Statics - TAM 211

Lecture 30

December 7, 2018

Chap 9.5

Announcements

- Check ALL of your grades on Blackboard! Report issues
- Prof. H-W office hours
  - Monday 3-5pm (Room C315 ZJUI Building)
  - Wednesday 7-8pm (Residential College Lobby)
- Upcoming deadlines:
  - Friday (12/7)
    - Written Assignment 11
  - Tuesday (12/11)
    - HW 12
  - Quiz 6
    - Week of Dec 10
    - CoG thru Fluid Pressure: Lectures 26-30 (Chap 9 material)

Chapter 9 Part II – Fluid Pressure

Chap 9.5

Goal and objective

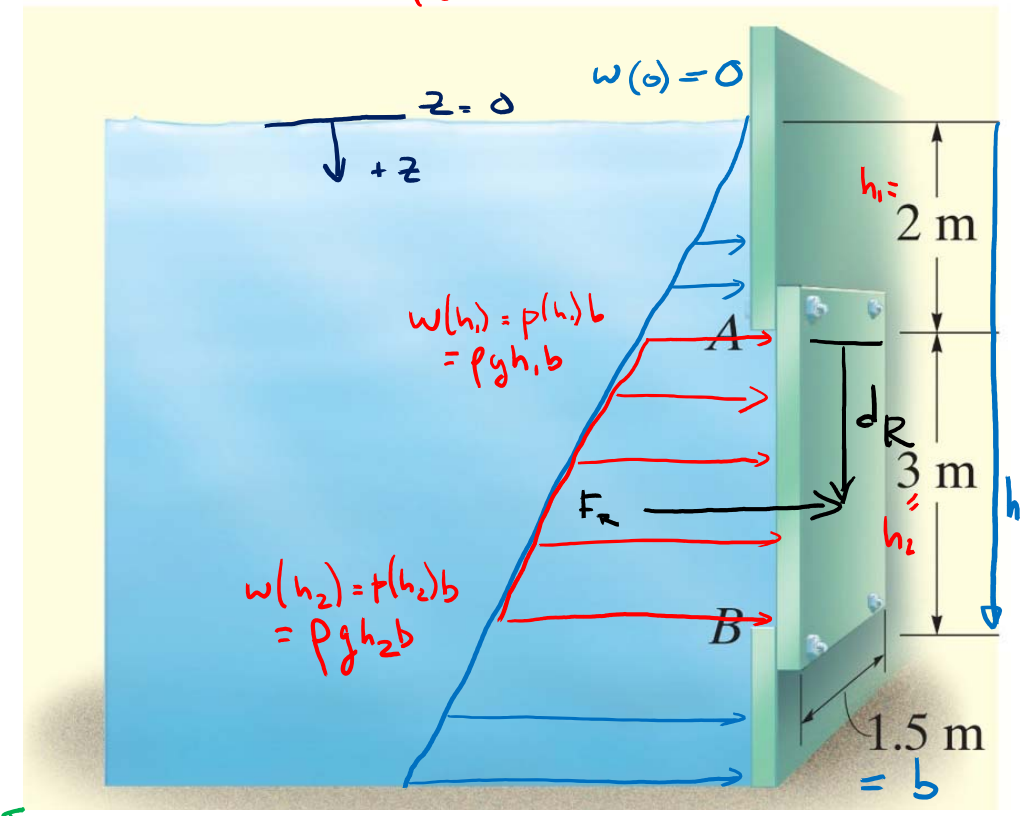
- Present a method for finding the resultant force of a pressure loading caused by a fluid

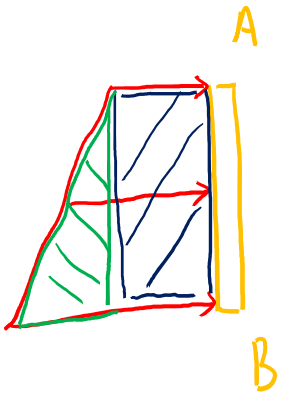
Recap:

