

Use of Freeway Shoulders for Travel

Part-time Shoulder Use Guide

NOCoE Webinar

Jim Hunt, FHWA

Pete Jenior, Kittelson & Associates, Inc.



U.S. Department of Transportation
Federal Highway Administration

July 2016

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

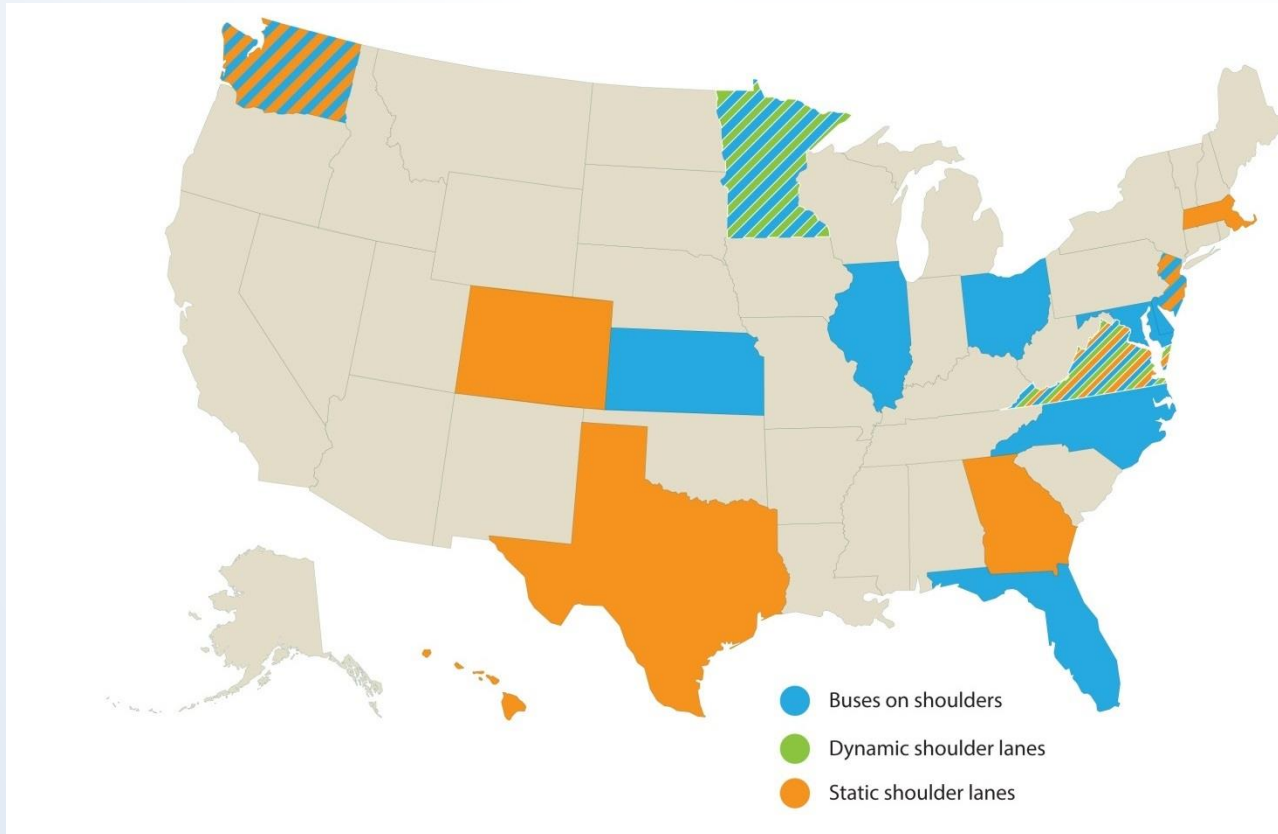
- Static shoulder use – open to passenger vehicles during predetermined hours of operation
- Dynamic shoulder use – open to passenger vehicles based on need and real-time conditions
- Bus-on-Shoulder (BOS) – open only to buses, usually at driver's discretion

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



Guide Chapters – Design / Implement / Operate

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?

