

FUNCTION: CARGO HANDLING AND STOWAGE

Q. 1) Cargo calculations - Draft survey / Making cargo plan given hatch dimensions, stowage factors, load density, broken stowage (maximum 4 cargoes)

DRAFT SURVEYS: 105, 106, 107, 108, 109

LOAD LINE

DEADWEIGHT CALCⁿ: 110, 111, 112

STABILITY REQ. FOR SHIP

LOADED WITH GRAIN IN BULK: 113, 114

Q. 2) Cargo calculations - Oil cargo calculations (including wedges)

M.V HINDSHIP Q. 124 to 134

* FORMULAS

1) correction to observed draft = $\frac{\text{Observed trim}}{\text{LBM}} \times \text{dist (from perpendicular)}$

Note: Intention to bring observed draft (i.e. on draft marks) to the perpendicular

If trim by stern & mark is fwd of perpendicular, then corrⁿ is +
mark is aft of perpendicular, then corrⁿ is -

If trim by head, vice versa

2) Quarter mean draft, M_4 draft = $\frac{F + A + 6 \cdot M}{8}$

→ 1st ^{trim} correction

$$\left\{ \frac{\text{Trim}}{\text{LBP}} \times \left(\frac{\text{LBP} - \text{LCF}}{2} \right) \right\} \times \text{TPC} \times 100$$

$x = \text{draft in meters}$

displacement in M.T

1st corrⁿ positive, then add
negative, then subtract

Method 1: $M_4 \text{ draft} + x = \text{H.S draft} \rightarrow \text{calculate disp.}$

Method 2: $M_4 \text{ displacement} + (x \times \text{TPC} \times 100) \rightarrow \text{corrected displacement}$

→ 2nd ^{trim} correction

$$(\text{MCTC}_{+50} - \text{MCTC}_{-50}) \times 50 \times \text{TRIM} \times \frac{\text{TRIM}}{\text{LBP}}$$

$\text{MCTC} @ M_4 \text{ draft} + 50 \text{ cm}$

$\text{MCTC} @ M_4 \text{ draft} - 50 \text{ cm}$

value comes in MT & always added

→ 3rd correction (list correction)

$$(\text{MP} \sim \text{MS}) \times (\text{TPC}_{\text{MP}} \sim \text{TPC}_{\text{MS}}) \times 6$$

$\downarrow$ midship port
 $\downarrow$ midship stbd

value comes in MT & always added

3) HOG & SAG

$$M_4 \text{ draft} = M + \frac{1}{4} \text{HOG}$$

$M = \text{midship draft}$

$$M_4 \text{ draft} = M - \frac{1}{4} \text{SAG}$$

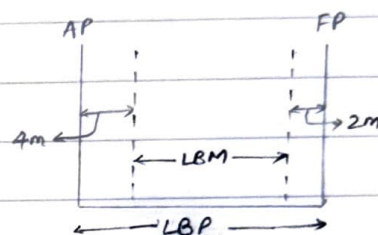
DRAFT SURVEY

①

(105) Observed drafts, $F: 8.65\text{m}$
 $A: 8.89\text{m}$ } Trim = 0.24m
 $M: 8.81\text{m}$

Draft marks are as follows: 2m aft of FP
 4m fwd of AP
 1m fwd of Midship

$$\begin{aligned} \text{LBM} &= \text{LBP} - 2 - 4 \\ &= 143.16 - 2 - 4 \\ &= 137.16\text{m} \end{aligned}$$



Remarks	FWD	AFT	MIDSHIP
Observed draft	8.65	8.89	8.81
Draft marks	2m aft of FP	4m fwd of AP	1m fwd of Midship
Correction i.e. $\frac{\text{obs trim} \times \text{dist.}}{\text{LBM}}$	$\frac{0.24}{137.16} \times 2$	$\frac{0.24}{137.16} \times 4$	$\frac{0.24}{137.16} \times 1$
	= 0.003	= 0.007m	= 0.002m
Corrected draft	8.65 - 0.003	8.89 + 0.007	8.81 + 0.002
	= 8.647	= 8.897	= 8.812

corrected draft, $F: 8.647\text{m}$
 $A: 8.897\text{m}$ } Trim = 0.25m
 $M: 8.812\text{m}$

