Physics 185F2013 Lecture Nine

Nov 26, 2013

Dr. Jones[1]

[1]Department of Physics
Drexel University

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More Static Equilibrium, Stability, and Elasticity

- More equilibrium problem practice.

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- Concepts of Stability for Static Equilibrium–more stable vs. less stable.

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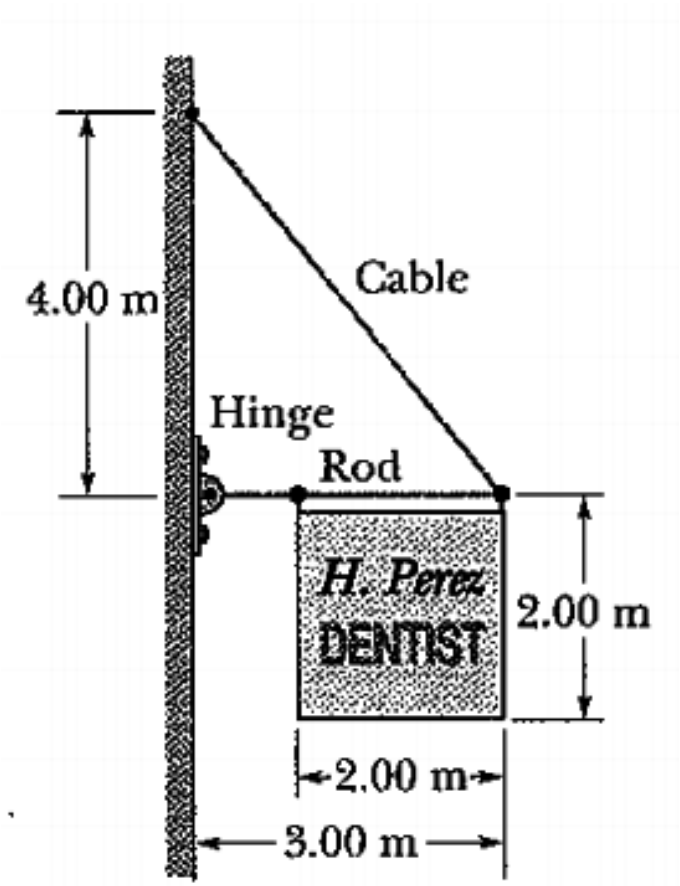
- Concepts of Stability for Static Equilibrium–more stable vs. less stable.
- Elasticity

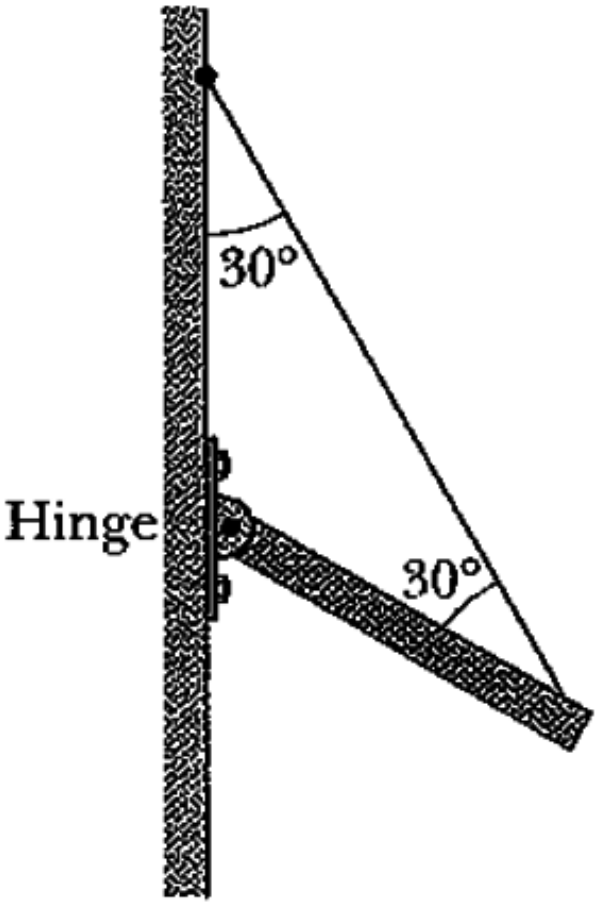
Example 0



A 50.0 kg sign (2.00 m long on each side) is hung from a 3.00 m rod of negligible mass which is held up by a cable. Identify all the forces involved with their magnitude and direction.

