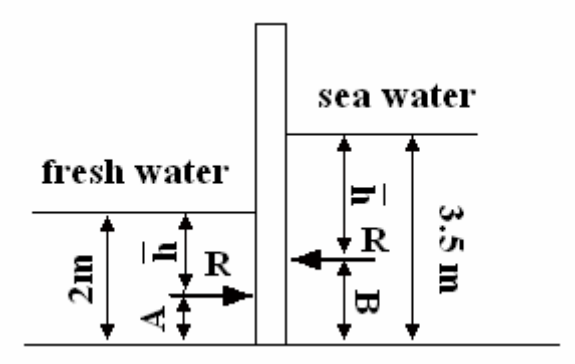
2. A vertical wall acts as a dam between fresh water (density 1000 kg/m^3) and sea water (density 1030 kg/m^3) on the other side. The depths are 2 m and 3.5 m respectively. Calculate the resultant force and resultant turning moment about the base for a init width.



FRESH WATER

$R = \rho g A \bar{y}$ and $\bar{y} = h/2 = 2/2 = 1$

$R = 1000 \times 9.81 \times 2 \times 1 = 19620$ N

$M = R\,A$ $\quad A = (2 - \bar{h})$ In this case $\bar{h} = 2h/3$

$M = 19620\ (2/3) = 13080$ N m

SALT WATER

$R = \rho g A \bar{y}$ and $\bar{y} = h/2 = 3.5/2 = 1.75$

$R = 1030 \times 9.81 \times 3.5 \times 1.75 = 61889$ N

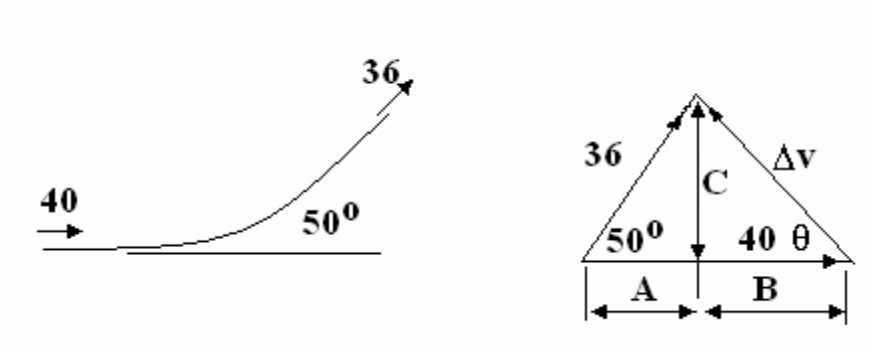
$M = R\,B$ $\quad B = (3.5 - \bar{h})$ In this case $\bar{h} = 2h/3$

$M = 61889 \times 1.1667 = 72204$ N m

Resultant Force = 61889 - 19620 = 42269 N (acting right to left)

Resultant Moment = 72204 – 13080 = 59124 Nm (acting anti clockwise)

Q7 A jet of water flows smoothly onto a stationary curved vane which turns it through an angle of 50^o as shown. The jet flows onto the vane with a velocity of 40 m/s and a circular cross section of diameter 0.04 m. The water leaves the vane with a velocity of 36 m/s. Calculate the magnitude and direction of the force on the vane. Neglect gravitational effects.



The vector diagram is constructed as shown. Find the change in velocity Δv

C = 36 sin 50 = 27.577 A = 36 cos 50 = 23.14

B = 40 – A = 16.86 $\Delta V = \sqrt{(27.577^2 + 16.86^2)} = 32.32$ m/s

Mass flow = ρ A v = 1000 x π x $0.04^2/4$ x 40 = 50.265 kg/s

F = m Δv = 1625 N
$\theta = \tan^{-1}(27.577/16.86) = 58.6^o$
The force on the vane is the opposite direction to ΔV