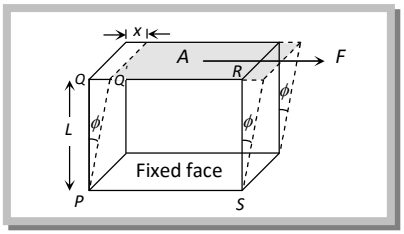
Modulus of Rigidity.

Within limits of proportionality, the ratio of tangential stress to the shearing strain is called modulus of rigidity of the material of the body and is denoted by η, i.e.

$$\eta = \frac{\text{Shearing stress}}{\text{Shearing strain}}$$



In this case the shape of a body changes but its volume remains unchanged.

Consider a cube of material fixed at its lower face and acted upon by a tangential force F at its upper surface having area A. The shearing stress, then, will be

$$\text{Shearing stress} = \frac{F_{\parallel}}{A} = \frac{F}{A}$$

This shearing force causes the consecutive horizontal layers of the cube to be slightly displaced or sheared relative to one another, each line such as PQ or RS in the cube is rotated through an angle ϕ by this shear. The shearing strain is defined as the angle ϕ in radians through which a line normal to a fixed surface has turned. For small values of angle,

$$\text{Shearing strain} = \phi = \frac{QQ'}{PQ} = \frac{x}{L}$$

So

$$\eta = \frac{\text{shear stress}}{\text{shear strain}} = \frac{F/A}{\phi} = \frac{F}{A\phi}$$

Only solids can exhibit a shearing as these have definite shape.