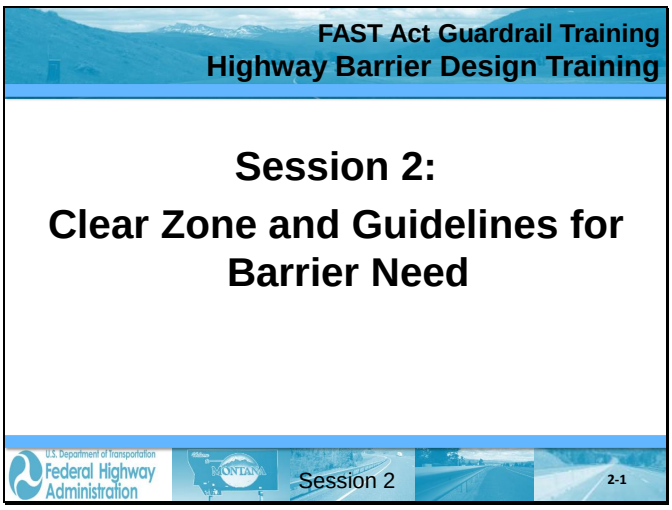
Session 2: Clear Zone and Guidelines for Barrier Need


FAST Act Guardrail Training
Highway Barrier Design Training
Session 2:
Clear Zone and Guidelines for Barrier Need
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Federal Highway Administration
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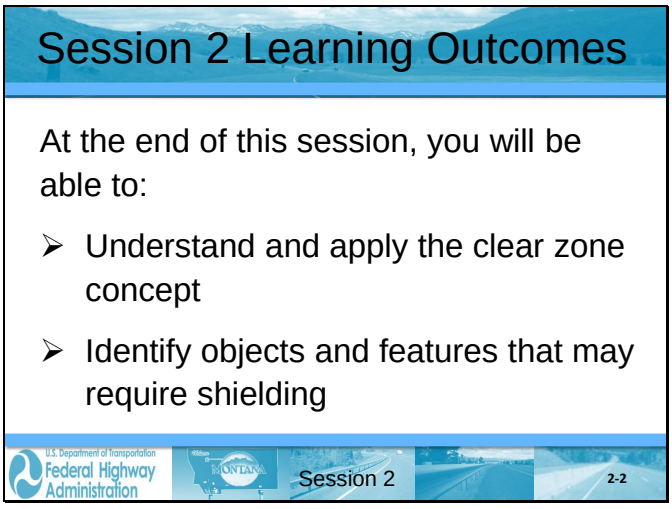
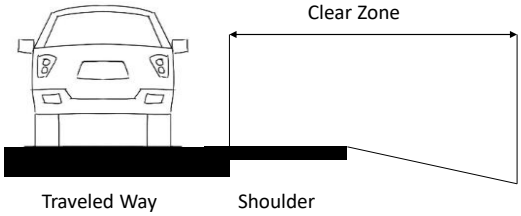
2-1


Session 2 Learning Outcomes
At the end of this session, you will be able to:
Understand and apply the clear zone concept
Identify objects and features that may require shielding
U.S. Department of Transportation
Federal Highway Administration
MONTANA
Session 2
2-2

Clear Zone: A Definition



The unobstructed, traversable area provided beyond the edge of the through traveled way for the recovery of errant vehicles. The clear zone includes shoulders, bike lanes, and auxiliary lanes, except those auxiliary lanes that function like through lanes.

Ref: AASHTO Roadside Design Guide, 4th Edition, Glossary

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MDT Clear Zone Guidance

4. **Measurement.** All clear zone distances are measured from the edge of the traveled way. For auxiliary lanes that function similar to through lanes (e.g., climbing lanes and weaving lanes), the clear zone is measured from the edge of the auxiliary lane based on the mainline design speed and mainline design Annual Average Daily Traffic (AADT).

