

Jonathan Pugh

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Vehicle technology

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14/05/2020

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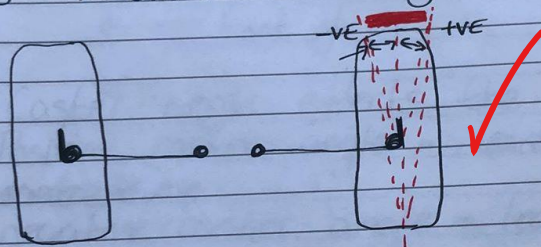
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$$g = 9.81 \text{ m/s}^2$$

28.5
40

i) Question 1
camber

camber is the angle of the wheels.
if the top of the wheels is out from
the centre this is positive camber.
when the bottom is further out this
is known as negative camber



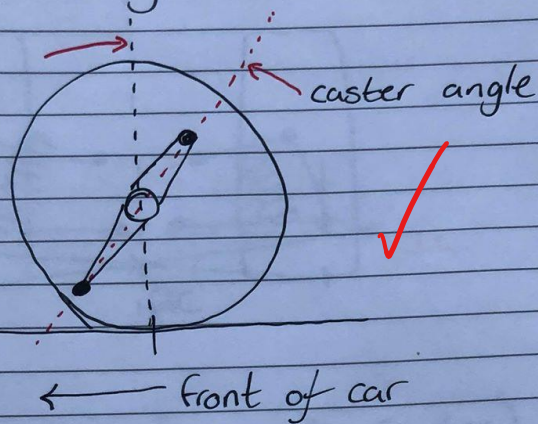
1.5

adjusting the camber will effect grip.
negative camber is used in most vehicles
and improves cornering, as it gives more
tyre contact on the road. $\frac{1}{2}$

Positive camber is mainly used in
offroad vehicles and ~~is~~ helps with
steering.

Camber
thrust

ii) Caster angle

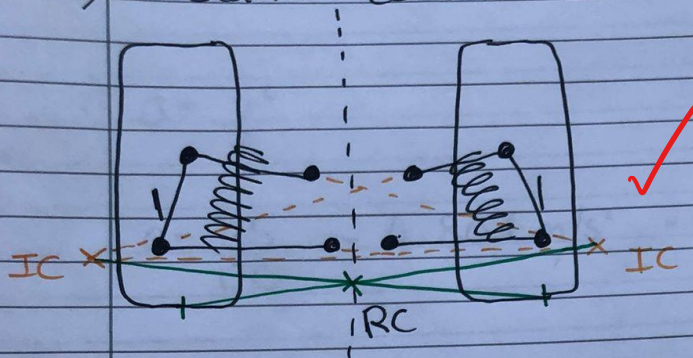


Caster angle effects the steering axis
Positive caster angle = leaning back

~~negative~~
negative caster angle = leaning forward

caster effects stability and can
create camber change with steering

iii) Instant centre



1.5

The IC (Instant Centre) is the virtual point that the $\frac{1}{2}$ wheel is moving around, the pivot point of the linkage at that instant.
 how does it effect
 Camber change $\rightarrow$ Scrub?

iv) roll centre

is the point where the IC from both sides of the car meet

Performance effects?

x

xx

⊕

Question 2

$$\begin{aligned}m &= 915 \text{ kg} \\r &= 130 \text{ m} \\v &= 25 \text{ m/s} \\h &= 0.375 \text{ m} \\t &= 1.16 \text{ m} \\w &= 2.65 \text{ m}\end{aligned}$$

i) $a = \frac{v^2}{r}$

$$a = \frac{25^2}{130} = 4.807 \text{ m/s}^2 = 4.81 \text{ m/s}^2$$

ii) lateral load transfer

$$\frac{mah}{t} = \frac{(915)(4.81)(0.375)}{1.16}$$

$$WT_{lat} = 1403.81 \text{ N}$$

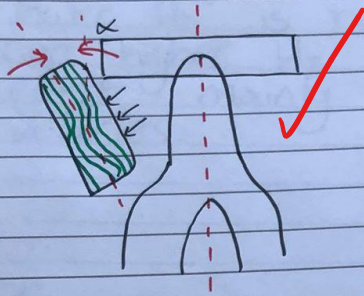
iii) weight transfer reduces grip, grip will increase on the outside wheel the inside wheel grip is reduced more due to the non linear relationship between vertical load and grip of a tyre.

iv) slip angle

slip angle is the difference between the direction the vehicle is traveling and the direction ~~that~~ that the body is facing

Slip angle Cont.

is created by deflecting the tyre



the tyre deflection yields an opposite force and that is when it grips.

