July 2008

A bulkhead is 7m high and is flooded to a height of 6.1m with seawater on one side only.

Calculate EACH of the following:

a) The hydrostatic pressure at the base of the bulkhead

b) The hydrostatic force on the circular access door 740mm in diameter having its centre situated 5.9m down from the top of the bulkhead

Density of seawater 1025kg/m³

December 20, Qu 7

a) Determine the thrust load in MN on a cofferdam bulkhead 25m wide by 26m deep when flooded with saltwater of density 1025kg/m³ on one side only. (4)

b) Determine the gauge pressure, in bar, at the lowest point on the bulkhead (4)

December 19, Qu 7

A ship's compartment becomes flooded with sea water. It has a bulkhead 7m wide by 8m deep.

Determine each of the following:

a) The pressure on the bulkhead at its lowest point (3)

b) The thrust on the bulkhead (5)

Note: sea water density is 1025kg/m³

March 19, Qu 9

A canal gate is approximately 24m wide and is flooded to its top edge, on one side only, with water of density 1005 kg/m^3.

Calculate EACH of the following:

a) the height of the gate, given that the thrust under the flooded condition is 29 MN; (6)

b) the pressure at a point 2.5 m from the base of the gate. (2)

A tank with a base area of 3.5m^2 is 3.7m deep and is two thirds full of water of density 1019 kg/m^3.

Determine EACH of the following:

(a) the pressure on the bottom of the tank; (3)

(b) the thrust load on the bottom of the tank when the tank is completely filled and the water rises 1.8m up the sounding pipe. (5)

7. A potable water tank shares a bulkhead with the engine room. The common bulkhead is 4 m high and 4 m wide. The amount of water in the tank is measured using a pressure transducer in the base of the tank. The density of water is 1000 kg/m^3.

Determine EACH of the following:

(a) the thrust on the bulkhead when the tank is filled to within 0.5 metre of the top; (4)

(b) the pressure indicated on the transducer, in kilopascals, when the tank is half full. (4)

Section B

7. (a) Determine the thrust load in MN on a cofferdam (bulkhead) 25 m wide by 26 m deep when flooded with seawater of density 1025 kg/m^3 on one side only. (4)

(b) Determine the gauge pressure, in bar, at the lowest point on the bulkhead. (4)

September 2006

A box barge 42m long and 16m beam floats in water of density 1021 kg/m^3.

Calculate EACH of the following:

a) The draught of the barge if the displacement is 1540 tonne

b) The pressure on the outer bottom plating when the barge is floating at the draught in (a)

Section B

7. A wooden beam is 3 m long x 20 cm wide x 75 mm deep and floats horizontally in sea water of density 1025 kg/m^3.

Calculate the height of wood above the water surface (freeboard) given that the wood has a density of 750 kg/m^3. (8)

Section B

7. A solid block of wood is 2 m long x 90 cm wide x 50 cm deep and floats in sea water of density 1025 kg/m^3.

Calculate the height of block above the water surface (freeboard) given that the wood has a density of 750 kg/m^3 and that it floats horizontally. (8)

11. A plank of wood is 4.88 m long x 25.8 cm wide x 175 mm deep and floats horizontally in calm water. Take the water density as 1010 kg/m^3 and the density of wood as 710 kg/m^3

Calculate the maximum mass that could be supported on this plank without it sinking. (8)

10. A crate 6 m long x 2 m wide x 2 m high is lost overboard. The crate has a mass of 9 tonnes and floats horizontally and upright in sea water of density 1025 kg/m^3. Assume the crate is waterproof.

Calculate the height of the container above the water surface. (8)

8. A standard shipping container 12.192 m long x 2.438 m wide x 2.591 m high. It has a mass of 29 tonnes. The container is lost overboard and floats on its side in sea water of density 1025 kg/m^3.

Calculate the height of the container above the water surface. (8)

12. A barge, which can be considered to be a rectangular box has the dimensions 20 m x 6 m x 3.5 m with a mass of 64 tonnes. The barge is loaded with 250 tonnes of coal and lowered into a river.

