

MECE 3321

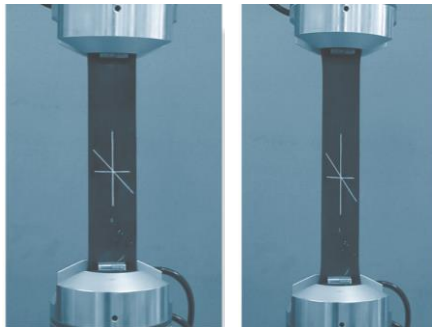
Mechanics of Solids

Chapter 2

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Deformation

- ▶ Deformation is defined as the changes to a body's shape and size when a load is applied.
- ▶ Deformation is specified by normal and shear strains and occurs because of loads and temperature.

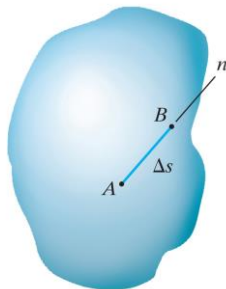


Average Normal Strain (ϵ)

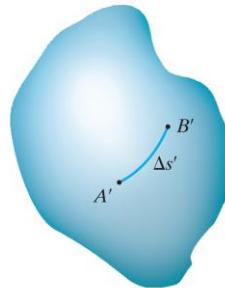
- ▶ The elongation or contraction of a line segment per unit length

$$\epsilon_{avg} = \frac{\Delta s' - \Delta s}{\Delta s} = \frac{\Delta L}{\Delta s}$$

- ▶ Strain depends on geometry of formation
- ▶ Stress and strain are independent of each other



Undeformed body

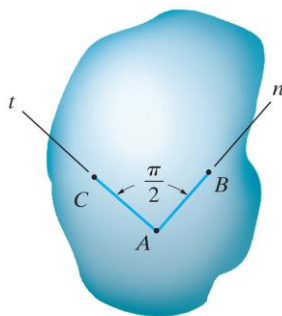


Deformed body

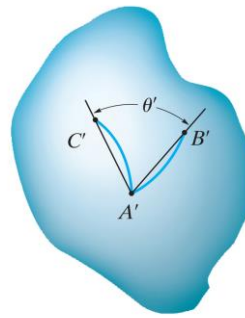
Average Shear Strain (γ)

- ▶ The change in angle between two lines that were originally perpendicular

$$\gamma_{nt} = \frac{\pi}{2} - \lim_{\substack{B \rightarrow A \text{ along } n \\ C \rightarrow A \text{ along } t}} \theta'$$

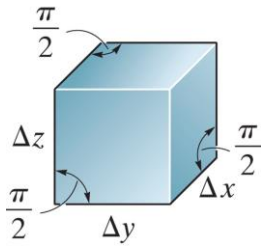


Undeformed body

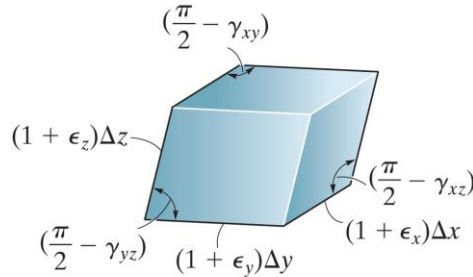


Deformed body

Cartesian Strain Components



Undeformed element



Deformed element

► Law of Sine

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

► Law of Cosine

$$c^2 = a^2 + b^2 - 2ab \cos(C)$$

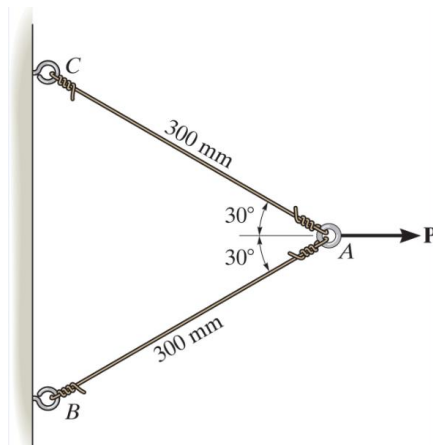
$$a^2 = b^2 + c^2 - 2bc \cos(A)$$

$$b^2 = a^2 + c^2 - 2ac \cos(B)$$



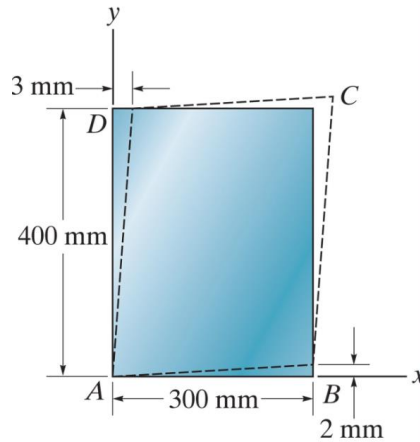
Problem 2-5

- The two wires are connected together at A. If the force P causes point A to be displaced horizontally 2 mm, determine the normal strain developed in each wire.



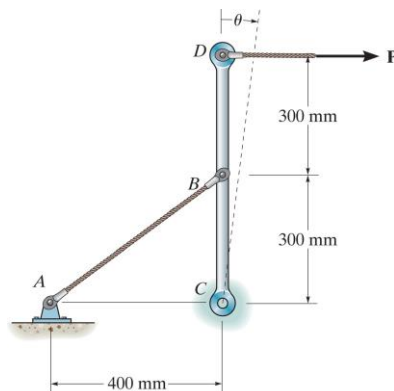
Problem 2-12

- The piece of rubber is originally rectangular. Determine the average shear strain γ_{xy} at A if the corners B and D are subjected to the displacements that cause the rubber to distort as shown by the dashed lines.



Problem 2-9

- Part of a control linkage for an airplane consists of a rigid member CBD and a flexible cable AB. If a force is applied to the end D of the member and causes a normal strain in the cable of 0.0035 mm/mm, determine the displacement of point D. Originally the cable is unstretched.



Problem 2-22

- The triangular plate is fixed at its base, and its apex A is given a horizontal displacement of 5 mm. Determine the shear strain γ_{xy} at A.

