M.V HINDSHIP

FORMULAs

No. 03 Date

* For changing draft to H.S.
  Take out mean draft
  ↓
  Find LCF at mean draft
  ↓
  Find corrⁿ to after draft = $\frac{TRIM \times LCF}{LBP}$
  ↓
  Hydrostatic draft = After draft ± corrⁿ to after draft
  {(-ve) when VSL trimmed by stern}
  {(+ve) when VSL trimmed by head}

* Deadweight = Present displacement − Light displacement

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

* KM − KG = GM (solid)
  (−) $\frac{FSC}{GM\ (Fluid)}$

* FSC = $\frac{FSM}{\text{displacement}}$

* FSM = moment of inertia x density.

* Locomotive kept at KG 13.83, derrick head 25.0 m above the keel
  (i) When locomotive hanging on derrick, 0.5 meter above the deck
  ⇒ KG ⇒ 25 − 13.83 = 11.17 m
  (ii) When locomotive is discharged
  ⇒ KG ⇒ 13.83 m

* weight x KG = V. moments
  weight x LCG = L. moment (in mtr. fwd of AP)

* Horizontal Athwartship shift of G
  $GG_1 = \frac{w \times d}{W}$ (or) $\frac{T.moment}{Final\ disp.}$

* List ⇒ $Tan\theta = \frac{GG_1}{GM(Fluid)}$ where, GG_1 = L. moment x w

* Righting lever, GZ = GM x sinθ (For small angle of heel)
  GZ = KN − (corrected KG x sinθ) :- For large angle of heel

* Righting moment = W x GZ

* DWA = $\frac{FWA \times (1.025 - \text{density of DW})}{1.025 - 1.000}$
  = $\frac{FWA \times (1.025 - \text{density of DW})}{0.025}$

Note:- FWA given in Plimsoll mark detail (at summer draft)

* Fresh water allowance, FWA = $\frac{W}{4 \times TPC}$ (mm)

* Block coefficient

$$C_b = \frac{\text{Volume of displacement (disp. density)}}{L \times B \times \text{draft}}$$

* Water plane coeff. = $\frac{\text{Area of water plane}}{L \times B}$

where area of water plane = $\frac{TPC \times 100}{1.025}$

* To upright the vessel in list problems:

LM port = LM stbd.

* Moment of statical stability = $W \times GZ$

where $GZ = GM \cdot \sin\theta$ (For small angle of heel)

$GZ = KN - (\text{corrected } KG \cdot \sin\theta)$ (For large angle of heel)

* Total trim (t) or Trim caused (t_c)

$$= \frac{LCB - LCG}{MCTC \times 100} \times \text{displacement}$$

$$t_a = \frac{\text{Total trim} \times LCF}{LBP}$$

$$t_f = \text{Total trim} - \text{trim aft} = t - t_a \quad \text{(OR)} \quad \frac{\text{Total trim} \times (LBP - LCF)}{LBP}$$

* Weight = $\frac{\text{volume}}{S.F}$

* Displacement, TPC & MCTC changes with density.

* Q NO. 70: Longitudnal shifting

From LCG 58.6 ⟶ To NO. 2 Hold LCG 103.14

Resultant LCG = 103.14 − 58.6 = 44.54m

L. moment : + (58.6 to 103.14)

L. moment : − (if 103.14 to 58.6)

* To finish on even keel, LCB = LCG

No. 05 Date

* FWA = $\frac{W}{40 TPC}$ (cm)

TPC = $\frac{A \times 100}{RD}$

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

* MCTC = $\frac{W \times G_{ML}}{100}$

(56)

Remarks	weight	KG	V.moment	Dist off CL	L.moment
Initial	13750	7.32	100650		536.25(S)
NO.3 TD	x	10.37	10.37x	1.5m(S)	1.5x(S)
NO.5 UTD	380-x	13.76	13.76(380-x) = 5228.8-13.76x	6.2(P)	6.2(380-x) = 2356-6.2x
Final W: 14130			Final V.moment = 105878.8-3.39x		

To, Find ILM

KM at 13750 t = 8.285m

KG = 7.320m

GM(solid) = 0.965m

FSC = 0.083m

GM(Fluid) = 0.882m

$\left(\frac{FSM}{W} = \frac{1146}{13750} = 0.083\right)$

$\tan\theta = \frac{GG_1}{GM(F)}$

$\tan 2.5^\circ = \frac{GG_1}{0.882}$

$GG_1 = 0.039$

Listing moment = $GG_1 \times W$

$= 0.039 \times 13750$

$= 536.25$

$FLM = 536.25 + 1.5x - (2356 - 6.2x)$

$= 536.25 + 1.5x - 2356 + 6.2x$

$= 7.7x - 1819.75$

Since $\tan 0^\circ = 0$

Hence,

$7.7x - 1819.75 = 0$

$7.7x = 1819.75$

$x = 236.3$ t in 3TD (stbd)

$380 - x = 143.7$ t in 5 UTD (port)

(57) From Condition NO.7,

$GM(F) = 0.458$

$\theta = 3^\circ$

Hence, $\tan\theta = \frac{GG_1}{GM(F)}$

$\tan 3^\circ = \frac{GG_1}{0.458}$

$GG_1 = \tan 3^\circ \times 0.458$

$= 0.024$

Initial listing moment $= GG_1 \times W$

$= 0.024 \times 18529.3$

$= 444.75\ (P)$

To find listing moment caused,

$W = 101.9 \times 0.88 = 89.672$

Dist from CL $= 3.8m$

Listing moment caused $= 89.672 \times 3.8$

$= 340.7536\ (S)$

Final listing moment $= 444.75 - 340.7536$

$= 103.9964\ (P)$

Final $W = 18618.972$

$GG_1 = \frac{LM}{W}$

$GG_1 = \frac{103.9964}{18618.972}$

$= 0.00559$

~~Final GM~~

Now, we require GM(F)

Remarks	Weight	KG	V. moment
Initial	18529.3	7.807	(+) 144658.245
NO.7 DB TK(S)	(+) 89.672	2.59	(+) 232.250
Final W :	18618.972	Final V. moment :	144890.495

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

$$= \frac{144890.495}{18618.972}$$

$$= 7.782\text{m}$$

KM at 18618.972 = 8.356m

KG = 7.782m

GM (solid) = 0.574m

FSC = 0.083m

GM (Fluid) = 0.491m

$$FSC = \frac{FSM}{W}$$

$$= \frac{1552}{18618.972}$$

$$= 0.083$$

Final list, $\tan\theta = \frac{GG_1}{GM(F)}$

$$\tan\theta = \frac{0.00559}{0.491}$$

$\theta = 0^\circ 39.1'$ list to Port

(59) Displacement: 19150 t

KG: 6.65m

FSC: 0.042

~~FSM = FSC = 0.042~~
~~W 19150~~ =

$FSC = \frac{FSM}{W} \Rightarrow FSM = FSC \times W$

$= 0.042 \times 19150$

$= 804.3$

Note:- Maxm list will occur when one locomotive is loaded on deck & other have been lifted by the derrick swung over the quay.

