Banking of a Road.

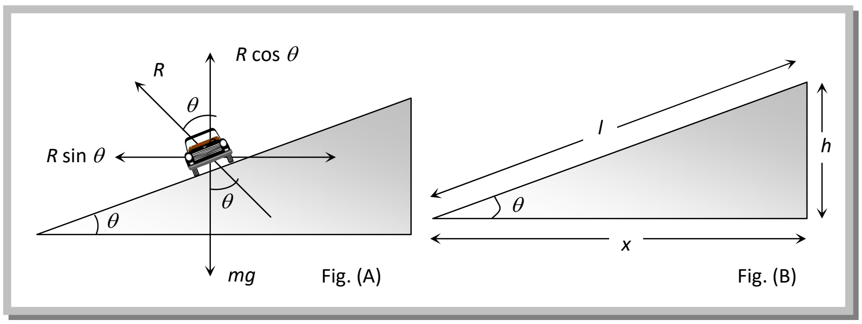
For getting a centripetal force cyclist bend towards the center of circular path but it is not possible in case of four wheelers.

Therefore, outer bed of the road is raised so that a vehicle moving on it gets automatically inclined towards the center.

In the figure (A) shown reaction R is resolved into two components, the component $R\cos\theta$ balances weight of vehicle

$\therefore \quad R\cos\theta = mg$ ......(i)

and the horizontal component $R\sin\theta$ provides necessary centripetal force as it is directed towards center of desired circle



Thus $\quad R\sin\theta = \dfrac{mv^2}{r}$ ......(ii)

Dividing (ii) by (i), we have

$$\tan\theta = \frac{v^2}{rg} \quad \text{...... (iii)}$$

or $\tan\theta = \dfrac{\omega^2 r}{g} = \dfrac{v\omega}{rg}$ ...... (iv) [As $v = r\omega$]

If l = width of the road, h = height of the outer edge from the ground level then from the figure (B)

$\tan\theta = \dfrac{h}{x} = \dfrac{h}{l}$ ....(v) [since θ is very small]

From equation (iii), (iv) and (v) $\quad \tan\theta = \dfrac{v^2}{rg} = \dfrac{\omega^2 r}{g} = \dfrac{v\omega}{rg} = \dfrac{h}{l}$

Note:

a. If friction is also present between the tyres and road then $\dfrac{v^2}{rg} = \dfrac{\mu + \tan\theta}{1 - \mu\tan\theta}$

Maximum safe speed on a banked frictional road $v = \sqrt{\dfrac{rg(\mu + \tan\theta)}{1 - \mu\tan\theta}}$