HW 1.4 CH.5 8, 24, 41, 61 ✓ ✓ ✓

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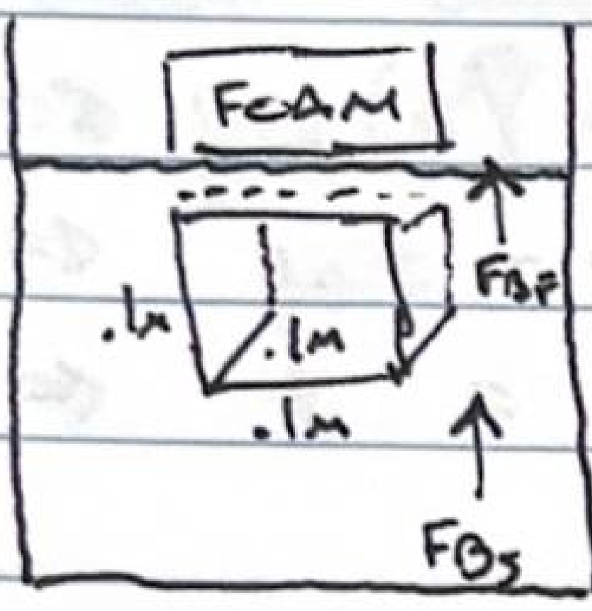
8)



PURPOSE: FIND MINIMUM REQ. VOLUME of BUOY.

GIVEN: STEEL CUBE $\forall = 1mm^3$

CUBE WEIGHT = 80N

(γ) BUOY WEIGHT = $470 N/m^3$

EQS: $F_v = \gamma \forall$, γ = WEIGHT / $\forall$

ASSUME H_2O PROPERTIES $\gamma = \rho g$

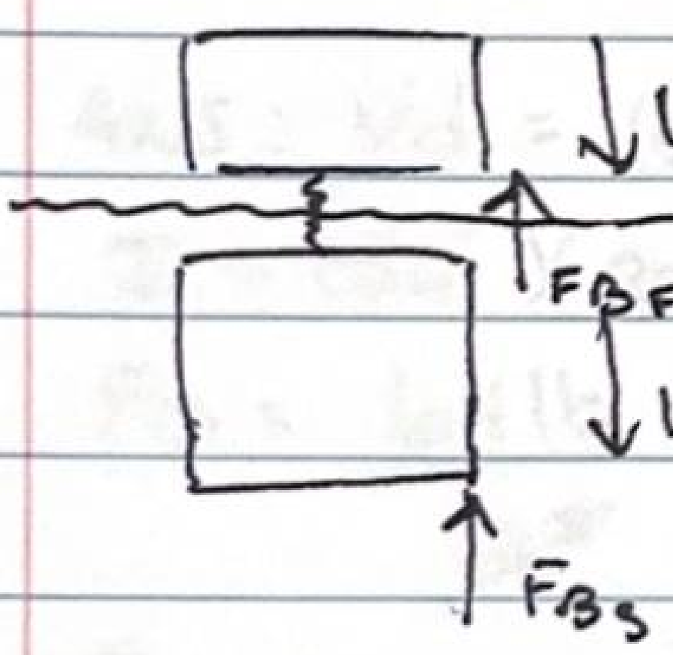
ANS: $F_{B\,STEEL} = (1000\,kg/m^3)(9.81\,m/s^2)(.001\,m^3)$

