Hydrostatic Pressure

The gravitational force exerted by a 1 cubic metre of water is 9.8×1000 Newtons. The gravitational force exerted by a rectangular column of water with square base of area 1 meter^2 and height d is therefore $9800d$ N.

If we have a horizontal region $\mathcal{R}$ of area A(expressed in square metres), the force exerted by a column of water d metres high is gAd, where g is the gravitational coefficient $9.8\frac{\text{metre}}{\text{sec}^2}$.

Pressure is measured in **pascals**: 1 Pascal=$1\frac{\text{Newton}}{\text{square metre}}$, or in

kilopascals(kPa): 1 kilopascal=1000 pascals=$1000\frac{\text{Newtons}}{\text{square metre}}$

Let $\mathcal{R} = \{(x, y) | c \leq y \leq d, g(y) \leq x \leq f(x)\}$ be a region in the plane.

Definition: The **hydrostatic force** exerted against $\mathcal{R}$ by water whose surface is at the level $y = d$ is

$$\int_c^d (d - y) 9.8 \left[g(y) - f(y) \right] dy$$

Theorem: This force equals $g\left(d - \bar{y}\right) A$, where A and $\bar{y}$ are the area and the y-coordinate of the centroid of $\mathcal{R}$.

Thus the mathematical theory of hydrostatic force is equivalent to that of the theory of centres of mass.