Quarter mean draft, M4 draft = $\frac{F+A+6 \cdot M}{8}$

$$\begin{aligned} &= \frac{8.647 + 8.897 + 6(8.812)}{8} \\ &= 8.802\text{m} \end{aligned}$$

1st Trim correction

$$\frac{\text{Trim}}{\text{LBP}} \times \left(\frac{\text{LBP}}{2} - \text{LCF} \right)$$

$$\text{LCF @ } 8.802\text{m} = 69.910\text{m}$$

$$\frac{0.25}{143.16} \times \left(\frac{143.16}{2} - 69.910 \right)$$

$$= 0.003\text{m}$$

Corrected draft = M₄ draft + 1st trim correction

$$\text{observed draft} = 8.802 + 0.003$$

$$= 8.805\text{m}$$

$$\text{Displacement for } 8.805\text{m} = 18577.2\text{t}$$

Draft marks are 2m aft of FP

8.80	18565
0.2	486
9.00	19051

$$\frac{486}{0.2} \times 0.005 = 12.15$$

2nd Trim correction

$$\frac{(\text{MCTC}_{+50} - \text{MCTC}_{-50}) \times 50 \times \text{TRIM} \times \text{TRIM}}{\text{LBP}}$$

$$\text{MCTC at } 9.302\text{m} = 215.979$$

$$\text{MCTC at } 8.302\text{m} = 201.679$$

$$= \frac{(215.979 - 201.679) \times 50 \times 0.25 \times 0.25}{143.16}$$

$$= \frac{14.3 \times 50 \times 0.25 \times 0.25}{143.16}$$

$$= 0.312\text{t}$$

(M₄ draft + 50 cm)

$$8.802 + 0.5 = 9.302$$

$$8.802 - 0.5 = 8.302$$

8.2	200.2	$\frac{2.9}{0.2} \times 0.102$
0.2		
8.4	203.1	= 1.479
9.2	214.5	$\frac{2.9}{0.2} \times 0.102$
9.4	217.4	= 1.479

True displacement = corrected disp. + 2nd trim correction

$$= 18577.2 + 0.312$$

$$= 18577.512\text{t}$$

* No 3rd correction is required as there is no list

③

$$\text{Displacement in DW} = \frac{18577.512 \times 1.018}{1.025}$$

$$= 18450.64 \text{ t} = 8647 + 8897 + 1612 \text{ t}$$

Qty of cargo discharged = Present disp - light ship disp - non cargo weight on-board

$$\text{1st Trim correction} = 18450.64 - 5499.8 - (250 + 85 + 112 + 18 + 45 + 150)$$

$$\text{TRIM} = 18450.64 - 5499.8 - 660$$

$$\text{LBP} = 12290.84 \text{ t}$$

$$\text{LCF @ 8.802} = 69.910$$

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$$\left. \begin{array}{l} \text{Observed draft, F: } 8.65 \text{ m} \\ \text{A: } 8.89 \text{ m} \\ \text{M: } 8.81 \text{ m} \end{array} \right\} \text{Trim} = 0.24$$

Corrected draft = Obs draft + 1st Cor'n

Draft marks are: 2m aft of FP

4m fwd of AP

Displacement 1m fwd of Midship

$$\text{2nd LBM} = 14316 - 4.2$$

$$\text{MTC} = 137.16 \text{ m} \times 50 \times \text{TRIM} \times \text{TRIM}$$

LBP

MTC at 8.802 = 207.279

Remarks	FWD	AFT	MIDSHIP
Observed draft	8.65	8.89	8.81
Draft marks	2m aft of FP	4m fwd of AP	1m fwd of Midship
Correction	$\frac{0.24}{137.16} \times 2$	$\frac{0.24}{137.16} \times 4$	$\frac{0.24}{137.16} \times 1$
i.e. $\frac{\text{Obstrim}}{\text{LBM}} \times \text{dist}$	$= 0.003 \text{ m}$	$= 0.007 \text{ m}$	$= 0.002 \text{ m}$
corrected draft	$8.65 - 0.003$ $= 8.647 \text{ m}$	$8.89 + 0.007$ $= 8.897 \text{ m}$	$8.81 + 0.002$ $= 8.812 \text{ m}$

$$\left. \begin{array}{l} \text{corrected draft, F: } 8.647 \text{ m} \\ \text{A: } 8.897 \text{ m} \end{array} \right\} \text{Trim} = 0.25 \text{ m}$$

