Part-Time Shoulder Use Guide Discussion

• Background and Motivation
• Link to Performance Based Practical Design
• Relationship to Transportation Systems Management and Operations (TSMO)
• Types of PTSU and extent of Use in the U.S.
• Contents of the Guide
  – Planning
  – Analysis
  – Design
  – Operations
  – Maintenance
Motivation for a Guide

- DOT’s facing increasing challenges
- Increasing interest across the Country
  - Currently over 30 shoulder use installations in operation in 16 states
  - Elected official interest
- Promote more consistency in ways States and FHWA Division Offices approach the concept
- Provide information on all the phases of a proposed projects; i.e., Planning, Evaluating, Environment, Design, Operations, Maintenance
- Good example of Performance-Based Practical Design
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!

http://www.fhwa.dot.gov/design/pbpd/
Common Themes of PBPD:

• Project decisions are based on critical examination of geometric elements
  – Select/size elements that serve priority needs
  – Reduce or eliminate those that don’t
• Utilizes relevant, objective data to inform decisions – engineering judgement
• Choices made to serve project priorities while trying to make cost effective decisions
• Project savings Benefit System Needs
Example Operations Strategies and Solutions

- Work Zone Management
- Traffic Incident Management
- Service Patrols
- Special Event Management
- Road Weather Management
- Transit Management
- Freight Management
- Traffic Signal Coordination

- Traveler Information
- Ramp Management
- Managed Lanes
- **Part-Time Shoulder Use**
- Active Traffic Management
  - Dynamic Speed Limits
  - Dynamic Lane Assignment
  - Queue Warning
  - **Dynamic Part-Time Shoulder Use**
Part-Time Shoulder Use

- Use of the safety shoulder as a travel lane during congested conditions – **Not a permanent conversion of a shoulder**
- 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
What is Part-Time Shoulder Use?

• Various names
  – Hard shoulder running (European)
  – Shoulder running
  – Temporary shoulder use
  – Part-time shoulder use

• Same meaning: use of the left or right shoulders of an existing roadway for travel during certain hours of the day.
  – TSM&O strategy for addressing congestion and reliability issues
  – Preserves shoulder as shoulder during most hours of day
Types of Part-Time Shoulder Use

• Static shoulder use – open to passenger vehicles during predetermined hours of operation
• Dynamic shoulder use – open to passenger vehicles based on need and real-time conditions
• Bus-on-Shoulder (BOS) – open only to buses, usually at driver’s discretion

Shoulder use typically implemented on freeways; but can be applied to arterials

Next presenter: Pete Jenior
Where is Part-Time Shoulder Use?

- Now 16 states
- Many international applications as well
Bus On Shoulder (BOS) in Minneapolis-St. Paul
Left-Shoulder Bus on Shoulder (BOS) in Chicago
Bus on Shoulder (BOS) on US 9 Arterial in New Jersey
Static Shoulder Use – US 2 in Washington State
Static Shoulder Use – I-66 in Virginia (Made Dynamic in 2015)

Dynamic signs over shoulder; but fixed hours of operation
Dynamic Shoulder Use – I-66 in Virginia
Dynamic Shoulder Use – I-35W in Minneapolis

- Part of Managed Lane (HOT) operation
Purpose of Shoulder Guide

Why did we need a Guide?

• No national guidelines
  – Existing research scattered in many sources
• Growing interest - Division Offices getting requests for projects
• Regulatory uncertainty/complexity
  – Air and noise analysis
  – NEPA
  – Design exceptions
  – Signing and pavement marking (MUTCD)
• The Guidebook is not a standard/directive/policy/etc.
  – Collection of referenced standards and applied best practices
• Consistent with other FHWA initiatives
  – PBPD
  – TSM&O and Active Traffic Management
Guide Chapters - Planning

Chapter 1 – What is Part-time Shoulder Use?
• Also contains summary of entire guide