Calculate the height of the barge above the water surface (freeboard) given that the river water has a density of 1005 kg/m^3 and that the barge floats horizontally. (8)

8. An oil bunker tank shares a bulkhead with the engine room. The common bulkhead is 8 m high and 4 m wide. The amount of oil in the tank is measured using a pressure transducer in the base of the tank.
Calculate EACH of the following:

(a) The thrust on the bulkhead when the tank is filled to within 1 m of the top;
(5)

(b) The pressure indicated by the transducer in kilopascals, when the tank is half full.
(3)

Note: The density of oil is 990 Kg/m^3

9. A single oil tank in a ship is 10 m wide and 17 m deep. The tank is empty with seawater outside. The tank is then filled to the top with crude oil of density 850 kg/m^3, assume any change in draft is negligible.
Calculate EACH of the following:

(a) The pressure on the bulkhead, at a point 8.5 m below the water surface before the tank is filled with oil; (3)

(b) The resultant force on the tank bulkhead when the tank is filled. (5)

Note: Sea water density = 1025 kg/m^3 $g = 9.81$ m/s^2

11. A ship has a displacement of 12000 tonnes. It floats in sea water of density 1025 kg/m^3.

Two double bottom fuel tanks measuring 10 m long x 4 m wide x 2.1 m deep are positioned equally either side of the centre line.

These tanks are now completely filled with sea water.

Calculate the change in position of G, in both magnitude and direction, given that the initial KG = 4.1 m. (8)

July 2008

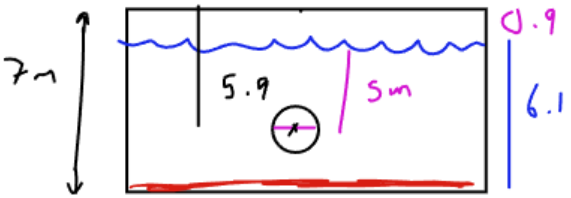
A bulkhead is 7m high and is flooded to a height of 6.1m with seawater on one side only.

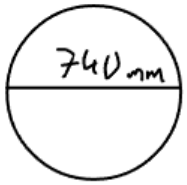
Calculate EACH of the following:

a) The hydrostatic pressure at the base of the bulkhead

b) The hydrostatic force on the circular access door 740mm in diameter having its centre situated 5.9m down from the top of the bulkhead

Density of seawater 1025kg/m³





$d = 740\,mm = 0.74\,m$

$r = 0.37\,m$

$A = \pi r^2 = 0.430084\,m^2$

a) $P = \frac{F}{A}$

$P = \frac{F}{A} = \rho \cdot g \cdot h$

$\rho = 1025$

$g = 9.81$

$h = 6.1$

$P = 1025 \cdot 9.81 \cdot 6.1$

$P = 61337.025\,Pa$

$61.337\,kPa$

b) $F = \rho g A h$

$\rho = 1025$

$g = 9.81$

$A = 0.43\,m^2$

$h = 5\,m$

$F = 1025 \times 9.81 \times 0.43 \times 5$

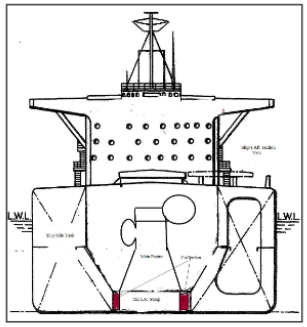
$F = 21623.01243\,N$

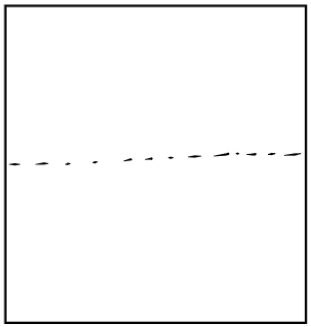
$21.623\,kN$

December 20, Qu 7

a) Determine the thrust load in MN on a cofferdam bulkhead 25m wide by 26m deep when flooded with saltwater of density 1025kg/m³ on one side only. (4)

b) Determine the gauge pressure, in bar, at the lowest point on the bulkhead (4)





a) $F = \rho g A \bar{h}$

$\rho = 1025$

$g = 9.81$

$A = 25 \times 26 = 650$

$\bar{h} = 13$

$F = 1025 \times 9.81 \times 650 \times 13$

$F = 84,966862.5$

$84.96686\ MN$

b) $p = \rho g h$

$\rho = 1025$

$g = 9.81$

$h = 26$

$p = 1025 \times 9.81 \times 26$

$p = 261436.5$

$p = 2.61\ bar$

December 19, Qu 7

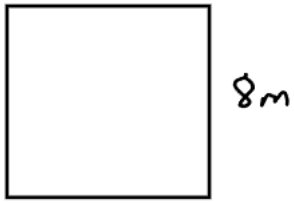
A ship's compartment becomes flooded with sea water. It has a bulkhead 7m wide by 8m deep.