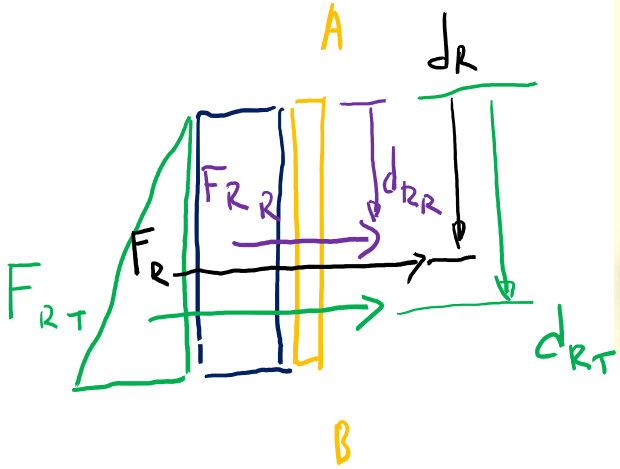
Determine the magnitude and location of the resultant hydrostatic force acting on the submerged rectangular plate AB. The plate has width 1.5m. The density of the water is 1000 kg/m^3 $= \rho$

$p(z) = \rho g z$

$w(z) = p(z) \cdot b = \rho g z b$



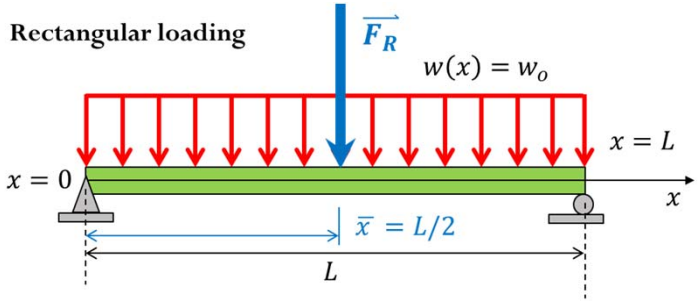




$$F_R = F_{RT} + F_{RR} = 154.5\,N$$

$$d_R = \frac{d_{RT} F_{RT} + d_{R2} F_{RR}}{F_R} = 1.71\,m \text{ below A}$$

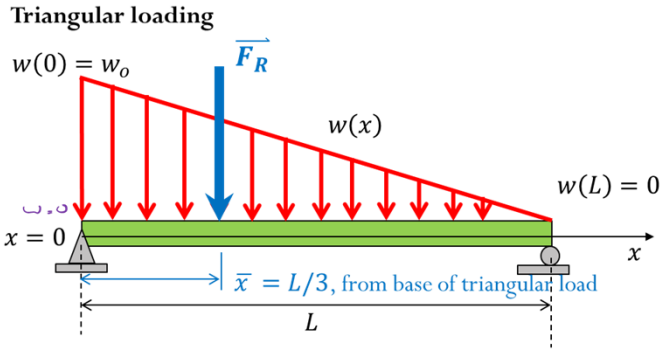
Simple Shape Centroid Locations



$$w(x) = w_o$$

$$\left|\overrightarrow{F_R}\right| = F_R = w_o L$$

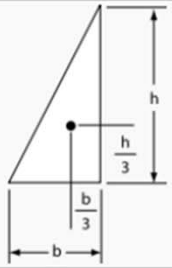
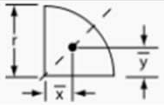
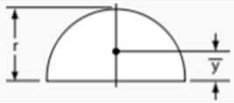
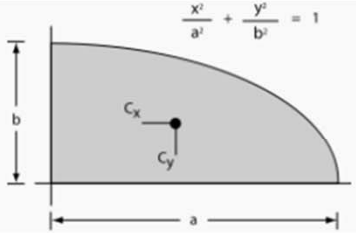
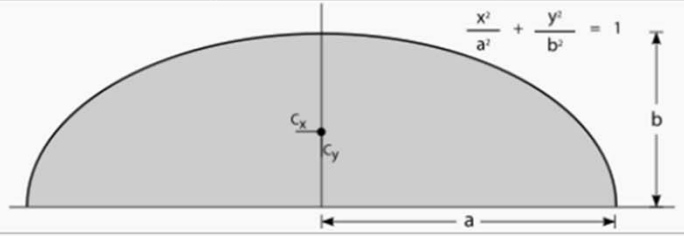
$$\bar{x} = \frac{L}{2}$$

