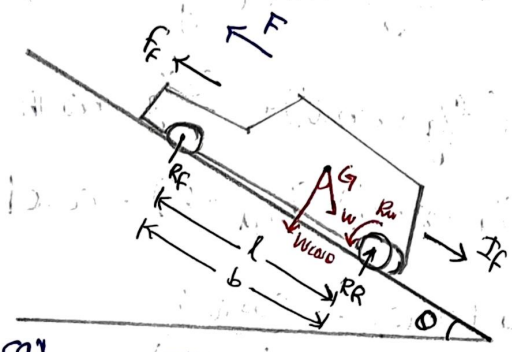
(1) Derive the equation of motion and maximum tractive effort for a car inclined at angle θ. also give the expression of maximum gradeability for a 4 wheel drive.



W - weight of the car
b - wheel base
G - Center of gravity
F - max forward accelaration
FF - max. tranctive effort
RR & RF - Total normal reaction at front & rear wheels
h - height frm road to G
If - Insta force

$$I_F = M \cdot F - W \sin\theta$$
$$= m \cdot f - mg \sin\theta \qquad m = W/g$$
$$= W/g \cdot f - W \sin\theta \quad \text{—— (1)}$$

$$\Sigma V = 0 \quad \text{—— (2)}$$
$$\Sigma H = 0 \quad \text{—— (3)}$$

(2) $\Rightarrow$ $W \cos\theta = R_F + R_R$ —— (4)

(3) $\Rightarrow$ $F_F = W/g \, f + W \sin\theta$

$\mu R_F = W/g \cdot f + W \sin\theta$

$R_R = W/g \cdot f + W/\mu \sin\theta$ ——

Taking moment about x

$$R_f \times b + (W/g\, f + \sin\theta)\, h = w\cos\theta \times l$$

$$\left(\frac{W}{g}\cdot\frac{l}{\mu} + \frac{w}{\mu}\sin\theta\right) b + \left(\frac{w}{g} f + w\sin\theta\right) h = w\cos\theta \, l$$

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

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

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

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

$$\frac{F}{g} = \frac{\cos\theta \, l}{b/\mu + h} - \sin\theta$$

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

$$R_f = w/\mu \times \frac{\cos\theta \, l}{(b/\mu + h)}$$

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

$$R_R = w\cos\theta - R_f$$

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

$$= w\cos\theta \left[1 - \frac{l}{b + \mu h}\right]$$

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

$$F_F = \mu R_f = \mu \times \left(\frac{w\cos\theta \, l}{b + \mu h}\right)$$

Four wheel Drive

$$F = R_f + F_f = \mu R_R + \mu R_f$$

$$\Sigma V = 0$$

$$W = R_f + R_R$$

$$\Sigma M = 0$$

$$(W/g)f = \mu R_R + \mu R_f = \mu (R_R + R_f)$$

$$= \mu W$$

$$F/g = \mu$$

$$\Sigma V = 0$$

$$W = R_R + R_f$$

$$\Sigma H = 0$$

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

Assuming slip to occurat front wheel

front $R_f < R_R$ then

$\Sigma MR = 0$ $\quad 2\mu R_f = (W/g/F)$

$$R_f b + (W/g) f_h = W_1$$

(2) Consider Car with the following specification that is parked on a level road. find the load on the front and rear axles.

$M = 1765 kg$

$l = 2.84m$

$a_1 = 1.22m$

$a_2 = 1.62m$

Load on front axle $f_{AF} = mg\left(\frac{a_2}{l}\right)$

$= 1765 \times 9.8 \left(\frac{1.62}{2.84}\right)$

$f_{AF} = 9866.59N$

Load on front axels $= 9866.59N$

Load on rear axels $f_{AR} = Mg\left(\frac{a_1}{l}\right)$

$= 1765 \times 9.8 \left[\frac{1.22}{2.84}\right]$

$= 7430.40N$

Load on rear axels $= 7430.40N$

③ what are the different ~~type~~ parts of tyres? Differentiate between types of tires on the basis of their construction

① Side wall :- The area of a tire from the bead to the tread. the side of the tire is known as side wall. It forms a protective covering for the cord body

② Tread :- Treads is the portion of tire that comes in contact with the road surface. The tread compond and it design have to balance wear, traction, handling & fuel economy, resistance and other characteristics of the tire.

③ Beads :- Beads holds the tire to the rim or the outer edge of the wheel. They are made of copper, brass or known plated high tensile steel wire wound into a rubber band. The bead prevents the tire from sliding out of place when the wheel roll.

④ Bead filler :- It is a rubber compound inside the tire beads it provides stability to the lower side wall and bead area. the density and stiffness of a tires bead filled helps to determine tire performance characteristics.

⑤ Radial cord body :- It gives the tire strength and transmits covering forces from the tread to the wheel. Rubber coated fabric

Cord, called body plies. make up the cord body
body plies can be made of polyester, rayon or nylon. polyester is most commonly used

⑥ Belt plies :- These are two or more strong layers of cord just under the tread area of the tire. The primary function of belt plies is to provides Strength and stability to the tire tread. They play a role in improving tire mileage, impact resistance and fracture. Steel is the most commonly used cord material in belt plies

⑦ Inner liner :- It is a rubber compound bonded to the inside of the cord body that retains air under pressure. It has no cord reinforcement and it functions like and inner tube. The modern car tire ~~have~~ no longer have inner tube inside them.

Diffrnt types

Bias ply

* The treads & side walls have the same casing plies
* Reduced traction
* Nylon belts
* Normal duty
* Low cost and low life expectancy

Radial

* Cord plies are arranged 90° to the direction of travel
* Outstanding traction
* steel belts
* Extreme duty
* Expensive and long life Expectancy