

Cornering

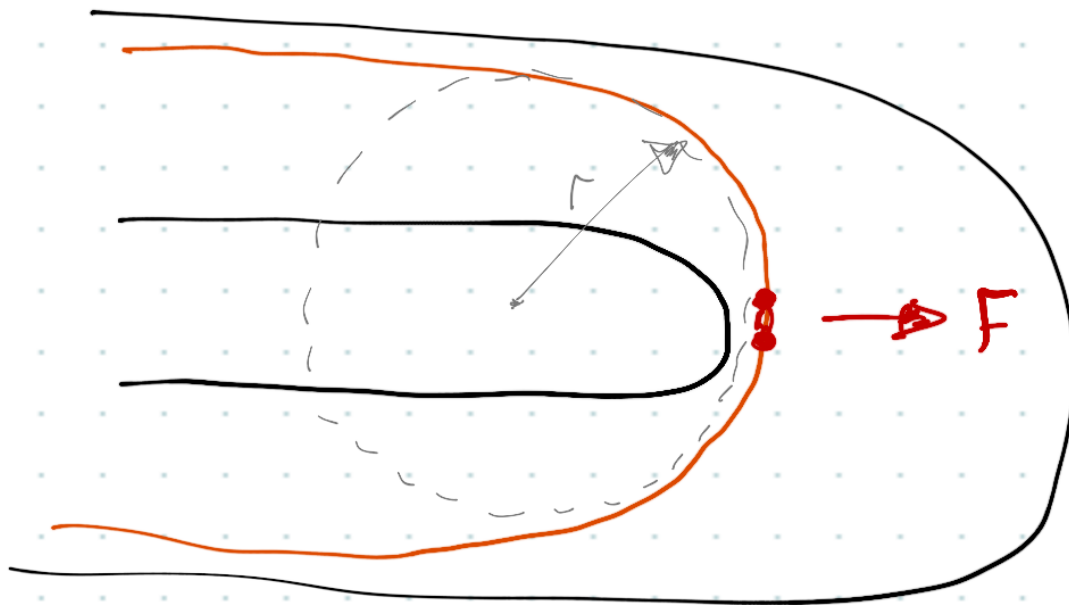
2 things allow a motorcycle to corner

The centrifugal force.

The gyroscopic force.

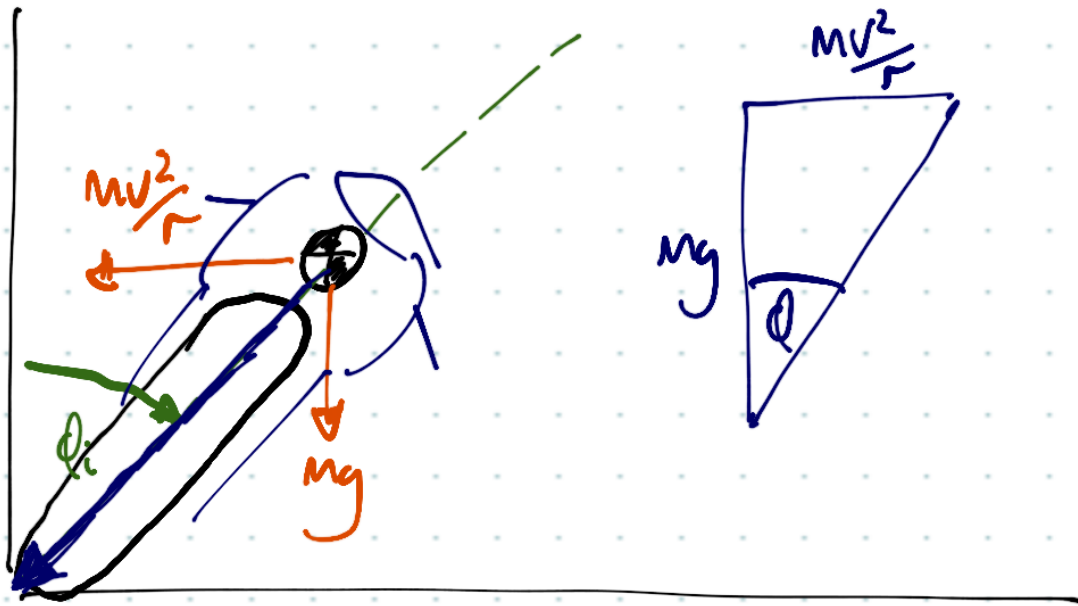
The centrifugal force is a 'pseudo' force that opposes a rotating motion acting at a centre of gravity, what is the real force.