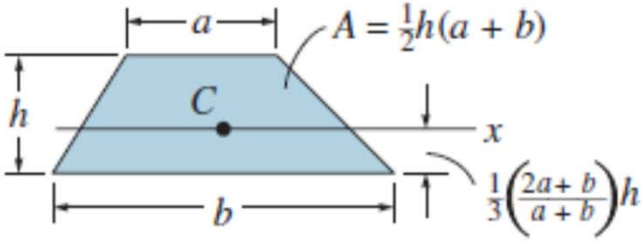


$$w(x) = w_o - \frac{w_o x}{L}$$

$$F_R = w_o \frac{L}{2}$$

$$\bar{x} = \frac{L}{3}$$

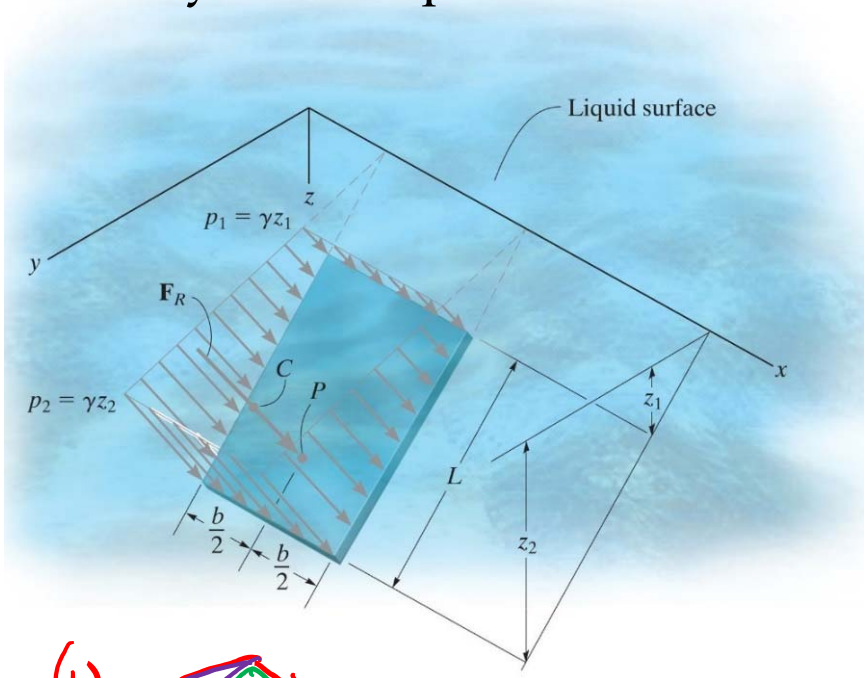
Shape	Figure	$\bar{x}$	$\bar{y}$	Area
Right-triangular area		$\frac{b}{3}$	$\frac{h}{3}$	$\frac{bh}{2}$
Quarter-circular area		$\frac{4r}{3\pi}$	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{4}$
Semicircular area		0	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{2}$
Quarter-elliptical area		$\frac{4a}{3\pi}$	$\frac{4b}{3\pi}$	$\frac{\pi ab}{4}$
Semielliptical area		0	$\frac{4b}{3\pi}$	$\frac{\pi ab}{2}$

