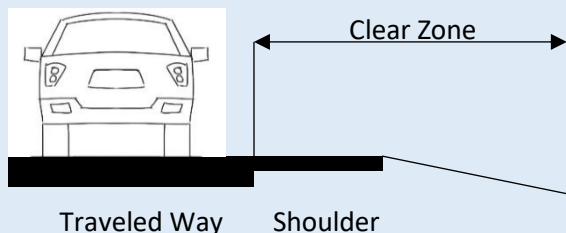


BARRIER DESIGN

CLEAR ZONE 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.



DESIGN OPTIONS

1. Remove the obstruction
2. Make the obstruction traversable
3. Relocate obstruction beyond the clear zone
4. Reduce impact severity by using an appropriate breakaway system
5. SHIELD the obstruction with a longitudinal barrier or crash cushion (only if obstruction cannot be removed, relocated, or redesigned)
6. Delineate obstruction (only if all above options are not appropriate.)

Ref: NDDOT DESIGN MANUAL, Appendix III-14-B, Jan 26, 2016

DESIGN CLEAR ZONE DISTANCE

Design Speed (mph)	Design ADT***	Foreslopes					Backslopes					
		Flatter than 1V:6H	1V:6H	1V:5H	1V:4H	1V:3H	Steeper than 1V:3H	1V:3H	1V:4H	1V:5H	1V:6H	Flatter than 1V:6H
≤40	UNDER 750	7-10	7-10	7-10	7-10	**	7-10	7-10	7-10	7-10	7-10	7-10
	750-1500	10	12	12	14	**	10-12	10-12	10-12	10-12	10-12	10-12
	1500-6000	12	14	14	16	**	12-14	12-14	12-14	12-14	12-14	12-14
	OVER 6000	14	16	16	18	**	14-16	14-16	14-16	14-16	14-16	14-16
45-50	UNDER 750	10	12	12	14	**	8-10	8-10	8-10	8-10	10	12
	750-1500	14	16	16	20	**	10	12	12	14	14	16
	1500-6000	16	18	20	26	**	12	14	14	16	16	18
	OVER 6000	20	22	24	28	**	14	16	18	20	20	22
55	UNDER 750	12	14	14	18	**	8	10	10-12	10-12	10-12	10-12
	750-1500	16	18	20	24	**	10	12	14	16	16	18
	1500-6000	20	22	24	30	**	14	16	16	18	20	22
	OVER 6000	22	24	26	32	**	16	18	20	22	22	24
60	UNDER 750	16	18	20	24	**	10	12	12	14	14	16
	750-1500	20	24	26	32	**	12	14	16	18	20	22
	1500-6000	26	30	32	40	**	14	18	18	22	24	26
	OVER 6000	30	32	36	44	**	20	22	24	26	26	28
65-75	UNDER 750	18	20	20	26	**	10	12	14-16	14-16	14-16	14-16
	750-1500	24	26	28	36	**	12	16	18	20	20	22
	1500-6000	28	32	34	42	**	16	20	22	24	26	28
	OVER 6000	30	34	38	46	**	22	24	26	30	28	30
75	UNDER 750	19	22	24	29	**	12	14	14	17	17	19
	750-1500	25	30	32	40	**	15	17	20	22	25	27
	1500-6000	32	36	39	49	**	17	22	22	27	29	32
	OVER 6000	37	39	44	54	**	24	27	29	32	32	34

Notes:

**Since recovery is less likely on unshielded traversable 3:1 slopes, fixed objects should not be present in the vicinity of the toe of these slopes. Recovery of high speed vehicles that encroach beyond the edge of the shoulder may be expected to occur beyond the toe of the slope. Determination of the width of the recovery area at the toe of the slope should take into consideration right of way availability, environmental concerns, economic factors, safety needs and crash histories. Also, the distance between the edge of the travel lane and the beginning of the 3:1 slope should influence the recovery area provided at the toe of the slope. While the application may be limited by several factors, the fill slope parameters, which may enter into determining the maximum desirable recovery area, is illustrated in Figure 3-2, AASHTO Roadside Design Guide (2011).

***Design ADT is the total ADT for both directions of travel for the design year. This applies to both divided and undivided facilities. Typically is based on the 20 year projected ADT.

Ref: NDDOT Design Manual, Appendix III-14-B, Revised Jan 26, 2016.

