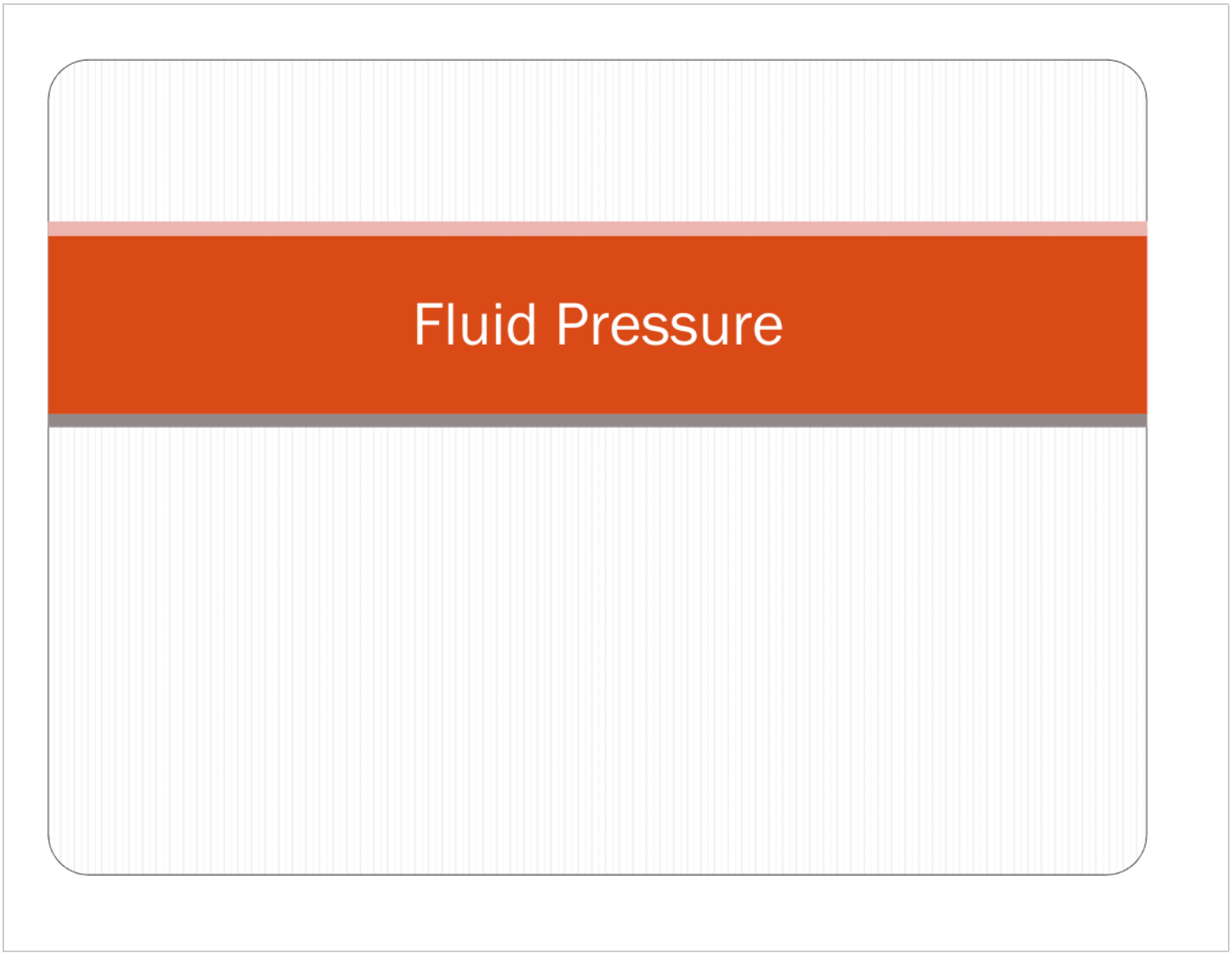
Announcements

- Thanksgiving break next week
- CBTF Quiz 5 in 2 weeks: Thursday (11/29) – Saturday (12/1)

❑ Upcoming deadlines:

- Tuesday (11/13)
  - PL HW


Fluid Pressure

Monday, November 12, 2018 10:28 AM

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

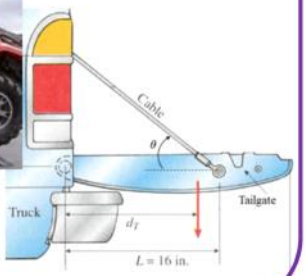
Rigid Bodies

TAM 210/211: Statics

TAM212: Dynamics

Deformable Bodies

TAM 251: Solid Mechanics



FLUIDS

- liquid.
- gas.