Determine each of the following:

a) The pressure on the bulkhead at its lowest point (3)

b) The thrust on the bulkhead (5)

Note: sea water density is 1025kg/m³



a) $P = \rho g h$

$\rho = 1025$

$g = 9.81$

$h = 8$

$P = 1025 \times 9.81 \times 8$

$P = 80,442 \ (P_a)$

b) $F = \rho g A \ t$

$\rho = 1025$

$g = 9.81$

$A = 7 \times 8 = 56$

$t = 4$

$F = 1025 \times 9.81 \times 56 \times 4$

$F \ 2,253,376 \ N$

$2.25 \ MN$

March 19, Qu 9

A canal gate is approximately 24m wide and is flooded to its top edge, on one side only, with water of density 1005 kg/m³.

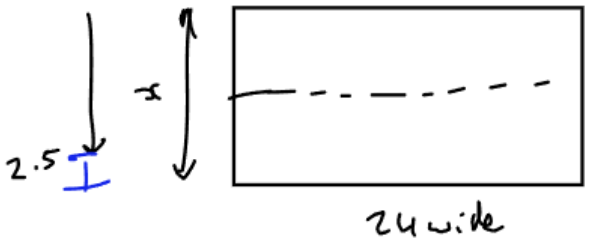
Calculate EACH of the following:

a) the height of the gate, given that the thrust under the flooded condition is 29 MN; (6)

b) the pressure at a point 2.5 m from the base of the gate. (2)

$P = \rho g h$

$F = \rho g A h$



$g = 9.81$

$F = 29{,}000{,}000$

$\rho = 1005$

$A = 24x$

$h = \frac{x}{2}$

$$29{,}000000 = (1005)\cdot(9.81)\cdot(24x)\cdot\left(\frac{x}{2}\right)$$

$$29{,}000{,}000 = 118308.6\,x^2$$

$$\frac{29000000}{118308.6} = x^2$$

$$x = 15.656\ m$$

b) $15.656 - 13.1563$ m

$$P = \rho g h$$

$$P = 1005 \times 9.81 \times 13.1563$$

$$129701.2262 \text{ Pa}$$

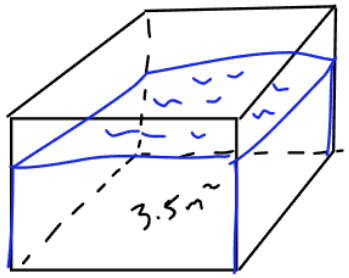
$$129.7 \text{ kPa}$$

A tank with a base area of 3.5m² is 3.7m deep and is two thirds full of water of density 1019 kg/m³.

Determine EACH of the following:
(a) the pressure on the bottom of the tank; (3)
(b) the thrust load on the bottom of the tank when the tank is completely filled and the water rises 1.8m up the sounding pipe. (5)

$P = \rho g h$

$F = \rho g A h$



a)

water depth

$3.7\,m \times \frac{2}{3} = 2.46667\,m$

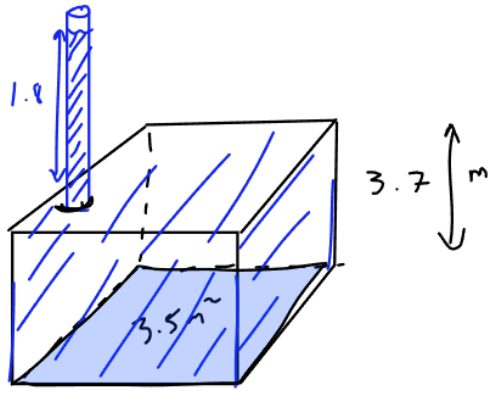
$\rho = 1019$

$g = 9.81$

$h = 2.46667$

$P = 24657.762$ (P_a)

