To do ...

- HW 26 due Today
- HW 27 due Wed
- HW 28(PL) due Friday

- WA11 due Sunday April 17
Quiz 5 stats

Mean score = 85%

Great job!!
Chapter 9 (9.5) - Fluid Pressure
Mechanics is a branch of the physical sciences that is concerned with the state of rest or motion of bodies that are subjected to the action of forces.

- SOLIDS
  - Rigid Bodies
  - TAM 210/211: Statics
  - TAM212: Dynamics

- FLUIDS
  - Deformable Bodies
  - TAM 251: Solid Mechanics

\[ \downarrow mg = \begin{array}{c} \text{Statics} \\ \end{array} = \begin{array}{c} \text{Scales} \\ \end{array} = mg = F \]

Replace weight scale with hand.

What is different?

Contrast area this force is acting on.
\[ P = \frac{F}{A_1} < P = \frac{F}{A_2} < P = \frac{F}{A_3} \]

\[
\text{Pressure} = \frac{\text{Force}}{\text{Area}} = \frac{N}{m^2} \quad \rightarrow \text{Similar to stress...}
\]

\[ F = mg + mg + mg \]

\[ P = \frac{F}{A} = \frac{3mg}{A_1} \]

This is true for a solid

Stress \( \sigma = \frac{F}{A} = \frac{N}{m^2} \)

think about beams compressed/stretched/sheared
Stress \[ \sigma = \frac{F}{A} \quad \frac{N}{m^2} \quad \text{Solid} \]

fluids \[ \leftarrow \] pressure \[ P = \frac{F}{A} = \frac{N}{m^2} = \text{Pa} \quad (\text{Pascal}) \]

liquid \[ \downarrow \]
gas \[ \downarrow \] \[\} \quad \text{Stuff that flows!}\]
What Makes a Fluid or Solid?

Honey

Rock

fluid takes the shape of its container.
What is Sand?

A - Fluid
B - Solid
C - both.
Particles swollen with water – ‘Squishy Baff’

↑ water + stuff = both? Solid? Liquid?
Whipping cream (liquid) + air (gas) = Foam (solid)

with compressed air

mechanical beating

Paint
peanut butter
Suspensions
Emulsions
Complex fluids.
They look like a fluid...

cornstarch  +  water  =
(small, hard particles)

Video
Fluids

**Pascal’s law**: A fluid at rest creates a pressure \( p \) at a point that is the same in all directions.

Assumptions: fluid at rest, fluid is incompressible.

**Incompressible**: An incompressible fluid is one for which the mass density \( \rho \) is independent of the pressure \( p \). Liquids are generally considered incompressible. Gases are compressible, but may be approximated as incompressible if the pressure variations are relatively small.

\[ \phi_{x} = 0 \]
\[ \phi_{y} = \]
Fluid Pressure

For an incompressible fluid at rest with mass density, the pressure varies linearly with depth $z$.

\[ P = \frac{\gamma}{A} \]

\[ \Sigma F_y: \ F_p - Mg = 0 \]
\[ PA - gAhg = 0 \]
\[ P = \gamma h \]

\[ \gamma = 9g \quad \text{specific weight} \]

\[ \gamma = \frac{kg}{m^3} \cdot \frac{m}{s^2} = \frac{kg}{m^2 \cdot s^2} \]

\[ \gamma = \frac{kg}{m^3} \cdot \frac{m}{s^2} = \frac{1}{m^3} \cdot \frac{kg \cdot m}{s^2} = \frac{N}{m^3} \]

\[ P = \gamma h = \frac{N}{m^3} \cdot m = \frac{N}{m^2} \]

Weight (force) per unit volume.
\[ \rho = \frac{\Delta h}{m^2} \]

\[ \rho = 1000 \text{ kg/m}^3 \]

\[ \mathcal{N} = \mathcal{S} \mathcal{g} = 9810 \frac{\text{N}}{\text{m}^3} \]

\[ 62.4 \frac{\text{lb}}{\text{ft}^3} \]

Only depends on \( \mathcal{S} \) and \( h \) (depth).

\[ p_1 > p_2 \]

\[ p_2 > p_1 \]

Other?

Equivalent to a distributed load
direction is perpendicular to surface!