THE 2008 OHIO FRICTION STUDY
OR
RELATIONSHIP BETWEEN SKID RESISTANCE NUMBERS MEASURED WITH RIBBED AND SMOOTH TIRE AND WET-ACCIDENT LOCATIONS

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2008 Ohio Friction Study

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Ohio Safety Efforts

- Developed base crash rates for intersections and freeways to help identify those with higher-than-average rates
- Developed crash reduction factors for various countermeasures
- Implemented a significant road safety audit (RSA) program
- Undertaken major research on friction qualities of various aggregates
- Participated in FHWA’s Highway Safety Information System (HSIS)
- Consistently reduced highway fatality rates, as well as the number of fatalities.
Ohio 2006 Safety Goals

Refine, refocus and respond to high crash locations

- Reduce crash frequency by 10% by 2015
- Reduce rear-end crashes by 25% by 2015
- Reduce state fatality rate to 1.0 fatality per 100 MVMT by 2008
- Reduce annual fatalities to 1100 by 2008
Research Objectives

• Determine if a correlation exists between locked-wheel friction (FN) and wet pavement crashes and, if so:
  • which test tire (ribbed or smooth) is more correlated.
  • what the desirable or target FN values should be for different site categories / friction demand categories.
• Develop improved guidance on use of ribbed versus smooth tires and provide recommendations regarding minimum friction numbers for each type.
Research Approach

- Task 1. Literature Review
- Task 2. Design Experiment
- Task 3. Collect Data
- Task 4. Develop Correlations
- Task 5. Recommend Friction Numbers
- Task 6. Final Report
Task 1. Literature Review

Conclusions

- Friction/texture is an important surrogate for safety.
- Greater attention to engineering safer roads can potentially reduce fatalities and serious injuries by a considerable amount.
Task 2. Design Experiment
Site Selection, Crash and Inventory Data

- 90 sites selected covering three categories
  - congested freeways: 30
  - signalized intersections: 30
  - unsignalized intersections: 30
- For each category,
  - low wet/total crash ratio (0.15): 10
  - medium ratio (0.15 to 0.35): 10
  - high ratio (>0.35): 10
- Representation across Districts, pavement types
Task 3. Collect/Compile Data

• ODOT provided:
  • Comprehensive inventory and pavement condition data.
  • Crash data for 2003-2005.
• Field testing by ODOT in summer/fall of 2007.
• At each of the 90 selected sites:
  • Friction tests at 40 mph and one other speed (20 mph for intersections, 60 mph for freeways) with both ribbed and smooth tire (using two ODOT locked-wheel friction trailers)
  • Macrotecture measurements using a high-speed laser profiler (85 of 90 sites) (MPD later converted to MTD)
• Develop analysis database (spreadsheet)
## Task 4. Develop Correlations

### Data Analysis

- Develop plots of friction and texture statistics versus crash statistics for the 90 sites.

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Dependent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>FN40R&lt;sub&gt;avg&lt;/sub&gt;</td>
<td>Total crashes</td>
</tr>
<tr>
<td>FN40R&lt;sub&gt;min&lt;/sub&gt;</td>
<td>Wet/total crash ratio</td>
</tr>
<tr>
<td>FN40S&lt;sub&gt;avg&lt;/sub&gt;</td>
<td>Rear-end crash rate</td>
</tr>
<tr>
<td>FN40S&lt;sub&gt;min&lt;/sub&gt;</td>
<td></td>
</tr>
<tr>
<td>FN20R&lt;sub&gt;avg&lt;/sub&gt; or FN60R&lt;sub&gt;avg&lt;/sub&gt;</td>
<td></td>
</tr>
<tr>
<td>FN20R&lt;sub&gt;min&lt;/sub&gt; or FN60R&lt;sub&gt;min&lt;/sub&gt;</td>
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<tr>
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<tr>
<td>MTD&lt;sub&gt;min&lt;/sub&gt;</td>
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</tbody>
</table>
Task 4. Develop Correlations

Example Analysis Plot

Wet/Total Crash Ratio vs. FN40 (Avg and Min) for All Sections (Ribbed and Smooth Tires)

- FN40R Avg: $y = -0.2597 \ln(x) + 1.1916$, $R^2 = 0.1712$
- FN40R Min: $y = -0.2566 \ln(x) + 1.1644$, $R^2 = 0.181$
- FN40S Avg: $y = -0.1578 \ln(x) + 0.7693$, $R^2 = 0.0697$
- FN40S Min: $y = -0.1422 \ln(x) + 0.7038$, $R^2 = 0.0673$
Task 4. Develop Correlations

Example Cumulative % Crashes Plot

Cumulative % of All Crashes (in Test Direction) Observed on Congested Freeways vs. FN40 for Ribbed and Smooth Tires

377 total crashes were observed in the test direction for sections included in this analysis.

Ribbed Tire
Smooth Tire

34
42

377 total crashes were observed in the test direction for sections included in this analysis.
### Task 5. Recommend Friction Numbers

#### Cumulative % Crashes vs. FN Results

<table>
<thead>
<tr>
<th>% of Total Crashes</th>
<th>Congested Freeways</th>
<th>Signalized Intersections</th>
<th>Unsignalized Intersections</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \text{FN40S}_{\text{avg}} )</td>
<td>( \text{FN40R}_{\text{avg}} )</td>
<td>( \text{FN40S}_{\text{avg}} )</td>
</tr>
<tr>
<td>90</td>
<td>&lt; 30</td>
<td>&lt; 42</td>
<td>&lt; 29</td>
</tr>
<tr>
<td>85</td>
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<tr>
<td>10</td>
<td>&lt; 22</td>
<td>&lt; 32</td>
<td>&lt; 13</td>
</tr>
</tbody>
</table>
Task 6. Final Report

Key Findings

• No single variable (ribbed tire, smooth tire, macrotexture) correlates highly with crashes for each site category

• $FN_{40R_{\text{avg}}}/FN_{40R_{\text{min}}}$ better correlated than $FN_{40S_{\text{avg}}}/FN_{40S_{\text{min}}}$

• $FN_{\text{min}}$ quite consistent and usually $\sim 2$ percentage points below $FN_{\text{avg}}$

• For congested freeways, rear-end crash rate drops significantly at MTD $\sim 1.0$ to $1.2$ mm
Task 6. Final Report

Key Recommendations

- Continue use of FN40R
- Use New York SKARP approach for setting investigatory and intervention levels
  - 3-prong check of wet/total crash ratio, total crashes (annual), and friction
- Supplement with macrotexture check
- Establish levels for 3-5 site categories (per AASHTO Guide for Pavement Friction)
Thank You!!

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