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What Makes a Fluid or Solid?

Honey

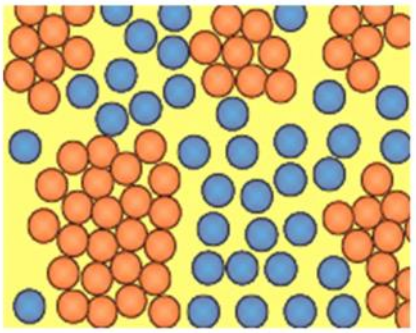
Rock

- It "flows"
- It takes the shape of the container.

They look like a fluid...

Cornstarch + water =

(small, hard particles)



(Mythbusters)

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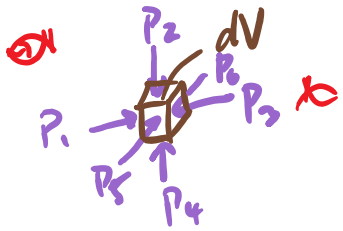
Fluids

Pascal's law: A fluid at rest creates a pressure p at a point that is the *same* in *all* directions

$P_1 = P_2 = P_3 = P_4 = P_5 = P_6$



Incompressible: An incompressible fluid is one for which the mass density 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.

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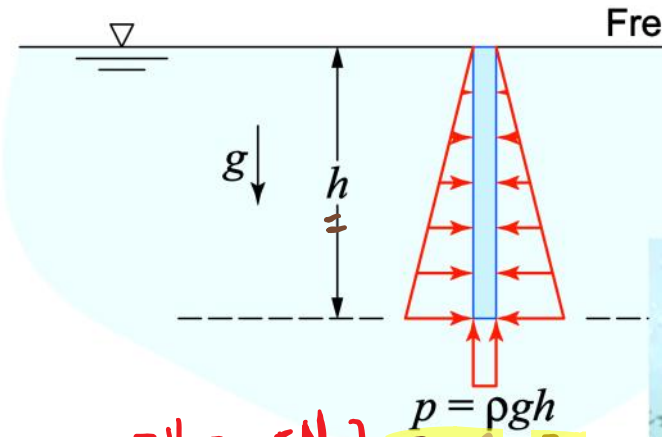
Observe that the pressure varies *linearly* from the free surface, and is *constant* along any horizontal plane (since h is constant):



$\rho = \left[\frac{kg}{m^3}\right]$ or $\left[\frac{slug}{ft^3}\right]$

$\gamma = \rho g = \left[\frac{lb}{ft^3}\right], \left[\frac{N}{m^3}\right]$

= specific weight

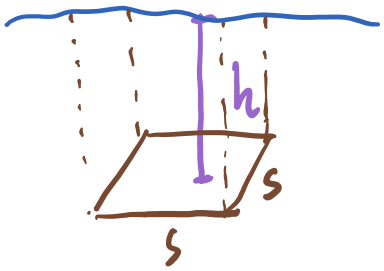
density

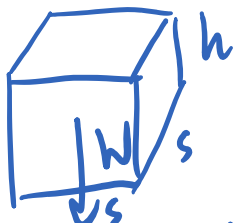
gravitational constant

$\rightarrow \boxed{p = \gamma h}$

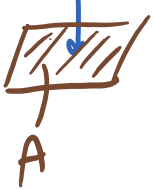
sometimes p is defined w/ γ.