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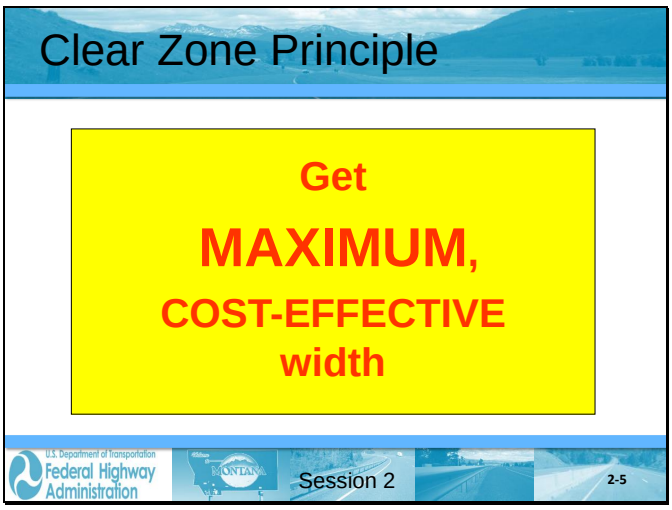
Clear Zone Principle
Get
MAXIMUM,
COST-EFFECTIVE
width
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Federal Highway Administration
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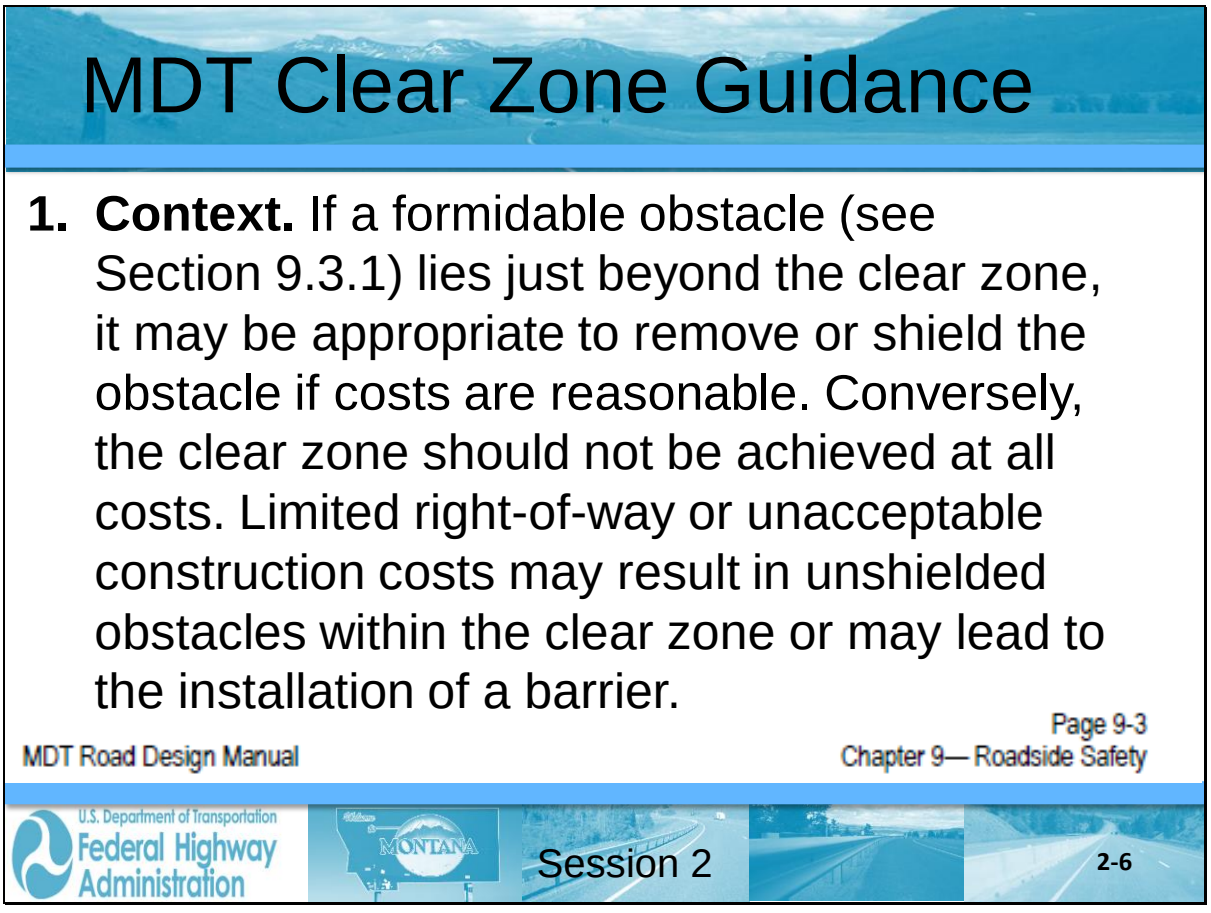
2-5


MDT Clear Zone Guidance
1. Context. If a formidable obstacle (see Section 9.3.1) lies just beyond the clear zone, it may be appropriate to remove or shield the obstacle if costs are reasonable. Conversely, the clear zone should not be achieved at all costs. Limited right-of-way or unacceptable construction costs may result in unshielded obstacles within the clear zone or may lead to the installation of a barrier.
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MDT Clear Zone Guidance

2. **Boundaries.** The design team should not use the clear zone distances as boundaries for introducing roadside obstacles such as bridge piers, non-breakaway sign supports, utility poles or landscaping features. Place these items as far from the traveled way as practical.

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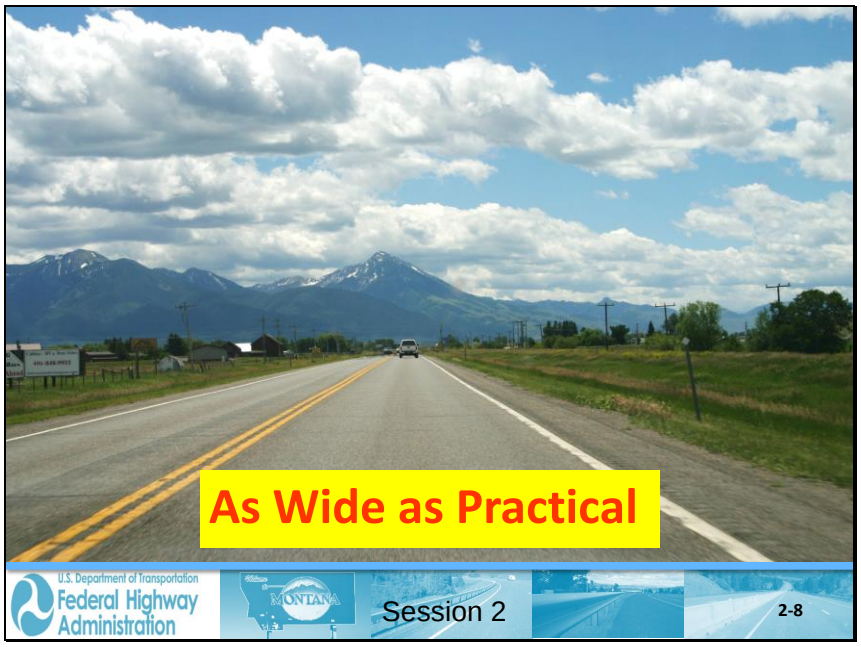

