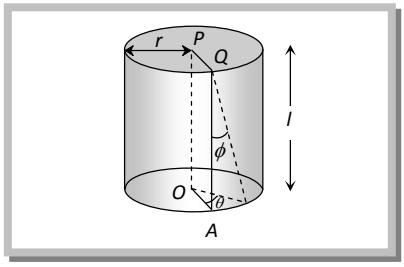
Torsion of Cylinder.

If the upper end of a cylinder is clamped and a torque is applied at the lower end the cylinder gets twisted by angleθ. Simultaneously shearing strain ϕ is produced in the cylinder.



(i) The angle of twist θ is directly proportional to the distance from the fixed end of the cylinder.

At fixed end $\theta = 0^o$ and at free end θ = maximum.

(ii) The value of angle of shear ϕ is directly proportional to the radius of the cylindrical shell.

At the axis of cylinder ϕ = 0 and at the outermost shell ϕ = maximum.

(iii) Relation between angle of twist (θ) and angle of shear (ϕ)

AB = $r\theta = \phi l$ $\quad\therefore\quad \phi = \dfrac{r\theta}{l}$

(iv) Twisting couple per unit twist or torsional rigidity or torque required to produce unit twist.

$$C = \frac{\pi\eta r^4}{2l} \qquad \therefore C \propto r^4 \propto A^2$$

(v) Work done in twisting the cylinder through an angle θ is $W = \dfrac{1}{2}C\theta^2 = \dfrac{\pi\eta r^4\theta^2}{4l}$