### Exhibit 1610-6 Barrier Length of Need

| Posted Speed (mph) | Design Parameters | | | | | | |
|---|---|---|---|---|---|---|---|
| | ADT | | | | Barrier Type | | |
| | Over 10,000 | 5,000 to 10,00 | 1,000 to 4,999 | Under 1,000 | Rigid & Rigid Anchored Barrier | Rigid Unrestrained Barrier | Semi-rigid Barrier |
| | LR (ft) | LR (ft) | LR (ft) | LR (ft) | F | F | F |
| 70 | 360 | 330 | 290 | 250 | 20 | 18 | 15 |
| 65 | 330 | 290 | 250 | 225 | 20 | 18 | 15 |
| 60 | 300 | 250 | 210 | 200 | 18 | 16 | 14 |
| 55 | 265 | 220 | 185 | 175 | 16 | 14 | 12 |
| 50 | 230 | 190 | 160 | 150 | 14 | 12 | 11 |
| 45 | 195 | 160 | 135 | 125 | 12 | 11 | 10 |
| 40 | 160 | 130 | 110 | 100 | 11 | 10 | 9 |
| 35 | 135 | 110 | 95 | 85 | 11 | 10 | 9 |
| 30 | 110 | 90 | 80 | 70 | 11 | 10 | 9 |
| 25 | 110 | 90 | 80 | 70 | 11 | 10 | 9 |

L1 = Length of barrier parallel to roadway from adjacent-side fixed feature to beginning of barrier flare. This is used if a portion of the barrier cannot be flared (such as a bridge rail and the transition).

L2 = Distance from adjacent edge of traveled way to portion of barrier parallel to roadway.

L4 = Length of barrier parallel to roadway from opposite-side fixed feature to beginning of barrier flare.

L5 = Distance from centerline of roadway to portion of barrier parallel to roadway. ***Note:*** If the fixed feature is outside the Design Clear Zone when measured from the centerline, it may only be necessary to provide a crash-tested end treatment for the barrier.

LH1 = Distance from outside edge of traveled way to back side of adjacent-side fixed feature. ***Note:*** If a fixed feature extends past the Design Clear Zone, the Design Clear Zone can be used as LH1.

LH2 = Distance from centerline of roadway to back side of opposite-side fixed feature. ***Note:*** If a fixed feature extends past the Design Clear Zone, the Design Clear Zone can be used as LH2.

LR = Runout length, measured parallel to roadway.

X1 = Length of need for barrier to shield an adjacent-side fixed feature.

X2 = Length of need for barrier to shield an opposite-side fixed feature.

F = Flare rate value.

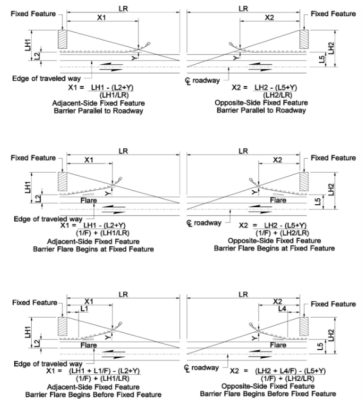
Y = Offset distance needed at the beginning of the length of need.

**Different end treatments need different offsets:**

- For the SRT 350 and FLEAT 350, use Y = 1.8 feet.
- For evaluating existing BCTs, use Y = 1.8 feet.
- For the FLEAT TL-2, use Y = 0.8 feet.
- No offset is needed for the non-flared terminals or impact attenuator systems. Use Y = 0.



