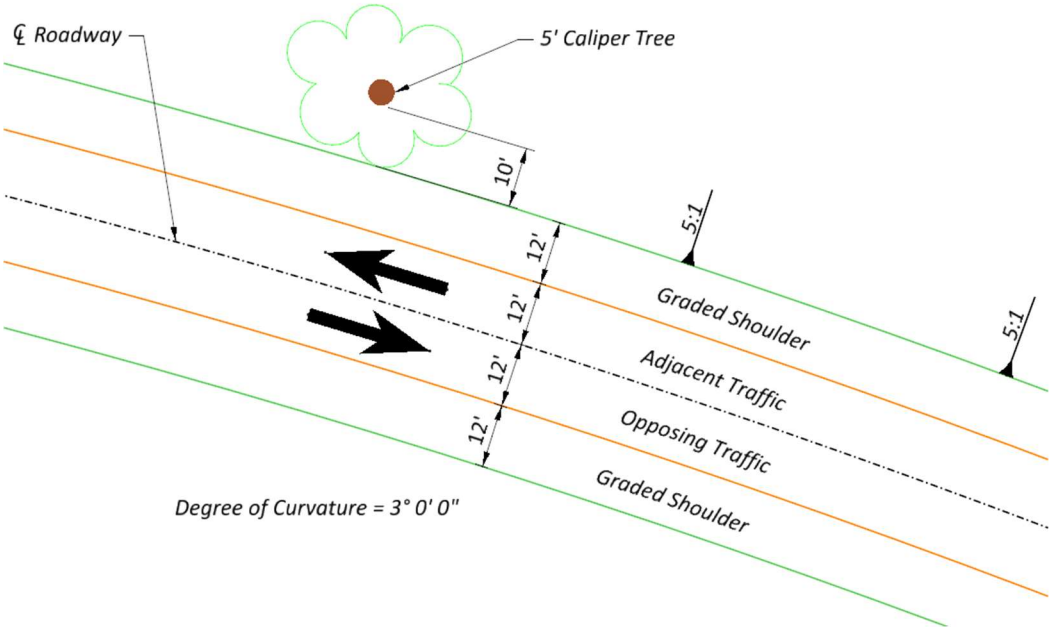
SAMPLE CALCULATIONS

Ex. 602-4

Barrier on the Outside of a Curve

Problem 4: Calculate the barrier length of need to shield the 200-yr old 5-ft. diameter tree located on the outside of a 3-degree curve as shown below. The HSP project is on a rural arterial and has a design speed of 55 mph, a design year traffic volume of 3,800 ADT, and a 5:1 foreslope. Assume that the HSP project is needed to address run-off-the-road impacts with the tree and assume that the tree cannot be removed.



Solution 4: **Step 1** – Determine whether the tree is in the clear zone for adjacent traffic. From **Figure 600-1** (for foreslopes steeper than 6:1 up to 4:1, 55 mph design speed, and 1,501 ≤ ADT ≤ 6,000) the required clear zone distance is 27 feet measured from the edge of traveled way. Since the tree is on the outside of a 3-degree curve, the clear zone should be widened by using the curve correction factor for 55 mph design speed (1.2) from the chart at the bottom of **Figure 600-1**.

Required Clear Zone = 1.2(27') = 33.4 ft.

Do not reduce this value to 30 ft. since this is a high accident location.

The offset to the face of the tree is 12' + 10' = 22 ft.
This is less than L_C = 33.4 ft.; therefore, install barrier.

SAMPLE CALCULATIONS

Ex. 602-4 | Barrier on the Outside of a Curve

(continued)

Step 2 – Select the type of barrier to be installed. Using **Figure 301-3**, the normal (minimum) barrier offset for a rural arterial (Design year ADT greater than 2,000) is 10 feet from the right edge of traveled way. The available barrier clearance at this location is 12 feet; therefore, use MGS Guardrail, which has a minimum barrier clearance of 5 feet (See **Figure 603-2**).

Step 3 – Calculate the length of need for adjacent traffic. The radius for the 3-degree curve is $R_{centerline} = 5729.58/D_C = 5729.58/3.0 = 1909.86'$

The radius at the edge of traveled way is 1909.86' + 12' = 1921.86'.

The lateral offset to the back of the tree is $L_H = 22' + 5' = 27'$.

