No. 49 Date 10.04.2025

JULY 2018 A vessel of length 200m floats in water of R.D 1.002 with draught of Fwd: 7.50m, Aft: 8.20m, she goes to water of R.D 1.020, without change in distribution of weight on-board. Find her new draft fwd & aft in water of R.D 1.020. Her hydrostatic particulars in salt water are as follows: MCTC = 140 tm, TPC = 25, LCF = 95m, LCB = 105m, Displacement = 40000 tonnes.

	Fwd	Aft
Initial	✓	✓
DWA	?	?
Tf/Ta	?	?
Final	:	

Sol:- So, we need to find DWA & Tf/Ta

→ To find DWA,

$$FWA = \frac{W}{40TPC_{in\ DW}}$$

$$= \frac{40000}{40 \times 24.878} = 40.198\ mm$$

$$= 0.040\ m$$

(TPC in R.D 1.020 $= \frac{25 \times 1.020}{1.025} = 24.878$)

($MCTC$ in R.D 1.020 $= \frac{140 \times 1.020}{1.025} = 139.317$)

$$DWA = \frac{FWA \times \text{change in density}}{0.025}$$

$$= \frac{0.040 \times (1.020 - 1.002)}{0.025}$$

$$= 0.029\ m$$

→ To find Tf/Ta

we need Trim, so, $TRIM = \frac{TM}{MCTC \times 100}$

$TM = BB_1 \times W$

$BB_1 = \frac{v \times (LCB \sim LCF)}{V}$ ← increase/decrease in u/w volume

V → final u/w volume

u/w volume in R.D 1.002 $= \frac{40000}{1.002} = 39920.160\ m^3$

u/w volume in R.D 1.020 $= \frac{40000}{1.020} = 39215.686\ m^3$

Increase in vol $= 704.474\ m^3$

$BB_1 = \frac{704.474 \times (105+95)}{39215.686}$

$BB_1 = 0.180m$

$TM = BB_1 \times W$

$= 0.180 \times 40000$

$= 7200$

$Trim = \frac{TM}{MCTC \times 100} = \frac{7200}{139.317 \times 100}$

$= 0.517m$ by stern

$Ta = \frac{Trim \times LCF}{LBP}$

$= \frac{0.517 \times 95}{200} = 0.246m$

$Tf = T - Ta$

$= 0.517 - 0.246$

$= 0.271m$

Draft	Fwd	Aft	
Initial	7.50	8.20	
DWA	(-) 0.029	(-) 0.029	(1.002 to 1.020, rise in ww roume)
Tf/Ta	(-) 0.271	(+) 0.246	
Final	7.200m	8.417m	

No. 51 Date 15.04

DEC 2020

A box shaped vessel 125m long, 20m broad, at 3m draft even keel in SW, KG: 3.0m. cargo of 1500 ts in loaded with LCG of 61m and KG: 4.8m Find the draft forward and aft after loading. Find GM

Soln:-

Displacement = u/w volume x density

$= (125 \times 20 \times 3) \times 1.025$

$= 7687.5\ t$

NOTE:- Initial LCG will be half of length (bcz vessel is on even keel)

LCB = ½ of length LCF = ½ of length

Remarks	Weight	K.G	V. moment	LCG	L. moment
Initial	7687.5	3.0	23062.5	62.5	480468.75
Loaded	(+) 1500	4.8	(+) 7200	61	(+) 91500
	Final W: 9187.5		Final V. moment: 30262.5		Final L. moment: 571968.75

