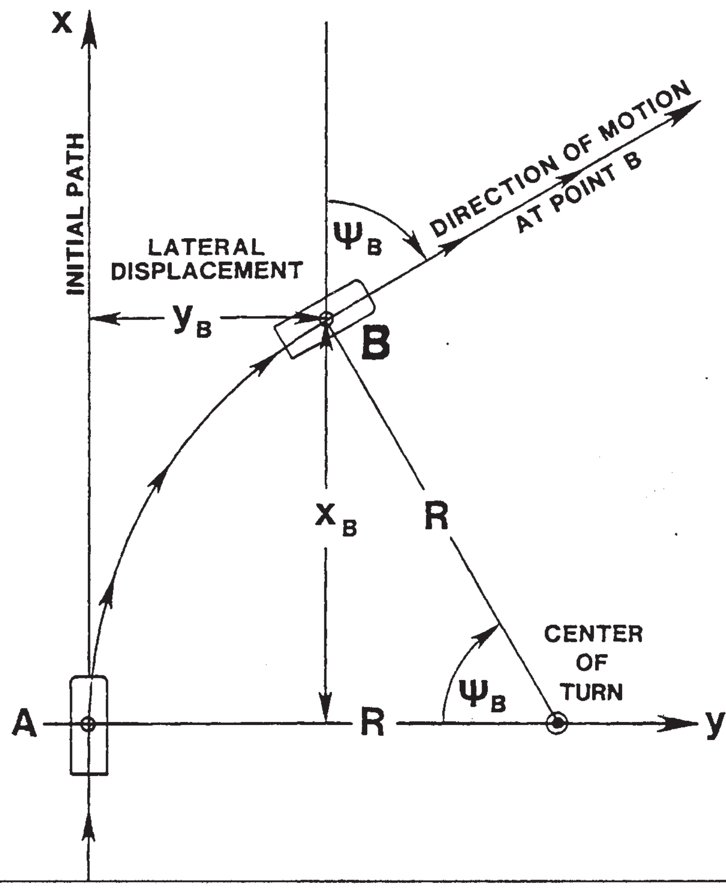

Lateral Travel,	$y_B = R\,(1-\cos\Psi_B)$
Minimum Path Radius,	$R = \dfrac{V^2}{\theta\mu g}$
Maximum Angle,	$\Psi_B = \arccos\left(1 - \dfrac{\theta\mu g y_B}{V^2}\right)$

Figure 10 Vehicle Motion Along Circular Arc

With the circular arc starting along the direction of the initial path, the center of a turn must lie on a perpendicular to the initial path (**Figure 10**). At any point, B, along the circular arc, the lateral displacement, Y_B, from the initial path is defined by equation (2).

$$y_B = R\,(1-\cos\Psi_B)\ \text{feet} \qquad (2)$$

Where R = Radius of turn, feet.

Ψ_B = Direction of motion relative to initial path, degrees.

The radius of turn, R, can be expressed, from equation (1), as follows:

$$R = \frac{MV^2}{F} \qquad (3)$$

Where F = The summation of tire forces which constitute the centripetal force, lbs.

The summation of tire forces is determined by the vehicle weight, the available friction coefficient and the extent to which the available friction is being utilized.

$$F = \theta\mu Mg \tag{4}$$

where

θ = extent of friction utilization ($0.00 \le \theta \le 1.00$)

μ = maximum friction coefficient.

M = mass of the vehicle, slugs.

g = acceleration of gravity, ft/sec^2

From equations (3) and (4),

$$R = \frac{V^2}{\theta\mu g} \tag{5}$$

Substitution of (5) into (2) and solution for Ψ_B yields:

$$\Psi_B = \arccos\left(1 - \frac{\theta\mu g Y_B}{V^2}\right) \tag{6}$$

In **Figure 10**, it may be seen that

$$x_B = R \sin \Psi_B \tag{7}$$

For example, the following results are obtained from equation, (6) and (7)

$\Psi_B = 90°$

V	10 MPH		50 MPH	
$\theta\mu$	0.25	0.75	0.25	0.75
$(y)_B$	26.7'	8.9'	668.1'	222.7'
$(x)_B$	26.7'	8.9'	668.1'	222.7'

$\Psi_B = 45°$

V	10 MPH		50 MPH	
$\theta\mu$	0.25	0.75	0.25	0.75
$(y)_B$	7.8'	2.6'	195.7'	65.2'
$(x)_B$	18.9'	6.3'	472.4'	157.5'

It may be seen from the preceding that the ability of a vehicle to change its direction of motion is dependent upon its forward speed, the utilized roadway friction and the lateral space available for the maneuver. Thus, it is possible, for example, to approximate the maximum angle of vehicle motion at the point of contact with a highway guardrail for a given combination of travel speed, highway width and the tire-pavement friction.

The following pages present some sample applications of the preceding simple theory for the determination of angles for evasive maneuvers and information on lane change maneuvers.

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Accident Reconstruction

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