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Federal Highway Administration
MONTANA
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Federal Highway Administration
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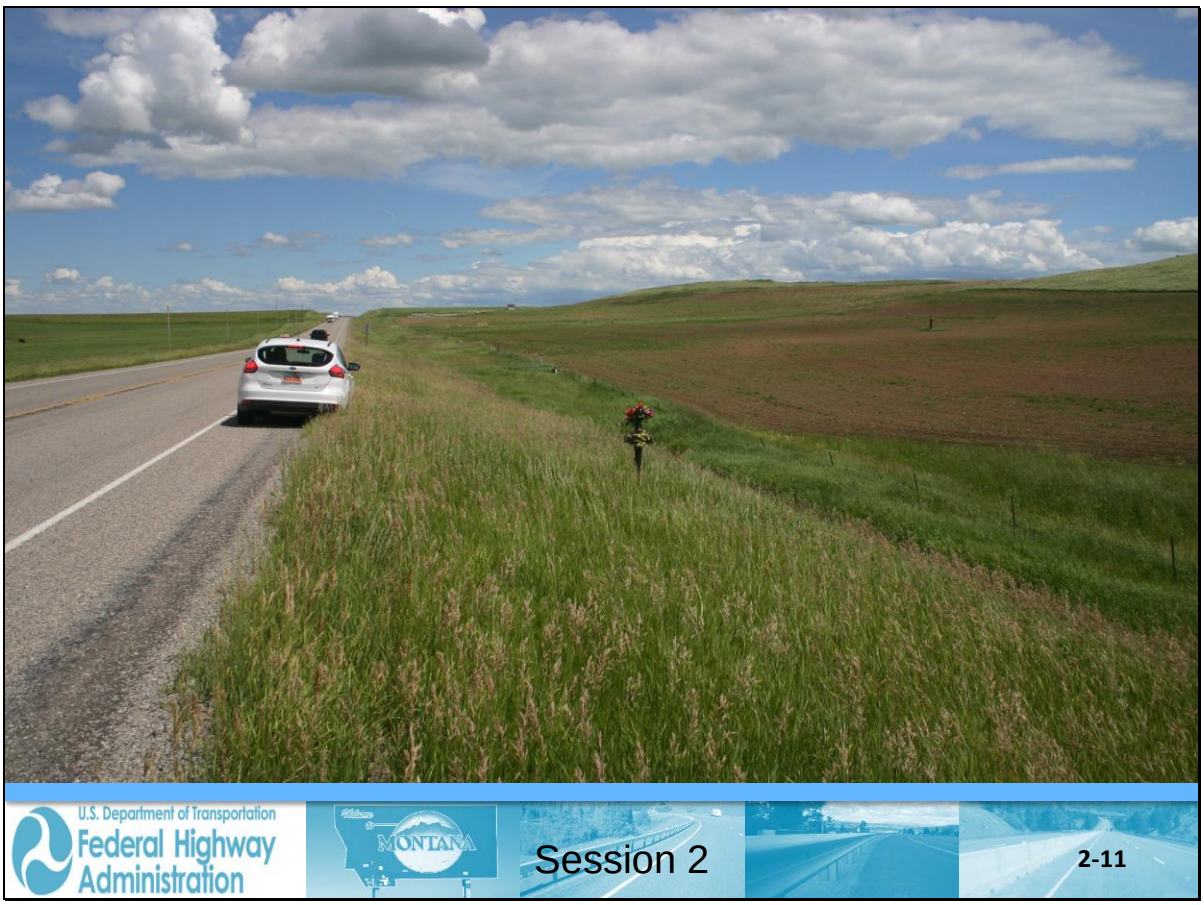
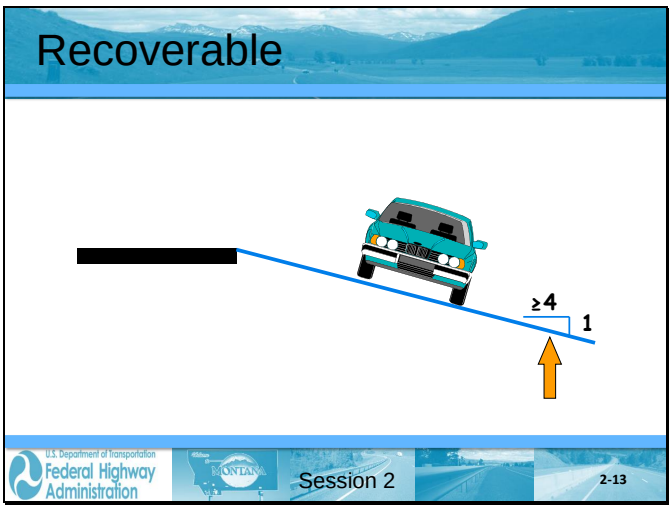
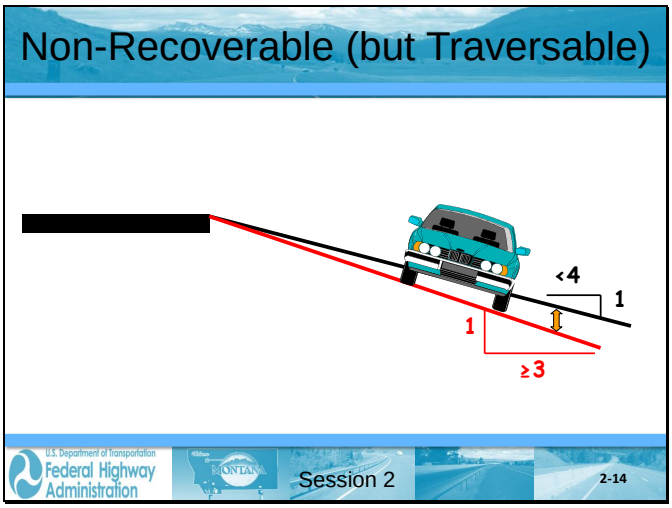


