

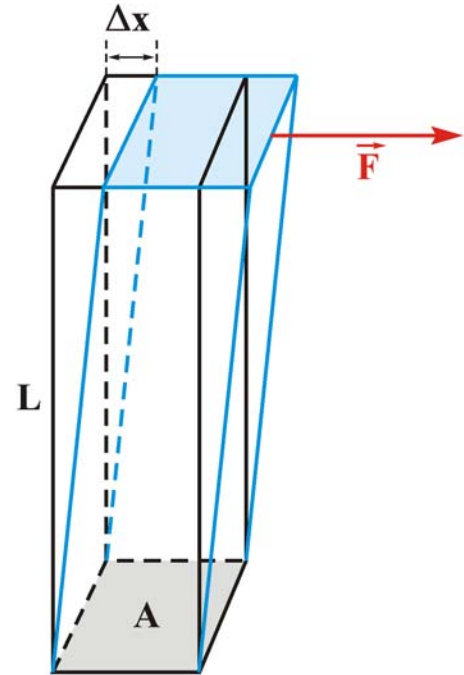
SHEAR MODULUS

The shear modulus is the elastic modulus we use for the deformation which takes place when a force is applied parallel to one face of the object while the opposite face is held fixed by another equal force.

When an object like a block of height L and cross section A experiences a force F parallel to one face, the sheared face will move a distance Δx . The **shear stress** is defined as the magnitude of the force per unit cross-sectional area of the face being sheared (F/A). The **shear strain** is defined as $\Delta x/L$.

The shear modulus S is defined as the ratio of the stress to the strain.

$$S \equiv \frac{\text{shear stress}}{\text{shear strain}} = \frac{\frac{F}{A}}{\frac{\Delta x}{L}} = \frac{FL}{A \Delta x} \quad (\text{units are Pascals})$$



The bigger the shear modulus the more rigid is the material since for the same change in horizontal distance (strain) you will need a bigger force (stress). This is why the shear modulus is sometimes called the modulus of rigidity.

To a first approximation there is no change in volume in this deformation. The planes of atoms merely slide sideways over one another. That is why the area A (which determines the number of atomic bonds) is important in defining the stress and not just F .

Note that in the diagram, since the block is not moving, there is a force F to the left on the bottom face which is not shown.