Chapter 5
Fluid Statics

Abstract

This chapter explains pressure fields in motionless fluids. The lack of velocity gradients means no shear and so pressure is the only stress in static fluid. The pressure at any point is the same in all directions and is a function of gravity. In fluids with uniform density, pressure is a linear function of position, increasing linearly with depth below the free surface of the liquid. The average pressure exerted by a liquid on a plate is submerged vertically in the liquid is equal to the local value exerted at the centroid of the plate. The atmospheric pressure is not only a function of distance in the direction of gravity, but is also influenced by the temperature changes as a function of altitude. Absolute and gauge pressure are defined and the original pressure measurement technique, Torricelli's mercury barometer, is introduced. Buoyancy is explained by Archimedes' principle; a body immersed in or floating in a fluid is acted upon by an upward force equal to the weight of the displaced fluid, which force acts through the center of gravity of the displaced volume. Examples include dams, weirs, tank walls, and solid inclusions and grains moving in a liquid metal or slag.