Design of Cylinder

1) A four Stroke diesel engine has the following

Specification:

Brake power = 5 KW

Speed = 1200 rpm

Indicated Mean effective pressure = $0.35 N/mm^2$

Mechanical efficiency = 80%.

Determine

(i) Bore & Length of the cylinder

(ii) Thickness of the cylinder head

(iii) Size of Studs for cylinder head.

Given data;

B.P = 5 KW

N = 1200 rpm

$P_m = 0.35 N/mm^2$

$\eta = 80\%$.

To find:

(i) D & L

(ii) t_h

(iii) d

Solution:

(i) Bore & Length of the cylinder

$$I.P = \frac{P_m \times l \times A \times n}{60}$$

$$n = \frac{N}{2}$$

$$= \frac{1200}{2}$$

$$\boxed{n = 600 \text{ rpm}}$$

$$B.P = \eta_m \times I.P$$

$$5 = 0.8 \times I.P.$$

$$\boxed{I.P = 6.25 \text{ KW}}$$

$$\boxed{l = 1.5 D}$$

$$I.P = \frac{P_m \times l \times A \times n}{60}$$

$$6.25 \times 10^3 = \frac{0.35 \times 1.5D \times \frac{\pi}{4} \times D^2 \times 600}{60 \times 10^3}$$

$$D = 114.9 \text{ mm} \approx 115 \text{ mm}$$

$$\boxed{D = 115 \text{ mm}}$$

$$l = 1.5 \times D = 1.5 \times 115$$

$$\boxed{l = 172.5 \text{ mm}}$$

$$L = 1.15 \times l = 1.15 \times 172.5$$

$$L = 198.38 \simeq 200$$

$$\boxed{L = 200 \text{ mm}}$$

(ii) Thickness of the cylinder

$$t_h = D \times \sqrt{\frac{C \times P}{\sigma_t}}$$

$P = q P_m$ [from data book

$P = 9 \times 0.35$

$\boxed{P = 3.15 \text{ N/mm}^2}$

$t_h = 115 \times \sqrt{\frac{0.1 \times 3.15}{50}}$

$\boxed{t_h = 9.128 \text{ mm}} \simeq 10 \text{ mm}$

$\boxed{t_h = 10 \text{ mm}}$

(iii) Size of stud

Force acting on cylinder head (on studs)

$= \frac{\pi}{4} \times D^2 \times P.$

$= \frac{\pi}{4} \times 115^2 \times 3.15$

Force acting on cylinder = 32719 N → (1)

Number of Studs $n_s = 0.02D + 4$

$= 0.02(115) + 4$

$= 6.3 \simeq 6$

$\boxed{n_s = 6}$

Resisting force offered by all studs

$= n_s \times \left(\frac{\pi}{4}\right) \times d_c^2 \times \sigma_t$

$= 6 \times \frac{\pi}{4} \times (0.84d)^2 \times 70$

$\boxed{\text{Resisting force} = 232.75\, d^2} \rightarrow (2)$

$(1) = (2)$

$32719 = 232.75\, d^2$

$d = 11.85 \simeq 12$

$\boxed{d = 12\text{mm}}$

Pitch circle diameter of stud

$D_p = D + 3d.$

$= 115 + 3(12)$

$\boxed{D_p = 151\text{mm}}$

Pitch of the studs $= \frac{\pi \times D_p}{n_s}$

$= \frac{\pi \times 151}{6}$

Pitch of studs $= 79.06$ mm

Result:

(i) $D = 115$ mm

$L = 200$ mm

(ii) $t_h = 10$ mm

(iii) $d = 12$ mm

$D_p = 151$ mm

Pitch $= 79.06$ mm