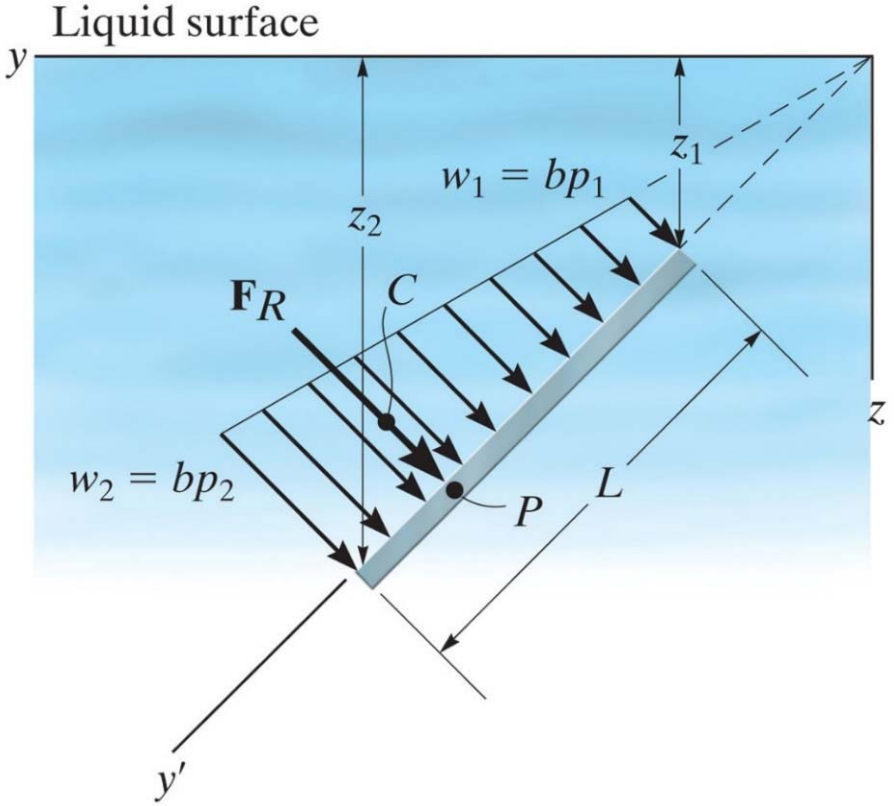


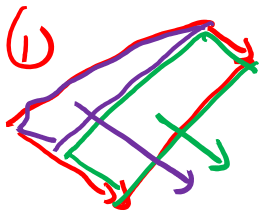
Trapezoidal area

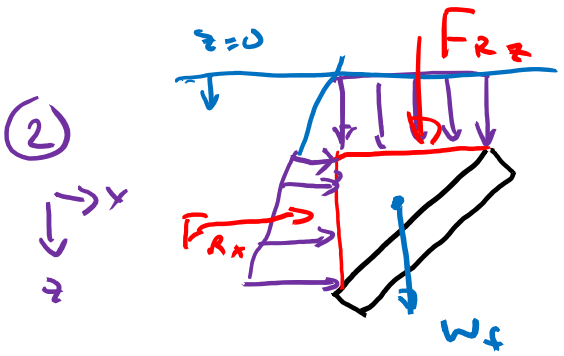
Fluid Pressure of a flat plate with constant width