$= \underline{9.81N}$

WEIGHT of FOAM $= \gamma(\forall_F) = 470\,N/m^3\,\forall_F$

$F_{B\,FOAM} = (1000\,kg/m^3)(9.81\,m/s^2)(\forall_F)$

$= \underline{9810\,kg/m^2s^2\,\forall_F}$

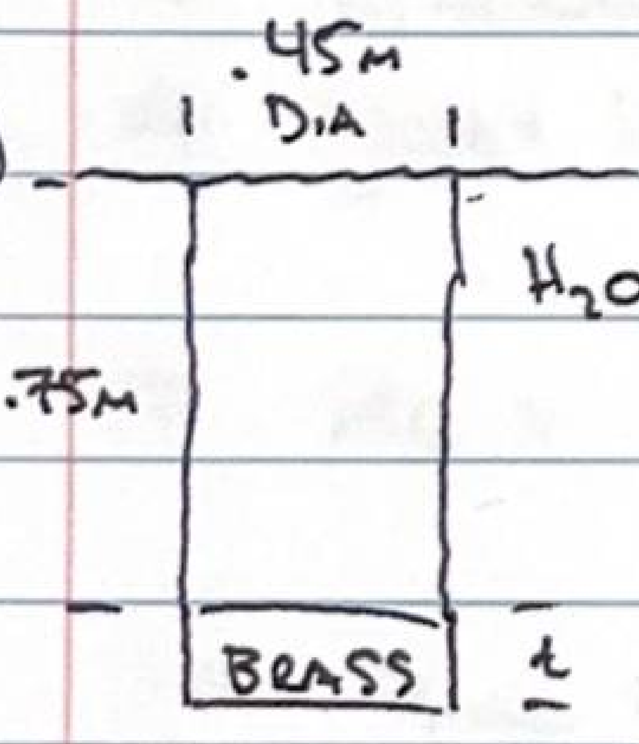


$\Sigma F_y = 0$, $9.81N + 9810\,kg/m^2s^2\,\forall_F - 470N/m^3\,\forall_F - 80N = 0$

$\Rightarrow 9340\,\forall_F = 70.19$

$\Rightarrow \boxed{\forall_F = 7.5mm^3}$

24)



PURPOSE: FIND THICKNESS of BRASS.

GIVEN: $\gamma_{BRASS} = 84\,kN/m^3$

TABLE A.1: H_2O @ 95°C, $\gamma = 9.44\,kN/m^3$

EQS: WEIGHT = $\gamma D t$, $F_B = \gamma \forall$

ANS: $\gamma_{CYLINDER}$ = WEIGHT / $\forall$ → USING KEROSENE @ 25°C

* .6m SUBMERGED $\Rightarrow W_{cyl} = F_{BK}$, γ_{KER} @ 25°C = $8.07\,kN/m^3$

$\Rightarrow \gamma_{cyl}(\cancel{A})(H_{cyl}) = \gamma_{KER}(\cancel{A})(H_{SUB})$ $\Rightarrow \gamma_{cyl} = (\gamma_{KER} H_{SUB}) / H_{cylinder}$

$\Rightarrow \gamma_{CYLINDER} = \frac{8.07\,kN}{m^3} / \frac{.6\cancel{m}}{.75\cancel{m}} = \underline{6.456\,kN/m^3}$

→

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24) CONT) $W_{cyl} + W_B = F_{Bcyl} + F_{B\,BRASS}$

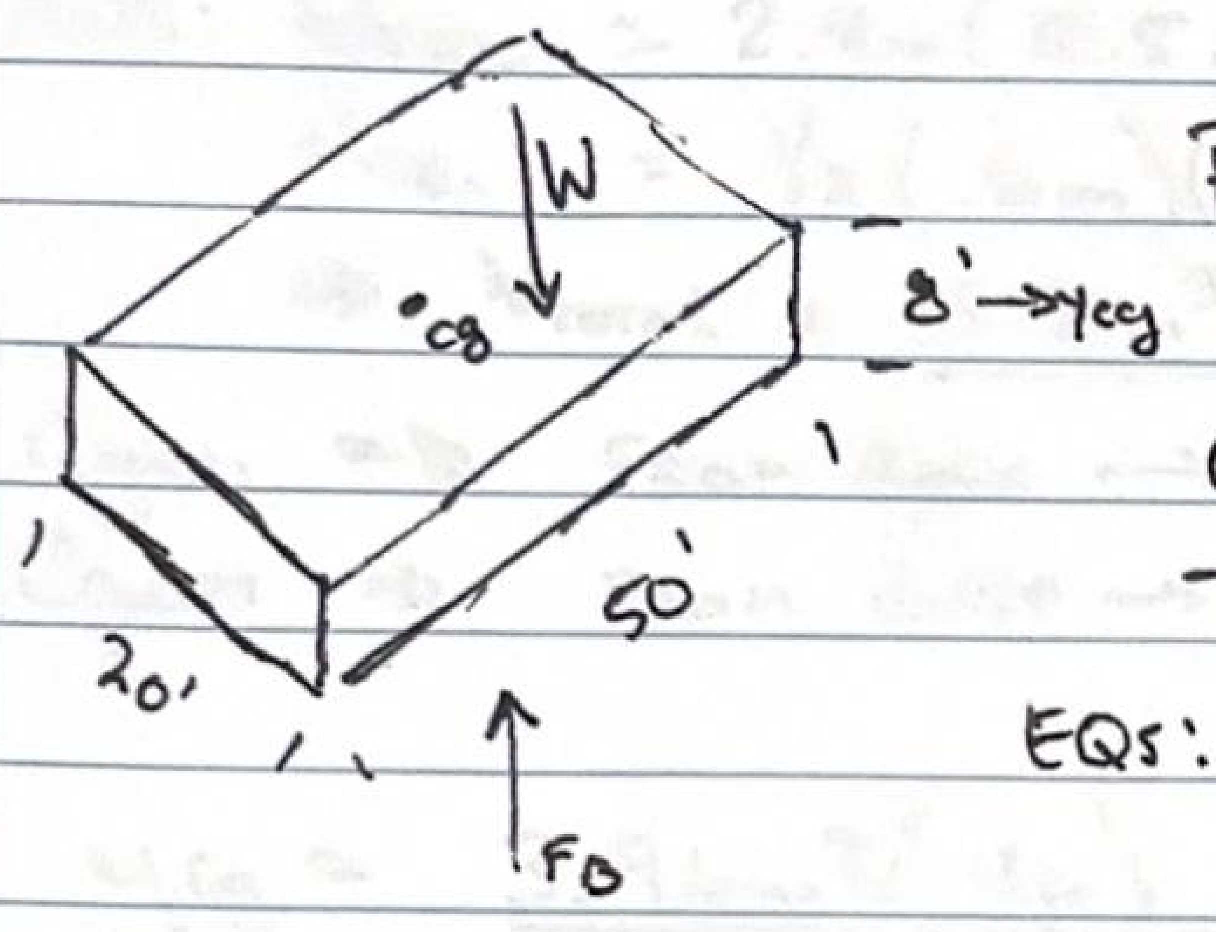
$\Rightarrow \gamma_{cyl}(\cancel{A})(H) + \gamma_{BRASS}(\cancel{A})(t) = \gamma_{H_2O}(\cancel{A})(H) + \gamma_{H_2O}(\cancel{A})(t)$

