SafetyEdge
Your Angle for Reducing Roadway Departures

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Today’s Presenter

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Topics

- Purpose and Need
  - Crash Types and Problem Locations
  - Risk Factors in Edge Drop-off Crashes
- A Practical Solution
  - Construction of the SafetyEdgeSM
  - Pavement edge Durability
  - Costs and Safety Benefits
Key Messages

The SafetyEdge\textsuperscript{SM}

• **Saves Lives**
  • Allows vehicles to safely return to the travel lane

• **Improves Durability**
  • Reduces edge raveling

• **Low Cost**
  • Minor change to paving operations
2006 FHWA / AAA Drop-Off Study

On rural paved roads with unpaved shoulders
- Drop-off crashes were **17.7%** of run-off-road (ROR) crashes in Iowa and **24.7%** of ROR crashes in Missouri
- Drop-off crashes in Iowa were **four times as likely to be fatal** as all rural crashes
- Drop-off crashes in Missouri were **twice as likely to be fatal** as all rural crashes on similar roads
- North Carolina and Illinois data also indicate edge drop-off crashes are more severe than other rural crashes


Without a SafetyEdge℠
Typical Drop-Off with Tire Scrubbing

https://www.youtube.com/watch?v=asy33BGQwUw&t=110s

With a SafetyEdge℠
Locations that Develop Drop-Offs

1. Horizontal Curves
2. Mailboxes
3. T-Intersection Bypass Areas
4. Shaded Areas
5. Other Poor Drainage Locations
6. Pavement Overlays

Horizontal Curves
Shaded Areas

Poor Drainage Areas

Source: Joa Sousa – stock.adobe.com
Asphalt Pavement Overlay

Risk Factors

What are the factors associated with pavement edge drop-off crashes?

- Speed
- Driver Experience
- Vehicle/Tires
- Drop-off Height
- Shape of Pavement Edge

https://www.youtube.com/watch?v=a1PjxqOtWNI
Averaged Test Results for All Vehicles in Scrubbing Condition

<table>
<thead>
<tr>
<th>Speed (mph)</th>
<th>1.5 inch</th>
<th>3.0 inch</th>
<th>4.5 inch</th>
<th>6.0 inch</th>
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<tbody>
<tr>
<td>35</td>
<td>3</td>
<td>2</td>
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<td>55</td>
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<td>3</td>
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<td>5</td>
</tr>
</tbody>
</table>

Subjective Rating:
- More Safe ➡ Less Safe
- No Effect ➡ Loss of Control


Longitudinal Edge Elevation (inches)

Research to Reality

Graphic Source: reproduced from TRC E-C134, Zimmer and Ivey, Figure 6

Risk Factors

What are the factors associated with pavement edge drop-off crashes?

• Speed
• Driver Experience
• Vehicle/Tires
• Drop-off Height
• Shape Of Pavement Edge

Crash Reductions

• Rollover
• Head-on (includes opposing sideswipe)
• Roadside Object

SafetyEdge℠

Depicts extension of Pavement Surface

30° - 35°

Depicts a plane parallel to Pavement Surface from the toe of the Wedge Surface

Recommendations for SafetyEdge℠

• Consolidating the pavement edge into 30° shape during paving to provide stability for vehicles recovering from a roadway departure
• Implement as a standard practice for paving and resurfacing projects
SafetyEdge\textsuperscript{SM} Implementation Status

Based on FHWA Division reporting on Proven Safety Countermeasures. Updated based on information from EDC Team.

Key Design Elements

- Rounded Edge
- Springs on End Gate
NOT SafetyEdge℠ Hardware

Source (both): NCDOT, used with permission
https://safety.fhwa.dot.gov/safetyEdge/design_constr_guide/

Conventional Edge vs SafetyEdge℠

Conventional Edge
https://www.youtube.com/watch?v=_fDW9_ukloc

With SafetyEdge℠
https://www.youtube.com/watch?v=NG-mK4aa0-k
Screed Attachments

TransTech: Shoulder Wedge Maker™

Advant-Edge Ramp Champ™

End Gate Attachments

Carlson Safety Edge End Gate

Willow Designs

Carlson Installation 2010

Willow Installation 2017
Modified Attachments

North Carolina Hardware Modifications

- Electric drill to adjust height
- Guiderails stabilize device
- HMA kept away from spring

SafetyEdge℠ on PCC
Shoulder Preparation Varies

- **Edge Exposed**
- **Minor Soil Disturbance**
- **Soil/Vegetation Build Up Removed**

**No prep** – Iowa Highway 143

**Shoulder Clipping** - Pennsylvania State Route

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**Paving**

- Image of a paving machine and workers
- Close-up of paving machinery components
Roller Pattern and Finished Angle

Iowa Installation 2010
North Carolina Foamed WMA installation 2011

Slope Results

[Graph showing slope results for various locations]
Where SafetyEdge℠ is NOT Used

- Open-Graded Top Mixes
- Mill and Fill Operations (shoulder not milled)
- Curb and Gutter

SafetyEdge℠ Benefits NOT Realized

- Areas with Non-Recoverable Slopes (steeper than 1V:4H)
- Wide Shoulders (lower B/C)
SafetyEdge℠ Under Guardrail

SafetyEdge℠ in Thin Lifts

Lift thickness does not correlate with edge depth.

Lift Thickness at Centerline
Lift Thickness at Pavement Edge
SafetyEdge™ Durability

Burke County, NC
SR 1611

No SafetyEdge™
24 months → 3.5”

Source (both): NCDOT, used with permission

SafetyEdge™ Section
24 months → 3.0”
Density Testing

- FHWA Nuclear Gage 6-inches from Edge and Cores: no statistical difference
- NCAT Edge Density of Cores:

<table>
<thead>
<tr>
<th></th>
<th>With SafetyEdge℠</th>
<th>Without</th>
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<tbody>
<tr>
<td>Top Lift</td>
<td>70.6%</td>
<td>63.9%</td>
</tr>
<tr>
<td>Middle Lift</td>
<td>78.5%</td>
<td>74.6%</td>
</tr>
<tr>
<td>Bottom Lift</td>
<td>82.4%</td>
<td>81.3%</td>
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Note: Conventional nuclear gage testing for quality control does not test within 1 foot of edge because expected lower density near edge

Construction Summary

Similar to Conventional Paving
(No Effect on Production)

- Clip Shoulders
- Construct Each Lift (or overlay)
- Pull Shoulders Flush
SafetyEdge℠ Cost

- Limited Quantitative Data on HMA
- Missouri SR 19 (1 days production)
  - Paving with SafetyEdge℠: 933 tons/mile
  - Paving w/o SafetyEdge℠: 923 tons/mile
  - Percentage Difference: 0.82%*
    *Within normal expected quantity variances
- Hardware Cost
  - $1,700 - $3,000
  - Re-used on many projects

Benefits of the SafetyEdge℠

- **Construction Benefits:**
  - Safety benefit
  - Increase production
  - Reduce patching and rework of edges
- **Increased Pavement Edge Durability**
- **Reduced Crashes Over Life of the Pavement**
SafetyEdge℠ Website

https://safety.fhwa.dot.gov/SafetyEdge/

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Which Side of the Road will YOU be on in Eight Years?

Original Project Constructed  
July 2003

Photos taken  
June 2011

With SafetyEdge℠  
Without SafetyEdge℠