$24.658\ kPa$



$F = \rho g A h$

$F = 1019 \times 9.81 \times 3.5 \times 5.5$

$F = 192430.5$

$192.43\ kN$

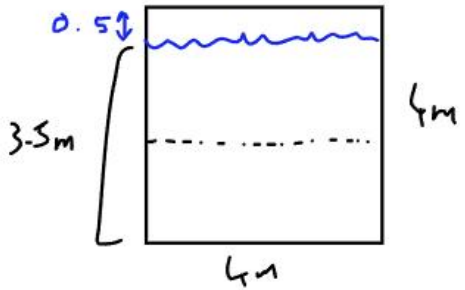
7. A potable water tank shares a bulkhead with the engine room. The common bulkhead is 4 m high and 4 m wide. The amount of water in the tank is measured using a pressure transducer in the base of the tank. The density of water is 1000 kg/m^3.

Determine EACH of the following:

(a) the thrust on the bulkhead when the tank is filled to within 0.5 metre of the top; (4)

(b) the pressure indicated on the transducer, in kilopascals, when the tank is half full. (4)

a)



$P = \rho g h$

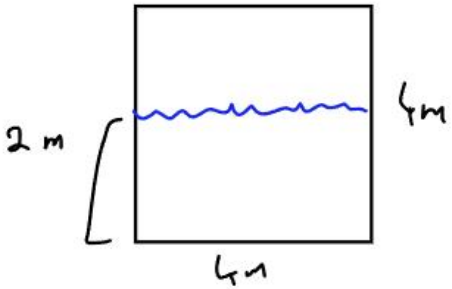
$F = \rho g A \bar{h}$

$\bar{h} = 1.75$

$F = 1000 \times 9.81 \times (3.5 \times 4) \times 1.75$

$F = 240345\ N$

b)



$P = 1000 \times 9.81 \times 2$

$P = 19620\ Pa$

September 2006

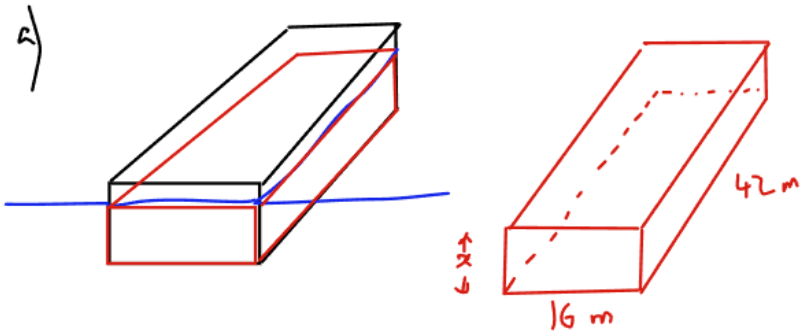
A box barge 42m long and 16m beam floats in water of density 1021 kg/m³.

Calculate EACH of the following:

a) The draught of the barge if the displacement is 1540 tonne

b) The pressure on the outer bottom plating when the barge is floating at the draught in (a)

a)



$Vol = l \times w \times h$

$16 \times 42 \times x$

$Vol = 672x$

$D = \frac{m}{v}$

$D \times V = m$

Mass Water displaced = Mass Barge

1540 tonnes

$D \times V$

$1021 \times 672x = 1{,}540{,}000\ kg$

$x = 2.2445\ m$

5) $p = \rho g h$

$= 1021 \times 9.81 \times 2.2445 = 22481.25$ Pa

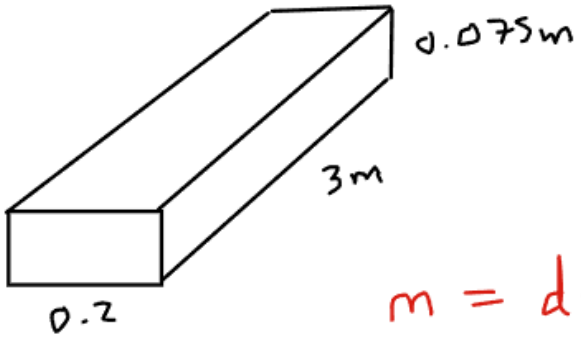
22.48 kPa

Section B

7. A wooden beam is 3 m long x 20 cm wide x 75 mm deep and floats horizontally in sea water of density 1025 kg/m³.

Calculate the height of wood above the water surface (freeboard) given that the wood has a density of 750 kg/m³. (8)

