Force due to liquid pressure

Pressure: force per unit area $P = \frac{F}{A}$

Fluid pressure: The pressure on an object at depth h in a liquid is

Pressure $= \boldsymbol{P = wh}$

where w is the weight-density of the liquid per unit of volume.

Common weight densities:

Water = 62.4 pounds per cubic foot
Seawater = 64.0 pounds per cubic foot

Pascal's principle: The pressure exerted by a fluid at a depth h is transmitted equally *in all directions.*

Fluid force: The fluid force on a submerged horizontal surface of area A is

Fluid force $= F = PA =$ (pressure)(area)

Examples:

1. A metal sheet is submerged horizontally in 5 ft. of water. The area of the sheet is 18 sq. ft. Calculate the fluid force on the metal.

What if the surface is submerged vertically?

Fluid force varies because the depth varies

ALWAYS MEASURE DEPTH FROM TOP DOWN

2. Find the fluid force on the indicated vertical side of a tank. Assume the tank is full of water.

3. Find the fluid force on the indicated vertical side of a tank. Assume the tank is full of water. Assume tank is semicircular in shape.

4. Find the fluid force on the vertical rectangular plate submerged lengthwise in water if the plate is 2 feet wide and 5 feet long and the top of the plate is 1 foot below the surface of the water.

5. The figure illustrates the vertical side of a form for poured concrete that weighs 140.7 lb./cu. ft. Determine the force on this part of the form.

6. A cylindrical gasoline tank is placed so that the axis of the cylinder is horizontal. Find the fluid force on a circular end of the tank if the tank is full, assuming the radius of the tank is 3 feet and the gasoline weighs 42 lb./ft^3.

7. A porthole on a vertical side of a submarine (submerged in seawater) is circular with diameter 1 foot. Find the fluid force on the porthole, assuming that the center is 15 feet below the surface.