M: 8.812 m is no use

(4)

$$\begin{aligned}
 \text{Quarter mean draft, M4 draft} &= \frac{F + A + 6 \cdot M}{8} \\
 &= \frac{8.647 + 8.897 + 6(8.812)}{8} \\
 &= 8.802 \text{ m}
 \end{aligned}$$

1st Trim correction

$$\frac{\text{TRIM}}{\text{LBP}} \times \left(\frac{\text{LBP}}{2} - \text{LCF} \right)$$

$$\text{LCF @ } 8.802 = 69.910$$

$$\frac{0.25}{143.16} \times \left(\frac{143.16}{2} - 69.910 \right)$$

$$= 0.003 \text{ m}$$

$$\begin{aligned}
 \text{Corrected draft} &= \text{M4 draft} + 1^{\text{st}} \text{ corr'n} \\
 &= 8.802 + 0.003 \\
 &= 8.805 \text{ m}
 \end{aligned}$$

$$\text{Displacement for } 8.805 \text{ m} = 18577.2 \text{ t}$$

2nd Trim correction

$$\frac{(\text{MCTC}_{+50} - \text{MCTC}_{-50}) \times 50 \times \text{TRIM} \times \text{TRIM}}{\text{LBP}}$$

$$\frac{(215.979 - 201.679) \times 50 \times 0.25 \times 0.25}{143.16}$$

$$= 14.3 \times 50 \times 0.25 \times \frac{0.25}{143.16}$$

$$= 0.312 \text{ t}$$

$$\text{MCTC at } 9.302 = 215.979$$

$$\text{MCTC at } 8.302 = 201.679$$

$$\begin{aligned}
 \text{True displacement} &= \text{corrected disp} + 2^{\text{nd}} \text{ trim correction} \\
 &= 18577.2 + 0.312 \\
 &= 18577.512 \text{ t}
 \end{aligned}$$

* NO 3rd correction is required as there is no list

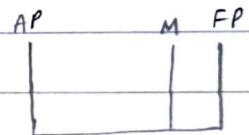
(5)

$$\text{Displacement in DW} = \frac{18577.512 \times 1.016}{1.025} = 18414.392 \text{ t}$$

$$\begin{aligned} \text{Cargo discharged} &= \text{Present disp} - \text{light ship disp.} - \text{non cargo weight on-board} \\ &= 18414.392 - 5499.8 - (350 + 135 + 162 + 22 + 54 + 160) \\ &= 18414.392 - 5499.8 - 883 \\ &= 12031.592 \text{ t} \end{aligned}$$

$$\begin{aligned} \text{Observed draft, Fwd} &= \frac{FP + FS}{2} = \frac{6.69 + 6.65}{2} = 6.67 \text{ m} \\ \text{Aft} &= \frac{AP + AS}{2} = \frac{8.86 + 8.75}{2} = 8.805 \text{ m} \\ \text{Midship} &= \frac{MP + MS}{2} = \frac{7.91 + 7.75}{2} = 7.830 \text{ m} \end{aligned} \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} \text{Trim} = 2.135 \text{ m}$$

Drafts marks are, 5m aft of FP
0m from AP
2m aft of Midship



$$\text{LBM} = 143.16 - 5$$

$$21.7 \text{ ton} \times 5 = 108.5$$

Remarks	Fwd	Aft	Midship
Observed draft	6.67	8.805	7.830
Draft marks	5m aft of FP	-	2m aft of Midship
Correction i.e. Obstrim x dist	$\frac{2.135}{138.16} \times 5$	-	$\frac{2.135}{138.16} \times 2$
LBM	= 0.077	-	= 0.031
Corrected draft	6.67 - 0.077 = 6.593m	- 8.805m	7.830 - 0.031 = 7.799m

