

MASH BARRIER DESIGN AIDS

REVISED NOVEMBER 2019

The supplemental information below is intended as an aid for selecting MASH barrier design features. Please refer to ADOT Roadway Design Guidelines and AASHTO Roadside Design Guide for barrier design guidance.

BARRIER LENGTHS:

Reference Chapter 300 of the ADOT Roadway Design Guide to determine End of Barrier Need (LON points)
See C-10.00 and referenced drawings for barrier feature measurements and begin/end Station locations

To determine barrier lengths:

- Determine where hazard begins and ends from mapping or field measurements
- Apply length of need formula on each end exposed to traffic and determine LON points
- Measure distance between LON points along face of barrier and subtract end treatments to determine barrier quantities
 - Subtract 47' for each tangent end terminal
 - Subtract 32' for each flared end terminal
 - Subtract 3' for each end anchor
 - Subtract 37½' for each transition
- Round barrier quantity
 - For concrete barrier quantity, round up to next foot
 - For guardrail quantity, round up to next 12.5' increment
- Adjust LON points to match rounded barrier quantities
- Determine Begin & End Stations and record on Barrier Summary sheet
 - For end terminals, Begin / End Station = LON points
 - For transitions and anchors, match Standard Drawing Station location

BLOCKOUTS

Use 12" deep blockouts for line rail per standard drawings C-10.03 & 10.04 whenever practical.
A single post with a 24" blockout, or unlimited posts with 16" blockouts may be used to avoid obstructions
8" blockouts may be used for restrictive conditions, but only with steel posts
Steel posts with no blockouts per MwRSF TRP-03-262-12 may be considered for some unique conditions

BRIDGE BARRIER:

Bridge barrier and concrete transitions to guardrail will be quantified on Bridge sheets
Guardrail transitions will be quantified on Roadway Barrier Summary Sheet
Constant slope bridge barrier transitions to F-shape roadway barrier will be quantified on Bridge sheets

CONCRETE BARRIER:

32" barrier meets MASH TL3 and 42" barrier meets TL5
Median barrier may be used on outside edge as shown in C-10.40 and C-10.41
Upstream end, determine best option between crash cushion or guardrail transition + end terminal
Downstream end, determine best option between extending barrier or guardrail transition + end anchor

Consider “zone of influence” per AASHTO RDG where applicable
Minimize placement of fixtures on top of barrier - place behind barrier where practical
Evaluate glare potential and consider a taller barrier or a MASH approved proprietary glare screen

CRASH CUSHIONS, REDIRECTIVE:

See Crash Cushion Selection Procedure memo

Use manufacturer’s drawings specified on APL in determining applicability of product

List in special provisions all MASH products from the APL that will work for the location

High speed locations with frequent crashes, use products that can be repaired quickly and inexpensively

Show approach and pad layout and dimensions in plans

For wider hazards, taper barrier at AASHTO RSDG flare rates to fit MASH crash cushion widths if possible

If barrier cannot be tapered to fit widest available MASH unit, request to use an NCHRP 350 compliant unit

Requests explaining the necessity for an NCHRP 350 product on the NHS must be approved by FHWA

CRASH CUSHIONS, NON-REDIRECTIVE (SAND BARRELS):

Consider for single point hazards off the shoulder

See Crash Cushion Selection Procedure memo

Use Roadway Detail Det-10.29 in determining applicability of sand barrels

Show approach and pad layout and dimensions in plans

For wider hazards, taper with barrier at AASHTO RSDG flare rates to fit maximum allowable width or less

If barrier cannot be tapered to fit, consider a redirective crash cushion

CURB WITH GUARDRAIL

In low speed conditions with 6” vertical curb, guardrail may be added where roadside hazards warrant

Face of guardrail can be in front of, flush with, or up to 7” behind face of vertical curb

For snowplowing locations, coordinate with Maintenance on desired offset

Or, locate guardrail between 4’ and 12’ behind curb, with 37” rail height measured from road

In high speed conditions with freeway curb, C-10.05 guardrail may be added where hazards warrant

In high speed conditions with embankment curb, guardrail should always be present

C-10.77 or similar aprons should be used for end terminals and crash cushions with curb

Only lip curb shown on C-10.31 should be used in w-beam to concrete barrier transitions

DOWNDRAIN & SPILLWAY INLETS:

Direct buried posts with leaveouts should be placed in downdrain and spillway inlets (no longspan)

Provide detail or directions for retrofitting post in existing inlets, such as

To avoid curb conflicting with post or leaveout placement, consider:

Strategically setting the first posts in the run across the inlet to minimize conflicts

Using shallower blockouts (with steel posts) to move the post further in front of the curb

Using deeper blockouts (up to 24” for a single post) to set the post behind the curb if slope allows

Moving post upstream or downstream and drilling an additional hole in w-beam per Spec 905

EMBANKMENT MATERIAL

Standard Drawings show AB from adjacent pavement section extending behind guardrail to slope hinge

Projects not otherwise requiring AB can use a milled AC / soil mix per stored spec 303SALV

Projects without AB or milled AC can use a compacted strong soil
Furnishing and placing embankment material should be measured and payed under respective bid items

END ANCHOR:

Use only on one way or divided roads where end is located outside recovery width of opposing traffic
Verify field conditions will allow the end anchor to extend 23½' beyond the end of hazard

END TERMINALS:

