

University of Wales Trinity Saint David

School of Engineering

Exam M4X00394 Vehicle Technology

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BEng Motorsport & Automotive Engineering

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40

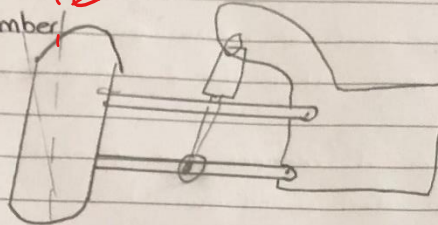
M4X00394

14th May 2020 ?

1800078

lpm

1) i) Camber

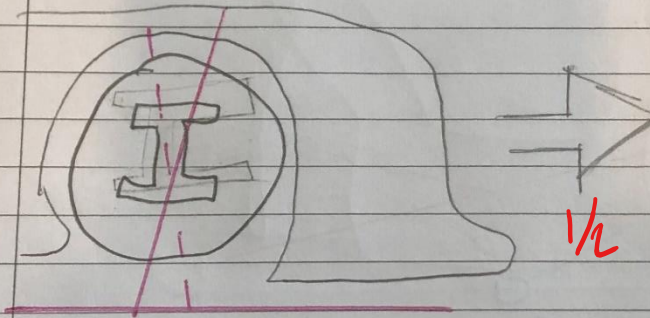


The camber angle is the angle between the vehicle axis of the wheel and the vehicle axis of the car/vehicle, when viewed from the rear or front.

The camber angle alters the handling characteristics of the car. As a general rule, increasing negative camber improves grip when cornering.

how? x

1) ii) Caster angle



Caster angle is the angular displacement from the vehicle axis of the suspension of the wheel of in a car. This is measured in the longitudinal direction.

Adjusting this alters the steering torque and the self centring ability.

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1,5

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1)iii Instant Centre

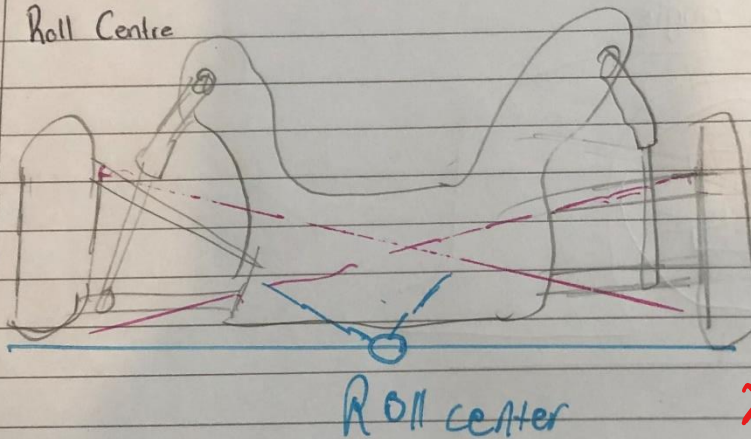
The instant centre is the point of which part of the suspension rotates at that point. It is the swing arm pivot point.

With a longer swing arm it reduces the camber and it be the opposite with a short swing arm

change ✓
1/2
1.5

1)iv

Roll Centre



Not clear
X ICS not correct.

The roll centre is the point at which the chassis rotates at that instant of time. The higher the roll centre, the higher the jacking forces, but lower the body roll. The opposite is said for a lower roll centre.