TRIM

(60) DF: 5.65m
DA: 7.45m
} Trim = 1.80m

LCG: 70.47m fwd of AP

Load 500t of cargo 100.5m fwd of AP

Mean draft = $\frac{DF + DA}{2} = \frac{5.65 + 7.45}{2}$

$= 6.55m$

LCF at mean draft 6.55m = 72.048m fwd of AP

Corrn to after draft = $\frac{Trim \times LCF}{LBP}$

$= \frac{1.80 \times 72.048}{143.16}$

$= 0.906$

Hydrostatic draft = Aft draft − Corrn

$= 7.45 - 0.906$

$= 6.544m$

Displacement at 6.544m = 13255.32t

	6.4	12927	
6.544	0.2		456
	6.6	13383	

$\frac{M_2 \cdot 456}{M\,0.2} \times 0.144 = 328.32$

Remarks	Displacement	LCG	L. moment
Initial	13255.32	70.47	934102.4004
Load	(+) 500.00	100.5	(+) 50250
Final W:	13755.32	Final L. moment:	984352.4004

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

$$= \frac{984352.4004}{13755.32}$$

$$= 71.562\text{m fwd of AP}$$

Against final displacement 13755.32t, find LCB & MCTC

	13383	6.6	72.889	179.3	72.005
372.32	13755.32	457	0.2	0.031	2.1	0.199
	13840	6.80	72.858	181.4	71.806

$\frac{0.031}{457} \times 372.32 = 0.025$ $\quad \frac{2.1}{457} \times 372.32 = 1.71$ $\quad 0.162$

H.S draft = 6.763

LCB = 72.864

MCTC = 181.01

LCF = 71.843

$$\text{Trim correction (t)} = \frac{\text{LCB} - \text{LCG}}{\text{MCTC} \times 100} \times \text{displacement}$$

$$= \frac{72.864 - 71.562}{181.01 \times 100} \times 13755.32$$

$$= 0.989\text{m}$$

$$Ta = \frac{\text{Total trim} \times LCF}{LBP}$$

$$= \frac{0.989 \times 71.843}{143.16}$$

$$= 0.496$$

$$Tf = t - ta$$

$$= 0.989 - 0.496$$

$$= 0.493m$$

~~Draft | Fwd | Aft~~

~~H.S | 6.544 | 6.544~~

~~Tf/Ta | (-) 0.493 | (+) 0.496~~

~~6.051 | 7.040~~

Draft	Fwd	Aft
H.S	6.763	6.763
Tf/Ta	(-) 0.493	(+) 0.496
Final draft:	6.270m	7.259m

63)

Remarks	Weight	KG	V.moment	LCG	L.moment
Initial	18529.3	7.539	139700	72.129	1336498
NO.1 TD	(-) 681.7	11.17	(+) 7615	124.67	(-) 84988
NO.5 POOP DK	(-) 542.6	13.76	(-) 7466	14.78	(-) 8020
Ref cargo space	(-) 235.0	10.36	(-) 2435	60.17	(-) 14140
4DPTK (C)	(+) 263.835	0.63	(+) 166.216	57.58	(+) 15191.619
Final W:	17333.835	Final V.moment:	122350.216	Final L.moment:	1244541.619

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

$$= \frac{122350.216}{17333.835}$$

$$= 7.058m$$

Final LCG = $\frac{\text{Final } \sum \text{moment}}{\text{Final } W}$

$= \frac{1244541.619}{17333.835}$

$= 71.798$ m fwd of AP

Find H.S draft, MCTC, LCB, LCF, K.M at disp. 17333.835 t

17116	8.20	200.2	72.532	70.409	8.270
17598	8.40	203.1	72.473	70.238	8.292

$\frac{0.022}{483} \times 217.835 = 0.009$

H.S draft :

MCTC :

LCB :

LCF :

KM : 8.279 m

FSM : 1552

FSC : $\frac{FSM}{W} = \frac{1552}{17333.835} = 0.089$

KM : 8.279

KG : 7.058

GM(S) : 1.221

FSC : 0.089

GM(F) : 1.132

Total trim (t) = $\frac{LCB - LCG}{MCTC \times 100} \times$ displacement

$Ta = \frac{\text{Total trim} \times LCF}{LBP}$

$Tf = t - Ta$

(65) DF: 5.62m } Trim: 1.16m
DA: 6.78m }

Mean draft = $\frac{5.62 + 6.78}{2}$ = 6.20m

LCF at mean draft 6.20m: 72.333m

Correction to after draft = $\frac{\text{Trim} \times \text{LCF}}{\text{LBP}}$

$= \frac{1.16 \times 72.333}{143.16}$

$= 0.586\,m$

Hydrostatic draft = draft aft + corr?

= 6.78 − 0.586

= 6.194m

Displacement at 6.194m : 12458.41

LCB at 6.194m : 72.940
MCTC at 6.194m : 175.649

Remarks	W	LCB	L. moment	LC
Initial	12458.41	71.305	888346.9251	
3TD → 112.5MT	220t	80.39 to 112.5	6976.2	
		= 31.71	895323.1251	

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

				LCF
6.0	12019	72.962	174.0	72.476
0.194 0.2	453	0.021	1.7	0.143
6.2	12472	72.941	175.7	72.333
	$\frac{453}{0.2} \times 0.194$ = 439.41	$\frac{0.021}{0.2} \times 0.194$ = 0.020	$\frac{1.7}{0.2} \times 0.194$ = 1.649	$\frac{0.143}{0.2} \times 0.194$ = 0.139