⑥

$$\left. \begin{array}{l} \text{Corrected drafts, F: } 6.593\text{m} \\ \text{A: } 8.805\text{m} \\ \text{M: } 7.799\text{m} \end{array} \right\} \text{Trim} = 2.212\text{m}$$

$$\text{Quarter mean draft, } M_4 = \frac{F + A + 6M}{8}$$

3rd correction (LWL only)

$$(M_4 - M_5) \times (TPC_{M_4} - TPC_{M_5}) = \frac{6.593 + 8.805 + 6(7.799)}{8}$$

$$TPC \text{ at } 7.91 = 23.98$$

$$TPC \text{ at } 7.74 = 22.58 = 7.774\text{m}$$

1st trim correction

$$= (7.91 - \text{TRIM}) \times \left(\frac{\text{LBP} - \text{LCF}}{2} \right) \times 6$$

$$\begin{array}{cc} 7.60 & 70.979 \\ 0.2 & 0.193 \end{array}$$

$$\text{LCF at } 7.774\text{m} = 70.806$$

$$\begin{array}{cc} 7.80 & 70.780 \end{array}$$

$$= \frac{2.212}{143.16} \times \left(\frac{143.16 - 70.806}{2} \right)$$

$$\frac{0.193}{0.2} \times 0.174 = 0.173$$

$$\frac{468}{0.2} \times 0.186 = 435.24$$

$$= 0.012$$

$$\text{Corrected draft} = M_4 \text{ draft} + 1^{\text{st}} \text{ trim correction}$$

$$= 7.774 + 0.012$$

$$\text{Constant: } (0.5 + 0) = 7.786\text{m}$$

$$\text{Displacement at } 7.786\text{m} = 16128.24\text{t}$$

$$\begin{array}{cc} 8.2 & 200.2 \end{array}$$

2nd trim correction

$$\frac{(MCTC_{+50} - MCTC_{-50}) \times 50 \times \text{TRIM} \times \text{TRIM}}{\text{LBP}}$$

$$\begin{array}{cc} 8.4 & 203.1 \\ \frac{2.9}{0.2} & \times 0.074 = 1.073 \end{array}$$

$$\text{MCTC at } 7.274\text{m} = 187.362$$

$$7.774 + 0.5 = 8.274$$

$$\text{MCTC at } 8.274\text{m} = 201.273$$

$$7.774 - 0.5 = 7.274$$

$$= \frac{(201.273 - 187.362) \times 50 \times 2.212 \times 2.212}{143.16}$$

$$= 13.911 \times 50 \times 2.212 \times \frac{2.212}{143.16}$$

$$= 23.77\text{t}$$

⑦

$$\begin{aligned}\text{True displacement} &= \text{Corrected disp.} + 2^{\text{nd}} \text{ trim correction} \\ &= 16128.24 + 23.77 \\ &= 16152.01 \text{ t}\end{aligned}$$

3rd correction (List corrⁿ)

$$(MP - MS) \times (TPC_{MP} - TPC_{MS}) \times 6$$

$$\text{TPC at } 7.91 = 23.48$$

$$\text{TPC at } 7.75 = 23.38$$

$$= (7.91 - 7.75) \times (23.48 - 23.38) \times 6$$

$$= 0.16 \times 0.1 \times 6$$

$$= 0.096 \text{ t}$$

7.60	23.29
7.75	$\frac{0.12}{0.2} \times 0.15 = 0.09$
7.80	23.41
7.91	$\frac{0.13}{0.2} \times 0.11 = 0.07$
8.0	23.54

$$\text{Final displacement} = \text{True disp.} + 3^{\text{rd}} \text{ corrⁿ}$$

$$\text{Observed draft} = 16152.01 + 0.096$$

$$\text{Draft marks} = 16152.106 \text{ t}$$

Correction

$$\text{Constant} = (0.5 + 0.05n) \% \text{ of her deadweight (16 years)}$$

$$\text{LBM} = (0.5 + 0.05 \times 16) \% \text{ of } 14117$$

$$\text{Corrected draft } 1.3 \% \text{ of } 14117$$

$$= 183.521$$

$$\text{Cargo on board} = \text{Present disp.} - \text{Lt ship disp.} - \text{non cargo wt on-board}$$

$$= 16152.106 - 5499.8 - (125.5 + 22.4 + 43.3 + 23.0 + 101.5 + 183.521)$$

$$= 16152.106 - 5499.8 - 499.221$$

$$= 10153.085 \text{ t}$$

(8)