Example 0

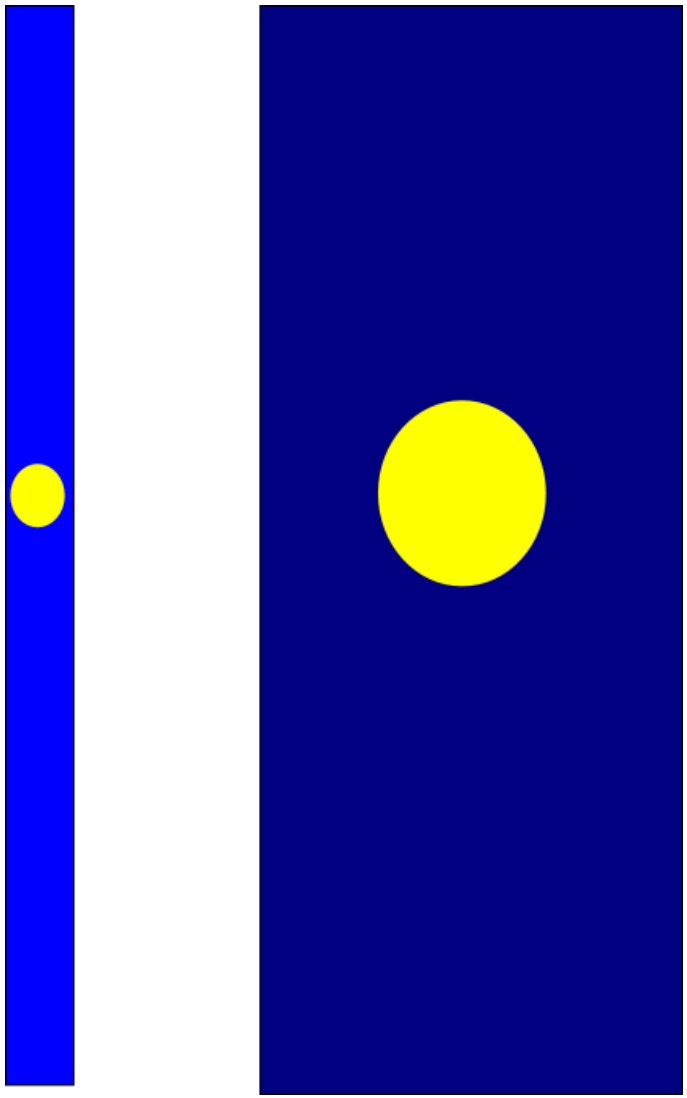
Example 1



One end of a uniform beam that weighs 222 N is attached to a wall with a hinge. The other end is supported by a wire. Find all the forces acting in this system with their magnitudes and direction.

Example 1

Stability



Which is more stable and exactly why?

Elastic properties

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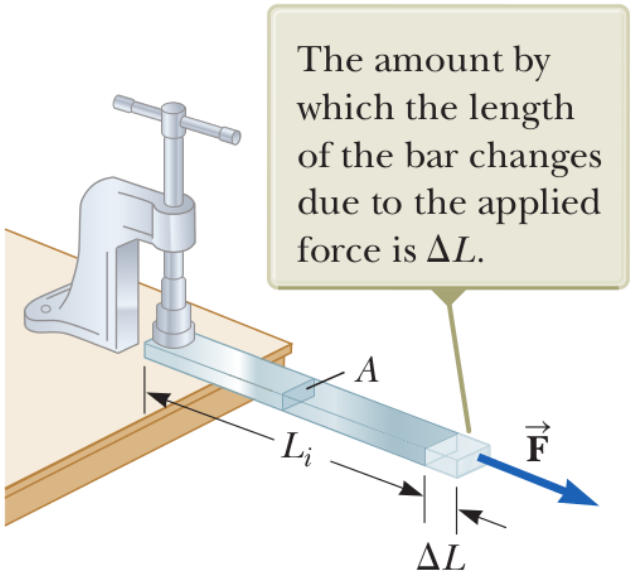
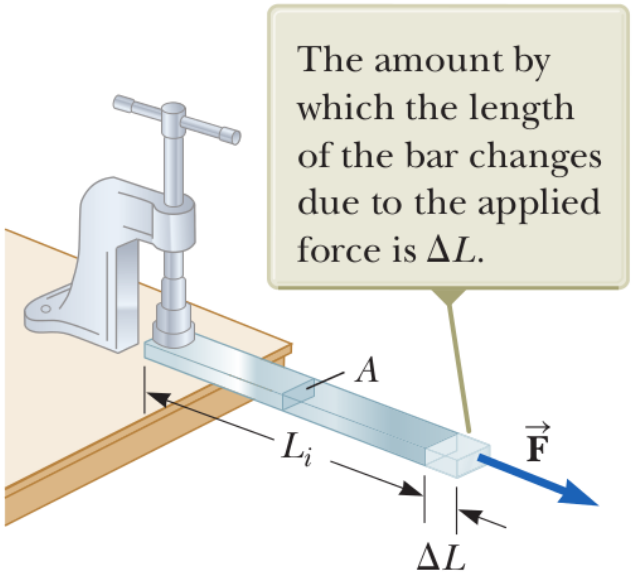
- Strain: Measure of degree of deformation.
- Elastic modulus = stress / strain

