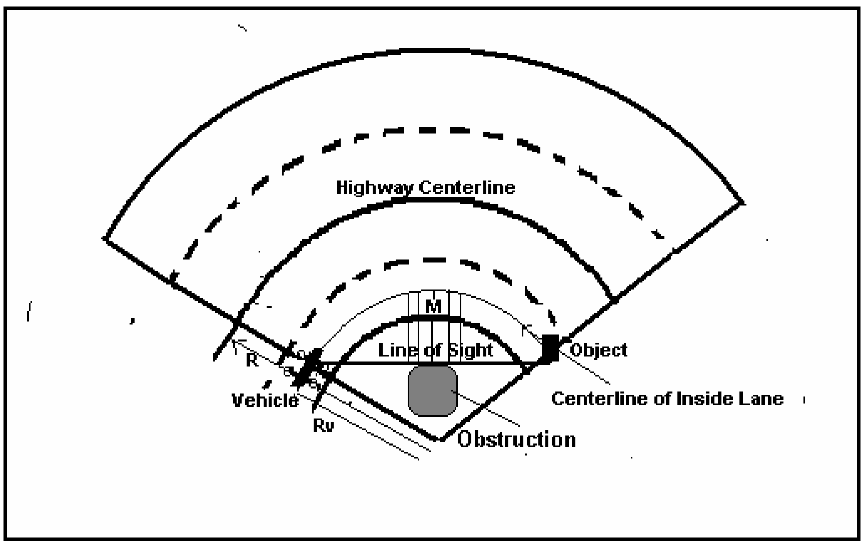
7.2.4 Stopping Sight Distance for Horizontal Curves

Horizontal curves occur frequently as the alignment of roads and highways move through hilly country, along winding rivers, or around obstacles that cannot be moved. Figure 7.18 shows a simple circular horizontal curve. The stopping sight distance on a horizontal curve depends on the ability of the driver to see an object in the road across an arc of the curve in time to perceive the object and then to stop. The stopping sight distances from Table 7.3 are used. Because the car travels on the curve and the sight will be along an arc of the curve although the stopping distance will be measured along the curve itself.

Equation 7.17 is used to define the stopping sight distance (SSD in the equation below or S in Figure 7.18). For design purposes, the *effective radius* of the curve (**R_v** in the equation below in Figure 7.18) is measured to the middle of the innermost lane. The other critical dimension in this analysis is the middle ordinate (**M_s** in the equation below or **M** in Figure 7.18). As shown in Figure 7.18, **M_s** (or **M**) is measured from the sight obstruction to the middle of the innermost lane.

Think about it: (a) Why is the innermost lane used to govern the design with respect to SSD on a horizontal curve? (b) Why are the effective radius and the middle ordinate of the curve measured to the *middle* of the innermost lane? After all, the steering wheel is not in the middle of the dashboard.

Figure 7.18 Simple horizontal circular curve



The sight distance will govern the setback of any building or other sight obstruction, such as hedges and trees. The distance that is needed is governed by the arc of the curve that comprises the stopping sight distance. The distance from the middle of the innermost lane to the line drawn between the vehicle and the potential object in the road is the middle ordinate, which will govern the setback.

The equation for the stopping sight distance (SSD) can be derived by first finding the central angle Δ_{SSD} for an arc equal to the required SSD from Table 7.3. Assuming that the arc of the curve is longer than the SSD, we have

$SSD = \frac{\pi}{180} R_v \times \Delta_{SSD}$. Substituting this into the equation for the middle ordinate M_s, we get

$$M_s = R_v\left(1-\cos\frac{\Delta}{2}\right) = R_v\left(1-\cos\frac{90\times SSD}{\pi\times R_v}\right) \quad (7.17)$$

The argument of the cosine in Equation 7.17 has the units *degrees*. Solving for SSD, Equation 7.17 becomes Equation 7.18.

$$SSD = \frac{\pi\times R_v}{90}\left(\cos^{-1}\frac{R_v - M_{SSD}}{R_v}\right) \quad (7.18)$$

Note: Velocity is very important and is a fundamental part of the SSD determination from Table 7.3.

Figure 7.19 Sight distances on horizontal curves

(a) Note how the hillside has been cut and filled to provide ample sight distance.

(b) Trees have been cut back from the road, affording adequate stopping sight distance.

Source Jon Fricker ???

Comment:

Example 7.11

The Mayor of Shoridan wants to erect a sign welcoming visitors as they enter the city on SR361. (The mayor's name will also be on the sign.) As SR361 enters Shoridan, it has four 12-foot lanes with 6-foot shoulders. Unfortunately, it is also a horizontal curve with a radius of 1200 feet. The speed limit is 45 mph. How far in from the inside shoulder of the highway must the sign be placed so as to avoid potential stopping sight distance problems?

Solution to Example 7.11

From Table 7.3, the desired design SSD is 400 feet. Correct the radius from the centerline of the highway to the driver on the innermost of the four lanes. If the typical driver in the innermost lane is 6 feet from the pavement edge, …

$$R_{vehicle} = 1200 - 12 - 6 = 1182 \text{ feet}$$

$$M_{SSD} = 1182\left(1 - \cos\frac{90 \times 400}{\pi \times 1182}\right) = 17 \text{ feet}$$

The welcome sign should be placed at least 17 feet inside the center line of the inner lane or 5 feet inside the shoulder.