Chapter 2 – Planning, Decision Making, and Preliminary Engineering
• Planning considerations
• NEPA requirements
• Preliminary Engineering
• Relationship to Planning for Operations and PBPD
Guide Chapters - Analysis

Chapter 3 – Mobility Analysis
• How to do it (HCM/FREEVAL, Simulation)
• Observed and simulated shoulder use capacities

Chapter 4 – Safety Analysis
• Before/after studies
• How to do analysis
• What Highway Safety Manual says

Chapter 5 – Environmental Analysis
• Air quality
• Greenhouse gas emissions
• Noise

Chapter 6 – Costs and Benefits Analysis
• Life cycle costs
• Benefit-cost ratio
Chapter 7 – Design Considerations
• Geometry
• Pavement/Drainage
• Signing and pavement marking

Chapter 8 – Implementation Process
• Design exceptions
• MUTCD
• Stakeholder/public involvement

Chapter 9 – Day-to-Day Operations
• Maintenance
• Incident management
• Law enforcement
• Opening and closing the shoulder
Some Design and Operations Questions

Preliminary Engineering

• Is shoulder width adequate, or can it be widened?
• Are vertical clearances adequate?
• Is the shoulder pavement structural capacity adequate in terms of drainage and rideability?
• Is it feasible to provide supplemental emergency turn-out or refuge areas beyond the shoulder at reasonable intervals?
• Is a sufficiently long segment available, or is an acute bottleneck being relieved?

Operations Concepts

• Should the right or left shoulder be used?
• What vehicles will the shoulder be open to?
• If the shoulder is open to more than buses, should it be static (fixed hours of operation) use dynamic use?
• Will there be speed restrictions?
• Use in conjunction with other operational strategies?
Shoulder Use Capacity Findings

- Shoulder lane utilization and effective capacity is highly dependent on geometric/design features
- Effective capacities of 1200 – 1800 VPH
- Left vs. Right shoulder use is quite different
Before and after Implementation of Shoulder Use

Washington State
Narrowing shoulders and adding a lane reduces crashes if the volume is high enough.
• Changes in traffic volumes or speeds may effect:
  – Air quality
  – Greenhouse gas emissions
  – Noise
• Likely minimal changes in roadway footprint with minimal effect:
  – Water quality
  – Plants and animals
  – Cultural resources
• Cannot generalize air and noise effects
  – Reduced congestion --> generally good for air quality/noise
  – Increased volume --> generally bad for air quality/noise
Part-Time Shoulder Effects on Design Criteria

- Likely effected
  - Shoulder width and bridge width (always will be less than minimum)
  - Lane width (on shoulder or narrowed full time lanes)
- Possibly effected
  - Superelevation and cross slope (unusual drainage on shoulder)
  - Horizontal alignment (slightly tighter curves)
  - Lateral offset to obstruction
  - Vertical clearance
  - Stopping sight distance
- Unlikely or never effected: design speed, vertical alignment, grade, structural capacity
Ramp Freeway Junctions – Parallel Style

- Entering/exiting traffic drives on portion of shoulder striped a speed change lane for short distance
- Shoulder ties into/”overlaps” speed change lane

Traffic Paths:

- Required path of entering traffic when shoulder lane is closed
- Optional path of entering traffic when shoulder lane is open

- Required path of exiting traffic when shoulder lane is closed
- Optional path of exiting traffic when shoulder lane is open

Optional path of exiting traffic when shoulder lane is open
Use of Freeway Shoulders for Travel
Turnoffs

• Have refuge for disabled vehicles approximately every half mile
• Construct turnoffs where other refuge spaces (ramps, gores, etc.) don’t exist
• If turnoffs cannot be constructed, part-time shoulder use still possible
• Not necessary for BOS, but still helpful
Signing and Pavement Marking

• Bus on shoulder
  – Minimal
  – Too much shoulder markings may make passenger car drivers think lane is open to them

• Static shoulder use
  – Static regulatory and warning signs
  – Can have dynamic lane control signs

• Dynamic shoulder use
  – Dynamic lane control signs
Regulatory Sign Examples (static shoulder use)