$\Rightarrow \gamma_B t - \gamma_{H_2O} t = \gamma_{H_2O} H - \gamma_{cyl} H$

$\Rightarrow t = \dfrac{H(\gamma_{H_2O} - \gamma_{cyl})}{(\gamma_B - \gamma_{H_2O})} = .75\text{m}\dfrac{(9.44\text{ kN/m}^3 - 6.456\text{ kN/m}^3)}{(84\text{ kN/m}^3 - 9.44\text{ kN/m}^3)}$

$\Rightarrow t = .03\text{ m} \Rightarrow$ $\boxed{\text{BRASS THICKNESS MIN} = 30\text{ mm}}$

41)



PURPOSE: WILL PLATFORM BE STABLE IN SEAWATER?

GIVEN: PLATFORM WEIGHT = 450 000 lbs

TABLES: $\gamma_{SEA\,H_2O} = 64\text{ lb/ft}^3$

EQS: $F_B = \gamma V$, $W_{PLAT} = F_B$, $MB = I/V_d$

$y_{MC} = y_{CB} + MB$, $I = BH^3/12$

IF $y_{MC} > y_{cg} \Rightarrow$ STABLE

ANS: $V_d = (50')(20')(h) = h1000'\text{ ft}^3$

$I = (50')(20')^3/12 = \underline{33333.3\text{ ft}^4}$

$F_B = \dfrac{64\text{ lb}}{\cancel{\text{ft}^3}}\Big|\dfrac{1000\,\cancel{\text{ft}^3}}{}\Big|\,h = 64000\text{ lbs }(h)$

$\Rightarrow 64000\,h\text{ lbs} = 450\,000\text{ lbs} \Rightarrow h = 7.03\text{ ft}$

$\Rightarrow y_{CB} = h/2 = \underline{3.515\text{ ft}}$

$\Rightarrow MB = 33333.3\text{ ft}^4/(50')(20')(7.03') = \underline{4.742\text{ ft}}$