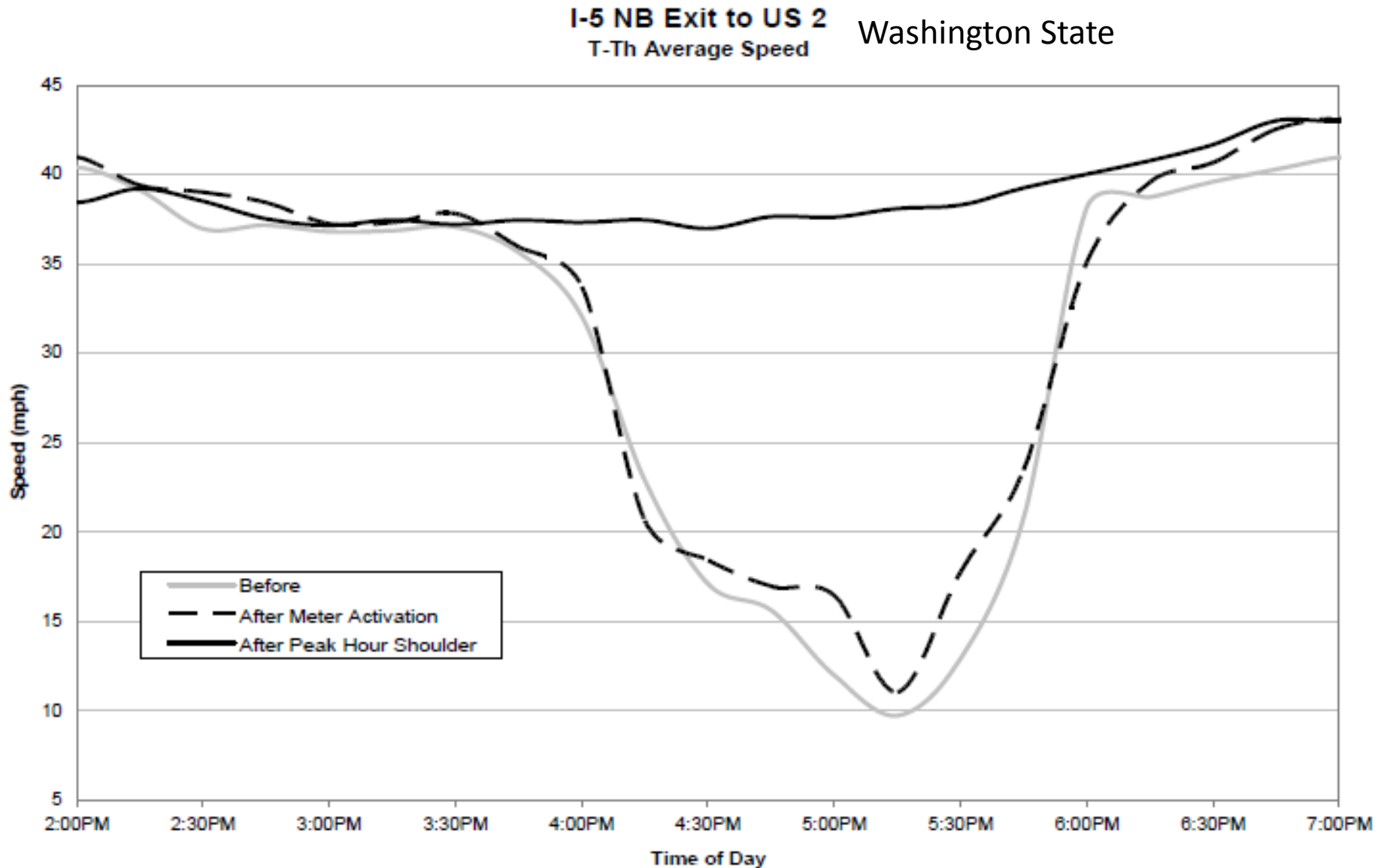


Shoulder Use Capacity Findings

- 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

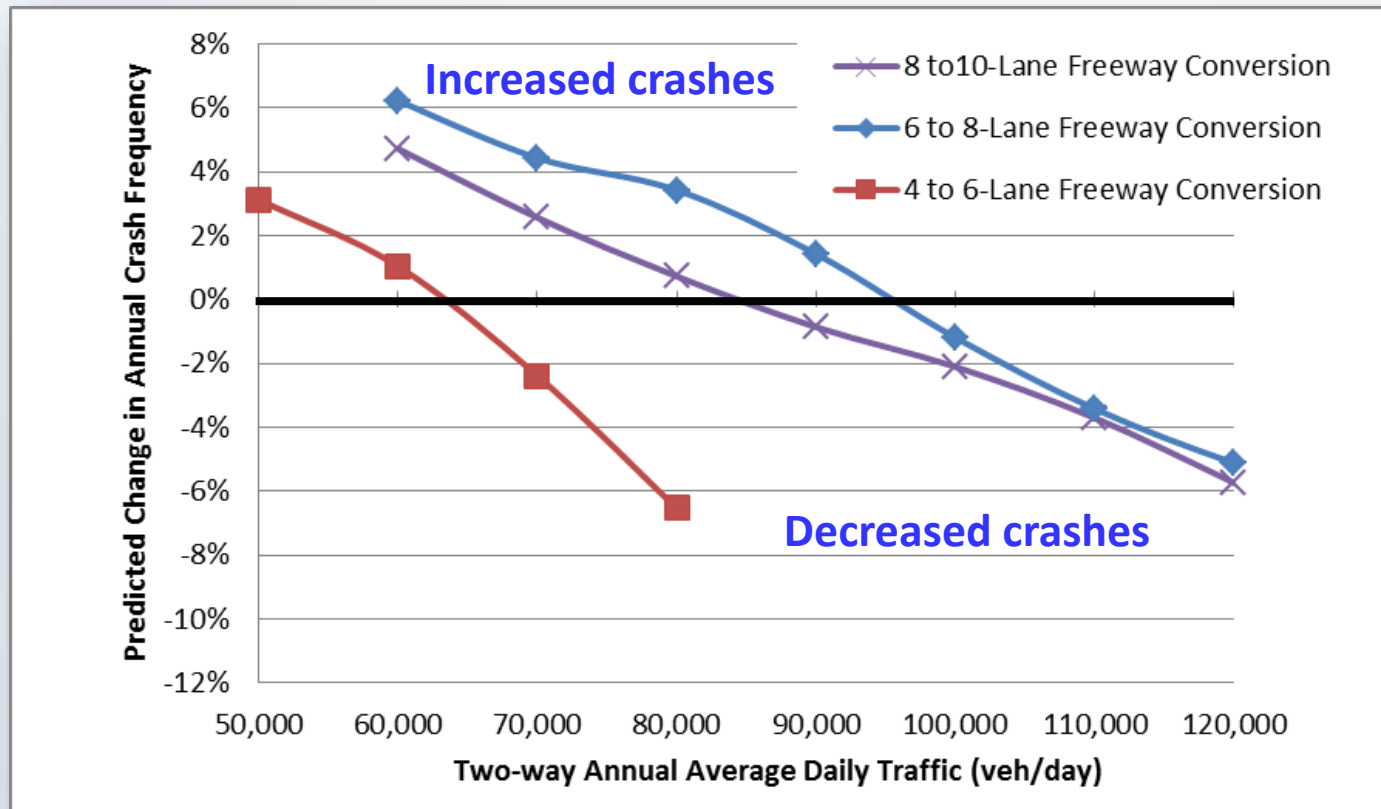


Before and after Implementation of Shoulder Use



Highway Safety Manual (HSM) Model Findings