1.5

Question 3

i) $k = \frac{1}{\frac{1}{k_1} + \frac{1}{k_2}}$ X

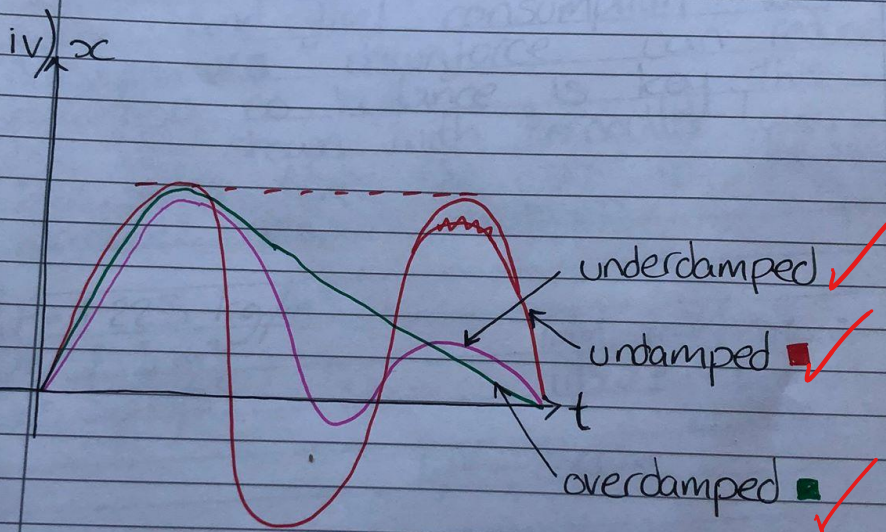
$M_s = 215 \text{ kg}$
 $k_1 = 13000 \text{ N/m}$
 $k_2 = 28000 \text{ N/m}$

$k = \frac{1}{\frac{1}{13000} + \frac{1}{28000}} = 8878.05 \text{ N/m}$ X

ii) $\frac{1}{2\pi} \sqrt{\frac{k}{M}} = \frac{1}{2\pi} \sqrt{\frac{8878.05}{215}}$ ✓

$f_n = 1.023 \text{ Hz}$ X

iii) natural stability of this vehicle was calculated at 1.023 Hz . This is the amount of times a second ~~the~~ an undamped suspension would bounce. lower Hz is better for offroad vehicles and higher Hz has a more rigid effect mainly used in performance vehicles.



Question 5

Aerodynamics

i) the faster the air flow around the vehicle the more downforce that ~~can~~ be applied, however too much downforce can create too much drag that decreases top speeds, increases tyre wear and fuel consumption. less Aerodynamic downforce can reduce handling so balance is key. This can be shown with Bernoulli's law. This states that the speed of the fluid increases pressure decreases.

ii)

$$P = 1.223 \text{ kg/m}^3$$
$$A = 1.1 \text{ m}^2$$
$$V = 35 \text{ m/s}$$

$$\text{Total downforce} = 1115 \text{ N} + 1485 \text{ N} = 2600 \text{ N}$$

$$\text{Lift} = -2600 \text{ N}$$

$$\text{Coef lift} = \frac{\text{Lift}}{\frac{1}{2} P A V^2} = \frac{-2600}{(\frac{1}{2})(1.223)(1.1)(35^2)} = -3.1$$

iii

$$(0.5)(P)(A)(C_d)(V^2) = (0.5)(1.223)(1.1)(0.67)(35^2)$$
$$= 552.08 \text{ N}$$

iv) Centre of Pressure (%)

$$\text{Front} = 1115\text{N}$$

$$\text{Rear} = 1485\text{N}$$

$$\frac{\text{front}}{\text{total}} \times 100 = \frac{1115}{2600} \times 100 = 0.429 \times 100 =$$

$$\text{front} \rightarrow 42\% \dots \times 42.9 \quad |$$

meaning that the rear has 58%
of the downforce