(107)

$$\text{Observed draft, Fwd} = \frac{FP+FS}{2} = \frac{8.88+8.92}{2} = 8.90\text{m}$$

$$\text{Aft} = \frac{AP+AS}{2} = \frac{9.24+9.36}{2} = 9.30\text{m}$$

$$\text{Midship} = \frac{MP+MS}{2} = \frac{8.96+9.16}{2} = 9.06\text{m}$$

TRIM = 0.40m

Draft marks are: 2m fwd of FP

3m aft of AP

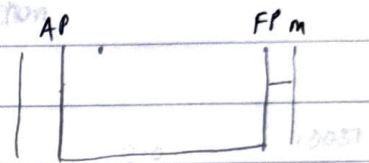
Corrected draft = 1m fwd of midship

$$= 9.072 + 0.005$$

$$\text{LBM} = 143.16 + 2 + 3 = 148.16\text{m}$$

$$= 148.16\text{m}$$

Displacement at 9.07m = 19238.11 t



Remarks	Fwd	Aft	Midship
Observed draft	8.90	9.30	9.06
Draft marks	2m fwd of FP	3m aft of AP	1m fwd of midship
Correction	$\frac{0.4}{148.16} \times 2$	$\frac{0.4}{148.16} \times 3$	$\frac{0.4}{148.16} \times 1$
i.e. ob trim	$\frac{0.4}{148.16} \times 2$	$\frac{0.4}{148.16} \times 3$	$\frac{0.4}{148.16} \times 1$
LBM	$= 0.005\text{m}$	$= 0.008$	$= 0.003$
Corrected draft	$8.90 + 0.005$ $= 8.905\text{m}$	$9.30 - 0.008$ $= 9.292\text{m}$	$9.06 + 0.003$ $= 9.063\text{m}$

$$\text{Corrected draft, F: } 8.905\text{m}$$

$$\text{A: } 9.292\text{m}$$

$$\text{M: } 9.063\text{m}$$

Trim = 0.387m

$$\text{Quarter mean draft, } M_f = \frac{F+A+6 \cdot M}{8}$$

$$= \frac{8.905 + 9.292 + (9.063) \cdot 6}{8}$$

$$= 9.072\text{m}$$

9

1st trim correction

$$\frac{\text{TRIM}}{\text{LBP}} \times \left(\frac{\text{LBP}}{2} - \text{LCF} \right)$$

9.0	69.768
0.2	0.157
9.2	69.611

$$\text{LCF at } 9.072\text{m} = 69.711\text{m}$$

$$= \frac{0.387}{143.16} \times \left(\frac{143.16}{2} - 69.711 \right)$$

$$\frac{0.157}{0.2} \times 0.072 = 0.057$$

$$= 0.005\text{m}$$

Corrected draft = M₄ draft + 1st trim correction

$$= 9.072 + 0.005$$

$$= 9.077\text{m}$$

9.0	19051
0.2	486
9.2	19537

$$\text{Displacement at } 9.077\text{m} = 19238.11\text{t}$$

$$\frac{486}{0.2} \times 0.077 = 187.11$$

2nd trim correction

$$\frac{(\text{MCTC}_{+50} - \text{MCTC}_{-50}) \times 50 \times \text{TRIM} \times \text{TRIM}}{\text{LBP}}$$

$$9.072 + 0.5 = 9.572$$

$$9.072 - 0.5 = 8.572$$

$$\text{MCTC at } 9.572 = 219.636$$

$$\text{MCTC at } 8.572 = 205.594$$

$$\frac{203.1}{0.2} \times \frac{2.9}{0.2} \times 0.172$$

$$= \frac{(219.636 - 205.594) \times 50 \times 0.387 \times 0.387}{143.16}$$

$$\frac{206}{0.2} \times \frac{2.6}{0.2} \times 0.172$$

$$= 14.042 \times 50 \times 0.387 \times 0.387$$

$$= 0.735\text{t}$$

True displacement = Corrd disp + 2nd trim correction

$$= 19238.11 + 0.735$$

$$\text{True displacement at } 6 = 19238.84\text{t}$$

(10)

3rd correction (List correction)

$$(MP \sim MS) \times (TPC_{MP} \sim TPC_{MS}) \times 6$$

$$TPC \text{ at } 8.96 = 24.116$$

$$8.8 \quad 24.02$$

$$TPC \text{ at } 9.16 = 24.236$$

$$9.0 \quad 24.14 \quad \frac{0.12}{0.2} \times 0.16 = 0.096$$

$$= (9.16 - 8.96) \times (24.236 - 24.116) \times 6$$

$$9.2 \quad 24.26$$

$$= 0.2 \times 0.12 \times 6$$

$$= 0.144 t$$

Final displacement = True disp + List corr

$$= 19238.84 + 0.144$$

$$= 19238.984 t$$

$$\text{Arrival displacement in DW} = \frac{19238.984 \times 1.016}{1.025} = 19070.06 t$$

Final observed draft F: 6.00 m

$$A: 6.00 m$$

$$M: 6.04 m$$

Since, obs trim is zero.