$1.16 = \frac{(72.940 - LCG)}{175.649 \times 100} \times 12458.41$

$20375.284 = (72.940 - LCG) \times 12458.41$

$72.940 - LCG = 1.635$

$LCG = 72.940 - 1.635$

$= 71.305$

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

$$= \frac{895323.125}{12458.41}$$

$$= 71.865$$

$$\text{Trim caused (t)} = \frac{LCB + LCG}{MCTC \times 100} \times \text{disp}$$

$$= \frac{72.940 - 71.865}{175.649 \times 100} \times 12458.41$$

$$= 0.762$$

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

$$= \frac{0.762 \times 72.337}{143.16}$$

$$= 0.385$$

$$Tf = t - ta$$

$$= 0.762 - 0.385$$

$$= 0.377$$

DF	DA
6.194	6.194
(-) 0.377	(+) 0.385
5.817m	6.579m

(67) DF: 7.66m } Trim: 0.16 m
DA: 7.82m }

Mean = $\frac{7.66+7.82}{2}$ = 7.74m

LCF at mean draft, 7.740 m = 70.8397

7.6		70.979	
0.140	0.2		0.199
7.8		70.780	

$\frac{0.199}{0.2} \times 0.140 = 0.139$

Correction to after draft = $\frac{Trim \times LCF}{LBP}$

$= \frac{0.16 \times 70.8397}{143.16}$

$= 0.079$

H.S draft = Aft draft − corrn

= 7.82 − 0.079

= 7.741 m

Find disp, LCB, MCTC at 7.741 m

7.6		15693	72.690	191.8
0.141	0.2	468	0.049	2.8
7.8		16161	72.641	194.6
		$\frac{468}{0.2} \times 0.141$	$\frac{0.049}{0.2} \times 0.141$	$\frac{2.8}{0.2} \times 0.141$
		= 329.94	= 0.035	= 1.974

Displacement = 16022.94 t

LCB = 72.655

MCTC = 193.774

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

$0.16 = \frac{(72.655 - LCG)}{193.774 \times 100} \times 16022.94$

$3100.384 = (72.655 - LCG) \times 16022.94$

$0.193 = 72.655 - LCG$

LCG = 72.462 m fwd of AP

Remarks	Weight	LCG	L.moment
Initial	16022.94	72.462	1161054.278
NO.2 TD	(+) 220	103.91	(+) 22860.2
TD DWT(P)	(-) 30	5.86	(-) 175.8
Final W:	16212.94	Final L.moment:	1183738.678

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

$$= \frac{1183738.678}{16212.94}$$

$$= 73.012\,m$$

Find ~~H.S draft,~~ LCB, MCTC, LCF at 16212.94

	16161	7.80	72.641	194.6	70.780
51.94	16212.94 474	0.2	0.053	2.8	0.185
	16635	8.00	72.588	197.4	70.595
		$\frac{0.2}{474} \times 51.94$	$\frac{0.053}{474} \times 51.94$	$\frac{2.8}{474} \times 51.94$	$\frac{0.185}{474} \times 51.94$
		$= 0.022$	$= 0.006$	$= 0.307$	$= 0.020$

H.S draft = 7.822m

LCB = 72.635m

MCTC = 194.907

LCF = 70.760

$$\text{Trim caused} = \frac{(LCB - LCG)}{MCTC \times 100} \times \text{displacement}$$

$$= \frac{(72.635 - 73.012)}{194.907 \times 100} \times 16212.94$$

$$* = -0.313\,m$$ (-) sign means down by head

$$Ta = \frac{Trim \times LCF}{LBP} = \frac{0.313 \times 70.760}{143.160}$$

$$= 0.155m$$

$T_f = T - Ta$

$= 0.313 - 0.155$

$= 0.158m$

	Fwd	Aft
Drafts:	7.822	7.822
Tf / Ta	(+) 0.158	(+) 0.155
Final draft:	7.980 m	7.665 m

(68) Given: Displacement: 10230 t @ RD 1.014

GM(F): 0.82m

FSC : 0.077m

LCG : 71.62m

Displacement in SW = $\frac{10230 \times 1.025}{1.014}$ = 10340.976 t

KM at disp. 10340.976 = 8.744m

10230	8.770	
110.976	444	0.106
10674	8.664	

$\frac{0.106}{444} \times 110.976 = 0.026$

GM(F): 0.820m

FSC : (+) 0.077m

GM(S) : 0.897m

KM : 8.744 m

KG : 7.847m

Remarks	Weight	KG	V. moment	LCG	L. moment
Initial	10230	7.847	80274.81	71.620	732672.6
Load	(+) 470	9.8	(+) 4606	60.20	(+) 28294.0
IDB TK	(+) 150	1.14	(+) 171	124.63	(+) 18694.5
Final W :	10850	Final V. moment:	85051.81	Final L. moment:	779661.1

Displacement in SW = $\frac{10850 \times 1.025}{1.014}$ = 10967.702

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

$$= \frac{85051.81}{10850}$$

$$= 7.839\,m$$

KM at displacement 10967.702 t = 8.607m

10674		8.664	
293.702	446		0.086
11120		8.578	

$$\frac{0.086}{446} \times 293.702 = 0.057$$

Initial FSM = FSC × W

$$= 0.077 \times 10230$$

$$= 787.71$$

Add. FSM created in 1DB TK = $419 \times 1.025 = 429.475$

Final FSM = $787.71 + 429.475$

$$= 1217.185$$

$$FSC = \frac{FSM}{W} = \frac{1217.185}{10850} = 0.112\,m$$

KM : 8.607m

KG : 7.839m

GM(solid) : 0.768m

FSC : 0.112m

GM(Fluid) : 0.656m

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

$$= \frac{779661.1}{10850}$$

$$= 71.858\,m$$

Now find, H·S draft, MCTC, LCB, LCF at disp. 10967·702

	10674	5·40	169·6	73·005	72·761
293·702	446	0·2	1·4	0·013	0·086
	11120	5·60	171·0	72·992	72·675
		$\frac{0.2}{446} \times 293.702$	$\frac{1.4}{446} \times 293.702$	$\frac{0.013}{446} \times 293.702$	$\frac{0.086}{446} \times 293.702$
		= 0·132	= 0·922	= 0·008	= 0·057

H·S draft = 5·532m

** MCTC = 170·522 → $\frac{170.522 \times 1.014}{1.025}$ = 168·692

LCB = 72·996

LCF = 72·704

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

$$= \frac{(72.996 - 71.858) \times 10850}{168.692 \times 100}$$

$$= \frac{1.138 \times 10850}{16869.2}$$

$$= 0.732m$$

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

$$= \frac{0.732 \times 72.704}{143.16}$$

$$= 0.372m$$

$$Tf = t - ta$$

$$= 0.732 - 0.372$$

$$= 0.360m$$

	FWD	AFT
H·S draft :	5·532	5·532
Tf/Ta :	(-)0·360	(+)0·372
Final draft:	5·172m	5·904m

(70) Done in classroom (see notes)

