In summary, roadside barriers perform most effectively when they are installed on slopes of 1V:10H or flatter. Caution should be taken when considering installations on slopes as steep as 1V:6H and any such installation should be offset so that an errant vehicle is in its normal attitude at the moment of impact. Depending on actual encroachment conditions, the distance from the traveled way at which a barrier can be installed and expected to perform adequately will vary, but in general, the placement recommendations shown in Figure 5-38 should be considered.

A rounded slope reduces the chances of an errant vehicle becoming airborne and affords the driver more control over the vehicle. Typically 1.2 m to 1.8 m [4 ft to 6 ft] is used for slope rounding. This rounding is generally obtained as part of the slope grading and vegetation establishment.

5.6.3 Flare Rate

A roadside barrier is considered flared when it is not parallel to the edge of the traveled way. Flare is normally used to locate the barrier terminal farther from the roadway; to minimize a driver's reaction to an obstacle near the road by gradually introducing a parallel barrier installation; to transition a roadside barrier to an obstacle nearer the roadway such as a bridge parapet or railing; or to reduce the total length of guardrail needed. The use of a flared barrier also reduces the number of barrier and terminal impacts as well as provides additional roadside space for an errant motorist to recover.

One concern with flaring a section of roadside barrier is that the greater the flare rate, the higher the angle at which the barrier can be hit. As the angle of impact increases, the severity of the crashes increases, particularly for rigid and semi-rigid barrier systems. A second disadvantage to flaring a barrier installation is the increased likelihood that a vehicle will be redirected back into or across the roadway following an impact. This situation is especially undesirable on two-way roadways where the impacting vehicle could be redirected into oncoming traffic. Testing of a flared MGS installation has shown an improvement over conventional strong-post W-beam guardrail that was crash tested in a parallel installation. The vehicles impacting the MGS system remained relatively close to the rail. The MGS passed crash testing at NCHRP Report 350 TL-3 with a 5:1 flare rate (12). Terminals used with the MGS system should follow the manufacturer's recommended flare rates.

As shown in Table 5-9, the maximum recommended flare rates are a function of highway design speed and barrier type (21, 22). Flatter flare rates may be used and often are, particularly where extensive grading would be required to obtain a flat approach to the barrier from the traveled way. This is often the case on existing facilities having relatively steep embankment slopes where slope flattening is not practical. It should also be noted that a flatter flare rate is suggested when a barrier is located within the shy-line offset distance. This is more applicable where the approach roadway is wider than the roadway near the obstacle and has an offset less than the suggested shy line offset. For example, if an approach roadway is wider then a bridge roadway, the use of flatter flare rates based on inside the recommend shy line values should be used.

Table 5-9. Suggested Flare Rates for Barrier Design

Design Speed		Flare Rate for Barrier Inside Shy Line	Flare Rate for Barrier at or Beyond Shy Line	
km/h	[mph]		A	B
110	[70]	30:1	20:1	15:1
100	[60]	26:1	18:1	14:1
90	[55]	24:1	16:1	12:1
80	[50]	21:1	14:1	11:1
70	[45]	18:1	12:1	10:1
60	[40]	16:1	10:1	8:1
50	[30]	13:1	8:1	7:1

Notes:
A = Suggested maximum flare rate for rigid barrier system.
B = Suggested maximum flare rate for semi-rigid barrier system.
The MGS has been tested in accordance with NCHRP Report 350 TL-3 at 5:1 flare.
Flatter flare rates for the MGS installations also are acceptable. The MGS should be installed using the flare rates shown or flatter for semi-rigid barriers beyond the shy line when installed in rock formations.