BARRIER DESIGN PRINCIPLES

- Deflection Distance** – The working distance (face of barrier to obstacle) in the TL-3 test for MGS w-beam guardrail was 59” with wood post. High Tension Cable Guardrail refer to the Manufacturer.
- Slope in Front of Barrier** – The slope in front of w-beam guardrail shall be 10:1 or flatter. High Tension Cable Guardrail can be placed on 6:1 slopes except in the area 1ft. to 8 ft. from the ditch bottom. It has also been tested on 4:1 slopes within restricted locations (typically, within 4 ft. of the hinge point).
- Guardrail and Curbs** – The combination of curbs and guardrail on high speed roadways is not desirable. When necessary at high speed locations (45 mph or greater), a 3” curb with face of curb flush with face of rail should be used. For MGS, up to 6” high curb within 6” in front of rail may be used.
- Post Support at Embankment** – A flat area (10:1) of 2.0 ft. measured from the back of post should be provided. The MGS has been tested at the breakpoint for a 2:1 slope with standard post length (with additional deflection) and with an 8 foot long steel post 1 ft. beyond the breakpoint.
- Flare rate** – Refer to Flare Rates below.

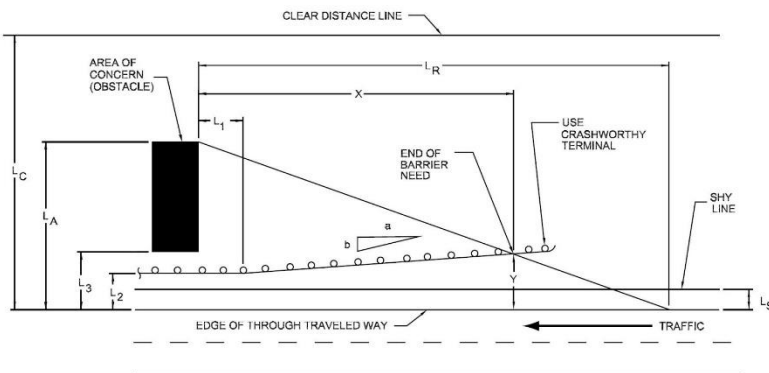
BARRIER GUIDELINES

The following obstacles may warrant guardrail as defined in NDDOT Design Manual III-13: bridge rail ends, non-breakaway light standards, utility poles, bridge piers, non-breakaway sign supports, large culverts, water (2’ or more deep), rock or rip rap, steep slopes. The treatment of these obstacles are addressed in NDDOT Design Manual III-13.05.

RUNOUT LENGTHS

Design Speed (mph)	Runout Length (L _R) Given Traffic Volume (ADT) (ft)			
	Over 6,000	2,000 to 6,000	800 to 2,000	Under 800
75	520	485	430	395
70	475	445	395	360
65	450	425	370	345
60	425	400	345	330
55	360	345	315	280
50	330	300	260	245
45	260	245	215	200
40	230	200	180 <td 165	
30	165	165	150	130

LENGTH OF NEED (LON) CALCULATION



Calculate the Length of Need (X) from the following equation:

$$X = \frac{L_A + (b/a)(L_1) - L_2}{(b/a) + (L_A/L_R)}$$

For parallel installations i.e. no flare rate, the previous equation becomes:

$$X = \frac{L_A - L_2}{L_A / L_R}$$

For two way traffic use the centerline as edge of traveled way for determining clear zone and length of need for the opposite direction.

- L_A = Back of Obstacle
- L_C = Clear Zone Distance
- b/a = Flare rate (see Table 5-9)
- L₁ = Beginning of Flare
- L₂ = Barrier Offset
- L_R = Runout Length (see Table 5-10)
- L_S = Shy Line Distance
- X = Length of Need
- Y = Lateral Offset

FLARE RATES

NDDOT standard flare rates which are maximum taper rates: (10:1 for 30 mph to 45 mph, 11:1 for 50 mph, 12:1 for 55 mph, 14:1 for 60 mph, 15:1 for 65 mph and 70 mph, and 16:1 for 75 mph) Any taper rate which is flatter than that prescribed for a given design speed is acceptable. A minimum length of 25 feet of tangent railing shall be installed in advance of an obstruction and a curved section will transition the straight section to the flared section. NDDOT encourages the use of flared guardrail wherever possible, and where necessary it may be flared at a rate flatter than the standard taper rates.

After determining the total amount of barrier needed for the obstacle, (in advance of obstacle – length of obstacle – downstream of obstacle) and after considering other barrier contributing to the amount of barrier needed that is paid for under another bid item – such as effective portion of end terminal, bridge rail, transition, etc. convert to LF for bid purposes using 12.5 or 25 ft. panel lengths.