



ROADSIDE

BARRIER DESIGN

ORDER OF PREFERENCE

- Remove obstacle
- Redesign obstacle to be safely traversed
- Relocate obstacle
- Reduce impact severity with a breakaway device
- Shield obstacle with barrier that will redirect vehicle or use crash cushion
- Delineate obstacle if other options are not appropriate

Ref: NCDOT Roadway Design Manual, 4.6 Roadside Design

BARRIER WARRANTS

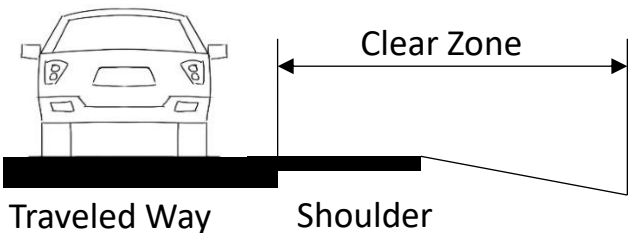
Obstacle	Guidelines
Bridge piers, abutments, and railing ends	Shielding generally required.
Boulders	Judgement decision based on nature of fixed object and likelihood of impact.
Culverts, pipes, headwalls	Judgment decision based on size, shape, and location of obstacle.
Foreslopes and backslopes (smooth)	Shielding not generally required.
Foreslopes and backslopes (rough)	Judgment decision based on likelihood of impact
Ditches (parallel)	Refer to RDG 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 Refer to RDG Figure 5-1(b).
Retaining walls	Judgment decision based on relative smoothness of wall and anticipated maximum angle of impact.
Sign/luminaire supports ^c	Shielding generally required for non-breakaway supports.
Traffic signal supports ^d	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 warranted on a case-by-case basis.
Permanent bodies of water	Judgment decision based on location and depth of water and likelihood encroachment.

Ref: NCDOT Roadway Design Manual, Table 6.1.

CLEAR ZONE DEFINITION

The unobstructed traversable area provided beyond the edge of the traveled way is termed the clear zone. This area is used for the recovery of errant vehicles and includes shoulders, bike lanes, and auxiliary lanes.

Ref: NCDOT Roadway Design Manual, 4.6.1 Clear Zone



DESIGN CLEAR ZONE DISTANCE

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	See Note b	7-10	7-10	7-10
	750-1500	10-12	12-14		10-12	10-12	10-12
	1500-6000	12-14	14-16		12-14	12-14	12-14
	OVER 6000	14-16	16-18		14-16	14-16	14-16
45-50	UNDER 750 ^c	10-12	12-14	See Note b	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 ^c	12-14	14-18	See Note b	8-10	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 ^a		16-18	20-22	22-24
60	UNDER 750 ^c	16-18	20-24	See Note b	10-12	12-14	14-16
	750-1500	20-24	26-32 ^a		12-14	16-18	20-22
	1500-6000	26-30	32-40 ^a		14-18	18-22	24-26
	OVER 6000	30-32 ^a	36-44 ^a		20-22	24-26	26-28
65-70 ^d	UNDER 750 ^c	18-20	20-26	See Note b	10-12	14-16	14-16
	750-1500	24-26	28-36 ^a		12-16	18-20	20-22
	1500-6000	28-32 ^a	34-42 ^a		16-20	22-24	26-28
	OVER 6000	30-34 ^a	38-46 ^a		22-24	26-30	28-30

Note:

- When a site-specific investigation indicates a high probability of continuing crashes or when such occurrences are indicated by crash history, the designer may provide clear-zone distances greater than the clear zone shown in Table 4-5. Clear zones may be limited to 30 feet for practicality and to provide a consistent roadway template if previous experience with similar projects or designs indicates satisfactory performance.

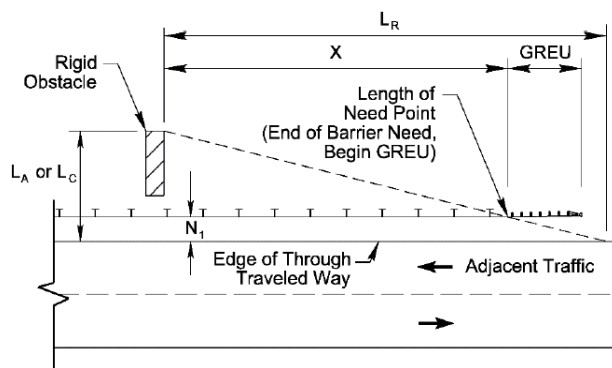
Ref: NCDOT Roadway Design Manual, Table 4-5.

BARRIER DESIGN PRINCIPLES

1. **Deflection Distance** – The distance from the face of barrier to a rigid obstacle; NCDOT deflection for standard guardrail is 5'-6" min; half-post spacing deflection is 3'-6". (See Standard 862.01, SH 1 for diagram and stiffening note). For High Tension Cable Guiderail (HTCG), refer to Manufacturer.
2. **Slope in Front of Barrier** – The slope in front of w-beam guardrail is to be 10:1 or flatter. High tension cable guiderail (HTCG) can be placed on 6:1 (or even 4:1) slopes with restrictions.
3. **Guardrail and Curbs** – The combination of curbs and guardrail on high speed roadways is not desirable. When necessary, a 6" curb with face of curb no more than 6" in front of face of rail may be used – for any speed. Refer to Standard 862.01, SH 12 for greater offsets at lower speeds.
4. **Soil Backing** – A flat area (10:1) of 3.0 feet measured from the face of rail should be provided. See standard 862.01, SH 11 for special applications including an 8' long steel post up to 12" beyond the breakpoint (to face of post). Note: a minimal extra deflection space (~7") is needed.
5. **Flare rate** – Refer to Table below.

LENGTH OF NEED (LON) CALCULATION

Figure 6-1 Detail of Guardrail Placement on Approach End of Rigid Obstacle Warrant



X = Length of Need of Barrier

L_C = Clear Zone Distance

L_A = Back of Obstacle

L_R = Runout Length (see Table)

N_1 = Barrier Offset

Calculate the Length of Need (X) from the following equation for straight or nearly straight sections of the roadway:

$$X = \frac{L_A - N_1}{L_A / L_R}$$

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

Subtract out from X any effective barrier that is paid for under another item such as bridge rail or bridge transition.

If one way traffic, add an End Anchor C.A.T.-1 plus 25' of standard guardrail beyond the end of needed effective barrier.

RUNOUT LENGTHS

Design Speed (mph)	Runout Length (L_R) Given Traffic Volume (ADT) (ft)			
	Over 10,000	5,000 to 10,000	1,000 to 5,000	Under 1,000
80	470	430	380	330
70	360	330	290	250
60	300	250	210	200
50	230	190	160	150
40	160	130	110	100
30	110	90	80	70

Ref: AASHTO ROADSIDE DESIGN GUIDE, 4th EDITION – TABLE 5.10 & 5.7

SUGGESTED FLARE RATES

Design Speed (mph)	Flare Rate for Barrier Inside the Shy Line	Flare Rate for Barrier at or Beyond Shy Line	
		Rigid Barrier	Semi-Rigid Barrier
70	30:1	20:1	15:1
60	26:1	18:1	14:1
55	24:1	16:1	12:1
50	21:1	14:1	11:1
45	18:1	12:1	10:1
40	16:1	10:1	8:1
30	13:1	8:1	7:1

If the barrier can be flared – only over flat ground – see the AASHTO Roadside Design Guide section on Length of Need for the formula including a flared layout

REF: AASHTO ROADSIDE DESIGN GUIDE, 4th EDITION – TABLE 5.9