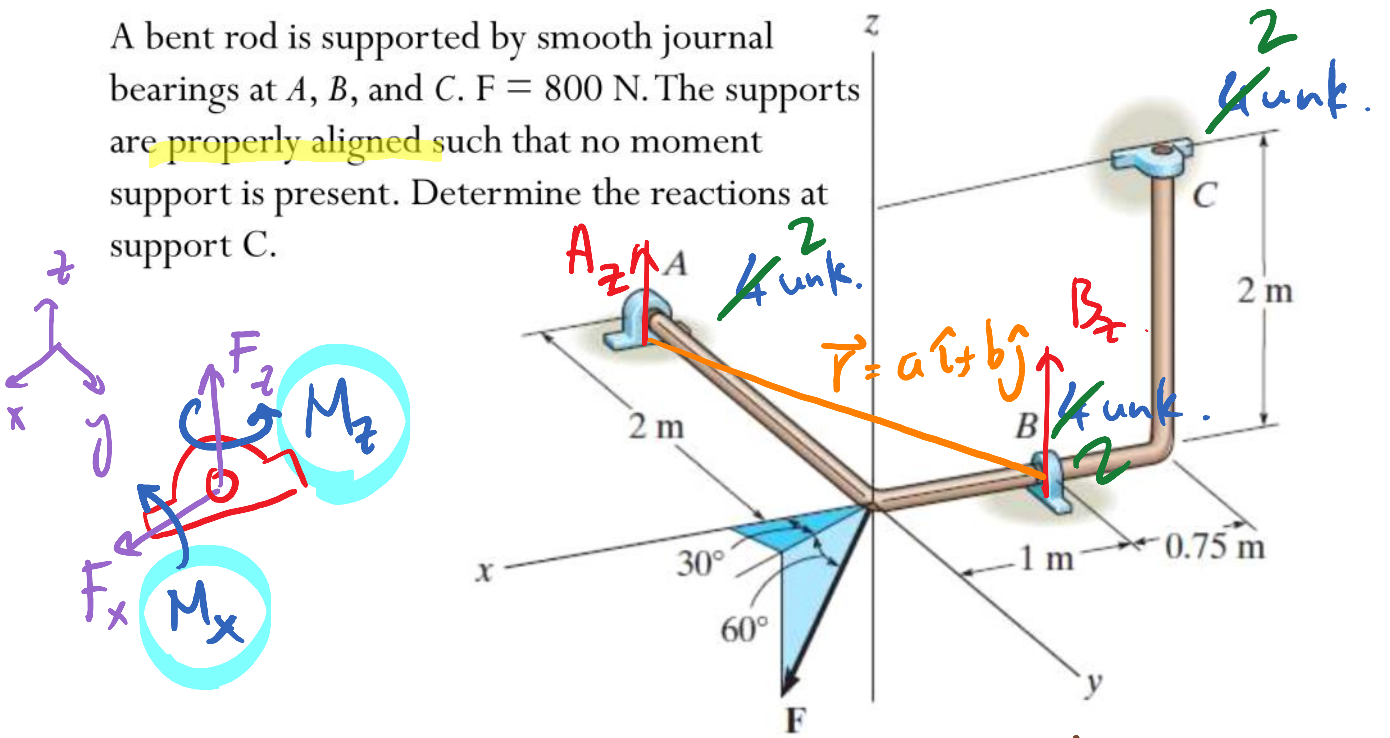
Announcements

- CBTF Quiz 7 next week
- 3D rigid body practice: PL HW10

❑ Upcoming deadlines:

- Friday (12/1)
  - WA #4
- Saturday (12/2)
  - ME HW25

A bent rod is supported by smooth journal bearings at *A*, *B*, and *C*. F = 800 N. The supports are properly aligned such that no moment support is present. Determine the reactions at support C.



Properly Aligned: supports provide no moments.