(Can crushing clip)





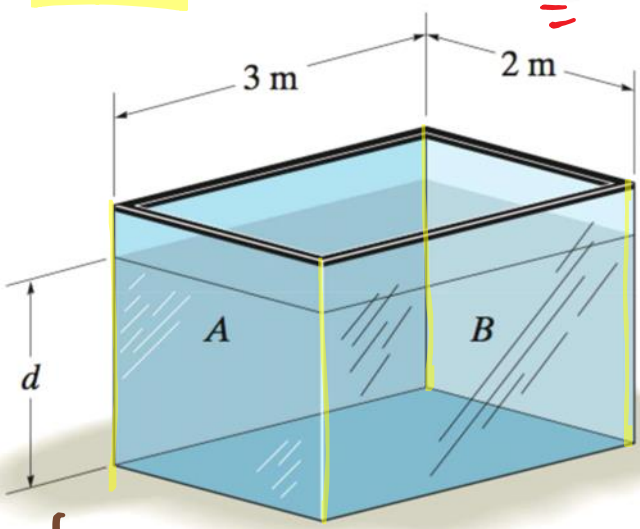
$W = (\rho V) g = (\rho s^2 h) g$

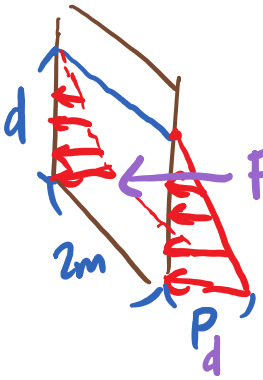


$\rightarrow p$ = force per unit area.

$= \frac{W}{A} = \frac{\rho s^2 h g}{s^2} = \underline{\rho g h}$

The tank is filled with water to a depth of $d = 4$ m. Determine the resultant force the water exerts on side A of the tank. ($\rho = 1000$ kg/m^3)





Total force from P = Volume of the

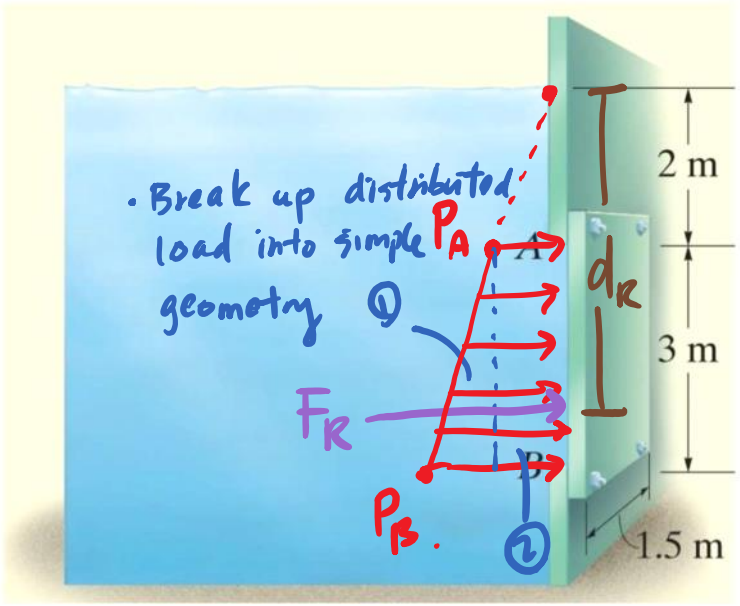
$F_R = \left(\frac{Pd}{2}\right)(2m)$

$P = \rho g h$

$\rightarrow P_d = \rho g d.$ $= \frac{\rho g d}{2} \cdot d \cdot (2\,m)$

$\rightarrow F_R = \frac{1}{2}\left(1000 \frac{kg}{m^3}\right)\left(9.81 \frac{m}{s^2}\right)(4m)^2(2m) \approx 157\ kN$

Determine the magnitude and location of the resultant hydrostatic force acting on the submerged rectangular plate AB. The plate has width 1.5m. ($\rho_{water} = 1000\ kg/m^3$)



Break up distributed load into simple geometry

Find: F_R, d_R.

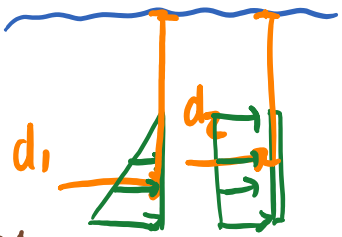
$F_R = F_1 + F_2$

$F_1 = \frac{(P_B - P_A)(3m)}{2}(1.5m)$

$= 66.2\ kN$

$F_2 = P_A(3m)(1.5m)$

$= 88.3\ kN$



$d_1 = 2m + \frac{2}{3}(3m)$

$= 4m$

$d_2 = 2m + \frac{1}{2}(3m)$

$= 3.5m$

$d_R = \frac{M_R}{F_R} = \frac{F_1 d_1 + F_2 d_2}{F_1 + F_2} \approx 3.71m$