

# HYDROSTATIC FORCE ON CURVE SURFACE

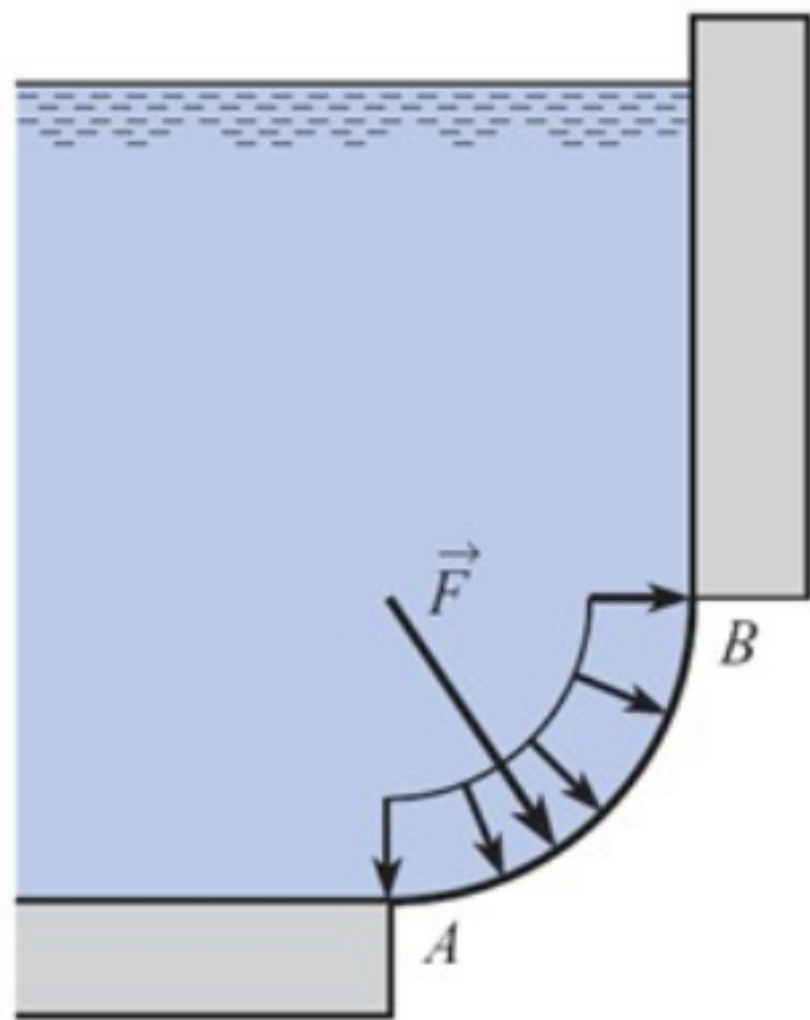
For hydrostatic force on curve surface, we have difficulties of force distribution that act on the curve surface.

They are not act on the same direction.