GA 400 Mainline

GA 400 Ramp
Use of Freeway Shoulders for Travel

Regulatory Sign Examples (static shoulder use)

I-H-1 (Hawaii)

Massachusetts
Regulatory Sign Examples (static shoulder use)

New Jersey Turnpike Newark Bay Extension (I-78)
Day-to-Day Operation

• Maintenance
  – More similar to a general purpose lane than shoulder
  – Presence of traffic clears debris
  – Some major snowfall removal issues if roadside barriers present

• Incident Management
  – Plans often in place already on freeways where shoulder use being considered
  – Potential enhancements:
    • Turnouts
    • Service patrols
    • CCTV
    • Changeable lane control signs
Day-to-Day Operation

• Law Enforcement
  – Police must know when lanes are open/closed
  – Targeted enforcement where roadside space available

• Opening and closing
  – “Sweep” the lanes before opening
    • Driving the facility most common
    • CCTV also used
    • Unnecessary for BOS
  – Police and/or TMC have authority to order closure of
    shoulder for incidents or other reasons.
Public Outreach and Education

- Critical to success
- Use multiple formats and forums
- Ongoing after opening to traffic

Active Traffic Management

SOUTHBOUND US-23
OPEN

NORTHBOUND US-23
CLOSED

MDOT
Michigan Department of Transportation

www.michigan.gov/mdotstudies

Use of Freeway Shoulders for Travel
Division Office Reference

- Internal document to help provide consistency across states/installations
- Includes questions to consider at all stages of a project

<table>
<thead>
<tr>
<th>Steps and Actions</th>
<th>Comment</th>
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<tbody>
<tr>
<td><strong>Planning and Preliminary Engineering (Chapter 2)</strong></td>
<td></td>
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<tr>
<td>Is there any regional opposition to shoulder use?</td>
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<tr>
<td>Will physical roadway conditions permit shoulder use?</td>
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<td>Is the shoulder pavement strong enough to carry traffic?</td>
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<tr>
<td>Will the right or left shoulder be used?</td>
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<tr>
<td>Is the segment long enough to provide meaningful congestion relief?</td>
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<tr>
<td>Will the shoulder use be bus-only, static, or dynamic?</td>
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<tr>
<td>Has an operating scheme been selected?</td>
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<td>Will vehicle use restrictions (such as a prohibition on large/commercial trucks)</td>
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<td>be used?</td>
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<td>Is real-time monitoring and incident response in place?</td>
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<tr>
<td>Does the corridor have supporting TSM&amp;O and Traffic Incident Management (TIM)</td>
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<td>capabilities in place?</td>
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<td>Does part-time shoulder use significantly reduce cost compared to a traditional</td>
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<td>capacity expansion?</td>
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<td>Has project been incorporated into Transportation Improvement Program (TIP) and</td>
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<td>long-range plan?</td>
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<tr>
<td>If an area has a congestion management process (CMP), is shoulder use a compatible</td>
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<td>strategy?</td>
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<tr>
<td><strong>Mobility Analysis (Chapter 3)</strong></td>
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<tr>
<td>What is a reasonable estimate of capacity for the shoulder?</td>
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<tr>
<td>What tools will be used for operations analysis?</td>
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<tr>
<td>Will part-time shoulder use improve reliability?</td>
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<tr>
<td><strong>Safety Analysis (Chapter 4)</strong></td>
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<tr>
<td>What types of crashes are occurring today?</td>
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<td>Are there congestion-related crashes that part-time shoulder use could reduce?</td>
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<tr>
<td>Is ADT in a range that graphs in the Chapter 4 of the full guide suggest part-</td>
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<td>time shoulder use may provide safety benefits?</td>
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Sample of Division Office Reference Questions
FHWA Task Order Next Steps

• Webinars
  – One more TBD

• Conference Presentations
  – Two more TBD

• 5 one-day workshops for states
  – Locations being determined
Questions and Comments

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