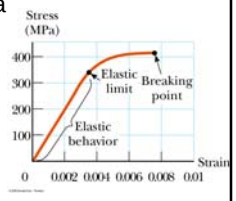
Phy 2053 Announcements

- Good luck on Exam 2!
- Exam 2 grades – grades should be available by Monday, April 6 on UF e-Learning web site.
- Exam 2 solutions will be posted early next week
- HW Assignment 9 next Wednesday, April 8

Elastic Properties of Solids

- *Stress* - force per unit area causing the deformation
- *Strain* - measure of the amount of deformation
- The *elastic modulus* is the constant of proportionality between stress and strain
- Three types of moduli:
  - Young's modulus, shear modulus, bulk modulus



Young's Modulus:

$$\frac{F}{A} = Y\frac{\Delta L}{L_o}$$

Stress = *Y x Strain* or $\dfrac{Stress}{Strain} = Y$

Stress (*F/A*) has units of N/m² 1 N/m² = 1 Pascal (Pa)

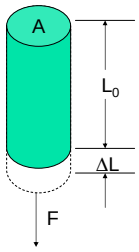
Young's Modulus: Elasticity in Length, Hooke's Law redux

Stress = F/A

Strain = $\Delta L/L_0$

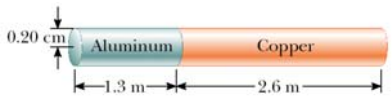
$$\frac{F}{A} = Y\frac{\Delta L}{L_0} \Rightarrow F = \left(\frac{AY}{L_0}\right)\Delta L$$

$$k$$



Example #9-11

Determine the elongation of the rod shown below if it is under a tension of 5.8×10^3 N.



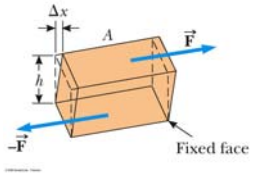
$Y_{Al} = 7 \times 10^{10}$ Pa $Y_{Al} = 11 \times 10^{10}$ Pa

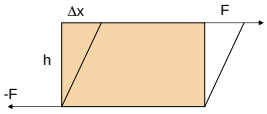
Shear Modulus

- $shear\ stress = \dfrac{F}{A}$

  $shear\ strain = \dfrac{\Delta x}{h}$

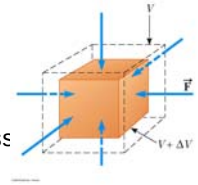
  $\dfrac{F}{A} = S\dfrac{\Delta x}{h}$
- S is the shear modulus
- A material having a large shear modulus is difficult to bend





Bulk Modulus

$$\Delta P = -B\frac{\Delta V}{V}$$



- A material with a large bulk modulus is difficult to compress
- The negative sign is included since an increase in pressure will produce a decrease in volume
  - B is always positive
- The *compressibility* is the reciprocal of the bulk modulus

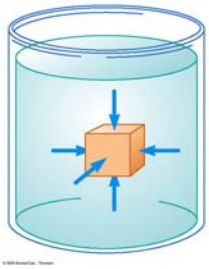
Notes on Moduli

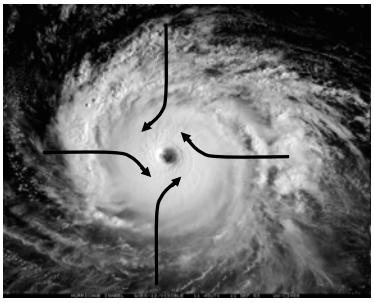
- Solids have Young's, Bulk, and Shear moduli
- Liquids and gases have only bulk moduli, they will not undergo a shearing or tensile stress
  - The liquid or gas would flow instead

Pressure

- The force exerted by a fluid on a submerged object at any point if perpendicular to the surface of the object

$$P \equiv \frac{F}{A} \text{ in } Pa = \frac{N}{m^2}$$





Density

- The density of a substance of uniform composition is defined as its mass per unit volume:

$$\rho \equiv \frac{m}{V}$$

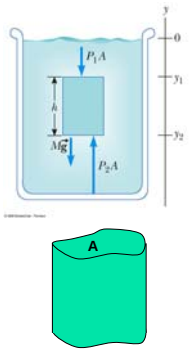
- Units are kg/m^3 (SI) or g/cm^3 (cgs)
- 1 g/cm^3 = 1000 kg/m^3

Pressure

$$P \equiv \frac{F}{A} \text{ in } Pa = \frac{N}{m^2}$$

Pressure and Depth

- Examine the darker region, assumed to be a fluid
  - It has a cross-sectional area A
  - Extends to a depth h below the surface
- Three external forces act on the region

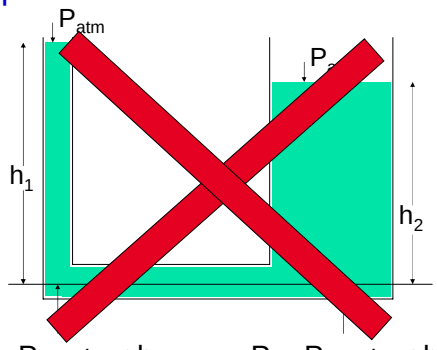


Pressure and Depth equation

- $P = P_o + \rho gh$
- P_o is normal atmospheric pressure
  1.013×10^5 Pa

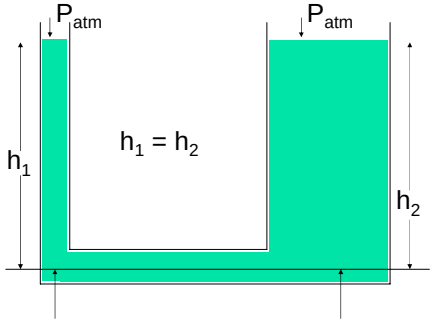
The pressure does not depend upon the shape of the container

Liquid in a U- tube



$P = P_{atm} + \rho gh_1$ $P = P_{atm} + \rho gh_2$

Liquid in a U- tube



$P = P_{atm} + \rho gh_1$ $P = P_{atm} + \rho gh_2$