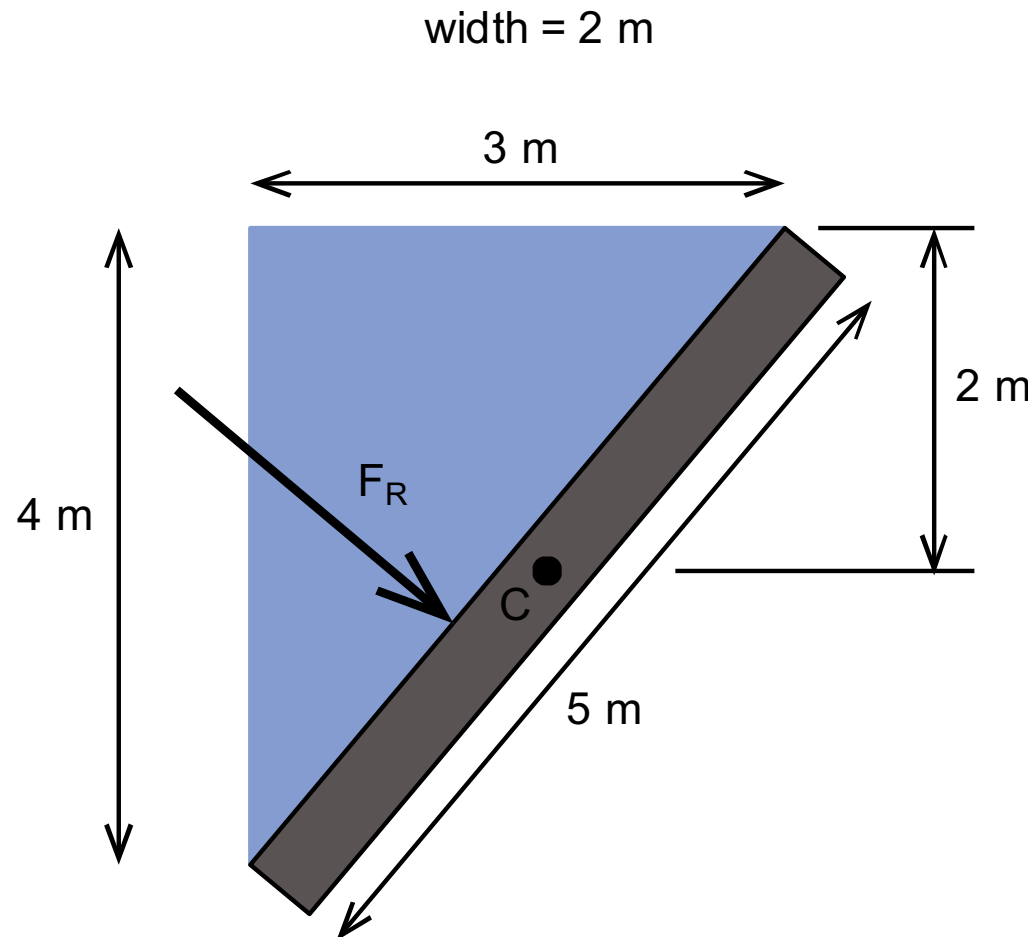
They also (maybe) have different value.

However, we could calculate the resultant force by using component forces (horizontal & vertical forces)

Please be careful about each equation. They have slightly different in definition.