Clear Zone Factors

- Slope Type and Steepness
- Design Speed
- Traffic Volume
- Horizontal Curvature


Recoverable
≥4
1
U.S. Department of Transportation
Federal Highway Administration
Session 2
2-13


Non-Recoverable (but Traversable)
<4
1
1
≥3
U.S. Department of Transportation
Federal Highway Administration
Session 2
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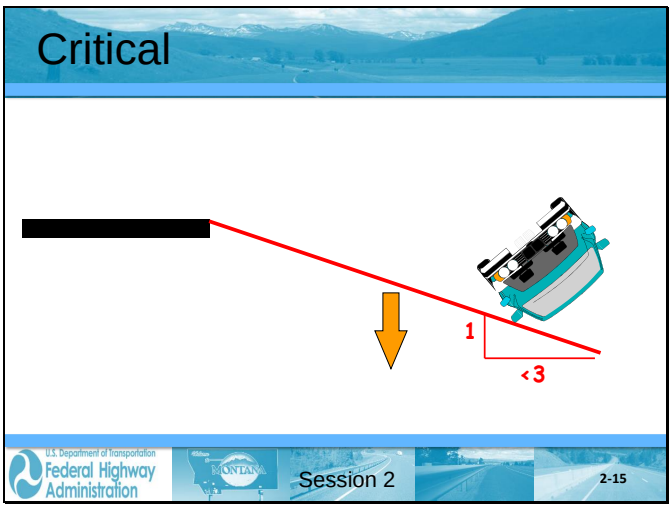
Critical
1
<3
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Federal Highway Administration
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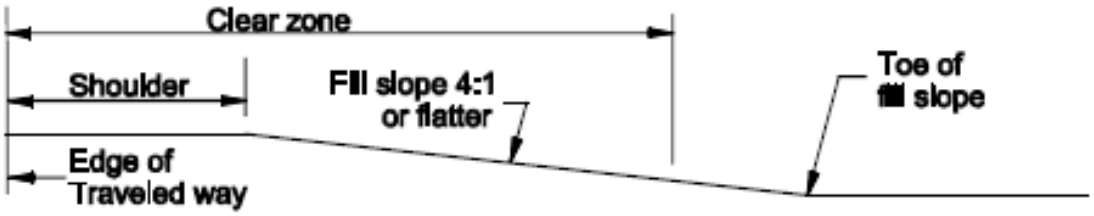
Clear Zone



RECOVERABLE PARALLEL SLOPE (a)

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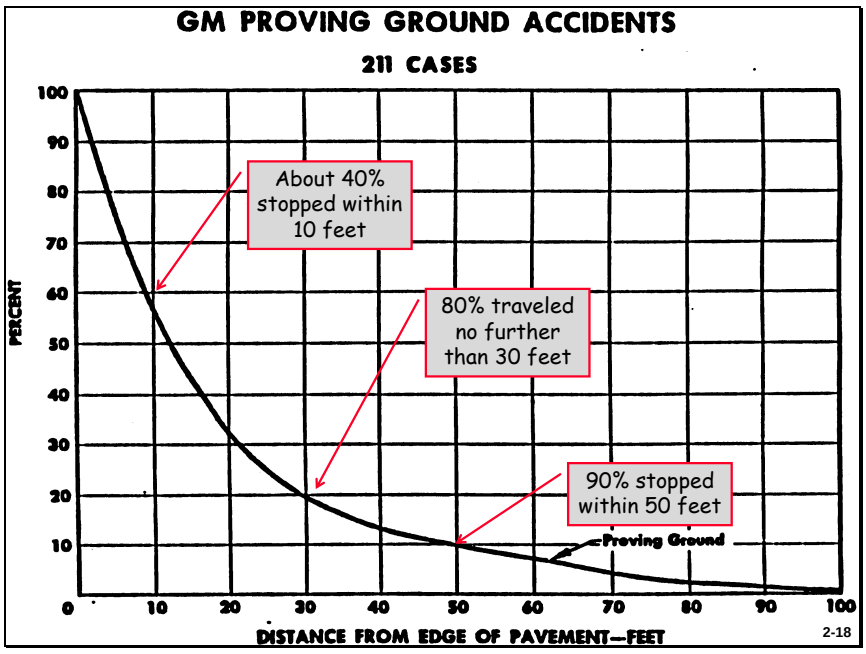
Clear Zone

TH[illegible] MAGIC”
3[illegible] FEET



Design Clear Zone Determination Table

Design Speed (mph)	Design ADT	Foreslopes			Backslopes		
		1V:6H or flatter	1V:5H to 1V:4H	1V:3H	1V:3H	1V:5H to 1V:4H	1V:6H or flatter
≤40	UNDER 750[c]	7-10	7-10	b	7-10	7-10	7-10
	750-1500	10-12	12-14	b	10-12	10-12	10-12
	1500-6000	12-14	14-16	b	12-14	12-14	12-14
	OVER 6000	14-16	16-18	b	14-16	14-16	14-16
45-50	UNDER 750[c]	10-12	12-14	b	8-10	8-10	10-12
	750-1500	14-16	16-20	b	10-12	12-14	14-16
	1500-6000	16-18	20-26	b	12-14	14-16	16-18
	OVER 6000	20-22	24-28	b	14-16	18-20	20-22
55	UNDER 750[c]	12-14	14-18	b	8-10	10-12	10-12
	750-1500	16-18	20-24	b	10-12	14-16	16-18
	1500-6000	20-22	24-30	b	14-16	16-18	20-22
	OVER 6000	22-24	26-32[a]	b	16-18	20-22	22-24
60	UNDER 750[c]	16-18	20-24	b	10-12	12-14	14-16
	750-1500	20-24	26-32[a]	b	12-14	16-18	20-22
	1500-6000	26-30	32-40[a]	b	14-18	18-22	24-26
	OVER 6000	30-32[a]	36-44[a]	b	20-22	24-26	26-28
65-70[d]	UNDER 750[c]	18-20	20-26	b	10-12	14-16	14-16
	750-1500	24-26	28-36[a]	b	12-16	18-20	20-22
	1500-6000	28-32[a]	34-42[a]	b	16-20	22-24	26-28
	OVER 6000	30-34[a]	38-46[a]	b	22-24	26-30	28-30