$$\text{Final KG} = \frac{\text{Final V. moment}}{\text{Final W}}$$

$$= \frac{30262.5}{9187.5}$$

$$= 3.294\ m$$

$$\text{Final LCG} = \frac{\text{Final L. moment}}{\text{Final W}}$$

$$= \frac{571968.75}{9187.5}$$

$$= 62.255\ m$$

$$\text{Final u/w vol} = \frac{9187.5}{1.025} = 8963.4\ m^3$$

$$\text{draft} = \frac{\text{u/w vol.}}{L \times B}$$

$$= \frac{8963.4}{125 \times 20} = 3.585\ m$$

$$KB = d/2$$

$$= 3.585/2$$

$$= 1.793\ m$$

Similiar question: APR 2016

$BM_T = \frac{lb^3}{12V}$

$= \frac{125 \times 20^3}{12 \times 8963.4}$

$= 9.297$

$BM_L = \frac{bl^3}{12V}$

$= \frac{20 \times 125^3}{12 \times 8963.4}$

$= 363.167$

M
G
B
K

$KM_T = KB + BM$

$= 1.793 + 9.297$

$= 11.090$

$KM_L = KB + BM_L$

$= 1.793 + 363.167$

$= 364.960$

$GM_T = KM_T - KG$

$= 11.090 - 3.294$

$= 7.796 m$

$GM_L = KM_L - KG$

$= 364.960 - 3.294$

$= 361.666$

$MCTC = \frac{W \times GM_L}{100L}$

$= \frac{9187.5 \times 361.666}{100 \times 125}$

$= 265.824$ tm

$Trim = \frac{(LCB - LCG)}{MCTC \times 100} \times disp.$

$= \frac{(62.5 - 62.255)}{265.824 \times 100} \times 9187.5$

$= 0.085 m$

$Ta = \frac{Trim \times LCF}{LBP}$

$= \frac{0.085 \times 62.5}{125} = 0.043 m$

$Tf = Trim - Ta$

$= 0.085 - 0.043$

$= 0.042 m$

Draft	Fwd	Aft
	3.585	3.585
Tf/Ta	(-) 0.042	(+) 0.043
Final	3.543m	3.628m

JULY 2015
JULY 2023

A vessel of L = 120m, w = 9100t floats at an even keel draft of 6.5 mtr FW. MCTC = 130 tonne m, TPC = 16.5t, LCF = 0.6m aft of midship and LCB 2.3m forward of midship. Calculate the new draft if the vessel moves in to water of density 1.024 t/m³ without change in displacement.

Soln:- So, we need to find DWA & Tf/Ta

→ Find DWA

$$FWA = \frac{W}{40 \text{ TPC in RD in which vsl is going}}$$

$$\left(\text{TPC in RD } 1.024 = \frac{16.5 \times 1.024}{1.025} = 16.484\right)$$

$$FWA = \frac{9100}{40 \times 16.484}$$

$$= 13.801 \text{ mm}$$

$$= 0.138 \text{ m}$$

$$DWA = \frac{FWA \times \text{diff in RD}}{0.025}$$

$$= \frac{0.138 \times (1.024 - 1.000)}{0.025}$$

$$= 0.132 \text{ m}$$

→ Find Tf/Ta

$$\text{Trim} = \frac{TM}{MCTC \times 100}$$

$$TM = BB_1 \times W$$

$$BB_1 = \frac{\text{diff in u/w vol} \times (LCB \sim LCF)}{\text{Final u/w vol}}$$

$$\text{Initial u/w volume} = \frac{W}{RD} = \frac{9100}{1.000} = 9100 \text{ m}^3$$

$$\text{Final u/w volume} = \frac{W}{RD} = \frac{9100}{1.024} = 8886.719 \text{ m}^3$$

$$\text{Diff in u/w vol} = 213.281 \text{ m}^3$$

$$LCB = 60 + 2.3 = 62.3 \text{ m}$$

$$LCF = 60 - 0.6 = 59.4 \text{ m}$$

$$BB_1 = \frac{213.281 \times (62.3 - 59.4)}{8886.719}$$

$$= 0.070$$

$$TM = BB_1 \times W$$

$$= 0.070 \times 9100$$

$$= 637 \text{ tm}$$

$$Trim = \frac{TM}{MCTC \times 100}$$

(MCTC in Rd $1.024 = \frac{130 \times 1.024}{1.025} = 129.873$)

$$Trim = \frac{637}{129.873 \times 100}$$

$$Trim = 0.049 m$$

$$Ta = \frac{Trim \times LCF}{LBP}$$

$$Ta = \frac{0.049 \times 59.4}{120}$$

$$Ta = 0.024 m$$

$$Tf = Trim - Ta$$

$$= 0.049 - 0.024$$

$$= 0.025 m$$

Draft	Fwd	Aft
Initial	6.500	6.500
DWA	(-) 0.132	(-) 0.132 (1.000 to 1.024)
Tf/Ta	(-) 0.025	(+) 0.024
Final	6.343 m	6.392 m