FINISHING ON AN EVEN KEEL

No. 20 Date 03.04.2025

To finish on even keel,

$$LCB = LCG$$

(71) Draft (fwd) : 7.20m
Draft (aft) : 7.80m
} Trim = 0.6m

$$\text{Mean draft} = \frac{D_f + D_a}{2} = \frac{7.20 + 7.80}{2} = 7.50m$$

LCF at mean draft 7.50m = 71.086m

Corrⁿ to aft draft $= \frac{\text{Trim} \times LCF}{LBP}$

$$= \frac{0.6 \times 71.086}{143.16} = 0.298m$$

Draft (aft) = 7.800m
Corrⁿ to aft draft = (-)0.298m
H.S draft = 7.502m

Now, we require Initial LCG

For that, we require Initial displacement, MCTC, LCB

	7.4	15226	189.0	72.737
0.102	7.502	0.2	467	2.8	0.047
	7.6	15693	191.8	72.690
		$\frac{467}{0.2} \times 0.102$	$\frac{2.8}{0.2} \times 0.102$	$\frac{0.047}{0.2} \times 0.102$
		= 238.17	= 1.428	= 0.024

Displacement = 15464.17 t
MCTC = 190.428
LCB = 72.713

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

$$0.6 = \frac{(72.713 - LCG)}{190.428 \times 100} \times 15464.17$$

$$11425.68 = (72.713 - LCG) \times 15464.17$$

$72.713 - LCG = 0.739$

$LCG = 72.713 - 0.739$

$LCG = 71.974m$

(a)

Remarks	Weight	LCG	L. moment
Initial	15464.17	71.974	1113018.172
Load	(+)200.00	x	200x

Final W = 15664.17 Final L. moment: $1113018.172 + 200x$

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

$$= \frac{1113018.172 + 200x}{15664.17}$$

LCB at 15664.17 = 72.693m

15226 / 15664.17 / 467 / 15693 — 72.737 / 0.047 / 72.690

$\frac{0.047}{467} \times 438.17 = 0.044$

To finish on even keel,

LCB = LCG

∴ Final LCG = 72.693m

$$\text{Final LCG} = \frac{1113018.172 + 200x}{15664.17}$$

$$72.693 = \frac{1113018.172 + 200x}{15664.17}$$

$$1138675.51 = 1113018.172 + 200x$$

$$200x = 25657.338$$

$$x = 128.29\ m \text{ fwd of AP}$$

(b)

Remarks	Weight	LCG	L. moment
Initial	15464.17	71.974	1113018.172
Swift NO.5 HOLD → NO.3 HOLD	x	17.31 to 80.63 = 63.32	(+) 63.32x
Final W : 15464.17			Final L. moment: $1113018.172 + 63.32x$

LCB at 15464.17 = 72.713m

To finish on even keel, LCB = LCG = 72.713m

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

$$72.713 = \frac{1113018.172 + 63.32x}{15464.17}$$

$$1124446.193 = 1113018.172 + 63.32x$$

$$63.32x = 11428.021$$

$$x = 180.48\text{t of cargo to be shifted}$$

(72) Condition No. 10

Remarks	Weight	LCG	L.moment
Initial	16133.0	70.289	1133972
NO.1 TD	x	125	(+) $125x$
NO.3 TD	$800-x$	80	(+) $64000 - 80x$
Final W:	16933	Final L.moment:	$1197972 + 45x$

LCB at disp. 16933t = 72.553m

Since Question says finish on even keel

$\therefore$ LCB = LCG = 72.553

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

$$72.553 = \frac{1197972 + 45x}{16933}$$

$$1228539.949 = 1197972 + 45x$$

$$45x = 30567.949$$

$x = 679.29$t in NO.1 TD //

In NO.3 TD = $800 - x$

$= 800 - 679.29$

$= 120.71$t //

Since, in final, vessel is finishing on even keel,
H·S draft is the Final draft

∴ Find H·S draft at displacement 16933 t

16635 | 298 | 17116 | 481 | 8·0 | 8·2 | 0·2 | $\frac{0·2}{481} \times 298 = 0·124$

H·S draft = 8·124m

∴ Also final draft (F&A) = 8·124m even keel

(73) Condition NO·6 *** Since, vessel is trim by astern, we consume more from Aft. Hence we take NO·7 DB TK as x

Remarks	Weight	LCG	L·moment
Initial	19617	71·813	1408746
NO·3 DB TK	230-x	80·63	(-) 18544·9 - 80·63x
NO·7 DB TK	-x	22·97	(-) 22·97x
	Final W = 19387		Final L·moment = 1408746 - 18544·9 + 80·63x - 22·97x

Final L·moment = 1390201·1 + 57·66x

LCB at disp. 19387 t = 72·243 t

19051 | 336 | 19537 | 486 | 72·288 | 72·223 | 0·065 | $\frac{0·065}{486} \times 336 = 0·045$

For vessel to arrive on even keel,

LCB = LCG = 72·243 t

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

$$72·243 = \frac{1390201·1 + 57·66x}{19387}$$

1400575·041 = 1390201·1 + 57·66x

57·66x = 1400575·041 - 1390201·1

57·66x = 10373·941

x = 179·92 t in NO·7 DB TANK

& 230 - x = 230 - 179·92

= 50·08 t in NO·3 DB tank

(74) Condition NO.7

Remarks	Weight(W)	LCG	L.moment
Initial	18529.3	72.340	1340415
NO.4 TD	(-) 296.2	57.68	(-) 17085
APT	(+) x	3.58	(+) 3.58x
Final W :	18233.1+x	Final L.moment :	1323330 + 3.58x

As per Question,

There is no change in LCB due to ballasting.

