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1440.01 General

A ramp meter uses a traffic signal at a freeway entrance ramp that allows a measured or regulated amount of traffic to enter the freeway. Drivers are required to stop at the specialized traffic signal before they are allowed to enter the freeway facility, usually being limited to one car per green light. Ramp meters are a relatively low-cost Transportation System Management and Operations (TSMO) alternative for freeways experiencing regular, reoccurring congestion that helps merging traffic enter the facility more efficiently by spreading the merging traffic and introducing gaps. For more information on ramp meters see Section [1360.03\(7\)](#).

Periodically, ramp meter locations have insufficient storage capacity to handle the on-ramp's traffic volume. In these situations, a metered shoulder may be a viable option that utilizes a shoulder approaching a ramp meter as a temporary additional lane for storage and metered throughput during the ramp meter's operational period. This can promote the ramp meter's operational efficiency/flow and help prevent the ramp meter's queueing from adversely affecting the interchanges overall operations (e.g., ramp meter queue overspill into the ramp terminal intersection and onto local street).

A metered shoulder is a low-cost TSMO alternative that utilizes existing infrastructure to add capacity and promote ramp meter operations during peak periods while avoiding a larger capital investment to construct an additional on-ramp lane. Additionally, using the shoulder during peak times allows a narrower ramp and removes a lane merge condition during off-peak times which is most of the time.



1440.02 Design Considerations

Design criteria outlined in the following sections are allowed with a Design Analysis.

Underlying design criteria for the Design Manual is provided by AASHTO, which does not include guidance associated with part time shoulders. During the metered shoulder's operational period, the use of the shoulder for the managed lane will result in shoulders and other design elements not meeting minimum AASHTO criteria. Consult with your ASDE for more information.

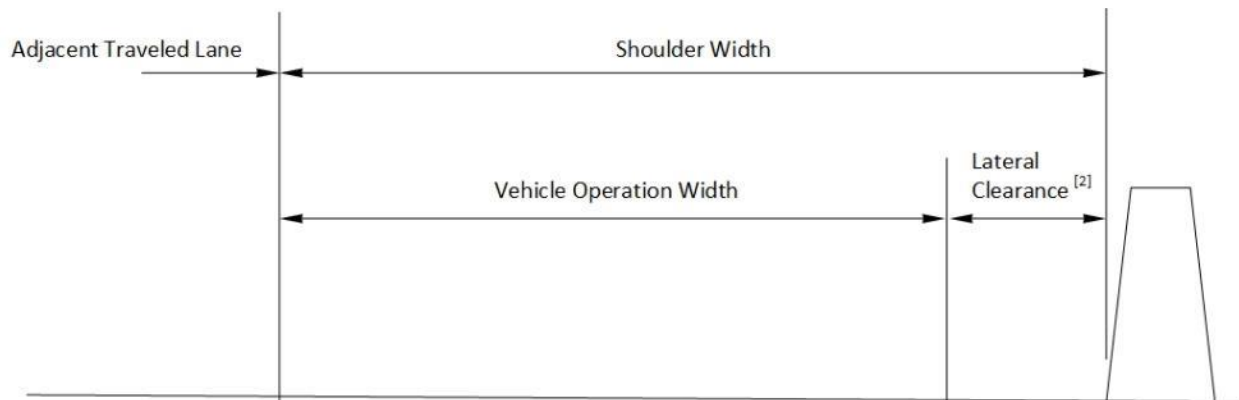
1440.02(1) Inside or Outside Shoulder Use

A metered shoulder can utilize either inside or outside shoulder of a ramp. Often, metered shoulders are placed on the outside shoulder because the outside shoulders are typically wider and can more readily accommodate the managed lane. Consider the ramp terminal intersection's layout, driver behavior and potential effects on the ramp's geometric configuration when selecting which shoulder to use (e.g., if a right turn slip lane or other features tends to direct drivers towards a particular side of the ramp then the opposite shoulder may be more appropriate to use as metered shoulder).