### Exhibit 1610-5 Barrier Length of Need on Tangent Sections




Note: For supporting length of need equation factors, see Exhibit 1610-6





### Exhibit 1600-2 Design Clear Zone Distance Table

| Posted Speed (mph) | Average Daily Traffic | Cut Section (Backslope) (H:V) 3:1 | 4:1 | 5:1 | 6:1 | 8:1 | 10:1 | Fill Section (H:V) 3:1 | 4:1 | 5:1 | 6:1 | 8:1 | 10:1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 or Less | | The Design Clear Zone Distance is 10 ft | | | | | | | | | | | |
| 40 | Under 250 | 10 | 10 | 10 | 10 | 10 | 10 | * | 13 | 12 | 11 | 11 | 10 |
| | 251 – 800 | 11 | 11 | 11 | 11 | 11 | 11 | * | 14 | 14 | 13 | 12 | 11 |
| | 801 – 2,000 | 12 | 12 | 12 | 12 | 12 | 12 | * | 16 | 15 | 14 | 13 | 12 |
| | 2,001 – 6,000 | 14 | 14 | 14 | 14 | 14 | 14 | * | 17 | 17 | 16 | 15 | 14 |
| | Over 6,000 | 15 | 15 | 15 | 15 | 15 | 15 | * | 19 | 18 | 17 | 16 | 15 |
| 45 | Under 250 | 11 | 11 | 11 | 11 | 11 | 11 | * | 16 | 14 | 13 | 12 | 11 |
| | 251 – 800 | 12 | 12 | 13 | 13 | 13 | 13 | * | 18 | 16 | 14 | 14 | 13 |
| | 801 – 2,000 | 13 | 13 | 14 | 14 | 14 | 14 | * | 20 | 17 | 16 | 15 | 14 |
| | 2,001 – 6,000 | 15 | 15 | 16 | 16 | 16 | 16 | * | 22 | 19 | 17 | 17 | 16 |
| | Over 6,000 | 16 | 16 | 17 | 17 | 17 | 17 | * | 24 | 21 | 19 | 18 | 17 |
| 50 | Under 250 | 11 | 12 | 13 | 13 | 13 | 13 | * | 19 | 16 | 15 | 13 | 13 |
| | 251 – 800 | 13 | 14 | 14 | 15 | 15 | 15 | * | 22 | 18 | 17 | 15 | 15 |
| | 801 – 2,000 | 14 | 15 | 16 | 17 | 17 | 17 | * | 24 | 20 | 18 | 17 | 17 |
| | 2,001 – 6,000 | 16 | 17 | 17 | 18 | 18 | 18 | * | 27 | 22 | 20 | 18 | 18 |
| | Over 6,000 | 17 | 18 | 19 | 20 | 20 | 20 | * | 29 | 24 | 22 | 20 | 20 |
| 55 | Under 250 | 12 | 14 | 15 | 16 | 16 | 17 | * | 25 | 21 | 19 | 17 | 17 |
| | 251 – 800 | 14 | 16 | 17 | 18 | 18 | 19 | * | 28 | 23 | 21 | 20 | 19 |
| | 801 – 2,000 | 15 | 17 | 19 | 20 | 20 | 21 | * | 31 | 26 | 23 | 22 | 21 |
| | 2,001 – 6,000 | 17 | 19 | 21 | 22 | 22 | 23 | * | 34 | 29 | 26 | 24 | 23 |
| | Over 6,000 | 18 | 21 | 23 | 24 | 24 | 25 | * | 37 | 31 | 28 | 26 | 25 |
| 60 | Under 250 | 13 | 16 | 17 | 18 | 19 | 19 | * | 30 | 25 | 23 | 21 | 20 |
| | 251 – 800 | 15 | 18 | 20 | 20 | 21 | 22 | * | 34 | 28 | 26 | 23 | 23 |
| | 801 – 2,000 | 17 | 20 | 22 | 22 | 23 | 24 | * | 37 | 31 | 28 | 26 | 25 |
| | 2,001 – 6,000 | 18 | 22 | 24 | 25 | 26 | 27 | * | 41 | 34 | 31 | 29 | 28 |
| | Over 6,000 | 20 | 24 | 26 | 27 | 28 | 29 | * | 45 | 37 | 34 | 31 | 30 |
| 65 | Under 250 | 15 | 18 | 19 | 20 | 21 | 21 | * | 33 | 27 | 25 | 23 | 22 |
| | 251 – 800 | 17 | 20 | 22 | 22 | 24 | 24 | * | 38 | 31 | 29 | 26 | 25 |
| | 801 – 2,000 | 19 | 22 | 24 | 25 | 26 | 27 | * | 41 | 34 | 31 | 29 | 28 |
| | 2,001 – 6,000 | 20 | 25 | 27 | 27 | 29 | 30 | * | 46 | 37 | 35 | 32 | 31 |
| | Over 6,000 | 22 | 27 | 29 | 30 | 31 | 32 | * | 50 | 41 | 38 | 34 | 33 |
| 70 | Under 250 | 16 | 19 | 21 | 21 | 23 | 23 | * | 36 | 29 | 27 | 25 | 24 |
| | 251 – 800 | 18 | 22 | 23 | 24 | 26 | 26 | * | 41 | 33 | 31 | 28 | 27 |
| | 801 – 2,000 | 20 | 24 | 26 | 27 | 28 | 29 | * | 45 | 37 | 34 | 31 | 30 |
| | 2,001 – 6,000 | 22 | 27 | 29 | 29 | 31 | 32 | * | 50 | 40 | 38 | 34 | 33 |
| | Over 6,000 | 24 | 29 | 31 | 32 | 34 | 35 | * | 54 | 44 | 41 | 37 | 36 |