Young's Modulus



- tensile stress: ratio of magnitude of external force F to cross-section area A

Young's Modulus



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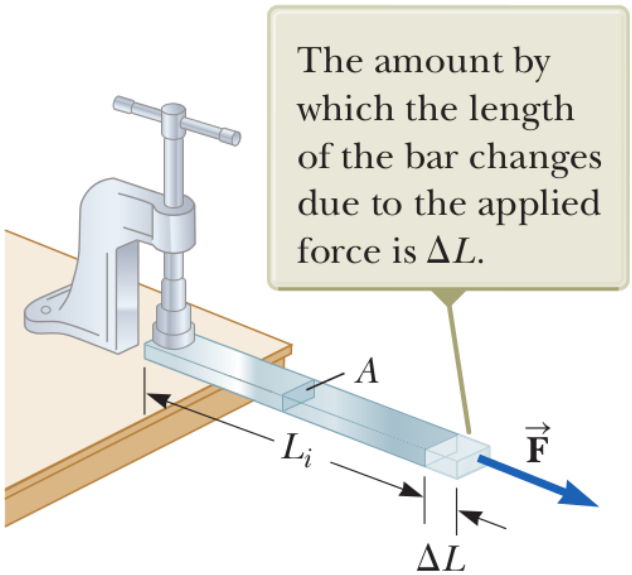
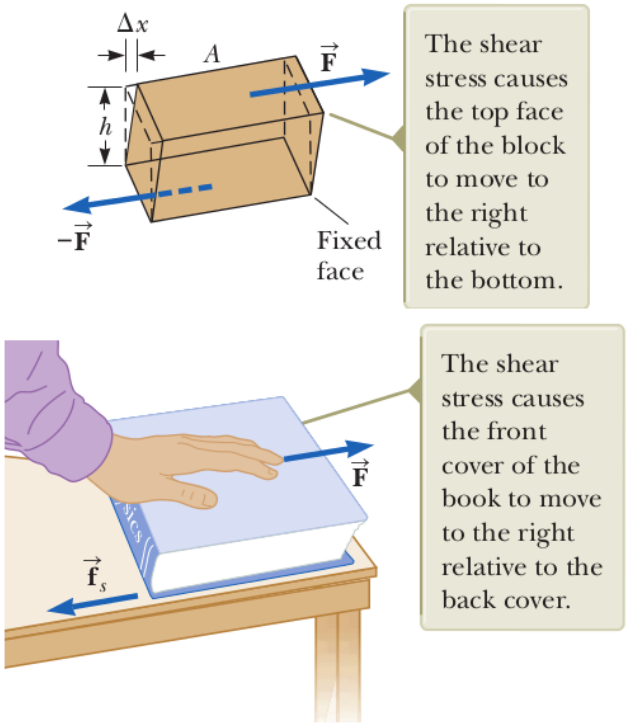
- tensile strain: ratio of change in length ΔL to original length.