1440.02(2) Shoulder Width

During operations, vehicles will be using a facility's shoulder for added storage capacity. The shoulder therefore comprises both the metered shoulder's vehicle operation width and lateral clearance or distance to edge of pavement. See [Exhibit 1440-1](#).

Exhibit 1440-1 Metered Shoulder Layout ^[1]



[1] Outside shoulder (right side) alignment shown. Inside shoulder (left side) alignment is allowable.

[2] Lateral clearance or distance to edge of pavement when barrier is not present.

Exhibit 1440-2 Considerations for Metered Shoulder Utilization ^[1]

Roadside Features	Minimum Shoulder Width (ft) ^{[2][3][4]}
Pavement Only	10
Barrier or Curb	12

[1] A Design Analysis will be needed for shoulder width, lane width and other elements. See Section [1440.02](#).

[2] Width of shoulder designated as metered shoulder.

[3] Includes vehicle operating width plus lateral clearance or distance to edge of pavement.

[4] Increase vehicle operating width as necessary for design vehicle over tracking on ramps with tight radius, as required.

1440.02(3) Vehicle Operation Width

For a metered shoulder, the vehicle operation width is the area of the metered shoulder that functions as the traveled way and is occupied by the vehicle during the ramp meter's operational period. See [Exhibit 1440-1](#) and [Exhibit 1440-2](#).

1440.02(4) Lateral Clearance

For a metered shoulder, the lateral clearance is the distance from the vehicle operation width to a roadside object (e.g., concrete barrier, guardrail). See [Exhibit 1440-1](#) and [Exhibit 1440-2](#). Due to the stop condition associated with the ramp meter, the metered shoulder will only be operated in low-speed conditions. In these situations, drivers are typically more comfortable driving closer to barrier or curb.

1440.02(5) Turning Roadway Width

Increase the lane width of the metered shoulder as necessary for over tracking associated with the design vehicle on the ramp's curve(s) (see [Chapter 1240](#)). Use turn simulation software (such as AutoTURN®) to verify design.

1440.02(6) Disabled Vehicle and Observation/Enforcement Area

The shoulder allows for disabled vehicles and law enforcement to occupy the shoulder under typical operations; however, during the metered shoulder's operation period the shoulder will be unavailable for these critical functions. Where possible and deemed appropriate, provide additional width to accommodate disabled vehicles and law enforcement. See [Exhibit 1410-4](#), [Exhibit 1410-5](#), and [Exhibit 1239-2](#) for more information.

1440.02(7) Signing

Additional signing is necessary to appropriately delineate and regulate use of the metered shoulder and should be posted as deemed appropriate. Coordinate with Region Transportation Operations to develop and locate appropriate signing.

1440.02(8) Clear Zone

Clear zone is available for use by errant vehicles and includes considerations for the probable distance that an errant vehicle may travel under free flow conditions. Ramp meters are typically utilized during congested periods in which operating speeds are lower than free flow conditions and control the on-ramp's traffic flow with a stop condition. Therefore, clear zone does not need to be assessed based on vehicles utilizing the metered shoulder, unless otherwise determined by the Region Traffic Engineer. Coordinate with the Region Traffic Engineer to assess the potential need for mitigation measures.

1440.03 References

1440.03(1) Federal/State Laws and Codes

Design Standards for Highways

[eCFR :: 23 CFR 625.4 -- Standards, policies, and standard specifications.](#)

1440.03(2) Design Guidance

NCHRP 835 – Guidelines for Implementing Managed Lanes (2016)

<http://www.trb.org/NCHRP/Blurbs/175082.aspx>

1440.03(3) Supporting Information

[Ramp metering | TSMO | WSDOT \(tsmowa.org\)](#)

[Ramp Metering - Freeway Management Program - FHWA Office of Operations \(dot.gov\)](#)

1440.03(4) Other States' Guidance Examples

[Ramp Metering | Caltrans website](#)

[RAMP METERING DESIGN MANUAL \(ca.gov\)](#) CalTran

[adotrampmeteringdesignguide_november2013.pdf \(azdot.gov\)](#)

Managed Lanes and Ramp Metering Manual, Part 3 Design Manual, Nevada Department Transportation
[3 \(nv.gov\)](#)