Use tangent end terminals for guardrail offset at least 5 feet from edge of travel lane (ETL)
Consider using flared end terminals on narrow roads with guardrail offset less than 5 feet from ETL
Verify field conditions will allow the end terminal to extend up to 19½' beyond the Begin/End Station
Use alternative grading for tangent pads per AASHTO Roadside Design Guide if site restrictions require
For sharp curves where the tangent terminal encroaches into shoulder, consider:
 Moving end terminal to tangent roadway if only a small amount of additional barrier is required
 Placing angle break at line rail end to move the impact head away from travel lane by up to 2'
 Using flared end terminal

EXISTING CONDITIONS

Follow standard drawings to the extent practical for the project scope
Use variations described in this document as necessary to fit existing conditions
Note deviations from standards in details or on barrier summary sheet

FIXED OBJECTS BEHIND BARRIER:

Avoid placing fixed objects within 59" behind guardrail face. When unavoidable, consider:
 Moving or eliminating fixed object
 Using steel posts (if fixed object is at least 50" behind face)
 Using double post spacing (every 3'-1½")
 Using concrete barrier

GUARDRAIL:

Typically, both C-10.03 and C-10.04 should be options for new runs
Always anchor both ends of guardrail with end terminal, end anchor or transition to concrete barrier
Minimum overall run length is 75'
Approach surface should be 10:1 or flatter and typically paved to face of guardrail
Paving should not extend past front face of post without leaveouts
Fixed objects should be located 59" inches behind face of rail (50" for steel posts)

LOW SPEED:

ADOT C-10 series standard drawings can be used for low speed roadways
But existing or new features that will meet MASH TL2 may also be utilized
See various research and manufacturer's websites for TL2 options

NARROW OFFSET:

On newly constructed slopes, guardrail should be offset 2' from normal shoulder width as described in the

“2 Foot Offset Distance to Roadside Barriers” memo, and as shown in C-10.01

For new guardrail installations on existing slopes, a 2' offset may not be practical, however

Guardrail posts should be set back at least enough to maintain existing shoulder width

Changes to the standard 2' offset should be noted in the Barrier Summary Sheet Remarks, or on a detail

NARROW SHELF:

On newly constructed slopes, guardrail should include a 2' shelf behind posts as shown in C-10.01, but

For existing slopes where a 2' shelf is not practical, consider the following options in order of preference:

- 1) Use a narrower shelf with standard 72" wood or steel post

Standard posts can be set at a 2:1 slope break point provided you:

Do not use within 12.5' of transitions or end terminals

Do not omit any posts

Do not use with curbs

- 2) Use 8" blockouts with 72" steel posts set at 2:1 slope break point and follow provisions in (1)

- 3) Use 8" blockouts with 96" steel posts set 12" beyond a 2:1 slope break point and follow (1)

Changes to C-10.01 should be shown in a plan sheet detail referenced on the Barrier Summary sheet

OMITTING POSTS:

Use C-10.06 long span system when culverts or other shallow underground features interfere with full depth placement of standard guardrail posts

Long span constraints:

Do not use when post are at or beyond 2:1 slope break

Avoid using in conjunction with curb

Omitted posts cannot be located within:

37.5' of downstream anchor

31.25' of end terminals with offsets of 1' or more

12.5' of end terminals with 0' offset

18.75' of transition to concrete barrier

43.75' of long span system

Long spans are not a separate pay item

include as part of guardrail length quantities

and note on Barrier Summary sheet

PAVEMENT

Standard drawings show pavement extending 8" beyond face of guardrail

Existing pavement edges not matching the above may remain as-is

If AC pavement extends beyond back of posts, remove or use leavouts

If PCC pavement extends beyond face of posts, remove or use leavouts

RECONSTRUCT GUARDRAIL:

Use this item only for in-place, single operation reconstruction

If construction phasing requires storing or hauling, use remove & salvage + construct from salvage instead

Do not re-use 64" wood posts

Do not re-use Cor-ten steel rail or hardware

72" steel posts can be re-used

Only rail with factory-punched bolt holes spaced 3'-1 1/2" apart can be re-used

8" blockouts can be re-used in conjunction with 4" blockouts and longer bolts

ROCK IN POST HOLE:

Use C-10.09 when in-situ rock interferes with post placement

SHALLOW BOX POSTS:

Use C-10.07 attached posts for shallow box culverts when long span is not a viable option

Shallow box culvert posts are paid as an each item

and included as part of guardrail length quantities

When neither long span or shallow box posts will work, consider:

Developing a side mounted weak post w-beam system based on MwRSF TRP-03-277-14

Coordinating with Bridge to develop customized concrete barrier attached to deck

TAPERS:

Use C-10.38 for connecting MASH guardrail to in-place G4 system

Include taper length in guardrail pay item

TRANSITIONS:

Use for roadway and bridge transitions to concrete barrier

Allow wood and steel post options whenever practical

Allow only steel post option if curb is used

Only use curb cross section shown on C-10.31

Curb should be continuous; move spillway and downdrain inlets outside of transition

For a sag within the transition, consider using a modified C-15.30 type 4 catch basin with a C-4.20 or C-4.50 outlet

TURNOUT CONFLICTS:

Move or eliminate turnout whenever practical

Add runs before and after turnout to meet LON and minimize curved guardrail target

Use MASH approved short radius system where practical

Consider Yuma type short radius system where applicable

Consider shop curved radius if necessary