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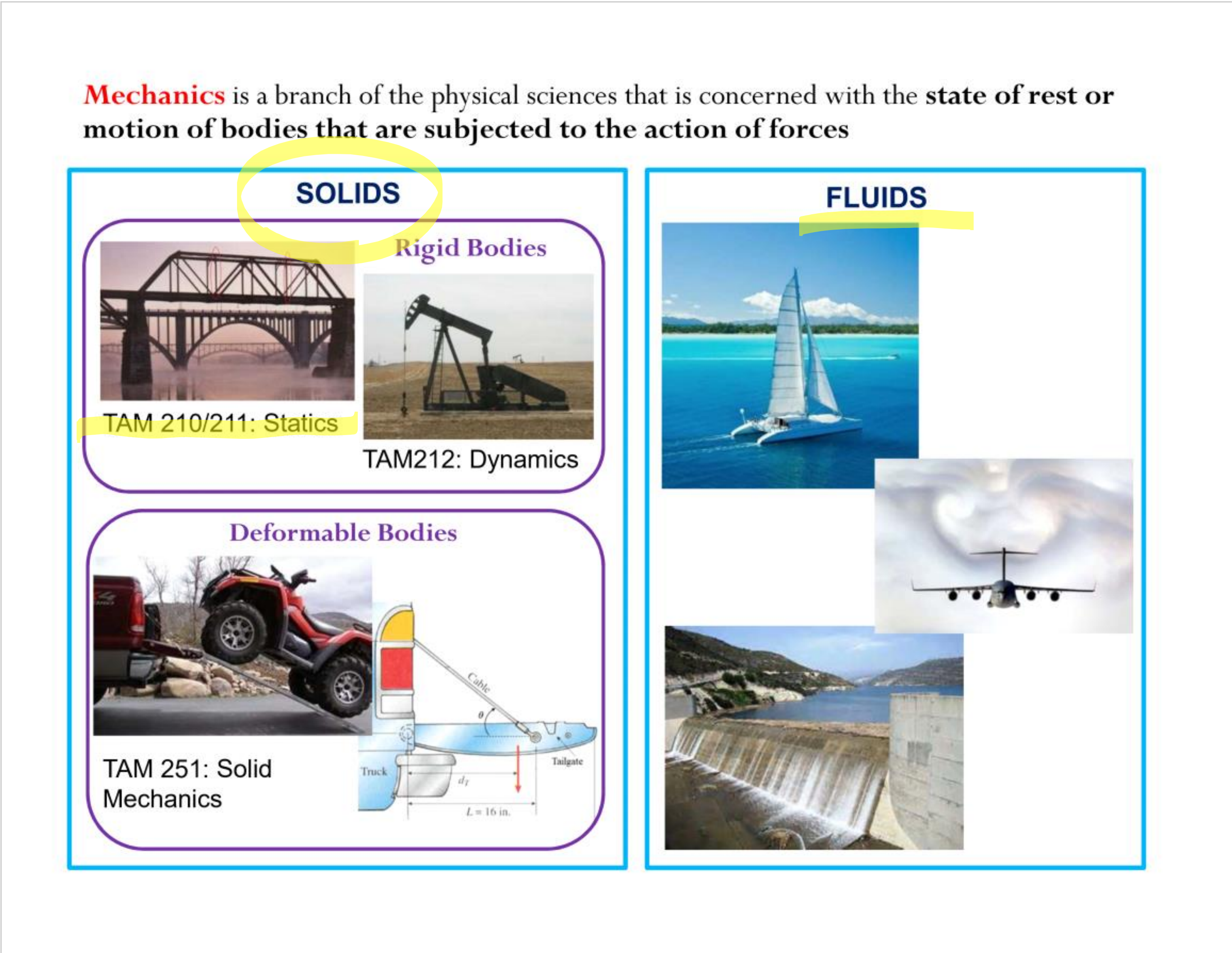
Chapter 9 Part II – Fluid Pressure


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
Deformable Bodies
Cable
Truck
Tailgate
L = 16 in.
TAM 251: Solid Mechanics
FLUIDS

What Makes a Fluid or Solid?

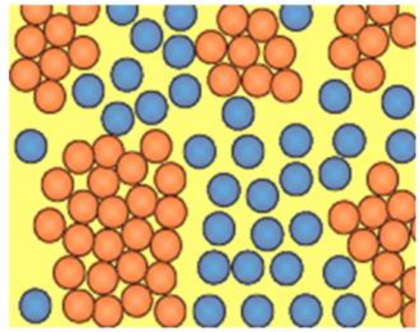
Honey

Rock

They look like a fluid...

