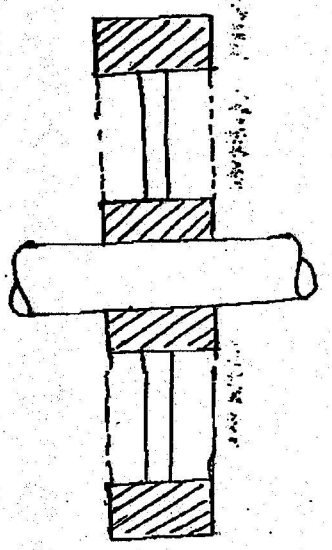
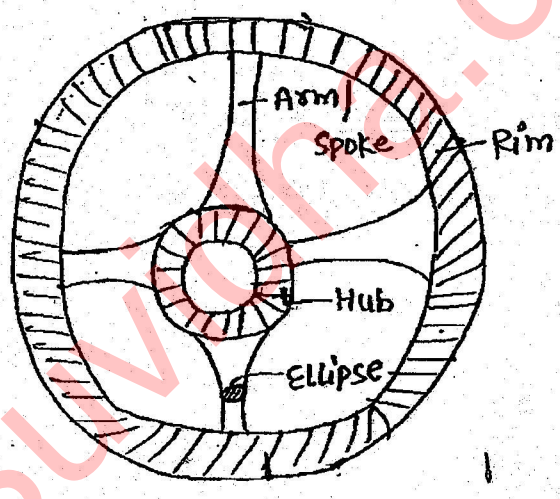
FLYWHEEL

1. To store and release energy when needed during work cycle.
2. To reduce power capacity of the electrical motor or Engine.
3. To reduce the amplitude of speed fluctuations.

Solid Flywheel (One piece Flywheel) :-





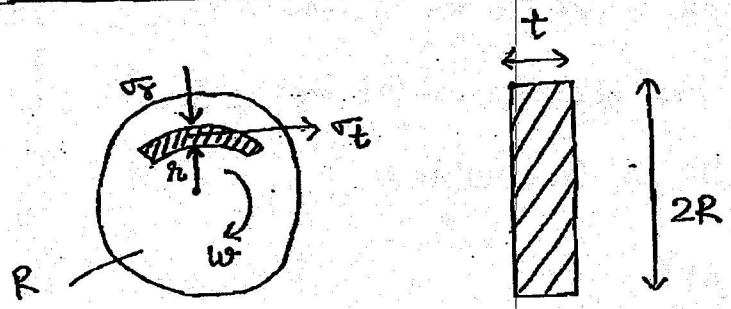
* Best area for arm/spoke
  ↓
  Ellipse

* Flywheel is made by casting process and cast iron is the best material for flywheel.
* The construction of solid flywheel is made by grey cast iron. In large flywheels stresses are induced in the arm during the casting process because there is a heavy mass concentration at the Rim and hub which results unequal cooling rate and these stresses are known as Thermal stresses or cooling stresses.

Hence in this case Hub and Rim are cut together from the centre and split flywheel is moulded by casting.

mP:

Solid Disc Flywheel :-



R → Radius of the Disc

I → mass moment of inertia of the Disc

ρ → Density of the Disc/flywheel

$$I = \frac{mR^2}{2}$$

And ~~$m = \rho \times$~~

$$m = \rho \pi R^2 \cdot t$$

There are two principle stresses in the rotating disc.