Ref: AASHTO ROADSIDE DESIGN GUIDE, 4th EDITION – TABLE 3.1, Pg. 3-3

MDT Design Clear Zone Distance - Fill

Design Speed	Design AADT	Fill Slopes/Foreslopes 6:1 or Flatter	5:1	4:1
40 mph or less	< 750	8	8	10
	750-1499	10	12	14
	1500-6000	12	14	16
	> 6000	14	16	18
45 mph	< 750	10	12	14
	750-1499	14	16	18
	1500-6000	16	20	24
	> 6000	20	24	26
50 mph	< 750	12	12	14
	750-1499	16	18	20
	1500-6000	18	22	26
	> 6000	22	26	28
55 mph	< 750	12	14	18
	750-1499	16	20	24
	1500-6000	20	24	30
	> 6000	22	26	32
60 mph	< 750	16	20	24
	750-1499	20	26	32
	1500-6000	26	32	40
	> 6000	30	36	44
70 mph	< 750	20	22	26
	750-1499	24	30	36
	1500-6000	30	36	42
	> 6000	32	38	46
80 mph	< 750	24	26	30
	750-1499	28	32	38
	1500-6000	34	40	46
	> 6000	38	44	50

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Notes:
- For 3:1 slopes, see the procedure in Section 9.2.2.2.
- All distances are measured from the edge of the traveled way (ETW)

MDT Design Clear Zone Distance - Cut

Design Speed	Design AADT	Backslopes/Earth cuts 6:1 or Flatter	5:1	4:1	3:1
40 mph or less	< 750	7	7	7	7
	750-1499	12	12	12	12
	1500-6000	14	14	14	14
	> 6000	16	16	16	16
45 mph	< 750	10	10	8	8
	750-1499	14	14	12	12
	1500-6000	16	16	14	14
	> 6000	20	20	18	16
50 mph	< 750	12	10	10	10
	750-1499	16	14	12	12
	1500-6000	18	16	14	14
	> 6000	22	20	18	16
55 mph	< 750	12	12	10	10
	750-1499	16	16	14	12
	1500-6000	20	18	16	14
	> 6000	22	22	20	18
60 mph	< 750	14	14	12	10
	750-1499	20	18	16	12
	1500-6000	24	22	18	14
	> 6000	26	26	24	20
70 mph	< 750	16	16	14	12
	750-1499	22	20	18	16
	1500-6000	28	24	22	20
	> 6000	30	30	26	24
80 mph	< 750	18	18	16	14
	750-1499	24	22	20	18
	1500-6000	30	26	24	22
	> 6000	32	32	28	26

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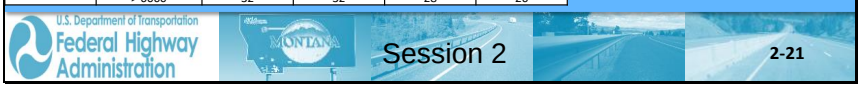

Important Distinction

Available Clear Zone = Area Existing for recovery

Design Clear Zone = A selected value used for design to provide recovery area for a majority of errant drivers

Do not compromise available clear zone

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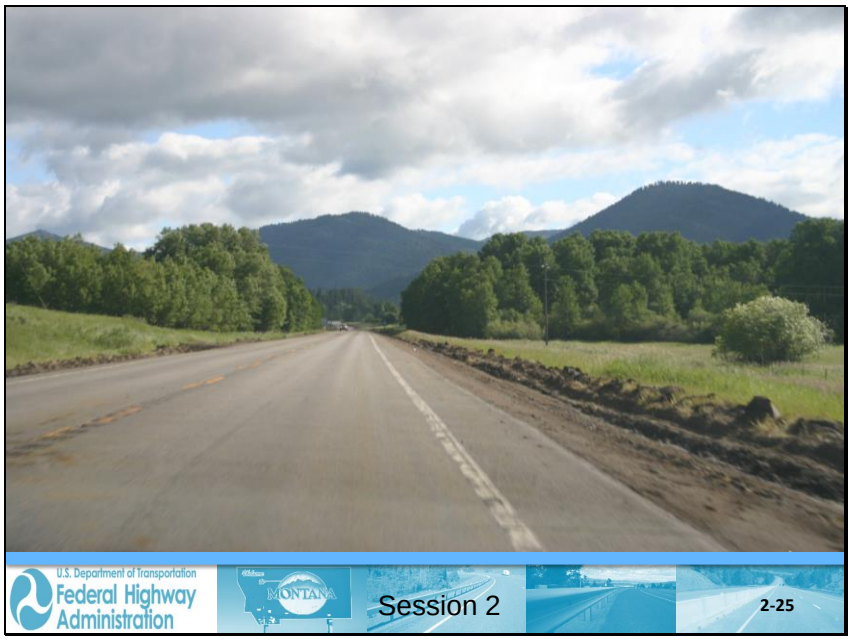
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Federal Highway Administration
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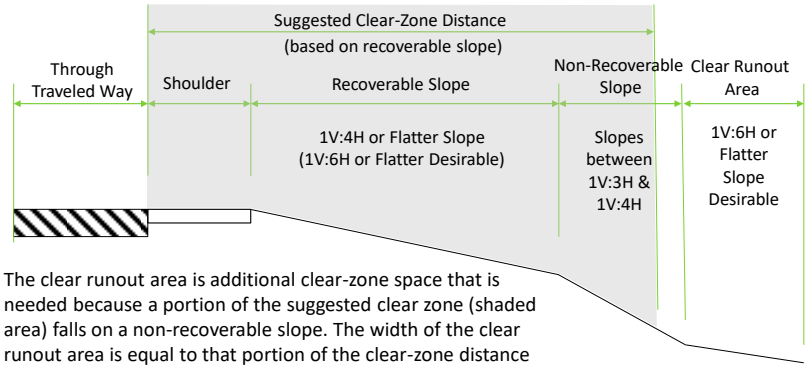
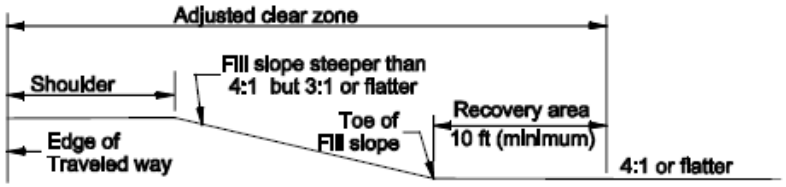
Clear Zone Adjustments for Non-uniform Slopes



