Use of Freeway Shoulders for Travel

Part-time Shoulder Use Guide

FHWA Guide

AASHTO SCOD, Baltimore, MD

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DOTs Face Increasing Challenges

Use of Freeway Shoulders for Travel
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!
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
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 29 Arterial in Maryland
Static Shoulder Use – US 2 in Washington State

- Shoulder open to traffic Mon-Fri 3-7 PM
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 turnout 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?

Use of Freeway Shoulders for Travel
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

I-5 NB Exit to US 2
T-Th Average Speed

Washington State
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

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
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
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

SOUTHBOUND US-23
OPEN

NORTHBOUND US-23
CLOSED

MDOT
Michigan Department of Transportation

www.michigan.gov/mdotstudies

Use of Freeway Shoulders for Travel
FHWA Task Order Next Steps

• Webinars
  – This summer through National Operations Center of Excellence
  – One more TBD

• Conference Presentations
  – Two more TBD

• 5 one-day workshops for states
Questions and Comments

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