∴ There will no correction.

SAG

$$6.04 - \frac{1}{4} \times 0.04$$

$$6.04 - 0.01 = 6.03$$

Here, vessel is SAG.

$$\therefore M_4 \text{ draft} = M - \frac{1}{4} \text{ SAG}$$

$$= 6.04 - \frac{1}{4} \times 0.04$$

$$= 6.04 - 0.01$$

$$= 6.03 m$$

Displacement at 6.03 m = 12086.95 t

$$\text{Final displacement in DW} = \frac{12086.95 \times 1.016}{1.025}$$

$$= 11980.82 t$$

(51)

(11)

Arrival displacement: 19070.06

$$FW \quad (-) 125 \times 1.1 \times 1.02 / (1.02 - 1.01) = 125 \times 1.1 \times 1.02 / 0.01 = 1402.5$$

$$DO \quad (-) 15 \times 1.1 \times 1.02 / (1.02 - 1.01) = 15 \times 1.1 \times 1.02 / 0.01 = 171.75$$

$$H.O \quad (+) 600$$

Disp. after operation: 19640.06

$$\text{Cargo discharged} = \text{Disp. after operation} - \text{Departure disp.} = 19640.06 - 11980.82$$

$$L.M. = 143.16 \times 7659.24 \text{ t} = 1100000 \text{ t}$$

$$\text{Draft: } F: 8.98 \text{ m} \quad A: 9.12 \text{ m} \quad M: 9.08 \text{ m}$$

$$\text{Trim} = 0.14 \text{ m}$$

$$\text{Quarter mean draft, } M_4 = \frac{F+A+6M}{8}$$

$$= \frac{8.98 + 9.12 + 6(9.08)}{8}$$

$$= \frac{72.58}{8} = 9.073 \text{ m}$$

1st Trim correction

$$\frac{\text{TRIM}}{\text{LBP}} \times \left(\frac{\text{LBP} - \text{LCF}}{2} \right)$$

$$\text{LCF at } 9.073 \text{ m} = 69.71 \text{ m}$$

$$= \frac{0.14}{143.16} \times \left(\frac{143.16 - 69.71}{2} \right) \times \frac{1}{1.02} = 0.002$$

$$= 0.002$$

Corrected draft = M_4 draft + 1st trim correction

$$= 9.073 + 0.002$$

$$= 9.075 \text{ m}$$

Displacement at 9.075 m = 19233.25 t

(11)

(12)

2nd Trim correction

$$(MCTC_{+50} - MCTC_{-50}) \times 50 \times \text{TRIM} \times \text{TRIM/LBP}$$

$$= (219.649 - 205.609) \times 50 \times 0.14 \times 0.14$$

$$143.16 \quad 9.073 + 0.5 = 9.573$$

$$= 14.041 \times 50 \times 0.14 \times 0.14$$

$$= 0.096$$

True disp = Corrd disp + 2nd trim correction

$$= 19233.25 + 0.096$$

$$= 19233.346 \text{ t}$$

$$\text{Initial disp. in DW} = 19233.346 \times 1.01480$$

$$= 19026.939 \text{ t}$$

$$(80.0) + 51.0 + 80.8 =$$

Final condition.

$$DF: 6.70 \text{ m} = 82.5 \text{ SF} =$$

$$DA: 6.70 \text{ m}$$

$$DM: 6.70 - 0.08 = 6.62 \text{ m (80 cm hog)}$$

$$M_4 \text{ draft} = M + \frac{1}{4} \text{ hog}$$

$$= 6.62 + \frac{1}{4} \times 0.08$$

$$= 6.64 \text{ m}$$

$$\text{Displacement at } 6.64 \text{ m} = 13474.4$$

$$\text{Final displacement in DW} = 13474.4 \times 1.014$$

$$= 13329.797 \text{ t}$$

(1)

(13)