The intensity of the force is given by



$$F = \frac{mv^2}{r}$$

So lets look at a motorcycle mid-corner...



So this combination of forces gives us our Ideal lean angle equation

$$\tan \phi_i = \frac{\cancel{mv^2}}{\cancel{r}mg} = \frac{v^2}{rg}$$

$$\phi_i = \tan^{-1} \left(\frac{v^2}{rg} \right)$$

V = Velocity r = Corner radius $g = g$

Maximum Cornering Speed Limit

For a 50m corner at $300 \text{ ms}^{-1} = 89^\circ!!$

How about the speed that Marc Marquez can take a 50m corner? Assume a 64° lean angle

This gives us 31.7 ms^{-1} or $114 \text{ km/h} / 71 \text{ mph}$

→ Reasonable!

But the limit of the equation is still an issue!

The maximum speed in a corner is reached when the opposing force of friction becomes equal to the centrifugal force,

$$\cancel{M} \frac{v^2}{r} = \mu \cancel{m} g \quad \text{so} \quad \frac{v^2}{r} = \mu g$$

$$V_{\max} = \sqrt{\mu r g}$$

So for a corner of 50 m radius we must have a μ value of (for 31.7 ms^{-1})

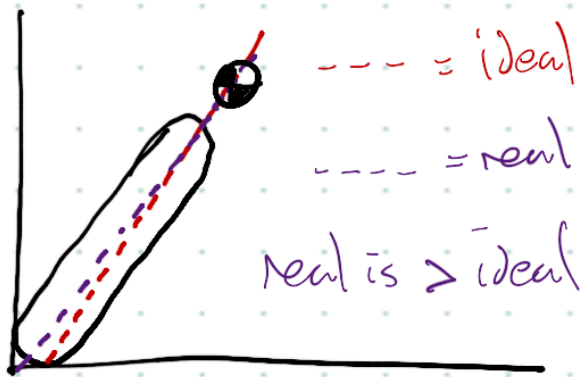
$$\Rightarrow 2.04 !!$$

Corner radius of 100m with a μ of 1.5

→ we get a top speed of 38.76 ms^{-1}

Corrections due to tyre thickness

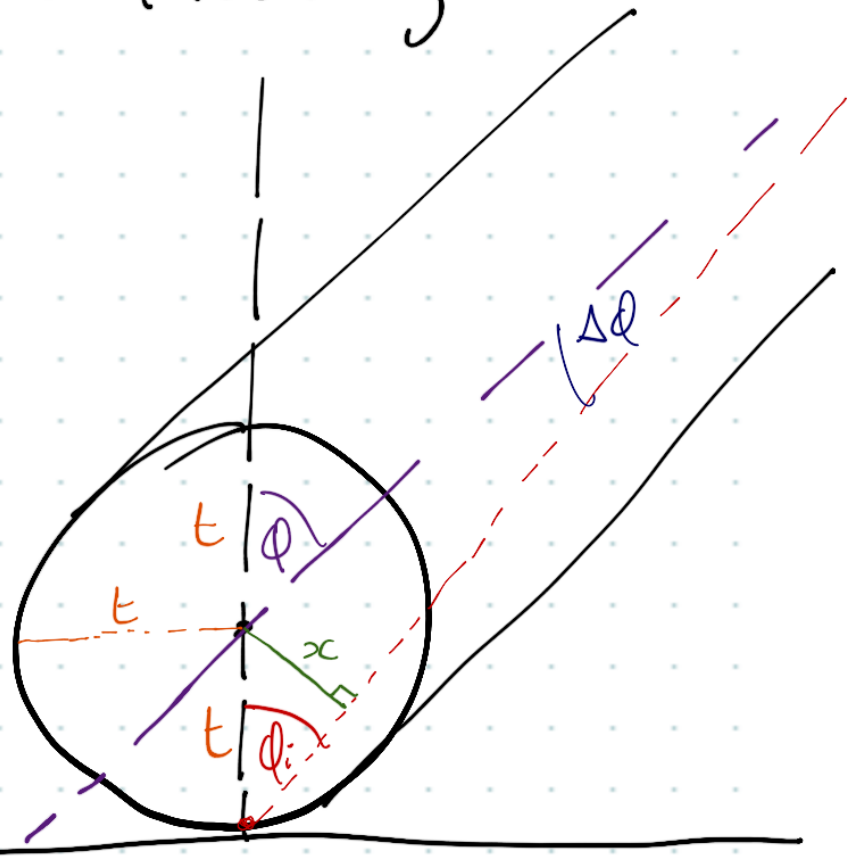
So far, we have the ideal lean angle

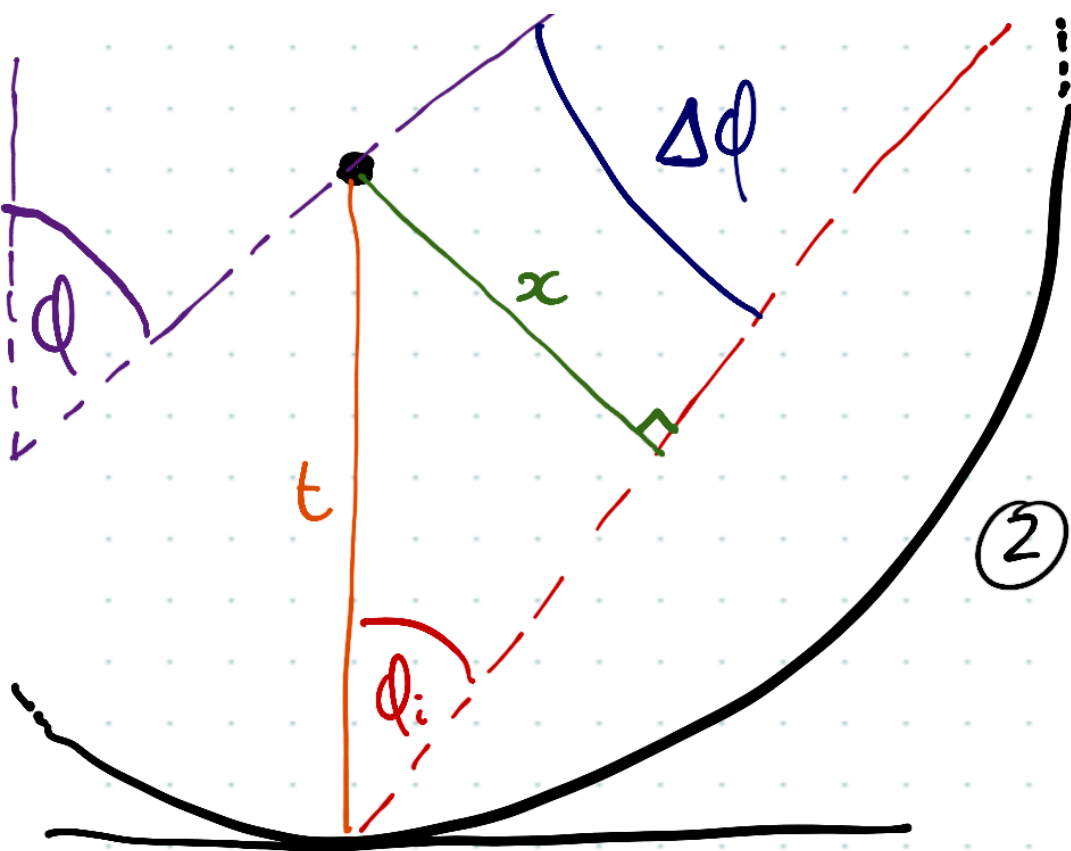


$$\phi = \phi_i + \Delta\phi$$

$$\textcircled{1} \sin \phi_i = \frac{x}{t}$$

$$\textcircled{2} \sin \Delta\phi = \frac{x}{(h-t)}$$





Recap

$$① \sin q_i = \frac{x}{t}$$

$$② \sin \Delta q = \frac{x}{h-t}$$



$$① \quad x = t \sin q_i$$

$$② \quad x = (h-t) \sin \Delta q$$

So equating x

$$t \sin q_i = (h-t) \sin \Delta q$$

This gives us the relationship in Vitellare's book

$$\frac{\sin \Delta q}{t} = \frac{\sin q_i}{h-t}$$