The clear runout area is additional clear-zone space that is needed because a portion of the suggested clear zone (shaded area) falls on a non-recoverable slope. The width of the clear runout area is equal to that portion of the clear-zone distance that is located on the non-recoverable slope – min 10'.

Ref: AASHTO Roadside Design Guide, 4th Edition, Figure 3.2, Pg. 3-6

Adjusted Clear Zone



NON-RECOVERABLE PARALLEL SLOPE (b)

(but Traversable)

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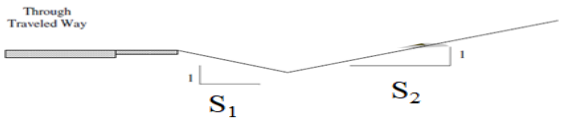
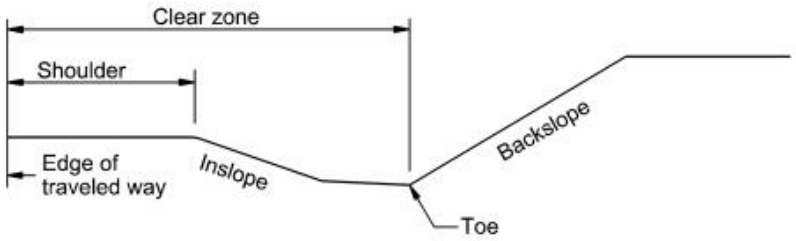
Clear Zone with a Ditch



- The combination of S_1 and S_2 needs to fall within the preferred area of Figure 3.6 of the RDG for the clear zone to extend beyond the ditch bottom
- If the combination is outside and S_1 is recoverable, the clear zone stops at the ditch bottom
- If S_1 is not recoverable, the clear zone stops at the top of the S_1 slope

Ref: AASHTO Roadside Design Guide, 4th Edition, Figure 3.6, Pg. 3-9

Clear Zone Application for Cut Slopes



TOE OF BACKSLOPE NOT WITHIN CLEAR ZONE (a)

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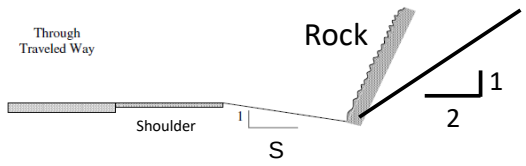
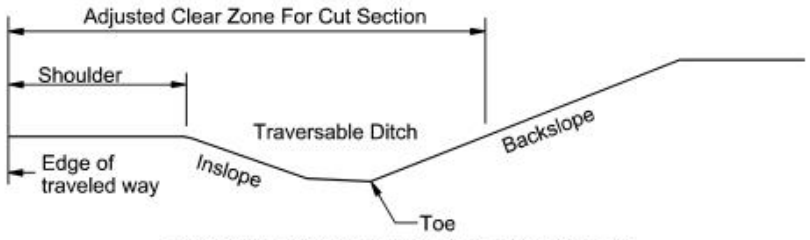
Clear Zone with a steep Cut Slope



S (≥4) Recoverable	Clear Zone extends to the base of the cut. If this distance is less than the design clear zone: • For a **smooth** rock cut – it can be considered a natural barrier. (Note a 2:1 smooth slope is not normally shielded) • For a **jagged** rock cut – it is considered as any other significant obstacle within the design clear zone.
S (<4) Non-Recoverable	Clear Zone ends at the edge of shoulder.

Ref: AASHTO Roadside Design Guide, 4th Edition, Pg.3-24

Clear Zone Application for Cut Slopes



TOE OF BACKSLOPE WITHIN CLEAR ZONE (b)