Cornstarch + water =

(small, hard particles)

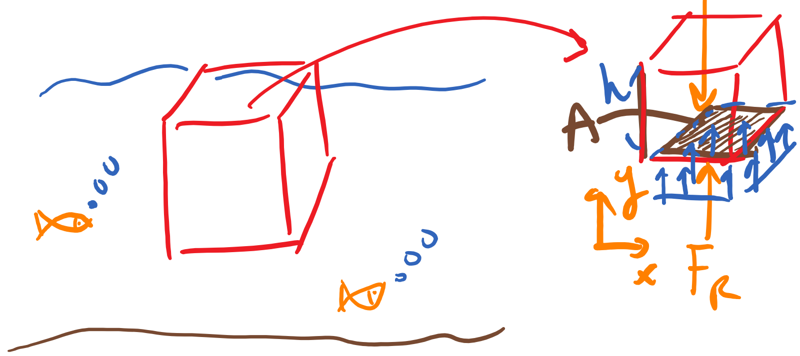


(Mythbusters)

Fluids

incompressible

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



EoE

$$\Sigma F_y = F_R - W = 0$$

$$W = mg = (Ah)\rho g$$

$$F_R = PA$$

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.

$$\Sigma F_y = \frac{PA - (Ah\rho g)}{A} = 0 \Rightarrow \boxed{P = h\rho g}$$

P units: $\frac{\text{Force}}{\text{Area}}$

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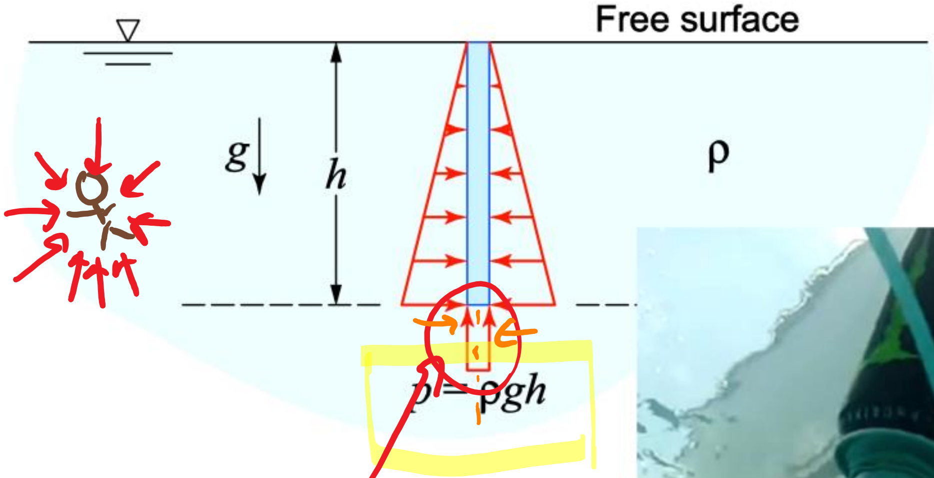
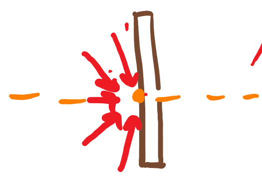
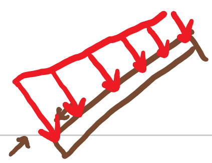
Observe that the pressure varies *linearly* from the free surface, and is *constant* along any horizontal plane (since h is constant):



(Can crushing clip)

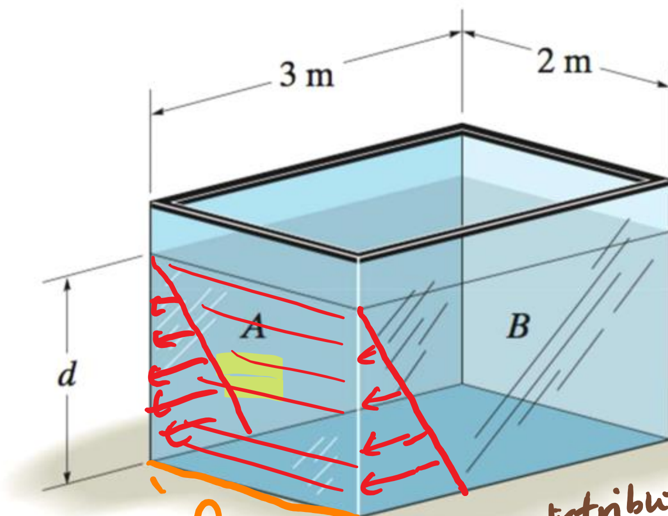


Vertical components cancel out.