- Narrowing shoulders and adding a lane reduces crashes if the volume is high enough



Environmental Effects of Part-Time Shoulder Use

- 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



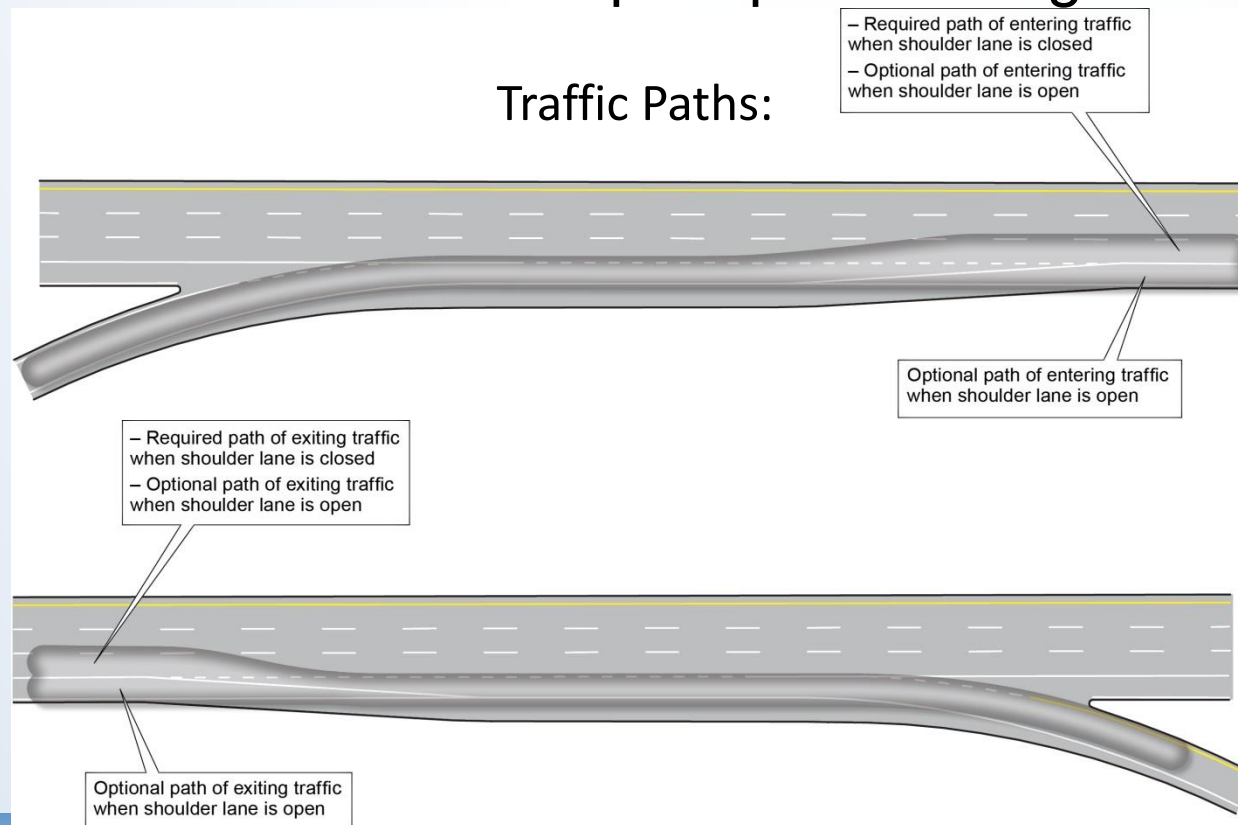
Part-Time Shoulder Effects on Design Criteria