2

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2 i $a = \frac{v^2}{r}$
 $a = \frac{25^2}{130}$ ✓ $a = 4.81 \text{ m/s}^2$ ✓

2

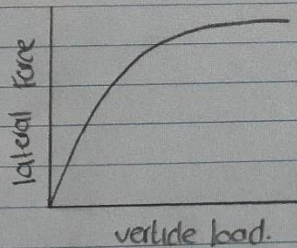
ii load Transfer = $\frac{mah}{t}$ ✓
 $= \frac{915 \times 4.81 \times 0.375}{2.65}$ X
 $= 622.80 \text{ N}$ X

$m = 915 \text{ kg}$
 $a = 4.81$
 $h = 0.375$
 $t = 2.65$

1

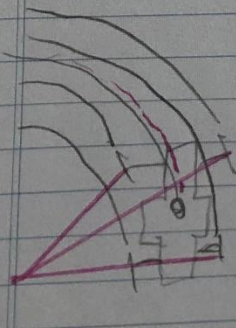
iii The outside ~~load~~ tyre load increases by the same as the inside... However the relationship between the pair is non linear. Therefore, the grip on the inside is lower than what is lost by the inside tyre.

Outside?



1

iv The term slip angle refers the angle of a rolling wheels actual direction and where they are pointed ✓



tyre deflection?

1

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2. $M_s = 215 \text{ kg}$

3 $k_1 = 13,000 \text{ N/m}$

$k_2 = 28,000 \text{ N/m}$

i $k = 2 \times \left(\frac{1}{\frac{1}{13000} + \frac{1}{28000}} \right)$
 $= 17,756.10 \text{ N/m}$

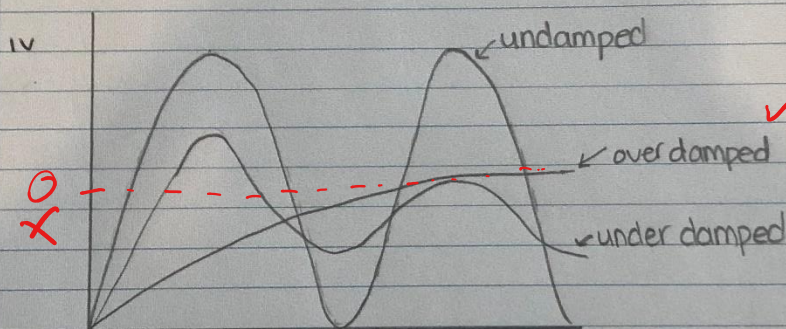
3

ii $f_n = \frac{1}{2\pi} \sqrt{\frac{k}{m}}$

$= \frac{1}{2\pi} \sqrt{\frac{17,756.1}{215}}$

$= 1.45 \text{ Hz}$

2



2

iii Due to the natural frequency of the suspension being 1.45 Hz, it would mean the vehicle would have a comfortable suspension. Therefore, it would be ideal for an off road vehicle.

maybe a little stiff

1

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4. Mass = 875 kg

decelerate = 7.5 m/s

Pedal Ratio: 4:1

Master cylinder piston diameter: 15.875 mm

Slave system piston area diameter: 44.45 mm

No. of slave cylinders: 2

Effective pad radius: 0.15 m

Pad coefficient of friction: 0.42

Rolling Radius: 0.285 m

a. $F = ma$

$$= 875 \times 7.5$$

$$= 6562.5 \text{ N}$$

$$\text{b. Force per wheel} = \frac{6562.5}{2} = 3281.25 \text{ N}$$

$$\text{Torque required per wheel: } F_w \times r = 3281.25 \times 0.285 = 935.16 \text{ Nm}$$

$$\text{Slave piston force: } \frac{T}{\mu \times r} = \frac{935.16}{(0.42 \times 0.15)} = 13916.07 \text{ N}$$

accuracy!

$$\text{Line Pressure: } \frac{F_s}{A_s \times n} = \frac{13916.07}{\pi \left(\frac{0.04445}{2} \right)^2 \times 2} = \frac{13916.07}{0.03103583}$$

one correct

$$= 4.5 \times 10^6 \text{ N/m}^2$$

$$\text{Pedal Force} = \frac{P \times A_m}{PR} = \frac{(4.5 \times 10^6) \times \pi \left(\frac{0.015875}{2} \right)^2}{4}$$
$$= \frac{4.5 \times 10^6 \times 0.000197933}{4}$$
$$= 311.74 \text{ N}$$