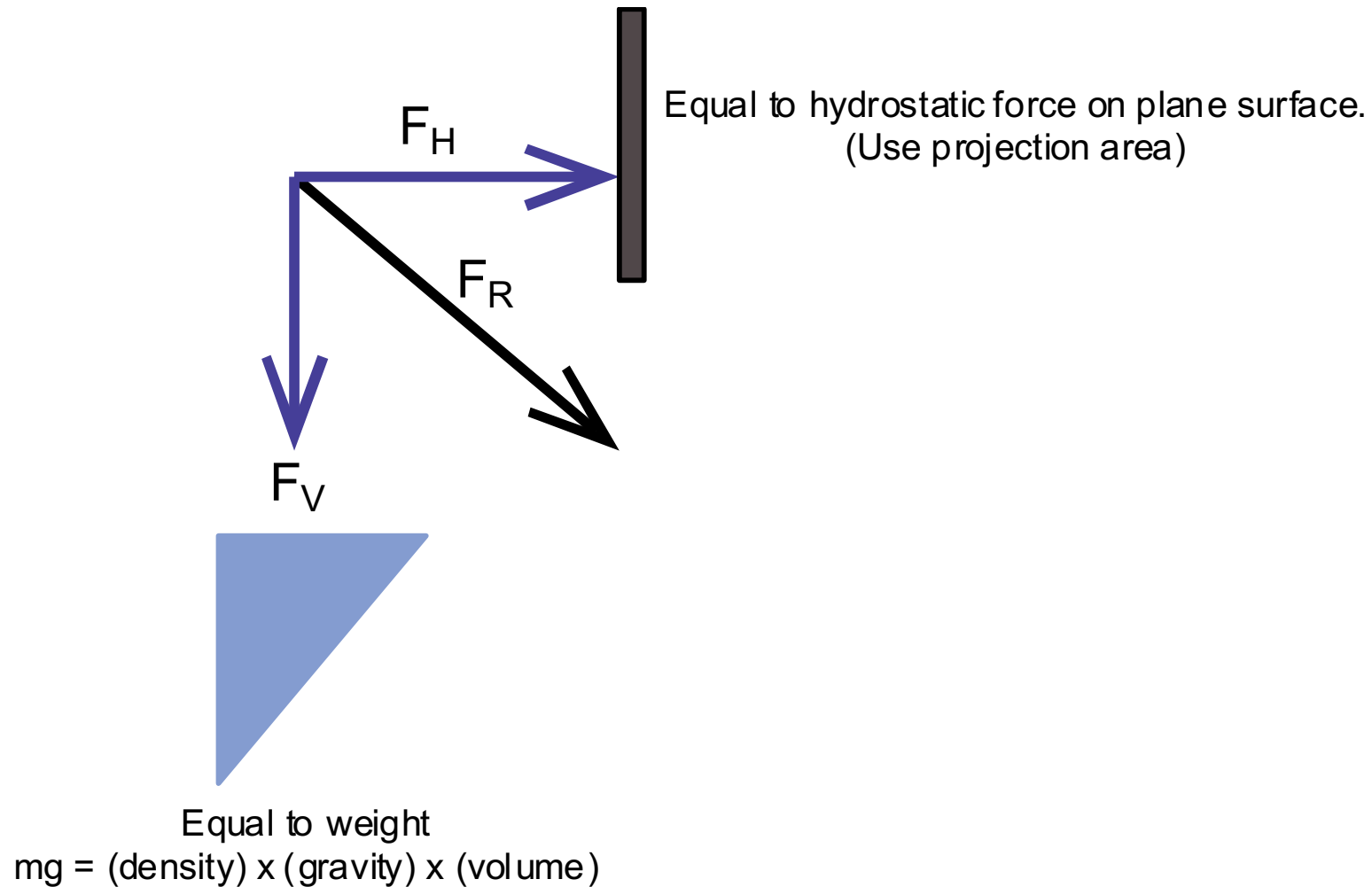
Let calculate the resultant force act on this plane surface.  
Use equation on the previous lesson.