So, get LCB at 18233.1

18081		72.413	8.60
152.1	484	0.062	
18565		72.351	8.80

$\frac{0.062}{484} \times 152.1 = 0.019$ $\quad$ $\frac{0.2}{484} \times 200.97 = 0.083$

LCB at 18233.1 = 72.394 m

To finish on even keel

LCB = LCG = 72.394

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

$$72.394 = \frac{1323330 + 3.58x}{18233.1 + x}$$

$$72.394(18233.1 + x) = 1323330 + 3.58x$$

$$1319967.041 + 72.394x = 1323330 + 3.58x$$

$$72.394x - 3.58x = 3362.9586$$

$$68.814x = 3362.9586$$

$$x = 48.87\,t \text{ (approx)}$$

Actual final displacement = 18233.1 + x

= 18233.1 + 48.87

= 18281.97 t

H.S draft at 18281.97t = 8.683 m

Since vessel is on even keel

Hence, Final draft (F&A) = 8.683 m

(75) Even keel draft = 8.4m

i.e. also H.S draft = 8.4m

Initial displacement in SW = 17598

Disp. in DW RD 1.018 = $\frac{17598 \times 1.018}{1.025}$

Initial displacement in DW = 17477.819 t

Initial LCB = Initial LCG = 72.473 m fwd of AP

Her summer displacement in SW: 19617t

Available weight for NO.1 & NO.5 Hold

= 19617 − (17477.819 + 400 + 350 + 650)

= 739.181 t

Remarks	Weight (W)	LCG (m)	L.moment
Initial	17477.819	72.473	1266669.976
NO.2	(+) 400	107	(+) 42800
NO.4	(+) 350	53	(+) 18550
NO.5 TD	(+) 650	18	(+) 11700
NO.1 HOLD	x	122	(+) $122x$
NO.5 HOLD	$739.181 - x$	15	(+) $15(739.181 - x)$ $11087.715 - 15x$

Final W : 19617 Final L.moment : $1350807.691 + 107x$

LCB at disp. 19617t = 72.212

19537 → 72.223

487 → 0.064

20024 → 72.159

$\frac{0.064}{487} \times 80 = 0.011$

Finishing on even keel,

LCB = LCG

∴ Final LCG = 72.212 m fwd of AP

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

$$72.212 = \frac{1350807.691 + 107x}{19617}$$

$$1416582.804 = 1350807.691 + 107x$$

$$107x = 65775.113$$

$$x = 614.7\text{t in NO.1 HOLD}$$

& 739.181 − x = 739.181 − 614.7
= 124.481 t in NO.5 HOLD //

GM(solid) : 0.45 m
KM : 8.292 m
Initial KG : 7.842 m

Remarks	Weight (mt)	KG	V.moment
Initial	17477.819	7.842	137061.057
NO.2	(+) 400	11	(+) 4400
NO.4	(+) 350	9.8	(+) 3430
NO.5 TD	(+) 650	10	(+) 6500
NO.1	(+) 614.7	5.5	(+) 3380.85
NO.5 HOLD	(+) 124.481	6	(+) 746.886
Final W :	19617	Final V.moment :	155518.793

Final KG = Final V.moment / Final W
= 155518.793 / 19617
= 7.928 m

19537 8.428
487
20024 8.468
0.04/487 × 80 = 0.006

KM at disp. 19617 m = 8.434 m

FSM = 2500 Mt

FSC = FSM/W = 2500/19617
= 0.127

KM : 8.434 m
KG : 7.928 m
GM(S) : 0.506 m
FSC : 0.127 m
GM(F) : 0.379 m //

TO KEEP THE DRAFT AT ONE END CONSTANT No. 27 Date 05.04.2025

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

ⓑ Ta = $\frac{Total\ trim \times LCF}{LBP}$

ⓒ Final draft = H.S draft + Ta

When told to keep the draft at one end constant, we will workout

ⓒ → ⓑ → ⓐ

(76) Condition NO.2

Initial displacement: 7799

Load : (+) 220

Final displacement: 8019 t

H.S draft at disp. 8019t = 4.191

Final draft(aft) = Initial draft(aft) = 6.012m

7605	4.0
8019 433 8038	0.2
	4.2

$\frac{0.2}{433} \times 414 = 0.191$

H.S draft + Ta = Final draft

4.191 + Ta = 6.012

Ta = 6.012 − 4.191

= 1.821

Ta = $\frac{Total\ trim \times LCF}{LBP}$

7605	73.131
433	73.104
8038	73.103

$\frac{0.028}{433} \times 414 = 0.027$

1.821 = $\frac{Total\ trim \times 73.104}{143.16}$

Total trim × 73.104 = 260.694

Total trim = 3.566m

Find MCTC, LCB at disp 8019t

7605	158.9	73.010
433	1.8	0.004
8038	160.7	73.014

$\frac{1.8}{433} \times 414 = 1.721$

MCTC : 160.621

LCB : 73.014

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

$$3.566 = \frac{(73.014 - LCG)}{160.621 \times 100} \times 8019$$

$$57277.4486 = (73.014 - LCG) \times 8019$$

$$7.143 = 73.014 - LCG$$

$$LCG = 73.014 - 7.143$$

Final LCG = 65.871

Remarks	weight(w)	LCG	L.moment
Initial	7799	65.344	509617
Load	(+) 220	x	(+) 220x
Final w :	8019	Final L.moment :	509617 + 220x

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

$$65.871 = \frac{509617 + 220x}{8019}$$

$$528219.549 = 509617 + 220x$$

$$220x = 18602.549$$

$$x = 84.557 \text{ m fwd of AP}$$

(77) Draft (F) : 7.25m } TRIM : 0.85m

Draft (A) : 8.10m }

$$\text{Mean draft} = \frac{F+A}{2} = \frac{7.25 + 8.10}{2} = 7.675$$

LCF at 7.675m = 70.904m

7.60	70.979
0.2	0.199
7.80	70.780

$$\frac{0.199}{0.2} \times 0.075 = 0.075$$

~~Correction~~

$$\text{Correction to aft draft} = \frac{\text{Trim} \times LCF}{LBP}$$

$= \frac{0.85 \times 70.904}{143.16}$

$= 0.421\,m$

H·S draft = Aft draft − corrn

$= 8.10 - 0.421$

$= 7.679\,m$

7.6 | 15693
0.2 | 468
7.8 | 16161

Displacement at 7.679m : 15877.86 t

$\frac{468}{0.2} \times 0.079 = 184.86$

① To find initial LCG,

Get MCTC, LCB at disp 15877.86t

15693 | 191.8 | 72.690
184.86 | 468 | 2.8 | 0.049
16161 | 194.6 | 72.641

$\frac{2.8}{468} \times 184.86$ $\quad$ $\frac{0.049}{468} \times 184.86$

MCTC = 192.906

LCB = 72.671

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

$0.85 = \frac{(72.671 - LCG)}{192.906 \times 100} \times 15877.86$

$16397.01 = (72.671 - LCG) \times 15877.86$

$1.033 = 72.671 - LCG$

$LCG = 72.671 - 1.033$

Initial LCG = 71.638 m

② To find Final LCG

Initial displacement: 15877.86 t

cargo loaded: (+) 170.00 t

Final displacement: 16047.86 t @ 1.015

For refering to particular, disp in SW = $\frac{16047.86 \times 1.025}{1.015} = 16205.967\,t$

