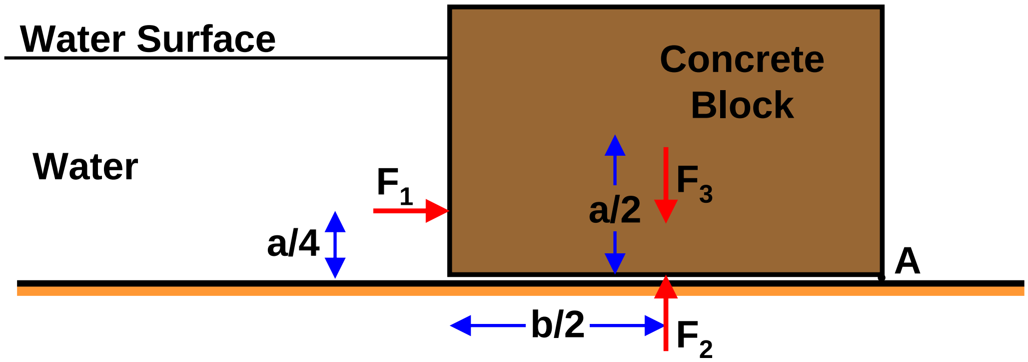
Solution to Problem 104D



The forces on the rectangular block of concrete are:

1. The force on the left hand side due to the pressure which will be equal to

$$\frac{1}{2}\rho g \left\{\frac{3a}{4}\right\}^2$$

   per unit dimension perpendicular to the sketch. This force will act horizontally with a line of action that is at a height $a/4$ (one third of the depth) above the point A.

2. The force due to the pressure underneath the block. Since the pressure underneath the block is $3\rho ga/4$ above atmospheric pressure, this force has a magnitude equal to

$$\rho g \left\{\frac{3ab}{4}\right\}$$

   per unit dimension perpendicular to the sketch. This force will act vertically upward with a line of action which is a distance $b/2$ from the point A.

3. The weight of the block $5\rho gab/2$ per unit dimension perpendicular to the sketch. It acts vertically downward through the center of mass and therefore has a line of action which is a distance $b/2$ from the point A.

To determine the stability of the block we take moments about the point A. The net clockwise moment, M, is therefore given by

$$M = \frac{1}{2}\rho g \left\{\frac{3a}{4}\right\}^2 \frac{a}{4} + \rho g \left\{\frac{3ab}{4}\right\} \frac{b}{2} - \frac{5\rho gab}{2}\frac{b}{2}$$

and this moment will become positive when

$$a^2 > \frac{7 \times 16}{9} b^2$$

so that the critical ratio becomes

$$\frac{b}{a} = \left\{\frac{9}{7 \times 16}\right\}^{\frac{1}{2}} = 0.283$$