Young's modulus-1

Sunday, 17 October, 2021 21:10

Lecturer: Mustafa Al-Zyout, Philadelphia University, Jordan.

R. A. Serway and J. W. Jewett, Jr., *Physics for Scientists and Engineers*, 9th Ed., CENGAGE Learning, 2014.
J. Walker, D. Halliday and R. Resnick, *Fundamentals of Physics*, 10th ed., WILEY,2014.
H. D. Young and R. A. Freedman, *University Physics with Modern Physics*, 14th ed., PEARSON, 2016.
H. A. Radi and J. O. Rasmussen, *Principles of Physics For Scientists and Engineers*, 1st ed., SPRINGER, 2013.

A bar has a square cross section and dimensions $1cm \times 1cm \times 20cm$. It is subjected to a 10000 N tension force and stretches 0.01cm. Find:

- The stress
- The strain
- What is Young's modulus for this bar?
- If the stress-strain graph is a straight line, how much does the bar stretch when the applied force is increased to 50000 N?

Young's modulus-2

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If the minimum cross-sectional area of the femur of a human adult is 6×10^{-4} m^2,

- What is the compression load at which fracture occurs?
  $(\sigma_{\text{bone}} = 17 \times 10^7\, N/m^2)$, $(Y_{bone} = 9 \times 10^9\, N/m^2)$
- Assuming the stress-strain relationship is liner until fracture, find the strain at which the fracture occurs.

Shear modulus-1

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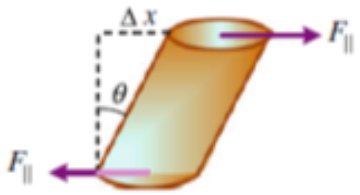
Assume that the rod in the figure shown has a cross-sectional area $A = 2 \times 10^{-3} m^2$, length $h = 1m$, and is made of brass with a shear modulus $S = 36 \times 10^9 \, N/m^2$. How large should the shear force exerted on each edge of the rod be if the displacement Δx is 0.02 cm?



Linear shearing

Shear modulus-2

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A skyscraper has an outer skin of brick-faced concrete panels attached to a structural frame by steel pins. Each pin is a cylinder of radius 0.01m and supports a mass of 1000kg.

- What is the shear stress on a pin? (for steel $S = 8.4 \times 10^{10}\ N/m^2$)
- What is the shear strain?

Bulk modulus-1

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A sphere of lead has a volume $V = 0.5m^3$ when placed in atmospheric pressure ($P_a = 1 \times 10^5\, N/m^2$). The sphere is lowered to a particular depth in the ocean where the water pressure is ($P = 1 \times 10^9\, N/m^2$). The bulk modulus of lead is ($B = 8 \times 10^9\, N/m^2$). What is the change in volume of the sphere?