Ans

Similar question: JULY 2023 PAPER 1

JULY 2023 PAPER 2

JAN 2024

OCT 2024

A box shaped vessel 180m long, 28m broad and 6m draft even keel KG 6.0m, Cargo of 1200ts is loaded with LCG of 80m and KG 4.5m. Find the draft forward & aft after loading

Soln:-

Displacement = u/w vol x density

= (180 x 28 x 6) x 1.025

= 30996 t

Initial LCG = $\frac{L}{2} = \frac{180}{2} = 90m$

Remarks	W	KG	V. moment	LCG	L. moment
Initial	30996	6.0	185976	90	2789640
Loaded	(+) 1200	4.5	5400	80	(+) 96000

Final W: 32196t Final V. moment = 191376 Final L moment = 2885640

$$\text{Final KG} = \frac{\text{Final V. moment}}{\text{Final W}}$$

$$= \frac{191376}{32196}$$

$$= 5.944m$$

$$\text{Final LCG} = \frac{\text{Final L. moment}}{\text{Final W}}$$

$$= \frac{2885640}{32196}$$

$$= 89.627m$$

$$\text{Final u/w vol} = \frac{\text{Final W}}{RD} = \frac{32196}{1.025}$$

$$= 31410.732\ m^3$$

$$\text{Draft} = \frac{\text{u/w volume}}{L \times B}$$

$$= \frac{31410.732}{180 \times 28}$$

$$= 6.232m$$

$$KB = d/2$$

$$= 6.232/2$$

$$= 3.116m$$

$$BM_L = \frac{bl^3}{12V}$$

$$= \frac{28 \times 180^3}{12 \times 31410.732}$$

$$= 433.228$$

$$KM_L = KB + BM_L$$

$$= 3.116 + 433.228$$

$$= 436.344$$

$$GM_L = KM_L - KG$$

$$= 436.344 - 5.944$$

$$= 430.400$$

$$MCTC = \frac{W \times GM_L}{100L}$$

$$= \frac{32196 \times 430.400}{100 \times 180}$$

$$= 769.842 \text{ tm}$$

$$Trim = \frac{(LCB - LCG)}{MCTC \times 100} \times disp$$

$$= \frac{(90 - 89.627)}{769.842 \times 100} \times 32196$$

$$= 0.156 \text{ m}$$

$$Ta = \frac{Trim \times LCF}{LBP}$$

$$= \frac{0.156 \times 90}{180}$$

$$= 0.078 m$$

$$Tf = Trim - Ta$$

$$= 0.156 - 0.078$$

$$= 0.078 m$$

Draft	Fwd	Aft
Initial	6.232	6.232
Tf/Ta	(-)0.078	(+)0.078
Final	6.154 m	6.310 m

OCT 2017 A 40m long, 9m broad, 6m deep barge consist of traingular cross section with apex down. The barge displacing 492t, KG 1.8m is floating in sw. Calculate her MCTC in the given condition

Soln:

$$\text{Volume displ} = \frac{\text{disp}}{\text{density}} = \frac{492}{1.025} = 480\ m^3$$