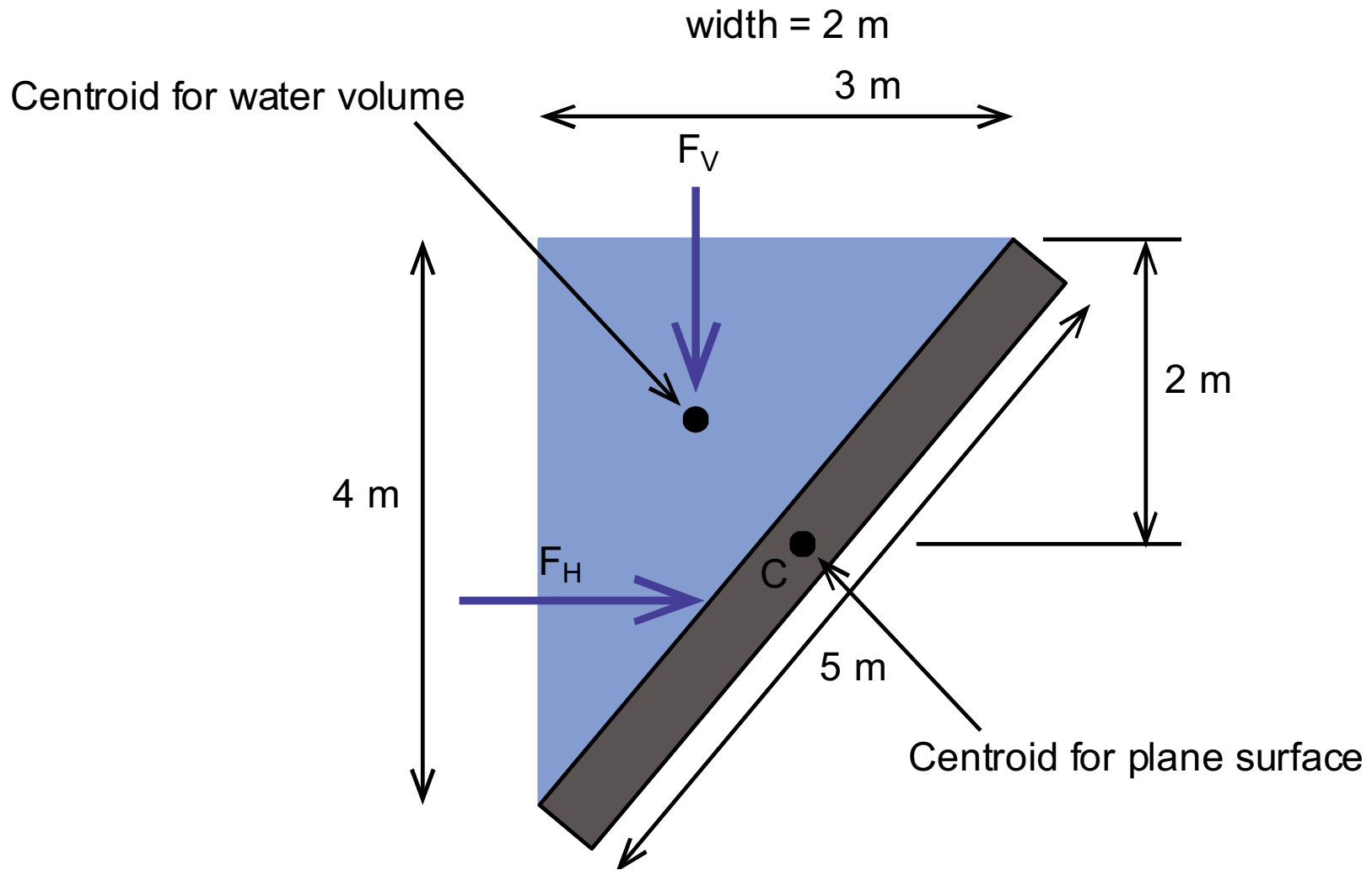


$$F_R = \rho g h_c \cdot A = \rho g (2)(5 \times 2) = \rho g (20)$$

$$y_R = \frac{I_x}{y_c \cdot A} + y_c = \frac{\frac{1}{12} (5)^3 (2)}{(2.5)(10)} + (2.5) = 3.333 \text{ (m)}$$

However, we could calculate the resultant force by using component forces (horizontal & vertical forces)





Horizontal force:

$$F_H = \rho g h_c \cdot A = \rho g (2)(4 \times 2) = \rho g (16)$$

$$y_R = \frac{I_x}{y_c \cdot A} + y_c = \frac{\frac{1}{12} (4)^3 (2)}{(2)(8)} + (2) = 2.667 \text{ (m)}$$

In this situation, we need to use a projection area as an  $A$ .

Thus, the (submerged) area become,  $A = 4 \times 2$

Vertical force:

$$F_V = \rho g \nabla = \rho g \left( \frac{1}{2} (3)(4)(2) \right) = \rho g (12)$$

This vertical force act through the centroid of the volume of water.



## Resultant force:

By using simple math, we could calculate the resultant force,

$$F_R = \sqrt{(F_V)^2 + (F_H)^2} = \sqrt{(\rho g 12)^2 + (\rho g 16)^2}$$

$$F_R = \rho g 20$$

This answer is same with the answer obtained from the first method.

It is means that, by using component forces, we could calculate the resultant force.

## Conclusion:

To calculate the (magnitude) resultant force on curve surface, we could use:

$$F_H = \rho g h_c \cdot A$$

Which  $A$  is the projection area.

$$F_V = \rho g \nabla$$

Which  $\nabla$  is the volume of liquid above the curve surface.

$$F_R = \sqrt{(F_V)^2 + (F_H)^2}$$

$y_R$

Location of the resultant force on curve surface. It can be determined by calculation but depend on the curve's shape.