Fluid Statics

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1 Archimede's Law

1.1 Definition

Archimedes' principle states that «every body partially or completely immersed in a fluid receives a vertical thrust from the bottom upwards, equal in intensity to the weight of the displaced fluid».

The intensity of the force is given by

$$F = \rho_{\text{fluid}} \cdot g \cdot V_{\text{body}}$$

The force is the same no matter the shape of the body.

1.2 Accelleration

An object dropped in a fluid will sink or float up depending on its density and the density of the fluid. The body will move with the following accelleration

$$\begin{aligned} F &= F_g - F_{\text{Archimede}} \\ &= gm - \rho_{\text{fluid}} V_{\text{body}} g \\ &= gm - \rho_{\text{fluid}} \frac{m}{\rho_{\text{body}}} g \\ ma &= m\left(g - \frac{\rho_{\text{fluid}} g}{\rho_{\text{body}}}\right) \\ a &= \frac{g\rho_{\text{body}}}{\rho_{\text{body}}} - \frac{g\rho_{\text{fluid}}}{\rho_{\text{body}}} \\ &= \frac{\rho_{\text{body}} - \rho_{\text{fluid}}}{\rho_{\text{body}}} g \end{aligned}$$

where m is the mass of the body.

A submerged body will

$$\begin{cases} \text{if } \rho_{\text{body}} > \rho_{\text{fluid}}, & \text{float up} \\ \text{if } \rho_{\text{body}} = \rho_{\text{fluid}}, & \text{float} \\ \text{if } \rho_{\text{body}} < \rho_{\text{fluid}}, & \text{sink} \end{cases}$$