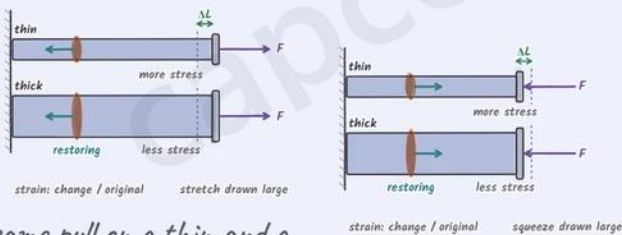


push, pull, or twist it, and it stretches back to tell you how stiff it is

Stress and strain

- a solid is deformable: a force changes its shape or size
- elastic: it regains its shape once the force is removed
- stress is the restoring force per unit area, N/m^2 or Pa
- same dimensions as pressure, but a stress acts inside the body
- strain is the fractional change, **no units**

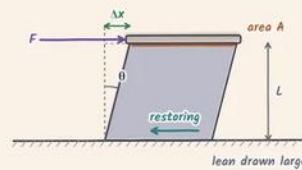


same pull on a thin and a thick rod: the thin one feels more stress, dashed is the old end

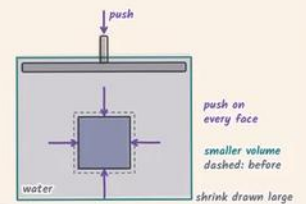
pushed instead: the rods shorten and the restoring force pushes back out

Shear and all round pressure

- shear: a force along the top face, the foot held
- the block leans through θ , and for small θ the strain is the angle
- all round: the same pressure on every face, shape unchanged
- the volume shrinks, and the volume strain is $\Delta V / V$



a force along the top face: the block leans through the angle θ , area A lit



a cube in water under a piston: pressure on every face, a smaller volume

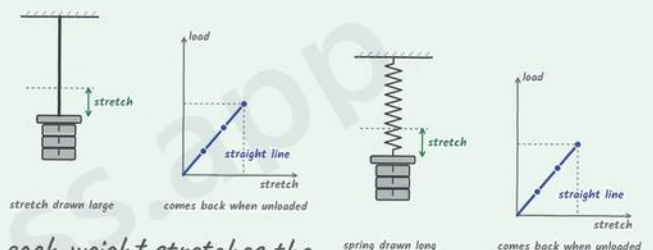
Three kinds of stress and strain

Type	Stress	Strain
Longitudinal	F/A along the length	$\Delta L / L$
Shearing	F/A along the face	$\Delta x / L = \tan \theta$
Volume	pressure change ΔP	$\Delta V / V$

length changes under longitudinal stress, shape under shear, size under volume stress

Hooke's law

- within the elastic limit, stress is proportional to strain
- stress = modulus $\times$ strain, the modulus is the constant
- for a wire or a spring, the stretch is proportional to the load
- so the load stretch graph is a straight line through the origin
- unload it and the hanger comes back



each weight stretches the wire the same: the load stretch graph is a straight line

a spring does the same: stretch in step with the load