Mass Water displaced = Mass of object



Vol = 0.045m

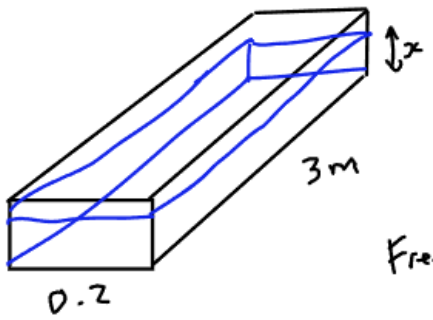
m = d x V

750 x 0.045

m = d x V = 33.75 kg

$\frac{33.75}{1025} = 0.0329268\ m^3$

Volume of water displaced



$$V = (0.2)(3)(x) = 0.0329268$$

$$x = 0.0548780 \text{ m}$$

$$\text{Freeboard} = 0.075\text{m} - 0.0548780$$

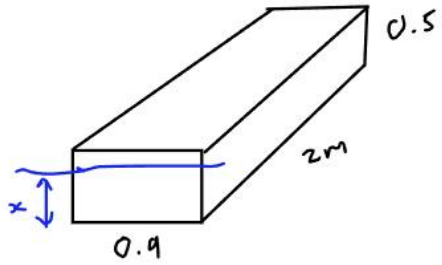
$$0.0201219\text{5 m}$$

20mm

Section B

7. A solid block of wood is 2 m long x 90 cm wide x 50 cm deep and floats in sea water of density 1025 kg/m³.

Calculate the height of block above the water surface (freeboard) given that the wood has a density of 750 kg/m³ and that it floats horizontally. (8)



Mass of water displaced = Mass of object

Mass of Object.

Vol x density = mass

$(0.9 \times 2 \times 0.5) \times 750$

675 kg

Volume of water displaced

$\frac{\text{mass}}{\text{density}} = \text{vol}$

$\frac{675}{1025} = 0.65853\ m^3$

Depth of wood in water

$Vol = l \times w \times h$

$0.65853 = 0.9 \times 2 \times x$

$x = 0.36585\ m$

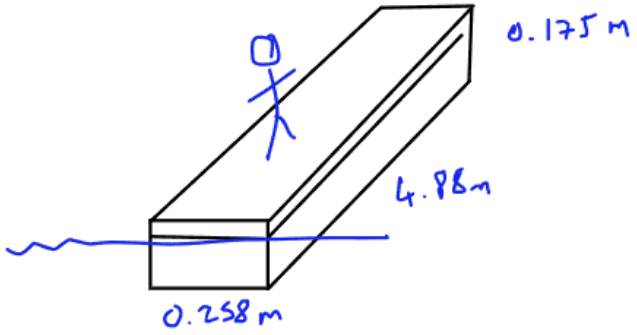
Free board

$h - x = 0.5 - 0.36585 =$

$0.13414\ m$

11. A plank of wood is 4.88 m long x 25.8 cm wide x 175 mm deep and floats horizontally in calm water. Take the water density as 1010 kg/m³ and the density of wood as 710 kg/m³

Calculate the maximum mass that could be supported on this plank without it sinking. (8)



Mass of water displaced = Mass of beam + load

Vol of beam

$V = l \times w \times h$

$0.258 \times 4.88 \times 0.175 = 0.220332\ m^3$

Mass of beam

$V \times d = m$

$710 \times 0.220332 = 156.43572\ kg$

Mass of water displaced

$d = \frac{m}{V}$ $\quad V d = m$

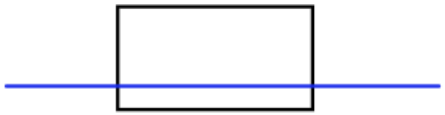
$0.220332 \times 1010 = 222.53532\ kg$

Max Load

$222.53532 - 156.43572 = 66.0996\ kg$

10. A crate 6 m long x 2 m wide x 2 m high is lost overboard. The crate has a mass of 9 tonnes and floats horizontally and upright in sea water of density 1025 kg/m^3. Assume the crate is waterproof.

