SNS COLLEGE OF TECHNOLOGY

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COIMBATORE-35.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

COURSE NAME : 19AUT302 – VEHICLE DYNAMICS AND STRUCTURES

III YEAR / V SEMESTER

Unit 1 – Vehicle Design

Topic : Technical terms in Vehicle Design

KERB WEIGHT

- The car's kerb weight includes all the equipment and fluids in a car, including a full tank of petrol or diesel in internal combustion engined models.
- Kerb weight does not include the driver, passengers or any luggage.
- There are other variations of kerb weight that you may encounter...
  - **Dry kerb weight or dry weight** - The weight of the car without fuel or fluids.
  - **Minimum kerb weight or unladen weight** - The weight of the car with all the fluids but no fuel.

GROSS WEIGHT

- Gross Weight is the kerb weight plus driver, passengers and luggage.
- The gross vehicle weight (GVW) is often otherwise referred to as Maximum Authorised Mass (MAM) or permissible maximum weight.
- A car, van or goods vehicle exceeding its gross vehicle weight is overloaded and breaking the law.
- Vehicles will also have a gross train weight (GTW) or gross combination weight (GCW that refers to the maximum total weight of the vehicle plus the maximum weight of trailer that it can tow.
- It is also called as laden weight

AIR RESISTANCE

- The resistance offered by the air to the movement of a vehice
- It has an influence on the performance, ride and stability of the vehicle
- It depends on the size and shape of the body, its speed and wind velocity

$$R_a = K_a A V^2$$

- ✓ A- Projected Frontal Area in m^2
- ✓ V – Speed of the Vehicle in km/h
- ✓ K_a – Coefficient of air resistance in $N\text{-}h^2/m^2$ k
  - For Best Streamlined cars – 0.023
  - For Average car – 0.031
  - For Truck and Lorries – 0.045

$R_a = \frac{1}{2} \rho A V^2 C_d$

$R_a \rightarrow$ Air resistance

$C_d \rightarrow$ coefficient of drag

$A \rightarrow$ Area (m^2)

$V \rightarrow$ Speed (m/s)

$\rho \rightarrow$ density of air (kg/m^3)

ROLLING RESISTANCE

- It is the force resisting the motion when a body rolls on a surface
- It is also called as road resistance.
- The magnitude of rolling resistance depends mainly on
  - Nature of the road
  - Type of tyre used
  - Weight of the vehicle
  - Speed of the vehicle

The rolling resistance is expressed as

$$R_r = KW,$$

where W = total weight of the vehicle, N,

and K = constant of rolling resistance and depends on the nature of road surface and types of tyre

= 0.0059 for good roads

= 0.18 for loose sand roaas

= 0.015, a representative value.

A more widely accepted expression for the rolling resistance is given by

$$R_r = (a + b\,V)\,W,$$

where V = speed of the vehicle, km/h.

Mean values of a and b are 0.015 and 0.00016 respectively.

GRADE RESISTANCE

- The component of the weight of the vehicle parallel to the gradient or the slope on which it moves is termed as grade resistance.
- Thus it depends upon the steepness of the grade
- If the gradient is expressed in 1/5, it means that for every 5 meters the vehicle moves, it is lifted by 1 meter

$$R_g = W \sin \theta,$$

where W = total weight of the vehicle, N,

and θ = inclination of the slope to the horizontal.

Percentage grade = $\tan \theta \times 100$, but for small values of θ, $\tan \theta \approx \sin \theta$.

TRACTION AND TRACTIVE EFFORT

- The force available at the contact between the drive wheel tyre and road is known as Tractive effort.
- The ability of the drive wheels to transmit this effort without slipping is known as traction

Engine torque, $T_E = \frac{60000\,P_E}{2\pi N}$, Nm.

Torque at drive wheels, $T_w = (g.r. \times a.r.)\,\eta_t\,T_E = G\,\eta_t\,T_E$, Nm.

Tractive effort, $F = \frac{T_w}{r} = \frac{T_E\,G\,\eta_t}{r}$, N.

Where, P_E = engine BP, kW,

T_E = mean engine torque, Nm,

η_t = overall transmission efficiency,

$g.r.$ = gearbox gear ratio,

$a.r.$ = axle ratio,

G = overall gear ratio = $(g.r \times a.r.)$,

r = radius of tyre, m,

and N = rpm of crankshaft.

When the tractive effort $F > R$, the total resistance on level road, the surplus tractive effort is utilized for acceleration, hill climbing and draw-bar pull.

ACCELERATION

- When the vehicle is accelerated, its rotating parts are also accelerated depending upon their moment of inertia and the gear ratio in the the drive line
- Due to this weight of the vehicle is increased and this increased weight is called effective or equivalent weight of the vehicle.
- When surplus power is fully utilized for acceleration, then

$$\text{Surplus or excess power} = W_E f \frac{V}{3600}, \text{ kW.}$$

$$\text{or, maximum acceleration, } f = \frac{1}{W_E} (\text{Surplus power}) \frac{3600}{V}$$

$$= \frac{1}{W_E} (P_E - P_R) \eta_t \frac{3600}{V} = \frac{1}{W_E} (P_E \eta_t - P_v) \frac{3600}{V}$$

$$= \frac{1}{W_E} (\text{Tractive effort} - \text{Road resistance}) = \frac{1}{W_E} (F - R).$$

GRADABILITY

- The maximum percentage grade, which a vehicle can negotiate with full rated condition is known as gradability.

$$\text{Surplus power} = \frac{W \times \text{Gradability} \times V}{100 \times 3600}.$$

$$\text{Therefore, Gradability} = \frac{100}{W}(P_E \eta_t - P_V)\frac{3600}{V}$$

$$= \frac{100}{W}(\text{Tractive effort} - \text{Road resistance}) = \frac{100}{W}(F - R).$$

DRAW PULL BAR

- When excess power is fully utilized for pulling extra load attached to vehicle then

Maximum drawbar pull = Tractive effort – Road Resistance

= F – R

- Road resistance in this case is made up of rolling resistance and air resistance

THANK YOU !!!