Performance-Based Safety Evaluation on a Systemic Level: The Wisconsin Story

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Agenda

• Why performance-based practical design (PBPD)?
• What is PBPD?
• Application of PBPD
• Status of PBPD Implementation
Why PBPD?
Asset Management

“Asset”: if you own it and spend public dollars to maintain, improve, or replace it, it’s an asset that needs to be managed.

How each public agency decides to manage those assets is a fundamental core responsibility.
Renewed Focus on Efficient Asset Management

- Blend financial realities with analysis to prioritize improvements
- Goal is to be more efficient with transportation dollars
- Eliminate nonessential project design elements
- Focus on data-driven decision making
- Performance-based practical design (PBPD) approach to system preservation

Source: www.rislaf.com
What is PBPD?
Performance-Based Practical Design

- Breaks from traditional design by “fixing only what is broken”
- Substandard ≠ deficient
- Uses data to drive the decision making process
- Focus on cost-effective solutions
- Safety: relies on substantive safety instead of nominal safety
Substantive Safety vs Nominal Safety

Nominal Safety – Assumes if you utilize standard values published in reference resources (e.g. AASHTO “Green Book” and Roadside Design Guide), your roadway will be “safe”

Substantive Safety – relies on data-driven tools like databases and the Highway Safety Manual (HSM) to perform actual and predictive crash analysis of proposed highway safety improvements

FHWA PowerPoint (Every Day Counts) “Data-Driven Safety Analysis –Nominal vs. Substantive Safety” by John McFadden, P.E.
WisDOT moved from a standard-based (nominal safety) approach to an analysis-based (substantive safety) approach

- No longer uses a “cook book” approach that starts with desirable design values
- Solutions will be specifically designed for individual situations to focus on meeting a project’s specific purpose and need
Challenges with Past WisDOT Safety Engineering Practices

- Regression to the mean bias
- Use of short-term rates and projects them into the future
PBPD Application
Wisconsin Department of Transportation

5 regions

72 counties

Maintains 1,600 CL miles of freeway

Maintains 10,200 CL miles of non-freeway roads

$1.2B annual construction budget
WisDOT Safety Certification Process (SCP)

- Determine potential safety concerns
- Crash vetting
- Alternatives determination
- Evaluate safety performance
- Economic appraisal
- Documentation
WisDOT SCP Task Flowchart
WisDOT Safety Certification Process (FDM 11-38)

Created to outline WisDOT SCP processes and procedures

• Provides a walkthrough of conducting each SCP task
• Lists Wisconsin-centric inputs when performing safety and economic analysis
• Provides links and attachments for documents to aid in performing SCP tasks
Determine Potential Safety Concerns

Project segment(s) or intersection(s) that require crash data analysis due to statistically-significant high crash rates and/or high KAB rates.

WisDOT – Meta-Manager database flags segments and/or spot locations.
Crash Vetting

Focus on crashes that can be mitigated with engineering solutions

Review crash data for each flagged site to determine crash causation

• Remove crashes without engineering solutions

Identify crash trends and patterns
Alternatives Determination

Focus on practical mitigation alternatives

Evaluate how geometric features may contribute to crash history
  - Functions as a secondary crash vetting

Determine practical mitigation alternative(s) to evaluate
Evaluate Safety Performance

Quantify future safety performance for comparison of the base (no-build) condition to the identified mitigation alternatives.

Use predictive crash modeling methods when applicable.

Evaluate Safety Performance

Use HSM methodologies to perform safety engineering analysis

- Use IHSDM to perform base and mitigation alternative crash prediction evaluations
- Estimated vs predicted vs expected crash frequency
- When CMF adjustments can be used and how they are applied to IHSDM results
- When to use Empirical Bayes method
Economic Appraisal

Quantify monetary change of crash frequency and severity changes

Quantify benefit-cost of proposed safety mitigation alternatives

Allows understanding of the cost-effectiveness of mitigation alternatives from a safety standpoint
Economic Appraisal

Crash benefit calculations determine the monetary benefit of reducing crash frequency and severity.

Project costs include construction and right of way costs.

Tools for economic analysis include IHSDM software or spreadsheets.

Table 8. Case Summary

<table>
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<tr>
<th>Is Base Case</th>
<th>Title</th>
<th>Present Value of Crash Cost ($)</th>
<th>Present Value of Other Cost ($)</th>
<th>Net Present Value of Benefits (B) ($)</th>
<th>Net Present Value of Costs (C) ($)</th>
<th>Present Value of Net Benefit (B-C) ($)</th>
<th>Benefit Cost Ratio (B/C)</th>
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Status of PBPD Application
PBPD Use by WisDOT

Rollout of WisDOT FDM 11-38 – November 2018

PBPD training to WisDOT staff – November 2018

All Regions are currently using PBPD at the scoping level for programmed projects

Many Regions are currently using PBPD to study corridors for future project needs
Safety (via SCP) is not absolute in decision-making process

- Traffic operations
- Feasibility / constructability

Improvements studied further in environmental process to determine preferred alternative
Thank you very much!

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