σ_t → tangential stress

σ_R → Radial stress

$$\sigma_t = \frac{\rho V^2}{10^6} \frac{(\mu+3)}{8} \left[1 - \left(\frac{3\mu+1}{\mu+3}\right)\left(\frac{r}{R}\right)^2\right]$$

$$\sigma_r = \frac{\rho V^2}{10^6} \left(\frac{\mu+3}{8}\right) \left[1 - \left(\frac{r}{R}\right)^2\right]$$

V → Periphery velocity and μ = poisson's ratio.

$$\boxed{V = R\omega}$$

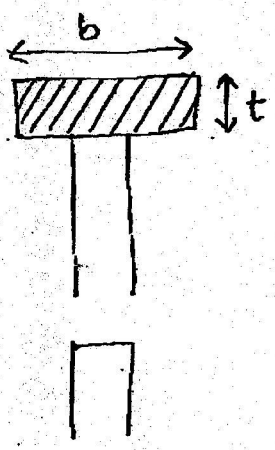
$$\frac{\sigma_t}{\sigma_r} = f(r)$$

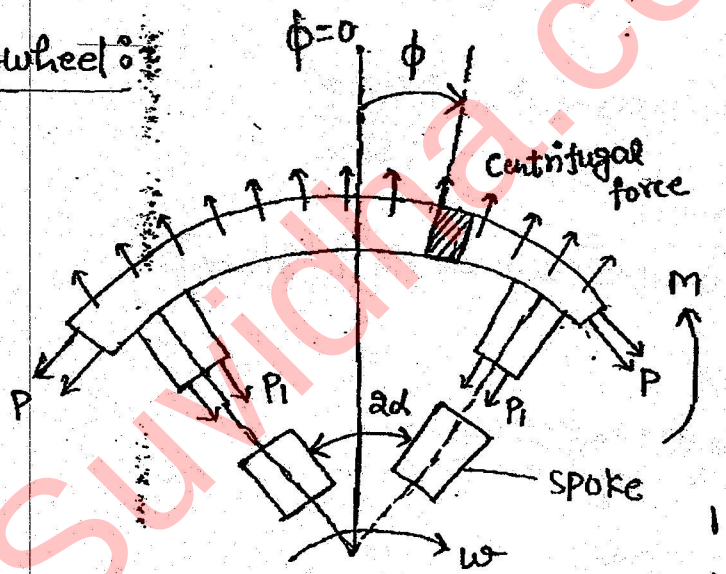
When $r = 0$

$$\sigma_t = \sigma_r = \sigma_{max} = \frac{\rho V^2}{10^6}\left(\frac{\mu+3}{8}\right) \quad [MPa]$$

NOT important

DESIGN Of Rimmed Flywheel:





Spoke

$$\sigma_{ind} = \frac{P_1}{A}$$

A → Spoke area

$$P_1 = \frac{2}{3}\left[\frac{1000\, m' V^2}{c}\right]$$

Rim

$$\sigma_{Rim} = \frac{P}{bt} \pm \frac{M y_{max}}{I_{NA}}$$

$$\sigma_{Rim} = \frac{P}{bt} + \frac{6M}{bt^2}$$

$$C = 12(10^6)\left[\frac{R^2}{t^2}\right]x + y + \frac{bt}{A}$$

$$x = \frac{1}{2\sin^2\alpha}\left[\frac{\sin 2\alpha}{4} + \frac{\alpha}{2}\right]$$

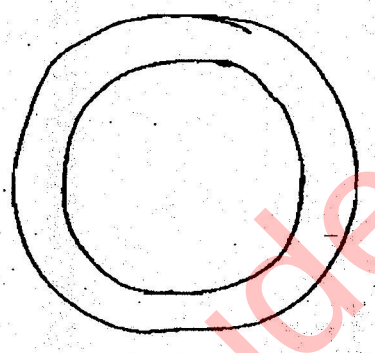
$$y = \frac{1}{2\sin^2\alpha}\left[\frac{\sin 2\alpha}{4} + \frac{\alpha}{2}\right] - \frac{1}{2\alpha}$$

$$M \text{ at } \phi = \frac{1000 P_1 R}{2}\left[\frac{\cos\phi}{\sin\alpha} - \frac{1}{\alpha}\right]$$

$$P \text{ at } \phi = 1000 m' v^2 - \frac{P_1 \cos\phi}{2\sin\alpha}$$

m' = mass per unit length [kg/mm]

If spokes are neglected :-



$$\sigma_h = \rho V^2$$

Centrifugal clutch :-