16.5: Pressure on a Vertical Surface

Figure XVI.5 shows a vertical surface from the side and face-on. The pressure increases at greater depths. I show a strip of the surface at depth z.

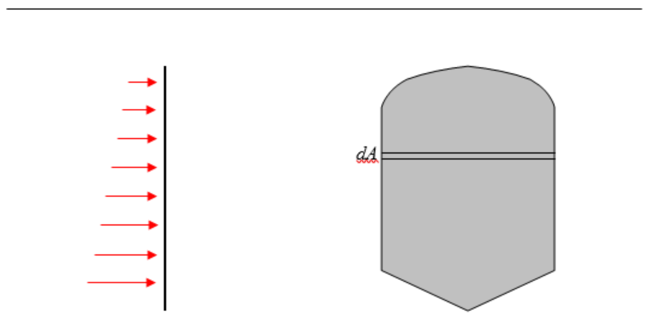

FIGURE XVI.5

Suppose the area of that strip is dA. The pressure at depth z is $\rho g z$, so the force on the strip is $\rho g z dA$. The force on the entire area is $\rho g \int z dA$, and that, by definition of the centroid (see Chapter 1), is $\rho g \bar{z} A$ where $\bar{z}$ is the depth of the centroid. The same result will be obtained for an inclined surface.

Therefore:

> *The total force on a submerged vertical or inclined plane surface is equal to the area of the surface times the depth of the centroid.*

Example 16.5.1

Figure XVI.6 shows a triangular area. The uppermost side of the triangle is parallel to the surface at a depth z. The depth of the centroid is $z+\frac{1}{3}h$, so the pressure at the centroid is $\rho g\left(z+\frac{1}{3}h\right)$. The area of the triangle is $\frac{1}{2}bh$ so the total force on the triangle is $\frac{1}{2}\rho g b h\left(z+\frac{1}{3}h\right)$.

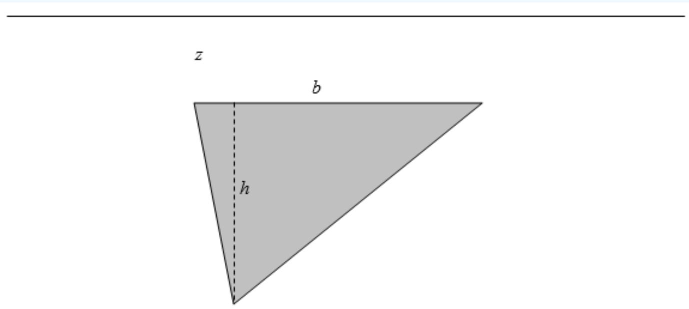

FIGURE XVI.6