No. Date

	Disp.	H·S draft	MCTC	LCB	LCF
	16161	7.80	194.6	72.641	70.780
16205.967	474	0.2	2.8	0.053	0.185
44.967					
	16635	8.00	197.4	72.588	70.595
		$\frac{0.2}{474} \times 44.967$	$\frac{2.8}{474} \times 44.967$	$\frac{0.053}{474} \times 44.967$	$\frac{0.185}{474} \times 44.967$
		$= 0.019$	$= 0.266$	$= 0.005$	$= 0.018$

H·S draft = 7.819 m

* MCTC = $\frac{194.866 \times 1.015}{1.025}$ = 192.965

LCB = 72.636

LCF = 70.762

Final draft = H·S draft − T_f

7.25 = 7.819 − T_f

T_f = 7.819 − 7.25

T_f = 0.569 m

*

$$T_f = \frac{\text{Total trim} \times (LBP - LCF)}{LBP}$$

$$0.569 = \frac{t \times (143.16 - 70.762)}{143.16}$$

$$81.458 = t \times 72.398$$

$$t = 1.125$$

$$\text{Total trim} = \frac{(LCB - LCG)}{MCTC \times 100} \times \text{disp}$$

$$1.125 = \frac{(72.636 - LCG)}{192.965 \times 100} \times 16047.86$$

$$21708.563 = (72.636 - LCG) \times 16047.86$$

$$1.353 = 72.636 - LCG$$

$$LCG = 72.636 - 1.353$$

Final LCG = 71.283 m

Remarks	Weight (W)	LCG	L·moment
Initial	15877·86	71·638	1137458·135
Load	(+) 170·00	x	(+) 170x
Final W	: 16047·86	Final L·moment	: 1137458·135 + 170x

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

$$71·283 = \frac{1137458·135 + 170x}{16047·86}$$

$$1143939·604 = 1137458·135 + 170x$$

$$170x = 6481·469$$

$$x = 38·126\text{ m fwd of AP}$$ //

TO ACHIEVE A DESIRED TRIM

(78) Condition NO·8

Initial displacement : 16133·0t

Initial LCG : 70·045m

Require Final LCG

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

Initial displacement : 16133 t

disch : (-) 300t

Final displacement : 15833 t

Find H·S draft, LCB, MCTC & LCF for final disp 15833t

15693	7·60	72·690	191·8	70·979
16161	7·80	72·641	194·6	70·780
	$\frac{0·2}{468} \times 140 = 0·060$	$\frac{0·049}{468} \times 140 = 0·015$	$\frac{2·8}{468} \times 140 = 0·838$	$\frac{0·199}{468} \times 140 = 0·060$

H·S draft = 7·660 m

LCB = 72·675m

MCTC = 192·638 t

LCF = 70·919m

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

$$1.5 = \frac{(72.675 - LCG)}{192.638 \times 100} \times 15833$$

$$1.825 = 72.675 - LCG$$

$$LCG = 72.675 - 1.825$$

Final LCG = 70.850m

Remarks	Weight	LCG	L.moment
Initial	16133	70.045	1130041
disch	(-) 300	x	(-) 300x
Final W	15833	Final L-moment	1130041 - 300x

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

$$70.850 = \frac{1130041 - 300x}{15833}$$

$$1121768.05 = 1130041 - 300x$$

$$300x = 1130041 - 1121768.05$$

$$300x = 8272.95$$

$$\boxed{x = 27.577m \text{ fwd of AP}}$$

To find draft,

$$Ta = \frac{\text{Trim} \times LCF}{LBP} = \frac{1.5 \times 70.919}{193.16}$$

$$= 0.743m$$

$$Tf = T - Ta = 1.5 - 0.743$$

$$= 0.757m$$

Draft		Fwd	Aft
H.S	:	7.660	7.660
Tf/Ta	:	(-) 0.757	(+) 0.743
Draft	:	6.903m	8.403m

(79) DF : 7·62m } Trim = 0·32
DA : 7·94m }

Mean draft = $\frac{7.62+7.94}{2}$

= 7·78m

LCF at mean draft 7·78m : 70·800m

Correction to aft draft = $\frac{\text{Trim} \times \text{LCF}}{\text{LBP}}$

= $\frac{0.32 \times 70.800}{143.16}$

= 0·158m

H·S draft = DA - corr^n

= 7·94 - 0·158

= 7·782m

TO find initial LCG

Find displacement, MCTC, LCB

7·6	15693	191·8	72·690
0·182			
7·8	16161	194·6	72·641
	$\frac{468}{0.2} \times 0.182 =$	$\frac{2.8}{0.2} \times 0.182 = 2.548$	$\frac{0.049}{0.2} \times 0.182 = 0.045$

Displacement = $\frac{16118.88 \times 1.007}{1.025}$ = 15835·82t

MCTC = $\frac{191.348 \times 1.007}{1.025}$ = 190·935

LCB = 72·645 m

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

0·32 = $\frac{(72.645 - LCG)}{190.935 \times 100} \times 15835.82$

0·386 = 72·645 - LCG

LCG = 72·645 - 0·386

Initial LCG = 72·259m

TO find Final LCG

Initial disp: 15835.82

Load: (+) 450.00

Final disp: 16285.82 t

Equiv. disp in SW (for referring into the particular)

$$= \frac{16285.82 \times 1.025}{1.007}$$

$$= 16576.93\ t$$

Find MCTC, LCB at 16526.03

16161	194.6	72.641	
16635	197.4	72.588	$\frac{0.053}{474} \times 415.93 = 0.047$
	$\frac{2.8}{474} \times 415.93 =$		

$$MCTC = \frac{197.056 \times 1.007}{1.025} = 193.596$$

LCB = 72.594

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

$$1 = \frac{(72.594 - LCG)}{193.596 \times 100} \times 16285.82$$

$$1.189 = 72.594 - LCG$$

$$LCG = 72.594 - 1.189$$

Final LCG = 71.405 m

Remark	Weight	LCG	L.moment
Initial	15835.82	72.259	1144280.517
Load	(+) 450	x	450x

Final W: 16235.82 Final L.moment: $1144280.517 + 450x$

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

$$71.405 = \frac{1144280.517 + 450x}{16285.82}$$

$$1162888.977 = 1144280.517 + 450x$$

$$450x = 18608.460$$

$$x = 41.352\,m$$

Posn w.r.t to AP where this weight can be loaded = **41.352m**

TO ACHIEVE A DESIRED DRAFT AT ONE END

(80) Here, we find final LCG first

Initial disp: 7087.3 t

Load : (+) 518.0 t

Final disp: 7605.3 t

Find, H.S draft, MCTC, LCB, LCF

7605	4.00	158.9	73.010	73.131
8038	4.20	160.7	73.014	73.103

$\frac{0.2}{433} \times 0.3 = 0.0001$

H.S draft: 4.00 m

MCTC : 158.9

LCB : 73.010

LCF : 73.131

H.S draft: 4.00 m

Ta : (+)