QTY WE CAN DISCHARGE

$$\text{Total cargo quantity discharged} = 19026.939 - 13329.797 = 5697.142$$

We are discharging

Since we read more, we have

to discharge more in order to

come on desired draft

$$\begin{aligned} \text{read} & \left\{ \begin{array}{l} 3.0: (+) 118 \\ \text{MFW: } (+) 1215 \end{array} \right. \\ \text{consumed} & \left\{ \begin{array}{l} 1000: (+) 781.8 \\ \text{FW: } (-) 501.8 \end{array} \right. \end{aligned}$$

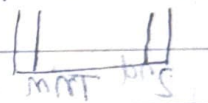
$$\text{QTY DISCHARGED: } 5973.142$$

Final displacement in SW = 14316.8

$$\text{LBM} = 143.16 - 3 - 5$$

$$\text{Trim} = 0.10 \text{ m}$$

$$= 135.16$$



Remarks	Fwd	MID	Aft	Midship
Observed draft	08.10	08.20	08.20	08.20
Draft marks	3m aft of F.P	5m fwd of AP	1.5m aft of midship	
Correction	$\frac{0.10}{3} \times 3$	$\frac{0.10}{5} \times 5$	$\frac{0.10}{1.5} \times 1.5$	
i.e. $\frac{\text{Obstrim}}{\text{LBM}} \times \text{dist}$	$\frac{135.16}{1000} \times 3$	$\frac{135.16}{1000} \times 5$	$\frac{135.16}{1000} \times 1.5$	
	= 0.002	= 0.004	= 0.001	
Corrected draft	$8.10 - 0.002$	$8.20 + 0.004$	$8.20 - 0.001$	
	= 8.098 m	= 8.204 m	= 8.199 m	

$$\text{Corrected draft: } \left. \begin{array}{l} \text{F: } 8.098 \text{ m} \\ \text{A: } 8.204 \text{ m} \end{array} \right\} \text{Trim} = 0.106 \text{ m}$$

$$8.200 \text{ m} \times 8.199 \text{ m} = 8.199 \text{ m}$$

$$105.780 \text{ F1}$$

$$\text{Quarter mean draft, } M_4 \text{ draft} = \frac{F + A + 6M}{8}$$

$$210.1 \times 105.780 \text{ F1} = \text{WE N}$$

$$= \frac{8.098 + 8.204 + 6(8.199)}{8}$$

$$8.187 \text{ m}$$

$$= 8.187 \text{ m}$$

1st trim correction

$$\frac{\text{TRIM}}{\text{LBP}} \times \left(\frac{\text{LBP}}{2} - \text{LCF} \right)$$

$$8.0 \quad 70.595$$

$$\text{LCF at } 8.187 \text{ m} = 70.421 - 3 \text{ m}$$

$$8.2 \quad 70.409$$

$$\frac{0.186}{0.2} \times 0.187 =$$

$$= \frac{0.006}{143.16} \times \left(\frac{143.16 - 70.421}{21.5032} \right)$$

$$= 0.0009 \text{ m}$$

$$\text{corrected draft} = M_4 \text{ draft} + 1^{\text{st}} \text{ trim correction}$$

$$= 8.187 + 0.0009$$

$$= 8.188 \text{ m}$$

$$\text{Displacement at } 8.188 \text{ m} = 17087.14 \text{ t}$$

2nd trim correction

$$(MCTC_{+50} - MCTC_{-50}) \times 50 \times \text{TRIM} \times \text{TRIM}$$

$$05.80$$

$$05.80$$

$$\text{LBR } 1.80$$

$$8.187 + 0.5 = 8.687$$

$$8.187 - 0.5 = 7.687$$

$$MCTC \text{ at } 8.687 : 207.305$$

$$MCTC \text{ at } 7.687 : 193.018$$

$$= (207.305 - 193.018) \times 50 \times 0.106 \times 0.106$$

$$100.0 =$$

$$100.0 =$$

$$5993.16 =$$

$$100.0 = 14.287 \times 50 \times 0.106 \times 0.106$$

$$m_{\text{cor}} =$$

$$14.287 = 143.16 \text{ m}_{\text{cor}} =$$

$$= 0.056 \text{ t}$$

$$\text{True displacement} = 17087.14 + 0.056$$

$$= 17087.20 \text{ t}$$

$$\text{Initial displacement in DW} = 17087.20 \times 1.015$$

$$(1.015) \times 17087.20 = 1.025$$

$$= 16920.5 \text{ t}$$

Final calculation

$$\text{Draft F: } 6.00 \text{ m}$$

$$A: 6.00 \text{ m}$$

$$M: 6 - 0.15 = 5.85 \text{ m (Hog by 15 cm)}$$

(61)

