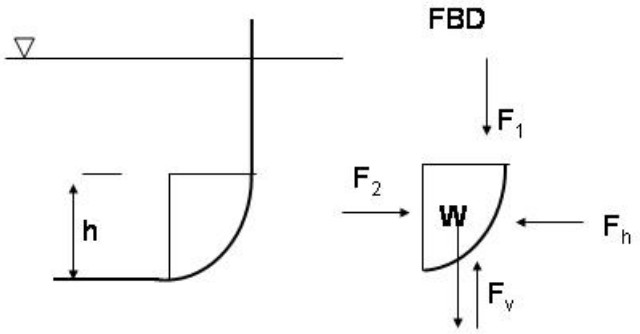
CIEG 305 CHAPTER 2 HANDOUT

HYDROSTATIC FORCES ON CURVED SURFACES

Consider a fixed curved surface under water as shown and determine the horizontal and vertical forces. Proceed by example.



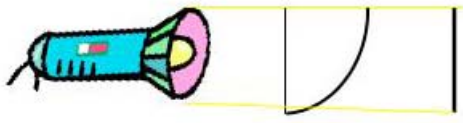
HORIZONTAL FORCE BALANCE:

The force the water supplies to the surface must be balanced for the force the surface supplies to the water.

$F_2 = F_h$, BUT $F_2 = PA = \rho g h\left(\frac{1}{2}hb\right)$, ½ comes since centroid halfway down, b is distance into paper.

So $F_h = \frac{1}{2}\rho g h^2 b$, this is just the force on a wall of the same height!

IMPORTANT! The horizontal force on a curved surface equals the force on the plane area formed by the projection of the curved surface onto a vertical plane normal to the component.



VERTICAL FORCE BALANCE

$$F_v = F_1 + W$$

IMPORTANT! The vertical component of pressure force on a curved surface equals in magnitude and direction the weight of the entire column of fluid (liquid and atmosphere) above the curved surface.

The resultant is found by vectoral magnitude

$$F_R = \sqrt{F_h^2 + F_v^2}$$

Horizontal line of action can be found from old formula and the vertical projection. Vertical line of action is more difficult. Calculating where resultant acts is tricky unless shape is circular or known (e.g. parabola) (See page 85-86).