NCHRP PROJECT 20-7 TASK 395
MASH EQUIVALENCY OF NCHRP REPORT 350 BRIDGE RAILINGS

AASHTO Subcommittee on Bridges & Structures
Technical Committee T-7
“Guardrails & Bridge Rails

Roger P. Bligh, Ph.D., P.E.
Senior Research Engineer
Texas A&M Transportation Institute

Minneapolis, MN
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RESEARCH OBJECTIVES

- Identify and prioritize bridge railings
- Determine MASH equivalent test levels
- Analyze current bridge rails with respect to MASH
- Assess eligibility and need for retesting
RESEARCH APPROACH

- Task 1: Collect Bridge Rail Information
- Task 2: Assess Analysis Methodologies
- Task 3: Analyze Selected Bridge Rails
- Task 4: Coordinate with Other MASH Implementation Efforts
- Task 5: Prepare FHWA Eligibility Requests
- Task 6: Present Research Findings
- Task 7: Submit Final Report
TASK 1 - COLLECT BRIDGE RAIL INFORMATION

- Identify bridge rails and their relative frequency of use
  - Review FHWA web site
  - Survey State DOTs
  - Almost complete with a thorough questionnaire that will soon be sent to the states and manufacturers

- Categorize and prioritize systems
  - Test Level
  - Material type (steel, concrete, etc.)
SURVEY

- Electronic, On-Line Survey of State DOTs
  - Draft Survey
    - Bridge Rail System Name
    - Standard Drawing
    - Test Specification
    - Test Level
    - Test Documentation
    - Eligibility Status
    - Relative Frequency of Use
  - Your input is needed!!
TASK 2 - ASSESS ANALYSIS METHODOLOGIES

• Assess methodologies previously used/accepted by FHWA
• Develop methodology for evaluating MASH compliance of existing bridge rails
  • Crash tested and/or FHWA eligible railings
• Consider:
  • Previous level of testing
  • MASH impact severity
  • MASH evaluation criteria
NCHRP REPORT 350 IMPLEMENTATION

• Similar issue faced during NCHRP Report 350 Implementation
• May 30, 1997 FHWA Technical Memorandum
  • In-house assessment of crash tested bridge rails
    • NCHRP Report 230
    • AASHTO Guide Specification for Bridge Railings
  • Conservatively assigned railings “approximately equivalent” NCHRP Report 350 test level
  • Review included comparison of impact severity, level of testing performed under earlier criteria, vehicle types used in tests, and impact performance in tests
  • Listing of bridge rail systems
    • Crash test reports, available drawings, and related FHWA letters
# REPORT 350 BRIDGE RAIL EQUIVALENCY

<table>
<thead>
<tr>
<th>TESTING CRITERIA</th>
<th>ACCEPTANCE EQUIVALENCIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCHRP Report 350</td>
<td>TL-1</td>
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<tr>
<td></td>
<td>TL-2</td>
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<td>TL-6</td>
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<td>NCHRP Report 230</td>
<td>MSL-1</td>
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<tr>
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<td>AASHTO Guide Specifications</td>
<td>PL-1</td>
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<td>AASHTO LRFD Bridge Specifications</td>
<td>PL-1</td>
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<td>PL-2</td>
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<td>PL-3</td>
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* This is the performance level usually cited when describing a barrier as tested under NCHRP Report 230. It is close to a TL-3 but adequate TL-3 performance cannot be assured without a pickup truck test.
FHWA “ACCEPTANCE” GUIDELINES

- May 16, 2000 FHWA Technical Memorandum
- Provided guidance for “acceptance” of bridge railings
  - Pertained to design modification/variation
  - Railing similar in basic geometry and strength to NCHRP Report 350 crash tested design
- AASHTO LRFD Bridge Design Specification
  - Section 13 – Railings
  - Strength analysis – consider all failure modes
    - System, components, connections
  - Geometric analysis – empirical relationships developed from full-scale crash testing experience
- Illustrated example submitted by state DOT
• Analyze existing data to determine if equivalent MASH test levels can be established
  • Supplemented by limited finite element impact simulations
• Evaluate prioritized bridge rails (Task 1) using approved methodology (Task 2)
  • Conservative analysis
  • MASH equivalent test level
  • Crash testing needed
KEY MASH CONSIDERATIONS

- Structural Adequacy
- Rail Height
- Rail Geometry
**STRUCTURAL ADEQUACY**

- Increased impact severity results in increased impact forces

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<thead>
<tr>
<th>Test</th>
<th>NC HRP 350</th>
<th>MASH</th>
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<tbody>
<tr>
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<td>-</td>
<td>+13%</td>
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<tr>
<td>4-12</td>
<td>-</td>
<td>+56%</td>
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</table>

- Impact forces vary with test level and rail height
  - TL-2: 27 kips → ?
  - TL-3: 54 kips → 70 kips?
  - TL-4: 54 kips → 68 – 80 kips

- AASHTO LRFD Bridge Design Specification analysis methodologies applicable
  - Conservative in nature
RAIL HEIGHT

- Minimum height for vehicle stability varies with test level

<table>
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<tr>
<th>Test Level</th>
<th>NC HRP 350*</th>
<th>MASH</th>
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<tr>
<td>2</td>
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<td>3</td>
<td>24</td>
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* AASHTO LRFD Bridge Design Specifications, Section 13
RAIL GEOMETRY

- Rail geometry effects vehicle-barrier interaction
  - Post setback distance
  - Vertical clear opening
  - Contact surface area
- Increased impact severity increases snagging potential
- Applicability of AASHTO LRFD Bridge Design Specification questionable
  - Different vehicles
  - Different impact conditions

Figure A13.1.1-2—Potential for Wheel, Bumper, or Hood Impact with Post
TASK 4 - COORDINATION WITH OTHER MASH IMPLEMENTATION EFFORTS

• Coordinate with pooled fund efforts and other research initiatives
  • Collect all available information
  • Share information to avoid duplication of effort
  • Work toward compiling information on all MASH devices

• Roadside Safety Pooled Fund Program
  • MASH Implementation Coordination Effort
    • Develop and maintain databases for MASH implementation needs and testing

• Research Efforts
  • Midwest States Pooled Fund
  • NCHRP
  • Other
TASK 5 – PREPARE FHWA ELIGIBILITY REQUESTS

• Prepare necessary documentation and rationale for submission of eligibility requests to FHWA
• Selected, prioritized bridge rail systems
• Methodology and rationale should be applicable to other rail systems
TASK 6 – PRESENT RESEARCH FINDINGS

- Present research findings
  - AASHTO Subcommittee on Bridges and Structures, Technical Committee T-7 “Guardrail and Bridge Rail”
  - AASHTO Technical Committee on Roadside Safety (TC RS)
TASK 7 – SUBMIT FINAL REPORT

• Prepare and submit final report
• Project details, methodology, analyses results, findings, and recommendations
  • Test level equivalency
  • FHWA eligibility requests
  • Additional crash testing needs
## TIME SCHEDULE

<table>
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<tr>
<th>Task</th>
<th>Months</th>
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<tr>
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<tr>
<td>Task 1. Review and Prioritize Bridge Rails</td>
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<tr>
<td>Task 2. Develop Analysis Methodology</td>
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<td>Task 3. Analyze Bridge Rails</td>
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<td>Task 4. Assist with MASH Coordination</td>
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QUESTIONS?

ROGER BLIGH, PH.D., P.E.
R-BLIGH@TTI.TAMU.EDU