Design of IC Engine Components - Cylinder

Functions of Cylinder

- Primary function is to retain the working fluid such as mixture of air and petrol or air and diesel

- Secondary function is to guide the piston

Requirements of Cylinder Material

- Should be strong enough to withstand high gas pressure
- Should be strong enough to withstand thermal stresses
- Should be hard enough to resist wear due to piston movement
- Should have good surface finish to reduce friction during piston movement
- Should be corrosion resistant

Common Cylinder Materials

a. Grey cast iron (usually)

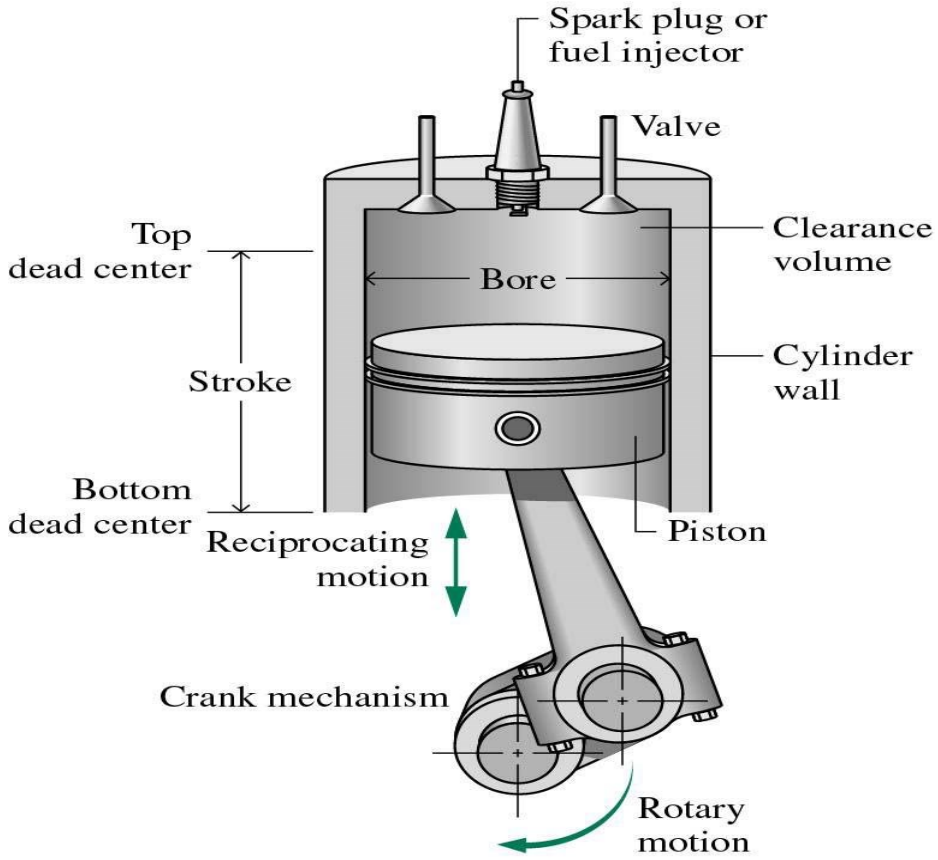
b. Nickel cast iron or Nickel Chromium cast iron for heavy duty applications

c. Cast steels and Aluminium alloys may also be used

Design of Cylinder

Involves assessment of following dimensions:

- Bore of cylinder
- Length of cylinder
- Thickness of cylinder wall
- Thickness of cylinder head
- No. and diameter of cylinder head studs
- Pitch circle diameter of studs



