ASSIGNMENT

Submitted by
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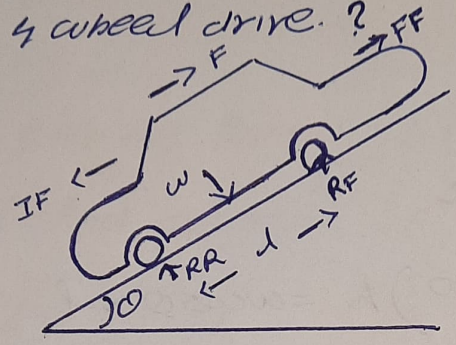
Q1 Derive the equation of motion & maximum tractive effort for a car inclined at angle θ. Also give the expression for maximum gradeability for 4 wheel drive. ?



W = weight of the car

CG - centre of gravity

b = wheel base

F = maximum fwd acceleration

F_F = maximum Tractive Effort

R&F = Rear and front wheel

RR & RF = Total normal reaction at front and rear wheel.

h = Height from CG to road surface

IF = inertia force $= M \cdot F - W\sin\theta$

$= mf - mg\sin\theta$

$= W/g \cdot F - W\sin\theta$ -①

$\Sigma V = 0$ -②

$\Sigma H = 0$ -③

from ② (using)

$W\cos\theta = RF + RR$ -④

From ⑧ using

$$F_f = w/g \cdot F + w\sin\theta \quad -⑤$$

$$\mu R_F = w/g + w\sin\theta \quad -⑥$$

$$R_F = w/g\, f + w/\mu \sin\theta \quad -⑦$$

$$\frac{w}{\mu}\left[f/g + \sin\theta\right]$$

Taking moment about R

$$R_F \times b + \left(\frac{w}{g} f + \sin\theta\right) h = w\cos\theta \times l$$

$$\left(\frac{w}{g}\frac{\theta}{\mu} + \frac{w}{\mu}\sin\theta\right) b + \left(w/g\, F + w\sin\theta\right) \times h = w\cos\theta \times l.$$

$$\left(\frac{f}{g\mu} + \frac{\sin\theta}{\mu}\right) b + \left(f/g + \sin\theta\right) h = \cos\theta l.$$

$$b/\mu\left(f/g + \sin\theta\right) + \left(f/g \sin\theta\right) h = \cos\theta l.$$

$$\left(f/g + \sin\theta\right)\left(b/\mu + h\right) = \cos\theta l$$

$$\left(f/g + \sin\theta\right) = \left(\frac{\cos\theta l}{b/\mu + h}\right) \quad -⑧$$

$$f/g = \left(\frac{\cos\theta l}{(b/\mu + h)}\right) - \sin\theta$$

$$F = g\left[\left[\frac{\cos\theta l}{(b/\mu + h)}\right] - \sin\theta\right] \quad -⑨$$

$$R_F = w/\mu \times \frac{\cos\theta l}{(b/\mu + h)} \quad -⑩$$

$$= \frac{w\cos\theta l}{b + \mu h}$$

$$R_R = W\cos\theta - R_F$$

$$= W\cos\theta - W/\mu \frac{\cos\theta d}{(b/\mu + h)}$$

$$= W\cos\theta \left[1 - \frac{d}{(b+\mu h)}\right]$$

$$= W\cos\theta \left[\frac{b+\mu h - d}{b+\mu h}\right]$$

$$F_F = \mu R_F = \mu \left[\frac{W\cos\theta d}{b+\mu h}\right]$$

Fourwheel Drive

$$F = R_F + F_F = \mu R_R + \mu R_F$$

$$\Sigma V = 0$$

$$W = R_F + R_R$$

$$\Sigma H = 0$$

$$(W/g)F = \mu R_R + \mu R_F$$

$$\mu(R_R + R_F) = \mu W$$

$$P/g = \mu$$

$$\Sigma V = \mu$$

$$\Sigma V = 0$$

$$W = R_R + R_F$$

$$\Sigma H = 0$$

$$W/g = \mu R_R + \mu R_F$$

Assuming slip to occur front wheels

I^st, RF & RR then

$\Sigma M_R = 0$, $2\mu R_F = (w/g) F$

$R_F b + (w/g) \cdot fh = cw1$

Q2 cosider a car with the following specification that is parked on a level road find the load on the front & rear axles

$M = 1765\ kg$, $l = 2.84m$, $a_1 = 1.22m$, $a_2 = 1.62m$

$m = 1765\ kg$

$l = 2.84m$

$a_1 = 1.22m$

$a_2 = 1.62m$

load on front axles $= F_{AF} = mg\,(a_2/l)$

load on rear wheel axles, $F_{AR} = mg\,(a_2/l)$

$F_{AR} = mg\,(a_1/l)$

$1756 \times 9.81 \left(\frac{1.22}{2.84}\right)$

$= 7430.4N$ (load on real axles)

$F_{AF} = mg\,(a_2/l)$

$= 1765 \times 9.81 \left(\frac{1.62}{2.84}\right)$

$= 9866.59N$ (load on front axles)

Q3 what are the different parts of tyers ? differentiate biw tyres of tyres on the basis of their construction.

Main parts of Tyers

1) Belts => These are rubber coated layers rayon, steel fibre glass & other materials which are located in mid of the thread and plies, across at angles, which holds the plies in place it provides resistances to punctures & help threads to in contact with the road.

2) sipes => special kind of threads within the thread improve tractive effort on different road surfaces

3) Thread => It is in the portion of the tire that comes in directly contact with in the road.
It should have higher strength & good heat dissipation property.

4) Grooves => It is in the spaces provided on the outer layer of the tyre it provides space for water flows friction.

5) shoulder => outer edge of the tyre which wraps into the sidewall area.

6) sidewall => It protects the cord plies used to feature tire markings, size, type.

7) Inner liner => Innermost layer of the tubeless tyre

It prevents flow of air from inner to outside & vice versa.

Based on construction =>

4) cross ply tyre construction

- It is also known as bias ply tyre construction
- They have good bonding to the road.
- It consist of carcass layers made from nylon cord which are placed diagonally along each other in thread & sidewall at an angle 50°
- less flexible
- strong & rigid sidewall

Advantages

High vehicle stability
good resistance against sidewall damages
Economical, cheaper.

Disadvantages

1) due to to rolling resistance tires heat up quickly
2) Rigid & less comfortable.
3) fuel consumption is high

2. Radial ply tyre construction

It consists of a carcass ply which is formed by textile cores running one bead to the other. Each ply embedded at an angle of 90°, to the rolling direction. At the top of tyre crown several plies is reinforced with metal wire on top of carcass ply.

Advantages

- lower rolling resistances
- less fuel consumption.
- longer thread life
- less heat generation
- larger resistance to punctures

Disadvantages

- sidewalls are vulnerable
- Due to harder thread they make high noise