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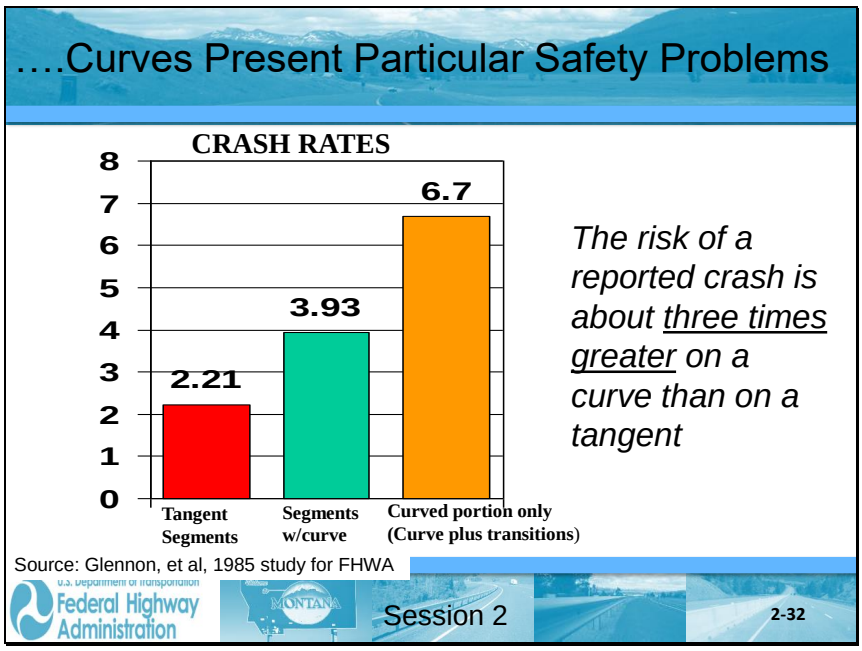
….Curves Present Particular Safety Problems
CRASH RATES
8
7
6
5
4
3
2
1
0
6.7
3.93
2.21
Tangent Segments
Segments w/curve
Curved portion only (Curve plus transitions)
The risk of a reported crash is about three times greater on a curve than on a tangent
Source: Glennon, et al, 1985 study for FHWA
Federal Highway Administration
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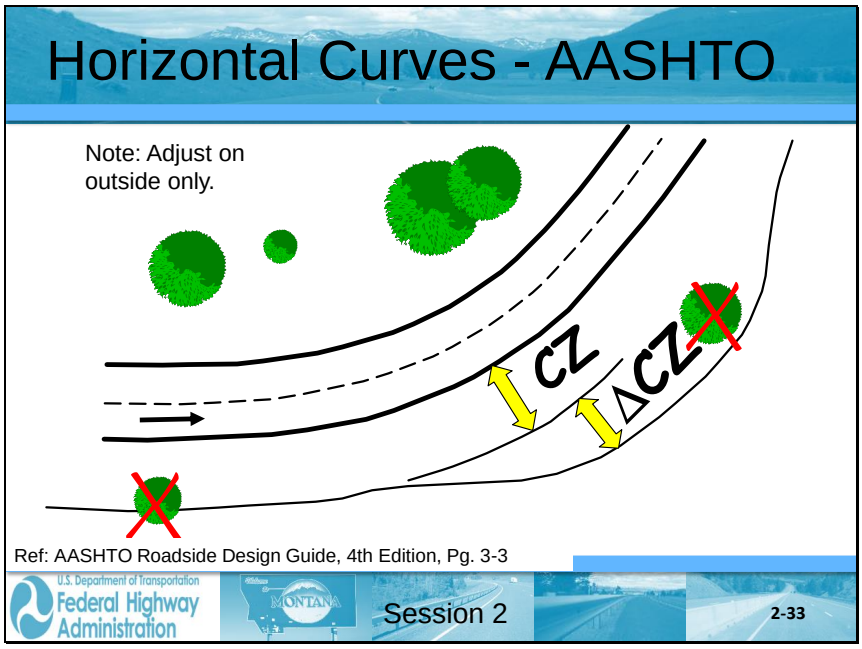
Horizontal Curves - AASHTO
Note: Adjust on outside only.
CZ
ΔCZ
Ref: AASHTO Roadside Design Guide, 4th Edition, Pg. 3-3
Federal Highway Administration
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Horizontal Curve Adjustments

K_{cz} (Curve Correction Factor)(U.S. Customary Units)

Radius (ft)	Design Speed (mph)					
	40	45	50	55	65	70
2,950	1.1	1.1	1.1	1.2	1.2	1.2
2,300	1.1	1.1	1.2	1.2	1.2	1.3
1,970	1.1	1.2	1.2	1.2	1.3	1.4
1,640	1.1	1.2	1.2	1.3	1.3	1.4
1,475	1.2	1.2	1.3	1.3	1.4	1.5
1,315	1.2	1.2	1.3	1.3	1.4	-
1,150	1.2	1.2	1.3	1.4	1.5	-
985	1.2	1.3	1.4	1.5	1.5	-
820	1.3	1.3	1.4	1.5	-	-
660	1.3	1.4	1.5	-	-	-
495	1.4	1.5	-	-	-	-
330	1.5	-	-	-	-	-

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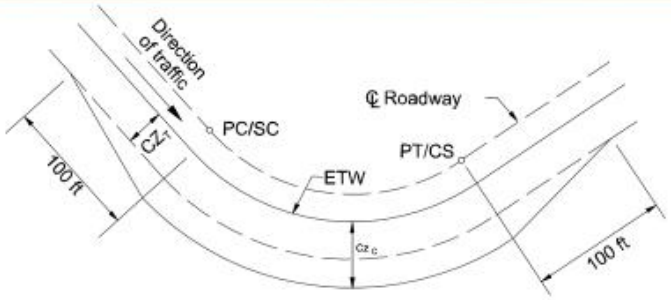
MDT Horizontal Curves



Notes:
On the inside of horizontal curves, use the clear zone distance for a tangent roadway.
CZ_t = clear zone on tangent section
CZ_c = clear zone on horizontal curve
ETW = edge of traveled way.