Net P acts ⊥ to the surface

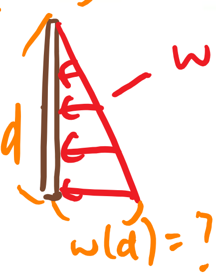
The tank is filled with water to a depth of $d = 4$ m. Determine the resultant force the water exerts on side A of the tank. ($\rho = 1000\ \text{kg/m}^3$)



Use the relationship:

p is a function of h → $p(h) = \rho g h$

to convert the problem to 2D:



distributed function of y.

FBD in 2D

- Since $p = \frac{\text{force}}{\text{area}}$, $w(y) = \frac{\text{force}}{\text{length}}$

$$w(y) = p\ell$$

- Distributed load over the wall has equivalent force F_R:

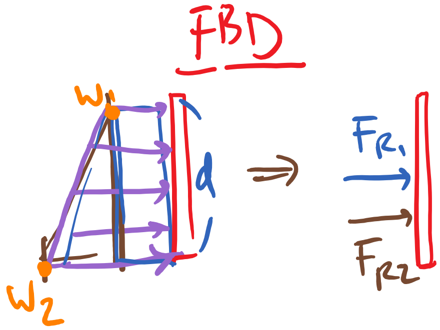
$$F_R = \frac{1}{2} w(d) \cdot d, \quad \left\{ \begin{aligned} w(d) &: \text{loading at depth } d \\ &= p(d) \cdot \ell = \rho g d \ell \end{aligned} \right.$$

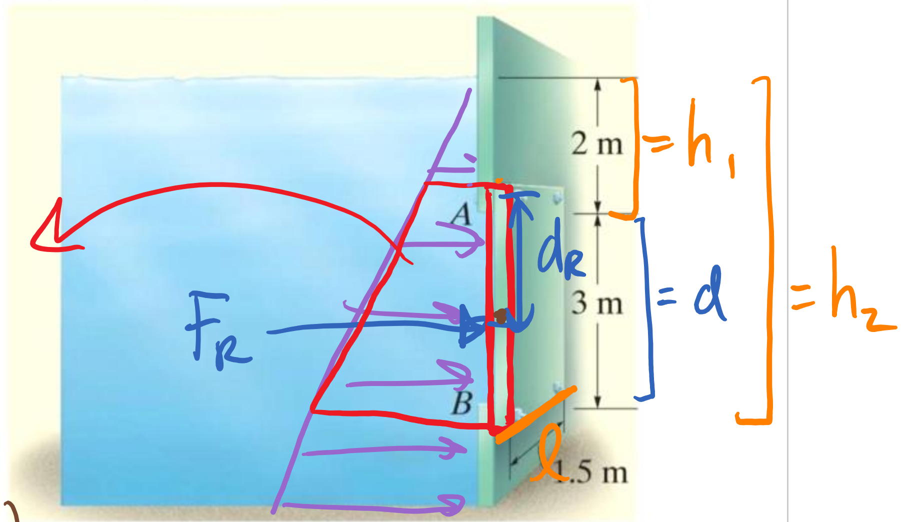
$$= \frac{1}{2}(\rho g d \ell) d$$

$$= \frac{1}{2} \rho g \ell d^2 = \boxed{157\ \text{kN} = F_R} \text{ on wall } A.$$

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

FBD





$w_1 = P_1 l = \rho g h_1 l$
$w_2 = P_2 l = \rho g h_2 l$
Find the loading function values at A & B

- Find the equivalent forces of the two simple geometry distributions

$F_{R1} = w_1 d = \rho g h_1 l d$.

$F_{R2} = \frac{1}{2}(w_2 - w_1) d = \frac{1}{2}(\rho g h_2 l - \rho g h_1 l) d = \frac{1}{2}\rho g d l (h_2 - h_1)$

- Total equivalent force on the plate:

$F_R = F_{R1} + F_{R2} = \boxed{154.5\ kN = F_R}$

- Find the location of F_R:

$\Sigma M_A = \int y\, w(y)\, dy = F_R d_R \Rightarrow d_R = \dfrac{\int y\, w(y)\, dy}{F_R} = \dfrac{d_{R1} F_{R1} + d_{R2} F_{R2}}{F_R}$

$d_{R1} = 1.5\ m$ from A
$d_{R2} = 2\ m$ from A
$\Rightarrow \boxed{d_R = 1.71\ m \text{ from } A.}$