Young's Modulus



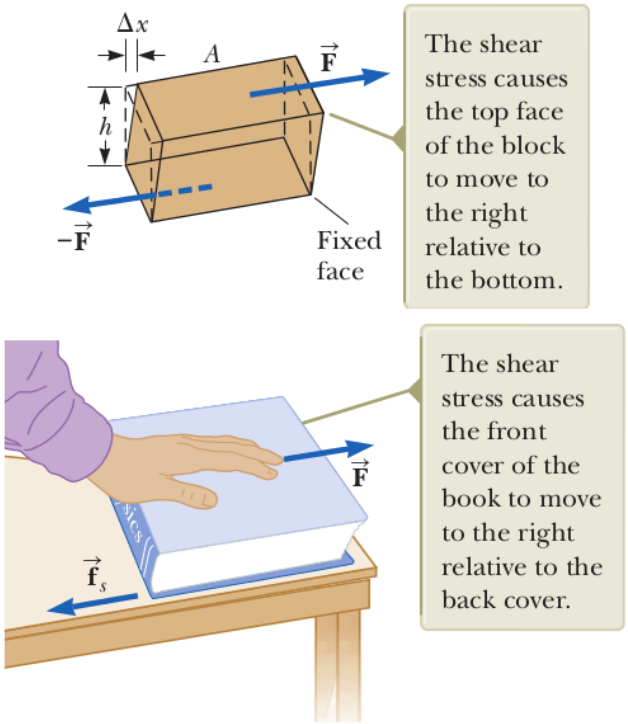
- tensile stress: ratio of magnitude of external force F to cross-section area A
- tensile strain: ratio of change in length ΔL to original length.
- Young's modulus: $\mathrm{Y} = \frac{\mathrm{F/A}}{(\Delta \mathrm{L})/\mathrm{L}}$

Shear Modulus



- shear stress: ratio of tangential force to the area A being shared

Shear Modulus



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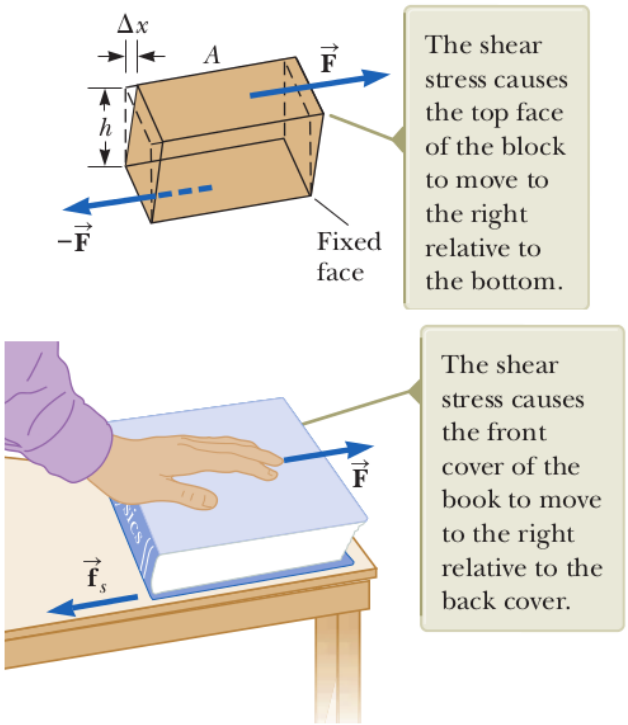
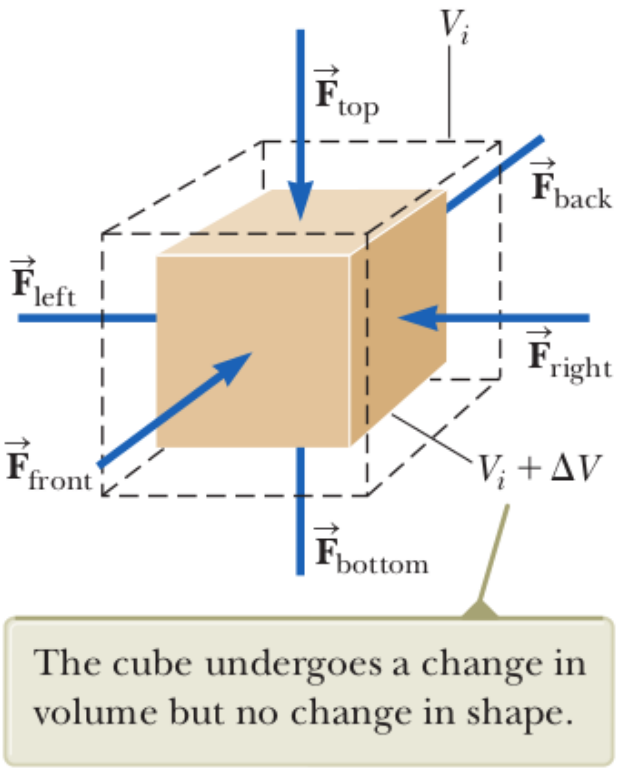
Shear Modulus