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Clear Zone and Curbs

The minimum lateral offset of 1.5 ft should be provided beyond the face of curbs to any vertical objects.
This is called the Lateral Offset and ***should not be construed as an acceptable clear zone distance*.**

Ref: AASHTO Roadside Design Guide, Section 10.2.1.1 Curbs

Order of Preference

1. Remove hazard
2. Redesign hazard (make traversable)
3. Relocate hazard (move away from traffic)
4. Reduce Impact Severity (use breakaway design)
5. SHIELD hazard
6. Delineate hazard so motorist can avoid

Ref: AASHTO Roadside Design Guide, 4th Edition – Pg. 1-4

MDT Guidance

Once the design team has concluded that an obstacle is located within the clear zone, the first attempt should be to remove or relocate the obstacle or to make the object breakaway.

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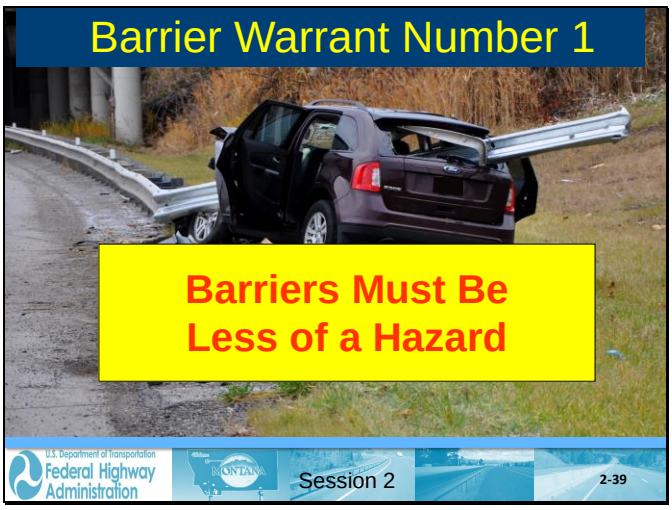
Barrier Warrant Number 1
Barriers Must Be Less of a Hazard
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Federal Highway Administration
MONTANA
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AASHTO Barrier Warrants

Obstacle	Guidelines
Bridge piers, abutments, and railing ends	Shielding generally required
Boulders	Judgment decision based on nature of fixed object and likelihood of impact
Culverts, pipes, headwalls	Judgment decision based on size, shape and location of obstacle
Foreslopes and backslopes (smooth)	Shielding not generally required
Foreslopes and backslopes (rough)	Judgment decision based on likelihood of impact
Ditches (parallel)	Refer to Figures 3-6 and 3-7
Ditches (transverse)	Shielding generally required if likelihood of head-on impact is high
Embankment	Judgment decision based on fill height and slope (see Figure 5-1)
Retaining Walls	Judgment decision based on relative smoothness of wall and anticipated maximum angle of impact
Sign/Luminaire supports	Shielding generally required for non-breakaway supports
Traffic signal supports	Isolated traffic signals within clear zone on high-speed rural facilities may warrant shielding
Trees	Judgment decision based on site-specific circumstances
Utility poles	Shielding may be needed on a case by case basis.
Permanent bodies of water	Judgment decision based on location and depth of water and likelihood of encroachment.

Ref: AASHTO Roadside Design Guide, 4th Edition Chapter 5 Table 5-2, Pg. 5-9

Examples of Roadside Obstacles

- Non-breakaway: sign supports, luminaire supports, traffic signals poles, railroad signal poles, and fire hydrants;
- Concrete footings extending more than 4 inches above the ground;
- Bridge piers and abutments at underpasses, bridge parapet ends, and pedestrian rail ends (see Exhibit 9-7);
- Trees with diameter greater than 4 inches (at present or at maturity);
- Retaining walls;
- Rough rock cuts;
- Large boulders;
- Critical parallel slopes;
- Streams or permanent bodies of water (where the depth of water is at least 12 inches);
- Non-traversable ditches;
- Utility poles or towers; and
- Culvert headwalls and ends.

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Is barrier warranted at the locations shown in the next five photos?

Do not consider effectiveness of existing barrier (if any) – except last slide, only the need for a barrier.

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U.S. Department of Transportation
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MONTANA
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U.S. Department of Transportation
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PRE-ASSESSMENT PHOTO
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MDT Range of Treatments

1. Eliminate obstacles or design proposed features free of obstacles (such as slope flattening to avoid barrier warrants, removing rock outcroppings, and removing point obstacles);
2. Relocate the obstacle;
3. Where applicable, make the obstacle breakaway (such as sign posts and luminaire supports);
4. Shield the obstacle with a roadside barrier, which is also considered an obstacle and should only be used when other alternatives cannot be achieved; or
5. Delineate the obstacle.

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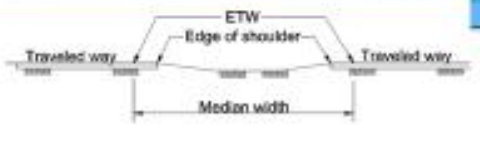
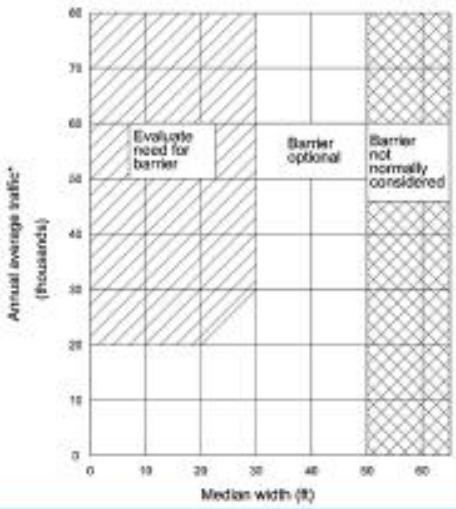
Barriers in the Median - Guidance





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Review Learning Outcomes

- Understand and apply the clear zone concept
- Identify objects and features that may require shielding

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