Bore and Length of Cylinder

- Brake power

$$B.P. = \frac{p_{mb}\ L\ A\ n}{60}$$

- Indicated power

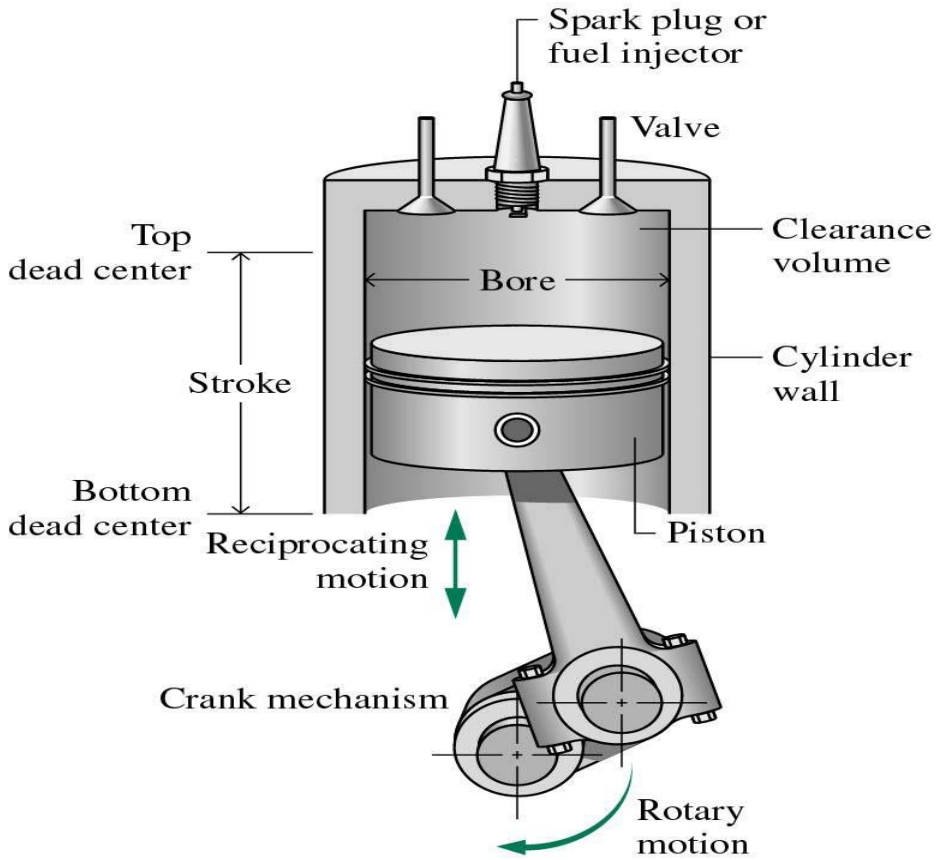
$$I.P. = \frac{p_{m}\ L\ A\ n}{60}$$

- Mechanical efficiency (usually 80 % if not given)

$$\eta_{m} = \frac{B.P}{I.P}$$

Bore and Length of Cylinder

- Length of stroke is usually 1.5 times bore diameter
- Length of cylinder is more than length of stroke (usually 15%)



Thickness of Cylinder wall

$$t = \frac{p_{max}\, D}{2\,\sigma_c} + C$$

t = thickness of cylinder wall (mm)

p_{max} = maximum gas pressure inside cylinder (10 times indicated mep)

σ_c = permissible circumferential stress for cylinder material (35 to 100 MPa)

D = Bore diameter (mm)

C = re-boring allowance (according to bore diameter from data book)

Thickness of Cylinder head

$$t_h = D\sqrt{\frac{K\, p_{max}}{\sigma_c}}$$

t_h = thickness of cylinder head (mm)

D = Bore diameter (mm)

K = a constant (= 0.162)

p_{max} = maximum gas pressure inside cylinder (10 times indicated mep)

σ_c = permissible circumferential stress for cylinder head material (30 to 50 MPa)

Studs for Cylinder head

- Minimum no. of studs = 0.01 D + 4
- Maximum no. of studs = 0.02 D + 4
- Diameter of studs

$$\left(\frac{\pi D^2}{4}\right) p_{max} = z\left(\frac{\pi d_c^2}{4}\right)\sigma_t$$

z = no. of studs

d_c = core diameter of studs (= 0.8 times nominal diameter d)

σ_t = allowable tensile stress for stud material (35 to 70 MPa)

- Pitch circle diameter of studs $D_p = D + 3d$