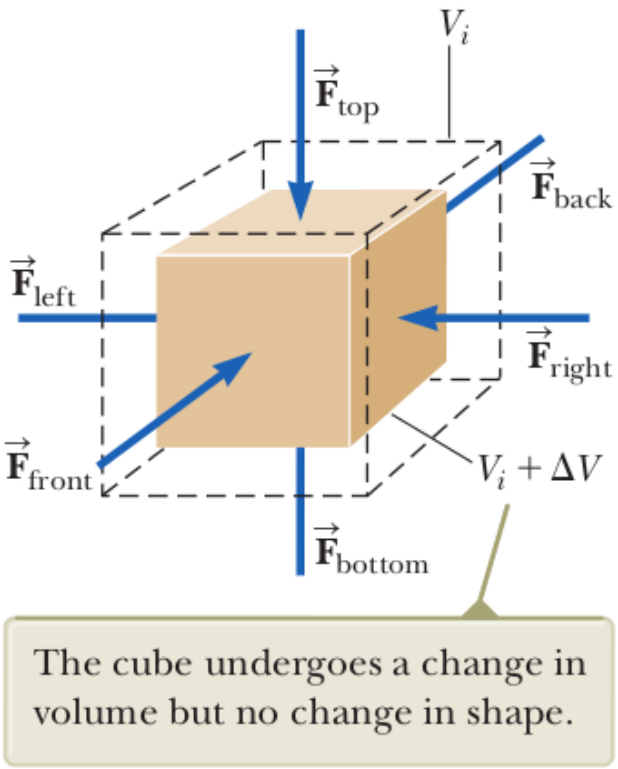
- shear stress: ratio of tangential force to the area A being shared
- shear strain: ratio of distance sheared surface moves over height of object.
- Shear modulus: $S = \frac{F/A}{(\Delta x)/h}$

Bulk Modulus



- volume stress: ratio of magnitude of total force exerted on surface to the area A of that surface.

Bulk Modulus



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- Pressure: $\mathrm{P} = \mathrm{F}/\mathrm{A}$

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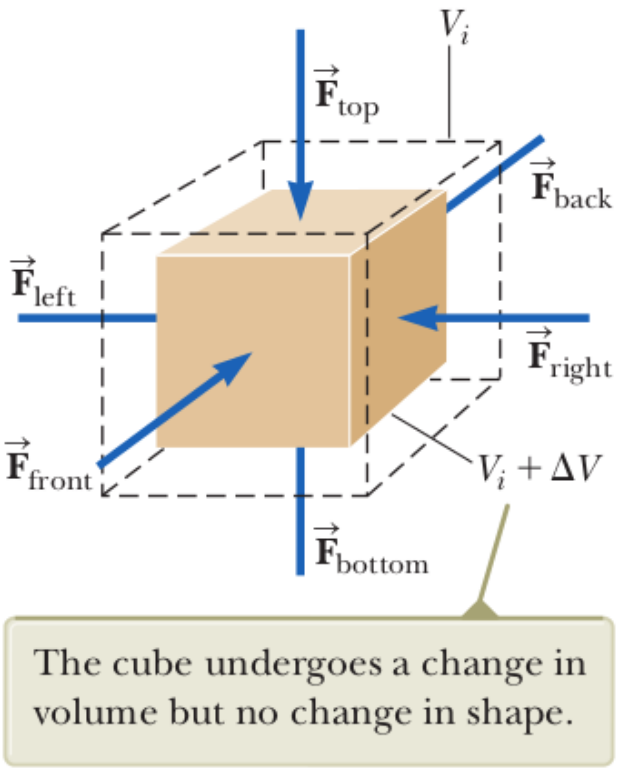