$\Rightarrow y_{MC} = 3.515' + 4.742' = 8.257'$

$\Rightarrow y_{MC} > y_{cg} \Rightarrow$ $\boxed{\text{STABLE}}$

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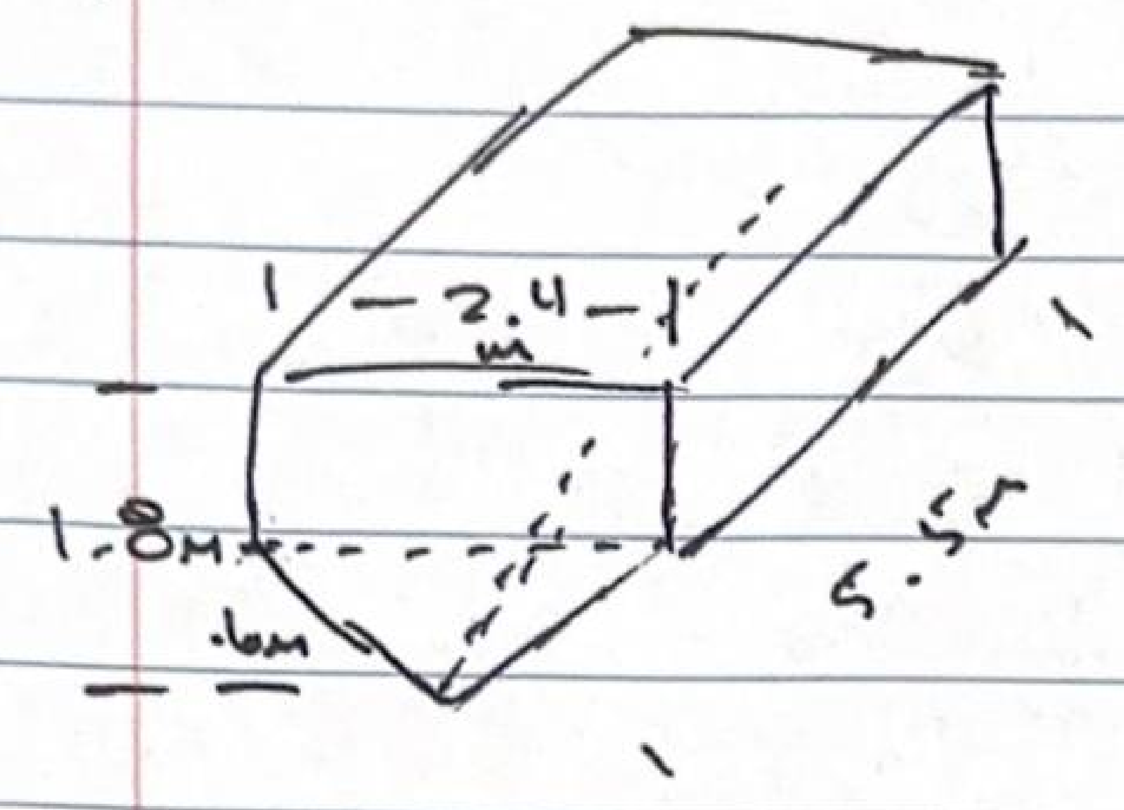
(61) WHOLE BOAT



PURPOSE: IS THE BOAT STABLE?

GIVEN: WATER

EQS: $y_{cg} = \dfrac{\sum(\text{volume})(cg)}{\sum \text{volume}}$, y_{CB}

$y_{MC} > y_{cg}$ = STABLE, $y_{MC} = y_{CB} + MB$

$MB = I/V_d$, $I = bh^3/12$

ANS: $V_{RECT} = 2.4M(5.5M)(1.2M) = \underline{15.84M^3}$

$V_{TRI} = \frac{1}{2}(.6M)(5.5M)(2.4M) = \underline{3.96M^3}$

$\Rightarrow V_{TOTAL} = \underline{19.8M^3}$

$Cg_{TRI} \Rightarrow$ FROM BASE $\rightarrow \frac{2}{3}(.6M) = \underline{.4M}$

$Cg_{RECT} \Rightarrow$ FROM BASE $\rightarrow (1.2M/2) + h_{TRI}$

$\Rightarrow \underline{1.2M}$

$$y_{cg} = \frac{3.96M^3(.4M) + 15.84M^3(1.2M)}{19.8M^3} = \underline{1.04M}$$

\# CENTER OF BUOYANCY \# (SUBMERGED)

$V_{RECT} = .9M(2.4M)(5.5M) = \underline{11.88M^3}$

$V_{TRI} = \frac{1}{2}(.6M)(5.5M)(2.4M) = \underline{3.96M^3}$

$V_{TOTSUB} = \underline{15.84M^3} = V_d$

$\Rightarrow$ $CB_{TRI} = \underline{.4M}$, $CB_{RECT} = (.9M/2) + .6M = \underline{1.05M}$

$$\Rightarrow y_{CB} = \frac{(1.05M)(11.88M^3) + (.4M)(3.96M^3)}{15.84M^3} = \underline{.8875M}$$

$\Rightarrow MB \Rightarrow 5.5M(2.4M)^3/12 = 6.336M^4$

$\Rightarrow 6.336M^4/15.84M^3 = \underline{.4M}$

$\Rightarrow y_{MC} = .8875M + .4M = \underline{1.2875M}$

$\Rightarrow y_{MC} \geq y_{cg} \Rightarrow \boxed{\text{STABLE}}$