**Notes:**

This exhibit applies to:

- All state highways outside incorporated cities.
- Limited access state highways within cities.

For Roadside and Median areas on managed access state highways within incorporated cities, see 1600.02 for guidance. Curb is not considered adequate to redirect an errant vehicle.

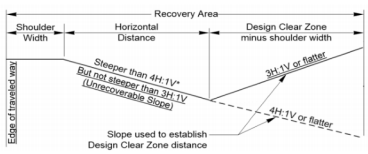
Design Clear Zone distances are given in feet, measured from the edge of traveled way.

*When the fill section slope is steeper than 4H:1V, but not steeper than 3H:1V, the Design Clear Zone distance is modified by the recovery area formula (see Exhibit 1600-4) and is referred to as the recovery area. The basic philosophy behind the recovery area formula is that the vehicle can traverse these slopes but cannot recover (control steering); therefore, the horizontal distance of these slopes is added to the Design Clear Zone distance to form the recovery area. Provide a minimum of 10 feet at the toe of all traversable, non-recoverable fill slopes.





### Exhibit 1600-4 Recovery Area




* When the fill section slope is steeper than 4H:1V, but not steeper than 3H:1V, the Design Clear Zone distance is modified by the recovery area formula (see Exhibit 1600-4) and is referred to as the recovery area. The basic philosophy behind the recovery area formula is that the vehicle can traverse these slopes but cannot recover and return to the roadway (control steering); therefore, the horizontal distance of these slopes is added to the Design Clear Zone distance to form the recovery area.

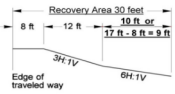
**Formula:**

Recovery area = (shoulder width) + (nonrecoverable slope distance) + the greater of [10 ft or (Design Clear Zone distance – shoulder width)]

**Example: Fill section (fore slope 3H:1V and 6H:1V)**

**Conditions:**

Speed = 45 mph
Traffic = 3,000 ADT
Fore Slope = 3H:1V (Nonrecoverable)
Fill Slope = 6H:1V = 17 ft from Exhibit 1600-2




**Criteria:**

Fore Slope 3H:1V → Use recovery area formula

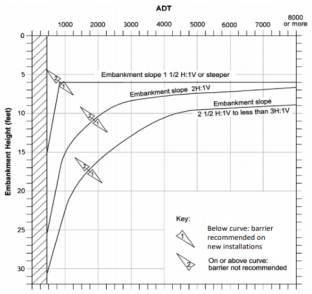
Recovery area = (shoulder width (8 ft)) + (nonrecoverable slope distance (12 ft)) + Grater of (1) or (2):
(1) **10 ft**
(2) Design Clear Zone distance for 6H:1V (17 ft) – shoulder width (8 ft)) = 9 ft

**Recovery area = 20 + 10 ft = 30 feet**





### Exhibit 1600-6 Guidelines for Embankment Barrier




**Note:**

Routes with ADTs under 400 may be evaluated on a case-by-case basis.