 lbs/mile</td>
<td>84 lbs/mile</td>
<td>20 mil</td>
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</tbody>
</table>

Image: 
- **Paint Nozzle**
- **Stabilizing Wheel**
- **INDOT Glass Beads Pressurized Drop**
- **3M Elements Pressurized Drop**
Two Assessment Techniques

Qualitative:
Empirical Video & Photography

Quantitative:
Retroreflectivity

![Retroreflectivity Graph](image-url)
Dry Day Images

Painted Rumble

Painted Line

Painted Rumble

Painted Line
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

Mark Cores with Direction/Station/Date/Study Area

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

SITE# 17+00

SITE# ~16+90
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**

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</tbody>
</table>

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)

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

Rumble Top
Rumble Bottom
Line
Post-Winter Yellow Glass Beads

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

Graph showing retroreflectivity vs distance for FHWA, Rumble Top WB, Rumble Bottom WB, and Line WB.
Post-Winter White Element Blend

STUDY AREA #2
Element Blend
MM 54
MM 52
MM 53
Post-Winter Yellow Element Blend

STUDY AREA #2
Element Blend
MM 54
MM 52
MM 53
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
White Post-Winter Results

FHWA recommended replacement threshold for dry pavement

Retroreflectivity

<table>
<thead>
<tr>
<th>Condition</th>
<th>Retroreflectivity</th>
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</thead>
<tbody>
<tr>
<td>Dry Rumble Stripe</td>
<td>127</td>
</tr>
<tr>
<td>Dry Painted Line</td>
<td></td>
</tr>
<tr>
<td>Wet Rumble Stripe</td>
<td>16</td>
</tr>
<tr>
<td>Wet Painted Line</td>
<td>191</td>
</tr>
<tr>
<td>Dry Rumble Stripe</td>
<td></td>
</tr>
<tr>
<td>Dry Painted Line</td>
<td></td>
</tr>
<tr>
<td>Wet Rumble Stripe</td>
<td></td>
</tr>
<tr>
<td>Wet Painted Line</td>
<td></td>
</tr>
<tr>
<td>Glass Beads</td>
<td></td>
</tr>
<tr>
<td>Element Blend</td>
<td></td>
</tr>
</tbody>
</table>

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Yellow Post-Winter Results

FHWA recommended replacement threshold for *dry* pavement

In direction of application
Against direction of application

<table>
<thead>
<tr>
<th>Retroreflectivity</th>
<th>Dry Rumble Stripe</th>
<th>Dry Painted Line</th>
<th>Wet Rumble Stripe</th>
<th>Wet Painted Line</th>
<th>Dry Rumble Stripe</th>
<th>Dry Painted Line</th>
<th>Wet Rumble Stripe</th>
<th>Wet Painted Line</th>
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</thead>
<tbody>
<tr>
<td>Glass Beads</td>
<td>14</td>
<td>12</td>
<td>188</td>
<td>129</td>
<td>151</td>
<td>1148</td>
<td></td>
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</tr>
<tr>
<td>Element Blend</td>
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Standard Painted Line
Painted Rumble Strip

Yellow Post - Winter Results

Retroreflectivity

Dry Rumble Stripe
Dry Painted Line
Wet Rumble Stripe
Wet Painted Line
Dry Rumble Stripe
Dry Painted Line
Wet Rumble Stripe
Wet Painted Line

Glass Beads
Element Blend

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SR28 Concluding Comments

• Edgeline Rumble Stripes are promising
  – Retroreflectivity (Emperical Video, Numerical Retro)
  – Cost

• Ongoing Studies on SR 38 and 120
  – Next slides
SR 38 Antioch to Kirklin Indiana
Section 1

Co Rd 300 E
Measurement 1: Rumble Top

Center of Measurement Area
Measurement 2: Rumble Bottom

South

Center of Measurement Area
Measurement 3: Rumble Top

Center of Measurement Area

South
Measurement 4: Rumble Bottom

Center of Measurement Area
Measurement 5: Line (Control)

West

Center of Measurement Area
Schematic: Eastbound

Measurement 1

Measurement 2

Measurement 3

Measurement 4

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

Painted Eastbound

Co Rd 300 E

Co Rd 450 E

Measurement Location #

Rumble Top (Long)  Rumble Bottom 1  Rumble Top (Short)  Rumble Bottom 2

Retroreflectivity

0  50  100  150  200  250  300  350
0  10  20  30  40  50  60

Section 1

Co Rd 450 E
Co Rd 300 E
Section 1 Eastbound
Section 1 Westbound
Section 2 Eastbound
Section 2 Westb
Schematic: Eastbound

Repeat at 40’ intervals (or to match skip pattern). Repeat for westbound.
Section 2 Westbound

Painted Westbound

Retroreflectivity

Measurement Location #

- Rumble Top (Long)
- Rumble Bottom 1
- Rumble Top (Short)
- Rumble Bottom 2
SPECIAL THANKS TO:

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SR28 Questions