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







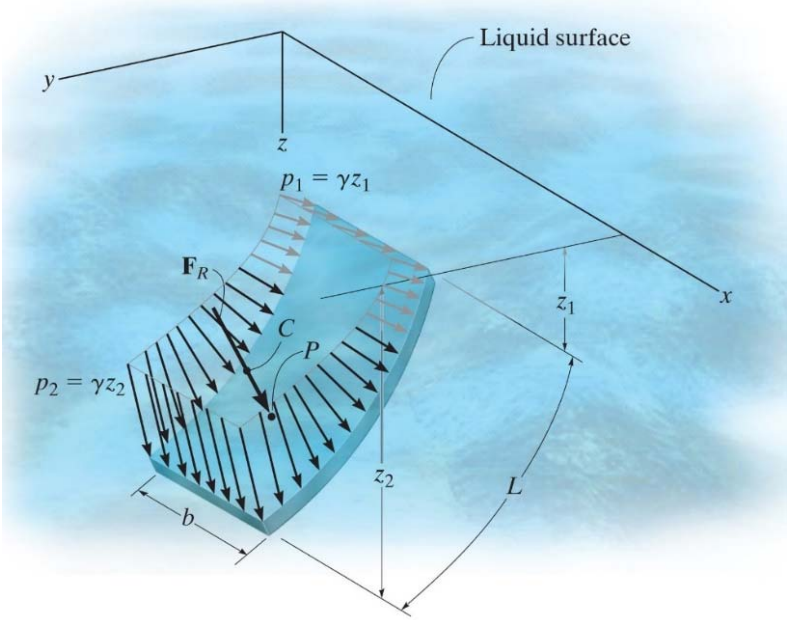


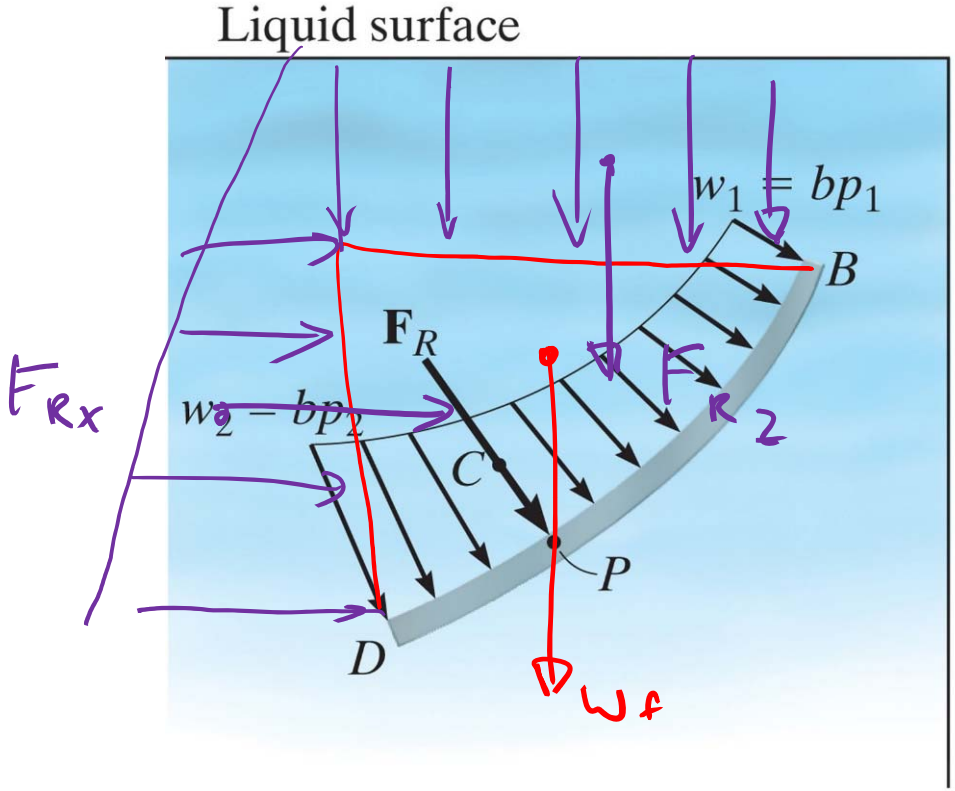
$\Sigma F_x : F_{Rx}$

$\Sigma F_z = F_{Rz} + W_f$

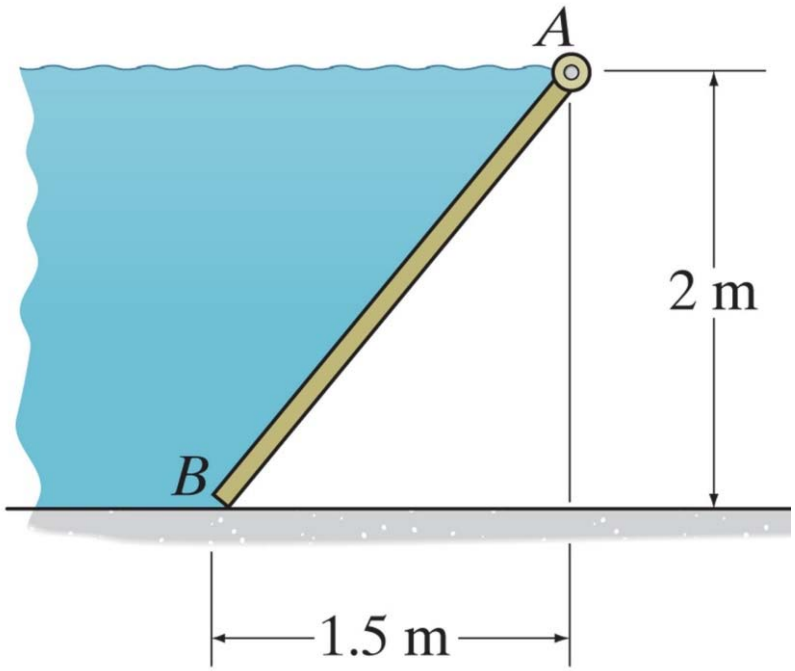
Fluid Pressure of a curved plate with constant width

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

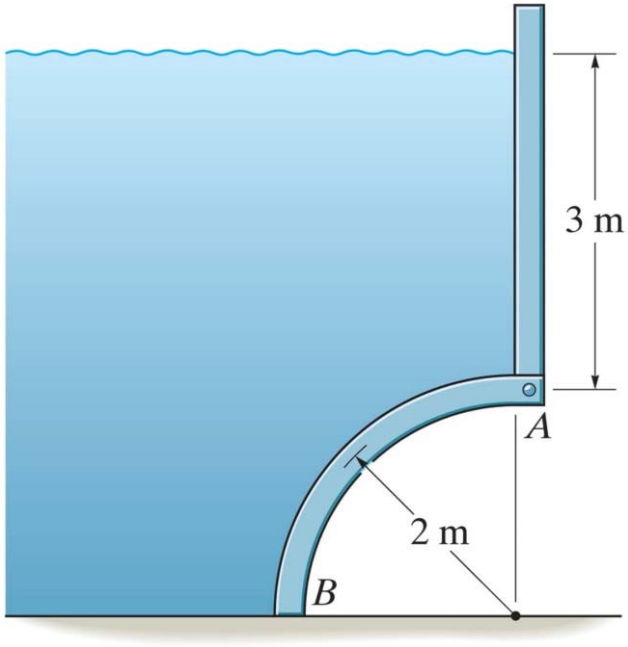


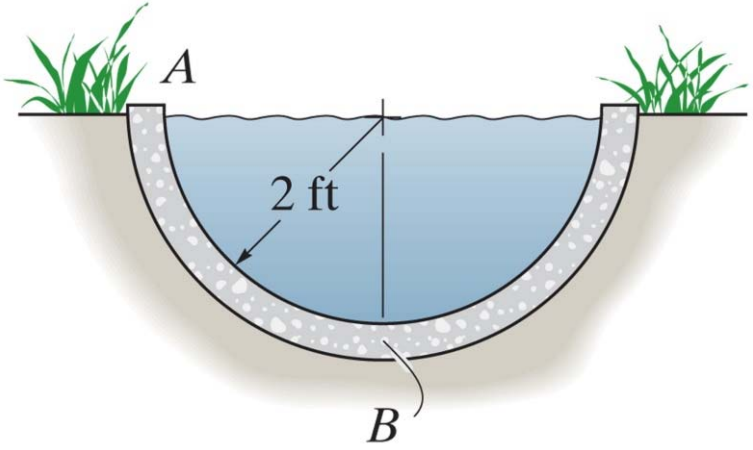


Determine the magnitude of the resultant hydrostatic force acting on the gate AB. The gate has width 1.5m.



The arched surface AB is shaped in the form of a quarter circle. If it is 8 m long, determine the horizontal and vertical components of the resultant force caused by the water acting on the surface.





The semicircular drainage pipe is filled with water. Determine the resultant force that the water exerts on the side AB of the pipe per foot of pipe length. The specific weight of the water is $\gamma = 62.4\ \text{lb/ft}^3$