Analysis of Load, Moment, Stresses on different Section of front axle

* Front axle are subjected to both bending and shear stresses.

* In the static condition, the axle may be considered as a beam supported vertically upwards at the ends. i.e., at the center of the wheels and loaded vertically downward at the centers of the spring pads.

* The Vertical bending moment thus caused is zero at the point of support and rises linearly to a maximum at the point of loading and then remains constant.

Thus the maximum bending moment $= W \times l$ (Nm)

where,

$W \rightarrow$ load on one wheel, (N)

$l \rightarrow$ distance between the center of wheel and the spring pad.

* Under dynamic condition, the Vertical bending moment is increased due to road roughness.

* But its estimate is difficult and hence generally accounted through a factor of safety.

* The front axle also experiences a horizontal bending moment because of resistance to motion and this is of a nature similar to the Vertical one

but of very small magnitude and hence can be neglected except in those situation when it is comparitively large.

* The resistance to motion also causes a torque in the case of drop type front axle.

* Thus the portion after spring pad are subjected to combined bending and torsion.

The magnitude of torque = $R\delta$, Nm

Where,

R = The resistance to motion (N)

δ = The drop from the spindle axis to the center of the section, (m)

* The shear stress in the axle due to braking torque and its magnitude is

$$= \mu W r \text{ (Nm)}$$

Where

r → Road wheel radius

μ → Coefficient of adhesion b/w wheel and road.

= 0.6 for dry, hard road surface

②→④

* The braking torque is lower for the section lying between the spring pads and is given by $\mu W(r-\delta)$

* In this portion the bending moment predominates whereas at steering head torsion predominates.

* Thus I section is used for the portion where bending moment predominates and is gradually changed to circular, oval or rectangular section at steering head.

For I Section,

$$\frac{M}{I} = \frac{f_b}{y}$$

For circular or oval section,

$$\frac{T}{I_p} = \frac{f_s}{y}$$