Final draft : 4.5 m

So, Ta = 0.5 m

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

$$0.5 = \frac{trim \times 73.131}{143.16}$$

$$71.58 = trim \times 73.131$$

$$trim = 0.979\,m$$

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

$$0.979 = \frac{(73.010 - LCG)}{158.9 \times 100} \times 7605.3$$

$$2.045 = 73.010 - LCG$$

Final LCG = 70.965 m

Remarks	Weight	LCG	L.moment
Initial	7087.3	67.679	479662
load	(+)518	x	(+)518x
Final W:	7605.3	Final L.moment:	479662 + 518x

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

$$70.965 = \frac{479662 + 518x}{7605.3}$$

$$539710.115 = 479682 + 518x$$

$$518x = 60048.115$$

$$x = 115.923 \text{ m from AP}$$

Distance from FP = 143.16 − 115.923

= 27.237 m

(81)

F: 6.32 m
A: 7.18 m
} Trim = 0.86 by stern

$$\text{Mean draft} = \frac{6.32 + 7.18}{2} = 6.75 \text{m}$$

6.6	72.005
6.80	71.806

$\frac{0.199}{0.2} \times 0.15 = 0.149$

LCF at mean draft = 71.856 m

correction to after draft = $\frac{\text{Trim} \times \text{LCF}}{\text{LBP}}$

$= \frac{0.86 \times 71.856}{143.16}$

$= 0.432$

H.S draft = Aft draft - corn

$= 7.18 - 0.432$

$= 6.748\text{m}$

Find initial displacement, MCTC, LCB at 6.763m

6.6	13383	179.3	72.889
0.148			
6.8	13840	180.4	72.858

$\frac{457}{0.2} \times 0.148 = 338.18$ 1.712

Displacement = $\frac{13721.18 \times 1.000}{1.025} = 13386.517$

MCTC = $\frac{180.854 \times 1.000}{1.025} = 176.443$

LCB = 72.866

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

$0.86 = \frac{(72.866 - \text{LCG})}{176.443 \times 100} \times 13386.517$

$1.134 = 72.866 - \text{LCG}$

Initial LCG = 71.732m

NOW to find Final LCG.

Initial disp : 13386.517t

disch : (-) 140.00

Final disp : 13246.517 t

Equivalent disp. in S.W (for refering in table)

$= \frac{13246.517 \times 1.025}{1.000}$

$= 13577.680\text{t}$

Find H.S draft, MCTC, LCB, LCF

13383	6.60	179.3	72.889	72.005	
13577.680					
13840	6.80	181.4	72.858	71.806	

$\frac{0.2}{457} \times 194.680$ $\frac{2.1}{457} \times$

H.S draft : 6.685 m

MCTC : $\frac{180.195 \times 1.000}{1.025} = 175.800$

LCB = 72.876 m

LCF = 71.919 m

H.S draft : 6.685 m

T : (-)

Fwd Final draft : 6.000 m

T_f = 0.685 m

$T_f = \frac{Trim \times (LBP - LCF)}{LBP}$

$0.685 = \frac{TRIM \times (143.16 - 71.919)}{143.16}$

$98.065 = TRIM \times 71.241$

Trim = 1.377 m

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

$1.377 = \frac{(72.876 - LCG)}{175.800 \times 100} \times 13246.517$

$1.827 = 72.876 + LCG$

Final LCG = 71.049 m

Remarks	Weight	LCG	L.moment
Initial	13386.517	71.732	960241.637
disch	(-) 140	x	(-) 140x
Final W:	13246.517	Final L.moment:	960241.637 - 140x

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

$$71.049 = \frac{960241.637 - 140x}{13246.517}$$

$$941151.786 = 960241.637 - 140x$$

$$140x = 19089.851$$

$$x = 136.356\text{m fwd w.r.t to AP.}$$

CHANGE OF TRIM DUE TO CHANGE OF DENSITY

(82) Since, vessel on even keel,

draft = H.S draft

So, H.S draft = 9.35m

Displacement at 9.35m = 19902.25

LCB at 9.35m = 72.175m = LCG

Displacement at DW RD 1.004 = $\frac{19902.25 \times 1.004}{1.025}$

$= 19494.497\text{ t}$

	9.20	19537	72.223	
	9.40	20024	72.159	

$\frac{487}{0.2} \times 0.15 =$

With this displacement vessel reached the sea

Hence, find H.S draft, LCB, MCTC, LCF at 19494.497

19051	9.0	72.288	211.8	69.768
19537	9.2	72.223	214.5	69.611

$\frac{0.2}{486} \times 443.497 = 0.183$

H.S draft = 9.183m

LCB = 72.229m

MCTC = 214.264

LCF = 69.625m

*** Note:- Since there is no ~~change~~ cargo loaded/discharged/shifted, the LCG will remain unchanged

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

$$= \frac{(72.229 - 72.175)}{214.264 \times 100} \times 19494.497$$

$$= 0.049\ m$$

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

$$= \frac{0.049 \times 69.625}{143.16}$$

$$= 0.024$$

$$Tf = T - Ta$$

$$= 0.049 - 0.024$$

$$= 0.02$$

Draft	Fwd	Aft
H.S	9.183	9.183
Tf/Ta	(+)0.02	(+)0.024
Final	9.158m	9.207m

No. 41 Date 10.04.2025

JAN 2025

M.V Hindship has to load at 2 different ports, each port a consignment of 1000t. The 1st port is in SW where she arrives with draft Fwd = 7m and Aft = 8m. Space is available in No. 2 TD & No. 5 Hold. How should the cargo be distributed at 1st port so that she arrives at even keel draft in 2nd port which is a FW river port? What will be her arrival draft at 2nd port assuming there was negible consumption of FW & bunker?

Soln:-

Draft Fwd: 7.00m
Aft : 8.00m
} Trim = 1.0m

Mean draft = $\frac{7.00 + 8.00}{2}$

= 7.50m

LCF at mean draft = 71.086m

Correction to after draft = $\frac{\text{Trim} \times \text{LCF}}{\text{LBP}}$

= $\frac{1.0 \times 71.086}{143.16}$

= 0.497m

M.S draft = Aft draft − Corrⁿ

= 8.00 − 0.497

= 7.503m

At 1st port

Displacement : 15466.505t

LCB : 72.713

MCTC : 190.442

To find initial LCG

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

1.0 = $\frac{(72.713 - LCG) \times 15466.505}{190.442 \times 100}$

Initial LCG = 71.482m.