Calculate the height of the container above the water surface. (8)



mass of water displaced = mass of object.

= 9000 kg

Vol of water displaced

$d = \frac{m}{v}$ $m = dv$ $\frac{m}{d} = V$

$\frac{9000}{1025} = 8.78049\ m^3$

depth of container

submerged vol = $8.78049\ m^3$

$8.78049 = w \times L \times d$

$6 \times 2 \times d$

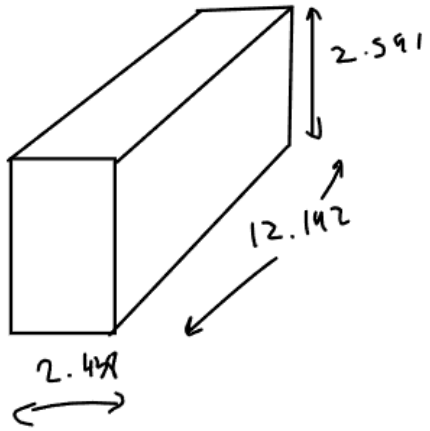
$$d = 0.73170 \text{ m}$$

height abae wter

$$2 - 0.7310 = 1.269 \text{ m}$$

8. A standard shipping container 12.192 m long x 2.438 m wide x 2.591 m high. It has a mass of 29 tonnes. The container is lost overboard and floats on its side in sea water of density 1025 kg/m^3.

Calculate the height of the container above the water surface. (8)



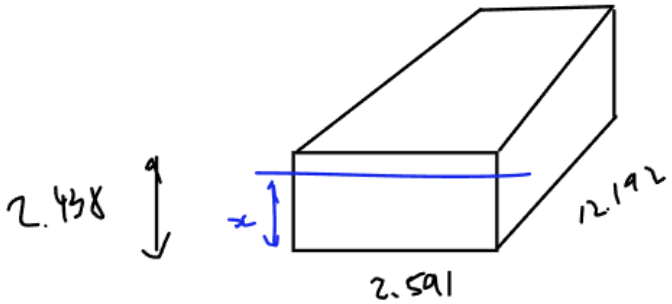
Mass water displaced = Mass of object

29,000kg

Vol of water displaced

$d = \frac{m}{V}$ $V = \frac{m}{d}$

$V = \frac{29,000}{1025} = 28.29268\ m^3$



depth of box in water

$Vol = w \cdot l \cdot h$

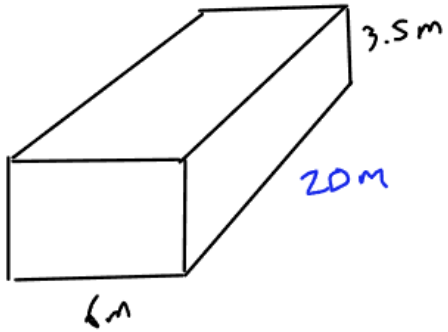
$28.29268 = 2.591 \times 12.192 \cdot x$

height above water

$2.438 - 0.8495364 =$ **1.588 m**

12. A barge, which can be considered to be a rectangular box has the dimensions 20 m x 6 m x 3.5 m with a mass of 64 tonnes. The barge is loaded with 250 tonnes of coal and lowered into a river.

Calculate the height of the barge above the water surface (freeboard) given that the river water has a density of 1005 kg/m^3 and that the barge floats horizontally. (8)



mass of water displaced = mass of barge + load

(250 + 64) tonnes

= 314 000 kg

Volume of water displaced

$d = \frac{m}{v}$ $v = \frac{m}{d}$

$v = \frac{314000}{1005} = 312.4378\ m^3$

depth of barge

$V = l \times w \times h$

$312.4378 = 6 \times 20 \times x$

$x = 2.60364$

height above wtr

$3.5 - 2.60364 = 0.8963$ m