- 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



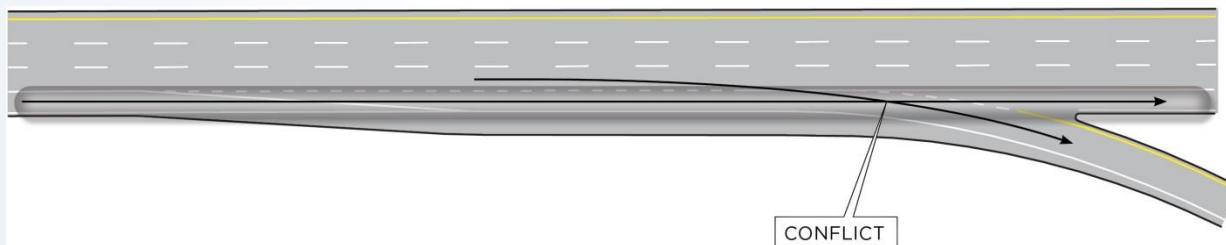
Ramp Freeway Junctions – Parallel Style

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

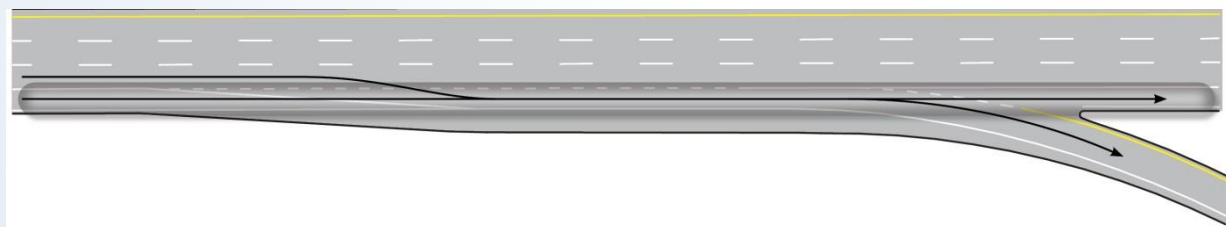


Ramp Freeway Junctions – Taper Style

Without modification:



Converted to parallel style:



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



UK Turnoff



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



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.

