ENGR 292 Fluids and Thermodynamics

Scott Li, Ph.D., P.Eng.
Mechanical Engineering Technology
Camosun College

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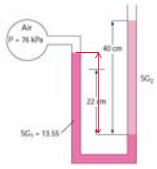
ENGR 292

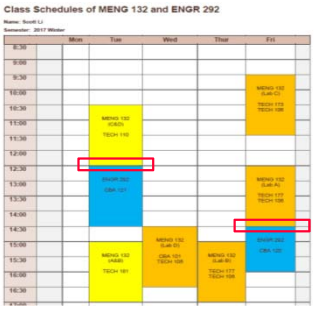
- **Notes of last week posted in**
  - **K Drive: Li\ENGR 292 (updated)**
  - **Website: http://www.fireflylabs.com/disted/courses/e292(2017)/e292-index.html (updated)**
- **D2L (Almost ready)**
  - **Assignment 1 (ready)**
  - **Submission (ready); Grading (ready)**
  - **Notes (pending)**

Assignment 1

- **Did you work on Assignment 1 yet?**
- **Due Day: Midnight Jan.31, 2017**
  - **D2L Dropbox**



My Weekly Schedule



Review of Last Class

- **Examples (1-7) with given conditions, for obtaining following values:**
  - **Volume**
  - **Mass**
  - **Weight**
  - **Pressure**
  - **Specific Weight**
  - **Specific Gravity**
  - **Bulk Modulus**

Review of Last Class

- **Pressure**
  - **Definition**

$$P = \frac{F}{A}$$

  - **F-A-P Triangle**

F-A-P Triangle

Review of Last Class

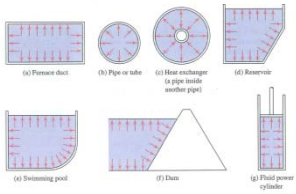
- **Pressure**
  - *Brief History – Blaise Pascal, a seventeenth-century scientist*
  - *Pascal's Law (also called as Pascal's Principle)*
    - *The pressure exerted anywhere in a mass of confined fluid is transmitted undiminished in all direction throughout the fluid*

Review of Last Class

- **Pressure**
  - *At any point pressure is the same in all directions*
  - *Pressure acting uniformly in all directions on a small amount volume of fluid*

Review of Last Class

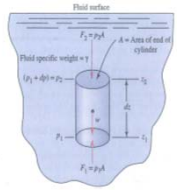
- **Pressure**
  - *In a fluid confined by solid boundaries, pressure acts perpendicular to the boundary*



Review of Last Class

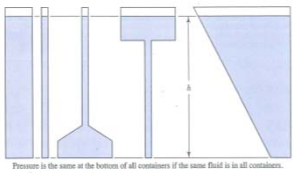
- **Pressure**
  - *Pressure increases linearly with depth (for a fluid standing still)*

$$p = \gamma h$$



Review of Last Class

- **Pressure**
  - *Pressure is independent of the shape of the vessel or the shape of the water above the point*

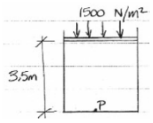


Review of Last Class

- **Pressure**
  - *Any pressure on the surface of the water (other than the atmosphere) is directly added on the fluid pressure.*

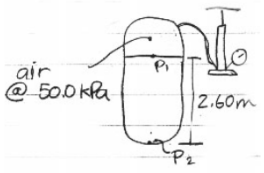
Example 9

Find the pressure at Point P of the water tank below:



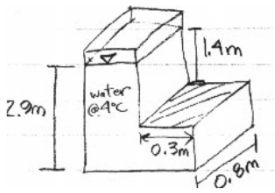
Example 10

The liquid is oil (sg=0.9), what is the pressure at P1 and P2?



Example 11

Calculate the force on the shaded area from the water pressure.

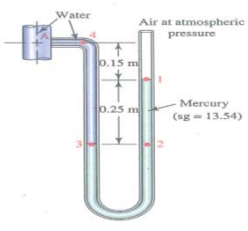


Example 11

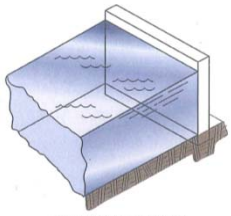
Before any force is applied the volume of the sample of oil is 1.000L. A force, F, is applied causing the pressure to rise to 4000 psi or 27,579 kpa. Calculate the new volume and the magnitude of force F. Perform your calcs in both metric and imperial.

Example 12

Calculate the pressure at point A (P_A) of the sketch shown below.



Forces Due to Static Fluids



(a) Vertical retaining wall

Forces Due to Static Fluids

- ***Vertical Rectangular Wall***
  - ***Average Pressure***
  - ***Magnitude of the Forces***

Forces Due to Static Fluids

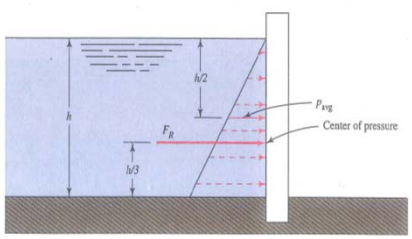
- ***Vertical Rectangular Wall***
  - ***Average Pressure (P_{avg})***

$$P_{avg} = \gamma(\frac{h}{2})$$

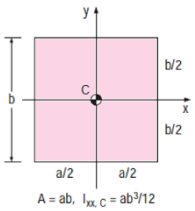
  - ***Magnitude of the Force***

$$F_R = P_{avg}A = \gamma\left(\frac{h}{2}\right)A$$

Forces Due to Static Fluids



Forces Due to Static Fluids



A = ab, $I_{xx,C} = ab^3/12$

(a) Rectangle

Forces Due to Static Fluids

- ***Vertical Rectangular Wall***
  - ***Moment of Inertia of rectangular section (I)***
  - ***Center of Pressure***

$$y_{cp} = \bar{y} + (\frac{I}{A\bar{y}})$$

where y_{cp} is the position of the center of pressure from the top

$\bar{y}$ is the half distance from the top

I is the moment of Inertia of the area

A is the area size

Buoyancy

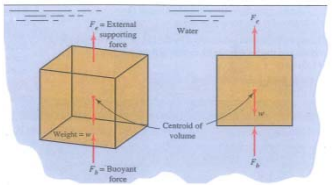
- ***The principles were discovered by the Greek scholar Archimedes.***
- ***Eureka***

Buoyancy

- ***Definition of Buoyancy:***

A body in a fluid, whether floating or submerged, is buoyed up by an upward force equal to the weight of the fluid displaced by the object

Buoyancy



Buoyancy

- ***Buoyant Force:***

$$F_b = \gamma_f V_d$$

where

F_b = *Buoyant force*

γ_f = *Specific weight of the fluid*

V_d = *Displaced volume of the fluid*

Buoyancy

- ***Weight of the object:***

$$W = \gamma_o V_o$$

where

W = *Weight of the object*

γ_o = *Specific weight of the object*

V_o = *The volume of the object*

Float or Sink ?

As we know: $0 \le V_d \le V_o$

Therefore:

Max Buoyancy: $F_{bmax} = \gamma_f V_o$

Min Buoyancy: $F_{bmin} = 0$

Forces	Specific Weight	Float or Sink
$F_{bmax} > W$	$\gamma_f > \gamma_d$	Float
$F_{bmax} = W$	$\gamma_f = \gamma_d$	Anywhere: Float or Sink
$F_{bmax} < W$	$\gamma_f < \gamma_d$	Sink

What is next?

- ***Any Questions?***
- ***Next class, we will continue on Fluid Statics***