Performance-Based Practical Design (PBPD) and Transportation Systems Management and Operations (TSMO) / ITS

ITS Maryland
September 22, 2016
Louis Neudorff
Agenda

• Background
• What is PBPD?
• How Does It Relate to TSMO-Related Activities?
• Examples
  – Recent FHWA Guidance
DOTs Face Increasing Challenges
The Transportation Environment is Also Rapidly Changing

- Increasing customer needs and expectations
- Growing emphasis on measuring performance
- Intensifying reliance on information and technology
  - Technology also offers opportunities
  - Multiple operations strategies and regional integration of modes
  - Paradigm shift of Connected Vehicles / Automated Vehicles
Several Approaches for Meeting These Challenges

• New and expanded transportation facilities
  – Roadway and transit infrastructure; additional capacity

• Improved and more reliable operations
  – Transportation systems management and operations (TSMO)

• Combination of approaches

Common Goal ➔ A Well-Performing Transportation System Using the Most Cost-Effective Improvements

How to Identify, Prioritize and Develop these Improvements?
Performance Based Practical Design

PBPD is a decision making approach that helps agencies better manage transportation investments and serve system-level needs and performance priorities with limited resources.

Modifying the traditional “top down, standards first” approach to a “design up” approach

This does not mean one can compromise on certain standards or regulations!
PBPD Concepts and Activities

Goals and Objectives
Needs and Performance Measures

Baseline Conditions
- Design Policies and Guidelines
- Project area and segments
- Current / projected operational issues
- Current / projected safety issues
- Stakeholder concerns and sensitivities

Optimal Design Concepts

Analyses
- Alternative geometric designs
- Alternative operations strategies
- Estimate changes in performance
- Estimate costs
- Trade-offs and engineering judgement

Moving Forward
(SELECT elements and validate)
- Cost Effective / return on investment
- Serves project and system needs
- Identify any design exceptions
- Documentation of trade-offs & decisions

Potential Cost Savings

Design Exceptions
Document Trade-offs
PBPD is NOT:

• New policy, regulation, or requirement
• Opportunity to disregard long-term needs:
  – For short term cost savings
  – Overlooking future development
• An excuse for compromising on safety, user needs, or accommodation of freight to save money
• Disregarding or ignoring design and other standards
  – PBPD does provide for “Design Exceptions”
Design Exceptions

• A documented decision to design a highway element or segment to design criteria that do not meet minimum values or ranges.

• Design exceptions are a useful “tool” for employing practicality and flexibility in decisions as part of a design-up approach
  – A design exception is **NOT** an indication of failure or a “flawed” design
  – It is a necessary and legitimate process to allow exercising professional and **engineering judgment**

• Updated FHWA Policy on Design Exceptions
  – Lane width, shoulder width, horizontal curve radius, among others

“Even the Cover Is Flexible”
Part-Time Shoulder Use

• Add capacity only when needed
• Keep shoulder intact for most hours of the day
• Do what is physically and financially possible
  – Support decisions with analysis
  – Analysis as part of PBPD
• A decision to use the shoulder part-time may defer major and costly widening.
Shoulder Use Options and Issues

• Left or Right Shoulder (Never Both)
• Vehicle Use (All, No Trucks, HOV / HOT, Buses Only)
• Existing Shoulder Width and Pavement Structure (perhaps narrow lanes)
• Drainage
• Emergency Pull-off / Refuge Areas
• Horizontal Curve Radius
• Emergency Response During Incidents
• Speed Limits During Operation
• Use of ATM (Dynamic Lane Use and Speed Limits)
Narrow Lanes and Shoulders

• Increase Capacity by adding lane(s) **within existing roadway footprint**

• Potential Scenarios
  – Add a general purpose lane
  – Add a managed lane (HOV / HOT)
  – Add ramp lane in interchange
  – Maintain lane continuity
  – Increase shoulder width

• *A decision to use narrow lanes may defer major and costly widening.*
  – Analysis as part of PBPD
  – Operational and safety impacts
  – Design exceptions
Examples: Narrow Lanes / Shoulders

US 59 - Houston

Los Angeles
Examples: Narrow Lanes / Shoulders

Miami-Dade

Potential Use of ATM
Case Study – Narrow Lanes

Freeway Modernization Along I-94 in Milwaukee

- Expansion from 3 lanes to 4 lanes in each direction
- One-mile segment with significant constraints
Analysis of Two Alternatives

12 – ft. lanes and full shoulders

11 – ft. lanes and minimal shoulders
## Results of PBPD – Based Analysis

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Double Deck</th>
<th>At-Grade / Narrow Lanes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations</td>
<td>Acceptable LOS</td>
<td>Acceptable LOS</td>
</tr>
<tr>
<td>Safety</td>
<td>Fewest total crashes</td>
<td>More than double deck; but 23% less than replace in kind</td>
</tr>
<tr>
<td>Costs</td>
<td>$295 to $345 million</td>
<td>$125 million</td>
</tr>
<tr>
<td></td>
<td>Additional $1.2 million in annual maintenance costs</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>Shorter construction schedule</td>
</tr>
</tbody>
</table>

Wisconsin DOT identified “at grade” as the preferred alternative: “The alternative selected provides the community with the best balance when all critical factors are evaluated together. The at-grade alternative is the least expensive to construct and have lower potential for community and cultural resources impacts.”
TSMO Strategies and ITS an Integral Part of PBPD Process

• A decision to use Active Traffic Management, ramp metering, etc. may defer major and costly widening.
  – Improve safety and travel reliability
  – Reduce the number of shockwaves and instances of flow breakdown

• Use of TSMO and ITS to support design exceptions
  – Dynamic speed limits, dynamic lane assignment, enhanced incident management, etc.

• The future of ubiquitous CV and AV
  – Narrow lanes may no longer be considered “narrow”