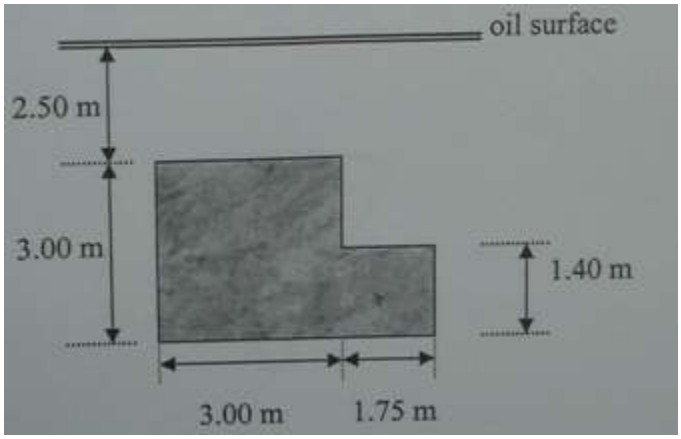
Q- A side door near the bottom of an oil tank is shown in the figure. Find the force on the door due to the oil pressure. The density of the oil is 855 kg/m^3.



The pressure due to a fluid column of height h is given by

P = h ρ g

Here ρ is the density of the fluid and g is acceleration due to gravity.

As the pressure is directly proportional to the depth we can take average pressure for a symmetric area.

The average depth of the part of the gate which is square of side 3.00 m is

2.50 + 3.00/2 = 4.00 m

Thus the force on this area is given by

$$F_1 = P * A = h\rho g * A = 4.00 * 855 * 9.80 * 9.00 = 3.02 * 10^5\ N$$

The average depth of the small rectangle area of length 1.75 m and width 1.40m is

2.5 + 3.00 – 1.4/2 = 4.8 m

Thus the force on this area is given by

$$F_2 = P * A = h\rho g * A = 4.80 * 855 * 9.80 * 1.75 * 1.40 = 0.985 * 10^5\ N$$

Hence the total force on the door is

$$F = F_1 + F_2 = 3.02 * 10^5 + 0.985 * 10^5 = 4.01 * 10^5 N$$