SURFACE TREATMENTS TO ALLEVIATE CRASHES ON HORIZONTAL CURVES

2014 Traffic Safety Conference
Research Projects

- 0-5439 – Identifying and Testing Effective Advisory Speed Setting Procedures
- 5-5439 – Workshops on Identifying and Testing Advisory Speed Setting Procedures
  - Criteria for setting advisory speed
  - Curve severity assessment
  - GPS Method
- 0-6714 – Surface Treatments to Alleviate Crashes on Horizontal Curves
  - Curve speed and safety trends
  - Margin-of-safety analysis framework
    - Friction supply – friction demand
    - Assess benefit of increasing supply with surface treatment
Objectives and Scope

0-6714– Surface Treatments to Alleviate Crashes on Horizontal Curves

- **Objectives**
  - Assess effectiveness of high-friction surface treatments at improving curve safety
  - Develop guidelines for application of high-friction surface treatments

- **Scope**
  - Horizontal curves
  - “High”-speed roadways
**Treatments**

- Select Treatments
  - High-friction surface treatment
  - Pavement texturing
  - Seal coat
Findings

- **The Issues**

  - Curve tracking errors

  ![](image)

  Spacek, 2005
The Issues

- Superelevation transition issues
  - Lack of full superelevation in beginning of curve
  - Hydroplaning

Glennon, 1969
Findings

The Issues

- Curve severity assessment
  - Based on friction demand and kinetic energy
  - Category E is most severe – use “special treatments”

Bonneson et al., 2007 (0-5439)
Findings

- Soft Shoulder
- Blind Curves
- Steep Grade
- Big Trucks
- Good Luck!
Crash Data Analysis

- Cross-sectional models
  - About 500 curve sites
  - Four models (all, wet-weather, run-off-road, and wet-weather run-off-road crashes)
  - CMF for skid number
Detailed Analysis
- Skid number CMF

![Graph showing Crash Modification Factor (CMF) against Skid Number for different types of crashes: All crashes, Wet-weather crashes, Run-off-road crashes, and Wet-weather run-off-road crashes. The graph indicates a decreasing trend with increasing skid number.]
Data Collection
- 15 sites
  - Bryan, Dallas, and Tyler districts
  - 55-70 mph speed limits
  - 30-55 mph advisory speeds
- 6000 vehicles
Field Evaluation

- Cross-Sectional Database
  - Data collection plan
Field Evaluation

- **Operational Data**
  - Speed
  - Lane placement

- **Friction Data**
  - Skid number

![Diagram of field evaluation setup](image)

**Legend**

- Speed Trap
- Z Trap
- Data Collection Zone

Not to Scale
Field Evaluation

- **Models**
  - Mid-curve speed model
  - Speed differential models
    - PC-MC, MC-PT
    - Used to compute side friction demand along the entire curve
  - Lane placement models
    - Probability of different track types
Texas Curve Margin of Safety (TCMS)

- Input data
  - Curve geometry
  - Traffic volume
  - Skid number
  - Speed limit

- Output
  - Margin of safety calculations
  - Curve CMFs
Improved by treatment

Low margin of safety at PC
Crash Modification Factors (CMFs)

### Crash Prediction Model Calculations

<table>
<thead>
<tr>
<th></th>
<th>Predicted Crash Counts in Analysis Period</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>All</td>
<td>1.406</td>
<td>1.386</td>
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<tr>
<td>Wet-weather</td>
<td>0.025</td>
<td>0.021</td>
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<tr>
<td>Run-off-road (ROR)</td>
<td>1.426</td>
<td>1.389</td>
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<tr>
<td>Wet-weather ROR</td>
<td>0.022</td>
<td>0.018</td>
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### Predicted Change in Crash Count

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>All</td>
<td>-3.1%</td>
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<tr>
<td>Wet-weather</td>
<td>-17.2%</td>
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<tr>
<td>Run-off-road (ROR)</td>
<td>-4.6%</td>
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<tr>
<td>Wet-weather ROR</td>
<td>-20.8%</td>
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### Overall Crash Modification Factors (CMFs)

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Curve radius</td>
<td>9.432</td>
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<tr>
<td>Lane width</td>
<td>1.066</td>
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<tr>
<td>Shoulder width</td>
<td>1.287</td>
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<tr>
<td>Skid number</td>
<td>1.033</td>
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<tr>
<td>Combined</td>
<td>13.368</td>
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### Wet-Weather CMFs

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<tbody>
<tr>
<td>Lane width</td>
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<tr>
<td>Skid number</td>
<td>1.208</td>
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<td>Combined</td>
<td>1.322</td>
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### Run-off-Road CMFs

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<tr>
<td>Curve radius</td>
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<td>Shoulder width</td>
<td>1.328</td>
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<td>Combined</td>
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### Wet-Weather Run-off-Road CMFs

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<td>Combined</td>
<td>1.390</td>
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High Friction Surface Treatments
Questions or comments?

Thank you for your time!