$$BM_L = \frac{bl^3}{12V} \qquad KB = \frac{2}{3}d$$

$$= \frac{9 \times 40^3}{12 \times 480} \qquad = \frac{2}{3} \times 6$$

$$= 100 \qquad = 4m$$

$$KM_L = KB + BM_L$$

$$= 4 + 100$$

$$= 104$$

$$GM_L = KM_L - KG$$

$$= 104 - 1.8$$

$$= 102.2$$

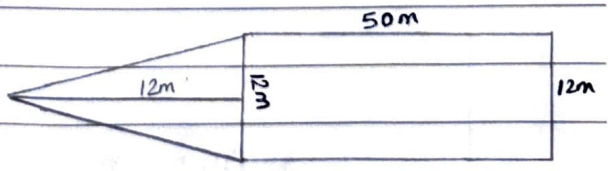
$$MCTC = \frac{W \times GM_L}{100L}$$

$$= \frac{492 \times 102.2}{100 \times 40}$$

$$= 12.571\ tm.$$

JULY 2019 The deck and keel of a flat bottomed barge are identical. Its sides are vertical. The deck consist of two sections. The bow is a traingle 12m broad and measures 12m in the fore and aft direction, the mid body is rectangle 50m long and 12m wide. If it is floating on an even keel in SW with displacement 3444t, find the position of its COB with reference to the keel and with reference to its after end.

Soln:



Total area of barge

= Area of □ + Area of Δ

$$= \left(\frac{1}{2} \times b \times h\right) + (l \times b)$$

$$= \left(\frac{1}{2} \times 12 \times 12\right) + (50 \times 12)$$

$= 600 + 72$

$= 672\ m^2$

Displacement = u/w volume × density

Displacement = (area × draft) × density

$3444 = 672 \times d \times 1.025$

$d = 5$

$COB = \frac{d}{2} = \frac{5}{2} = \boxed{2.5m}$ with reference to keel

$LCB = \frac{\text{Total moment}}{\text{Total W}}$

Moment = W × LCB

Total moment of barge = Total moment of □ + Total moment of Δ

W × LCB = (W of □ × LCB) + (W of Δ × LCB)

W of □ = u/w vol × density

$= 50 \times 12 \times 5 \times 1.025$

$= 3075\ t$

LCB of □ = l/2

$= 50/2$

$= 25m$

W of Δ = u/w vol × density

$= \frac{1}{2} \times 12 \times 12 \times 5 \times 1.025$

$= 369\ t$

LCB of Δ = Length of □ + $\left(\frac{1}{3} \times \text{length of } \Delta\right)$

$= 50 + \left(\frac{1}{3} \times 12\right)$

$= 54m$

$3444 \times LCB = (3075 \times 25) + (369 \times 54)$

$3444 \times LCB = 76875 + 19926$

$3444 \times LCB = 96801$

$LCB = \frac{96801}{3444}$

$\boxed{LCB = 28.107\ m}$

LIST

No. 59 Date 20·05·2025

JULY 2019 A ship displacing 8500t, GM 1·0m is listed to 2·5° on the port side. A weight of 60t on deck KG 11·5m and 3·5m to port of CL is to be discharged over the stbd side. Using her derrick, the head of which is 21m above the keel, with an outreach of 10m from the CL. Calculate the list @ when the weight is picked up by the derrick plumped over the weight
ⓑ when the derrick is swung out

Soln:- @ Since the weight is not moved, listing moment will be the same

$$\tan\theta = \frac{LM}{W \cdot GM}$$

$$\tan 2.5^\circ = \frac{LM}{8500 \times 1}$$

Listing moment, LM = 371·118 tm to port

$$GG_1 = \frac{d \cdot w}{W}$$

$d = 21 - 11.5$ $\quad w = 60t$

$= 9.5m$

$$GG_1(\uparrow) = \frac{60 \times 9.5}{8500}$$

$= 0.067m$

Original GM : 1·000 m
$GG_1(\uparrow)$: (+)0·067 m
New GM : 0·933 m

$$\tan\theta = \frac{LM}{W \cdot GM}$$

$$\tan\theta = \frac{371.118}{8500 \times 0.933}$$

$\theta = 2.68^\circ$ to port

ⓑ LM caused, wd = $60 \times (10 + 3.5)$ = 810 tm to stbd

FLM = 810 − 371·118
= 438·882 to stbd

GM will not change bcz weight is still on derrick

$$\tan\theta = \frac{FLM}{W \cdot GM}$$

$$\tan\theta = \frac{438.882}{8500 \times 0.933}$$

$\theta = 3.17^\circ$ to stbd