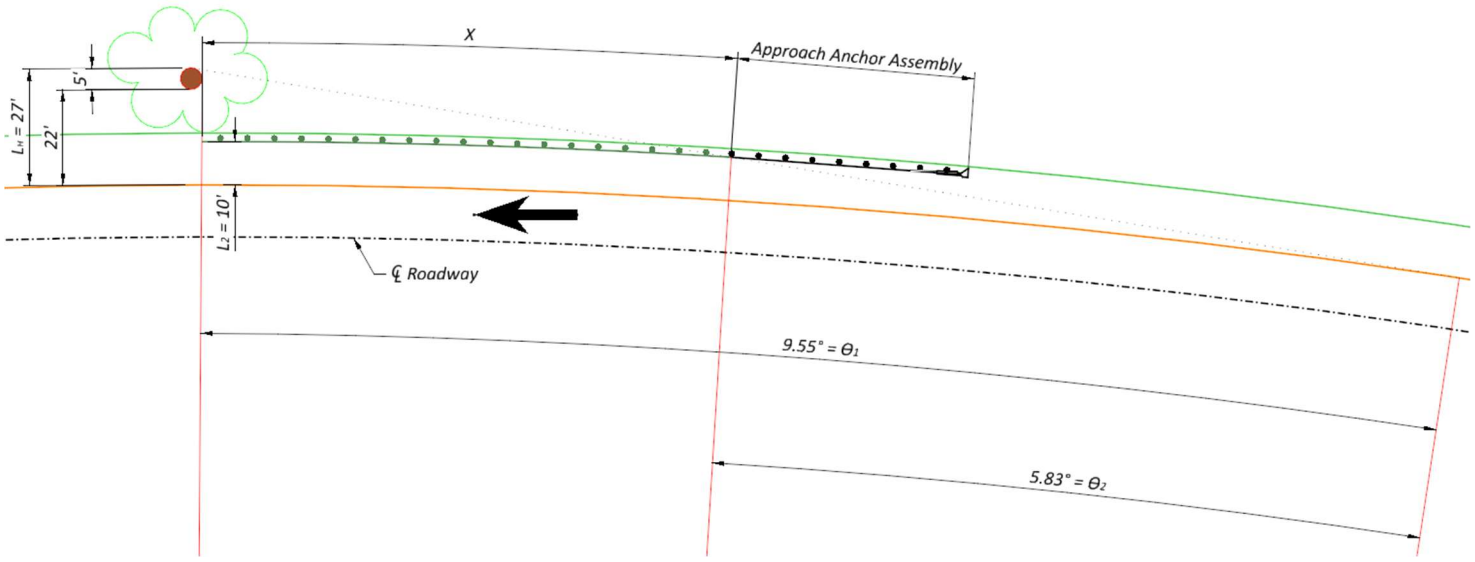
$\theta_1 = \cos^{-1}(R_{adj} / (R_{adj} + L_H)) = \cos^{-1}(1921.86 / (1921.86 + 27)) = 9.5484^0$

$9.5484^0(\pi/180) = 0.1666$ radians

$\theta_2 = \cos^{-1}(R_{adj} / (R_{adj} + L_2)) = \cos^{-1}(1921.86 / (1921.86 + 10)) = 5.8323^0$

$5.8323^0(\pi/180) = 0.1018$ radians

$X = (R_{adj} + L_2)(\theta_1 + \theta_2) = (1921.86 + 10)(0.1666 + 0.1018) = 125.18'$



SAMPLE CALCULATIONS	
Ex. 602-4	**Barrier on the Outside of a Curve**

(continued)

Step 4 – Determine whether the tree is within the clear zone for opposing traffic. The offset to the face of the tree is 12’ + 12’ + 10’ = 34’. Since this is outside the clear zone, guardrail is not needed last the left side of the tree to shield it from opposing traffic. At the trailing end install a Type T Anchor Assembly because it is outside the clear zone for opposing traffic; per **Section 603.3.5,** the end post of the Type T must be located 25’ downstream of the hazard being shielded. Assuming a post will be placed on the far side of the hazard, add 12.5’ to the total (3.125’ from post to splice + 12.5’ + 9.375’ from splice to end post of Type T = 25’)

The total length of guardrail needed is 125.18’ + 5’ (hazard length) + 12.5’ = 142.68’ → Use 12 panels (150’)

Refer to **Table 603-1** in **Section 603.3.3** to determine the recommended approach anchor assembly for a project with foreslopes steeper than 6:1 up to 4:1. On the approach end install a Type E Anchor Assembly. Since 37’-6” of the 50’ long Type E can be deducted from the guardrail length of need, decrease the amount of rail specified above at the approach end by this amount. (Use 112.5’).

Notes – If a point of curvature exists in the vicinity of the runout path, the curve may need to be extended past the PC or OT (into the tangent portion of the roadway) to construct the tangent control line. If this is the case, then the standard runout lengths for tangent roadways should be used to calculate length of need.