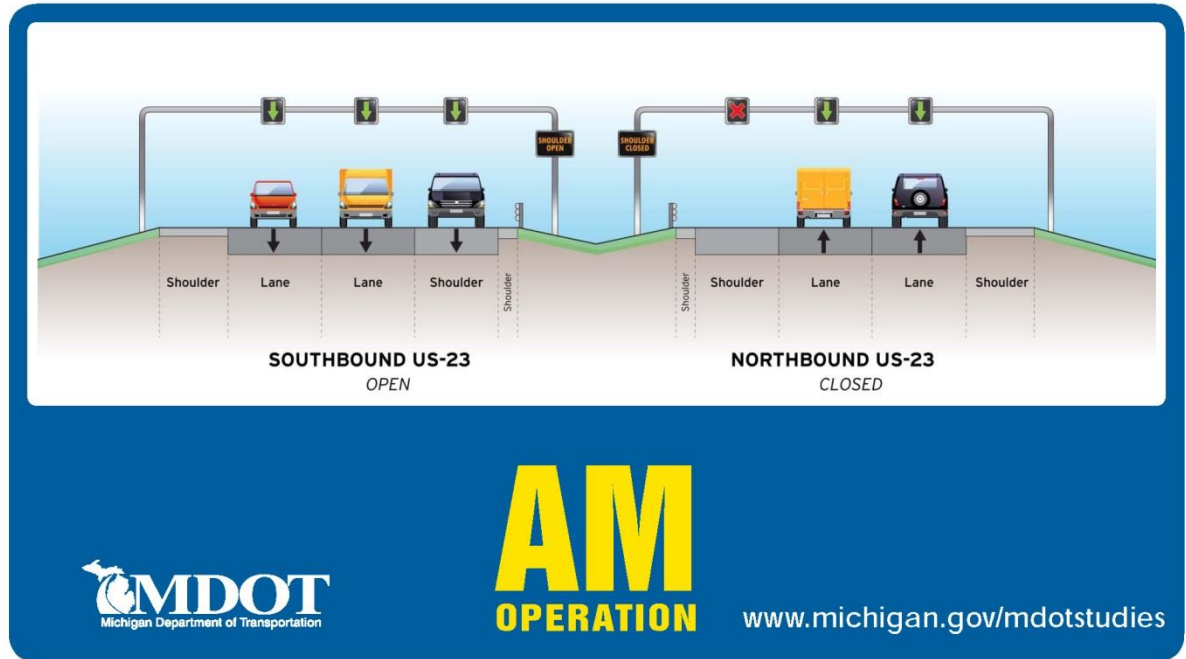


Public Outreach and Education

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



Active Traffic Management



Division Office Reference

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

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

Sample of Division Office Reference Questions



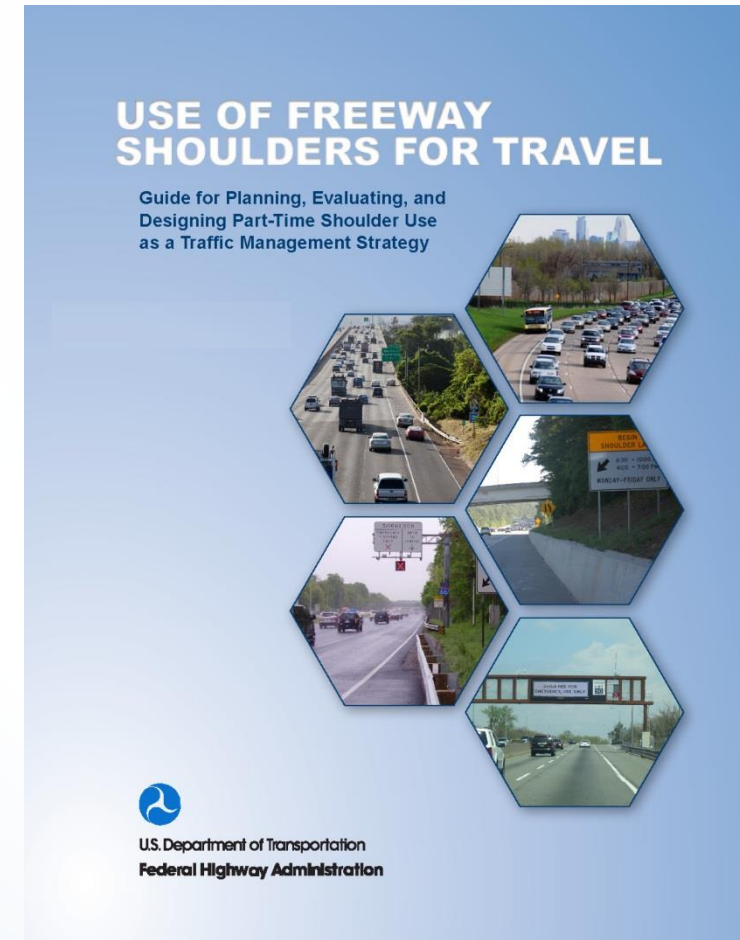
FHWA Task Order Next Steps

- Webinars
 - One more TBD
- Conference Presentations
 - Two more TBD
- 5 one-day workshops for states
 - Locations being determined



Questions and Comments

- Jim Hunt Jim.Hunt@dot.gov
- Greg Jones
GregM.Jones@dot.gov
- Pete Jenior
pjenior@kittelson.com



<http://www.ops.fhwa.dot.gov/publications/fhwahop15023/index.htm>