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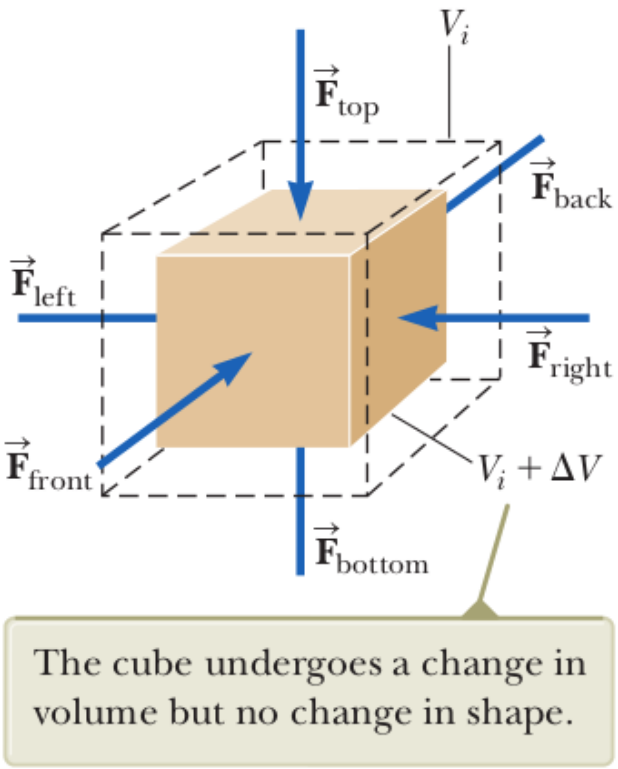
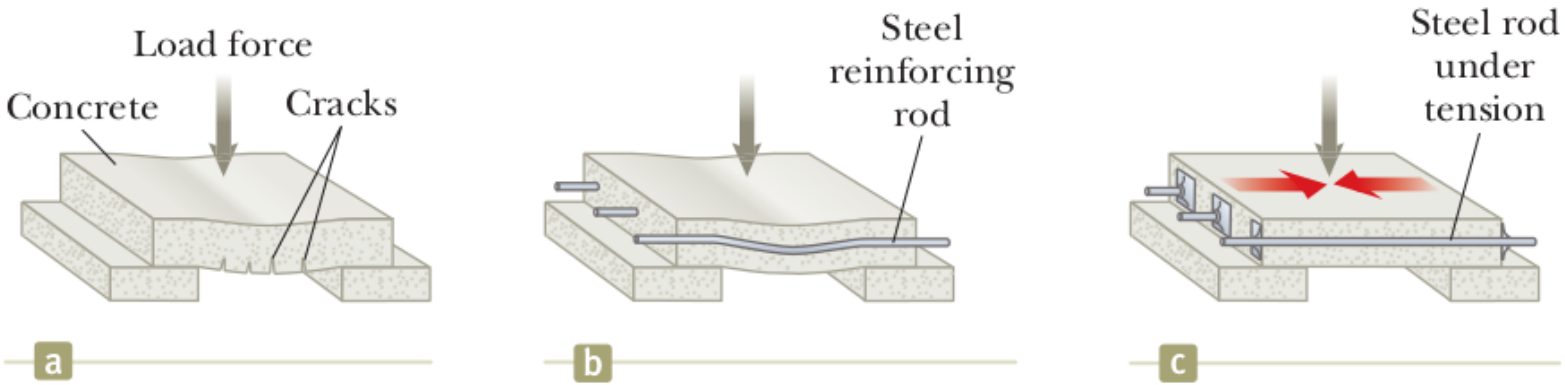


- volume stress: ratio of magnitude of total force exerted on surface to the area A of that surface.
- Pressure: $\mathrm{P} = \mathrm{F}/\mathrm{A}$
- volume strain: ratio of change in volume over initial volume
- Bulk modulus: $\mathrm{B} = -\frac{\Delta \mathrm{F}/\mathrm{A}}{\Delta \mathrm{V}/\mathrm{V_o}} = -\mathrm{V_o}\frac{\Delta \mathrm{P}}{\Delta \mathrm{V}}$

Prestressed concrete



Further examples