Now, vessel will load 1000t at 1st port

Initial displacement = 15466.505t
load = (+)1000
Final displacement = 16466.505 t (departure 1st port)

↓

with this displacement vessel arrives 2nd port (FW)

Her displacement in FW = 16466.505 t (arrival 2nd port)

Equivalent disp in SW = $\frac{16466.505 \times 1.025}{1.000}$

= 16878.168 t

We require Final LCG

Since vessel will arrive at even keel

LCB = LCG = 72.560m
H.S draft = 8.101m

Remarks	Weight	LCG	L.moment
Initial	15466.505	71.482	1105576.71
NO.2 TD	x	103.91	(+) 103.91x
No.5 hold	1000-x	17.31	(+) 17310 − 17.31x
Final W:	16466.505	Final L.moment:	1122886.71 + 86.6x

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

$72.560 = \frac{1122886.71 + 86.6x}{16466.505}$

$86.6x = 71922.893$

$x = 830.518$ t in NO.2 TD

$1000 - x = 169.482$ t in No.5 hold.

Final draft (arrival at 2nd port) = 8.101m E.K

Ans

OCT 2020 M.V Hindship is floating in sw at an even keel draft of 9.158m. Find how much ballast should run in FPK or APK to maintain her even keel condition when she goes from SW to FW

Soln:- E.K draft = M.S draft = 9.158m

Displacement at 9.158m = 19434.94t

LCB = LCG = 72.237

↓ with this displacement vsl goes in FW

For final parameters,

Equivalent disp. in SW = $\frac{19434.94 \times 1.025}{1.000}$

= 19920.81t

At 19920.81t

- LCB = 72.173

MCTC = $\frac{216.786 \times 1.000}{1.025}$ = 211.498

Note:- Without loading anything we will see where is trim in order to decide where we need to run ballast (FPK or APK)

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

Trim = $\frac{(72.173 - 72.237)}{211.498 \times 100} \times 19434.94$

Trim = -0.059m

Since, trim is by head, we need to run ballast in APK Tank.

In final condition also, vessel at even keel, so

LCB = LCG

Final LCG = 72.173m

Remarks	Weight	LCG	L.moment
Initial	19434.94	72.237	1403921.761
APK	+x	3.58	(+)3.58x

Final W : 19434.94 + x

Final L.moment : 1403921.761 + 3.58x

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

$$72.173 = \frac{1403921.761 + 3.58x}{19434.94 + x}$$

$$1402677.925 + 72.173x = 1403921.761 + 3.58x$$

$$72.173x - 3.58x = 1243.836$$

$$69.133x = 1243.886$$

$$x = 17.992\,t$$

Q.70 OF APR 2018, APR 2023, APR 2024, OCT 2024 M.V HINDSHIP

M.V HINDSHIP berthed in a dock where RD of water is 1.007, at a draft of F: 7.87m, A: 8.32m, KG: 7.45m, FSM: 970 mt. She discharge 410t of cargo from 2TD. A 60t case is shifted from deck, KG 14.7m, LCG 58.6m to NO.2 Hold. 110t water KG 2.77, LCG 16.23m was recieved in NO.8 P&S tank, filling them completely. Calculate the draft F&A at which she would sail from the dock.

Soln:-

Draft (F) 7.87m

Draft (A) : 8.32m

Mean draft : 8.095m

Trim : 0.45m

8.0	70.595
8.2	70.409
	0.186 / 0.2 x

LCF at mean draft: 70.507m

$$\text{correction to aft draft} = \frac{\text{Trim} \times \text{LCF}}{\text{LBP}}$$

$$= \frac{0.45 \times 70.507}{143.16} = 0.222\text{m}$$

Aft draft 8.320m

Corrn : 0.222m

H.S draft : 8.098m

Find displacement, MCTC, LCB at 8.098m

8.0	16635	197.4	72.588
8.2	17116	200.2	72.532

Factor = 0.49 $\frac{481}{0.2} \times 0.098$

$$\text{Displacement} = \frac{16870.69 \times 1.007}{1.025} = 16574.424\,t$$

$$MCTC = \frac{198.772 \times 1.007}{1.025} = 195.281 \text{ tm}$$

LCB = 72.561 m

TO find Initial LCG

$$\text{Trim} = \frac{LCB - LCG}{MCTC \times 100} \times \text{displacement}$$

$$0.45 = \frac{72.561 - LCG}{195.281 \times 100} \times 16574.424$$

$$0.530 = 72.561 - LCG$$

Initial LCG = 72.031 m

Remark	W	KG	V. moment	LCG	L. moment
Initial	16574.424	7.45	123479.459	72.031	1193872.335
DISCH FROM 2TD	(-) 410	10.72	(-) 4395.2	103.91	(+) 42603.1
Deck(shift)	60	14.77 to 4.98 9.72	(-) 583.2	58.6 to 103.14 44.54	(+) 2672.4
Rcvd 8P & S	(+) 110	2.77	(+) 304.7	16.23	(+) 1785.3
Final W =	16274.424	Final V. moment = 118805.759		Final L. moment = 1155725.2	

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

$$= \frac{118805.759}{16274.424}$$

$$= 73.002 \text{ m}$$

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

$$= \frac{1155725.2}{16274.424}$$

$$= 71.015 \text{ m}$$

$$\text{Equivalent disp. in SW (for reffering to table)} = \frac{16274.424 \times 1.025}{1.007}$$

$$= 16565.327 \text{ t}$$

Find, H.S draft, LCB, MCTC at 16565.327 t

H.S draft = 7.971 m

LCB = 72.596 m

$$MCTC = \frac{196.988 \times 1.007}{1.025} = 193.529 \text{ tm}$$

LCF = 70.622 m

$$\text{Total trim} = \frac{LCB - LCG}{MCTC \times 100} \times \text{disp}$$

$$\text{Total trim} = \frac{72.596 - 71.015}{193.529 \times 100} \times 16274.4$$

$$= 1.330m$$

$$Ta = \frac{\text{Total trim} \times LCF}{LBP}$$

$$= \frac{1.33 \times 70.622}{143.16}$$

$$= 0.656m$$

$$Tf = T_C - Ta$$

$$= 1.330 - 0.656$$

$$= 0.674m$$

	Fwd	Aft
Final H.S draft	7.971m	7.971
Tf / Ta	(-) 0.674m	(+) 0.656
Final draft	7.297m	8.627m