(15)

$$M_4 = M + \frac{1}{4} HOC$$

$$= 5.85 + \frac{1}{4} \times 0.15$$

$$= 5.888m$$

$$\text{Displacement at } 5.888m = 11767t$$

$$\text{Final displacement in DW} = 11767 \times 1.015 \times 0.2 \times (1 - 0.2)$$

$$= 11652.28t$$

$$\text{Amount of cargo to discharge} = 16920.5 - 11652.2$$

$$\text{Draft : F: } 7.25m$$

$$A: 7.95m$$

$$M: 7.55m$$

$$\text{Trim} = 0.70m$$

$$\text{Quarter mean draft, } M_4 = \frac{F + A + 6M}{8}$$

$$= \frac{7.25 + 7.95 + 6(7.55)}{8}$$

$$\text{1st trim correction}$$

$$\frac{\text{TRIM}}{\text{LBP}} \times \left(\frac{\text{LBP}}{2} - \text{LCF} \right)$$

$$\text{LCF at } 7.563 = 71.019m$$

$$= \frac{0.70}{143.16} \times \left(\frac{143.16}{2} - 71.019 \right)$$

$$= 0.003m$$

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$$\text{Corrected draft} = M_4 \text{ draft} + 1^{\text{st}} \text{ trim correction}$$

$$= 7.563 + 0.003$$

$$= 7.566 \text{ m} \quad 210 \times \frac{1}{P} + 28.2 \times 7.4 \quad 15226$$

$$\text{Displacement at } 7.566 \text{ m: } 15613.62 \text{ t} \quad m888.2 =$$

2nd Trim Correction

$$(MCTC_{+50} - MCTC_{-50}) \times 50 \times \text{TRIM} \times \text{TRIM} \text{ Wt Ni } 7.563 + 0.5 = 8.063$$

$$250.1 \text{ LBP}$$

$$7.563 - 0.5 = 7.063$$

$$2^{\text{nd}} \text{ MCTC at } 8.063 : 198.282 \text{ t} \quad 7.0 \quad 183.8$$

$$(MCTC_{+50} - MCTC_{-50}) \times 50 \times \text{TRIM} \times \text{TRIM} \text{ Wt Ni } 7.063 : 184.619 \text{ t} \quad 7.2 \quad 186.4$$

$$198.282 - 184.619 = 13.663 \text{ t} \quad 8.0 \quad 197.4 \quad 2.6 \times 0.063 = 0.1638$$

$$(198.282 - 184.619) \times 50 \times 0.70 \times 0.70$$

$$8.2 \quad 200.2 \quad 2.8 \times 0.063 = 0.1764$$

$$= 13.663 \times 50 \times 0.70 \times 0.70$$

$$= 2.338 \text{ t} \quad 143.16$$

$$= 2.338 \text{ t}$$

$$\text{True displacement} = \text{corrected disp} + 2^{\text{nd}} \text{ trim corr}$$

$$= 15613.618 + 2.338$$

$$= 15615.956 \text{ t}$$

$$\text{Initial displacement in DW: } 15615.95 \times 1.027 = 15646.44 \text{ t}$$

$$1.025$$

$$\text{Desired Departure SW draft (Tropical zone): } F = 9.425$$

$$mctc \text{ at } 9.425 \text{ F to } 7.2$$

$$(C10.1F - 21.1M) \times 9.425 - 0.04 = 9.385 \text{ m (Hog by 4 cm)}$$

$$M_4 = M + \frac{1}{4} \text{HOG}$$

$$= 9.385 + \frac{1}{4} \times 0.04$$

$$= 9.395 \text{ m}$$

correct this

Displacement at 9.395m = 20011.825t

Cargo can load = 20011.825 - 15646.44

= 4365.385

(-) 100 we are loading

(-) 100 Since, we rec'd more, we have to

(+) 84

2- load test in order to come on

2nd Actual cargo can load: 4249.385

desired draft

(MCTC + 50 - MCTC) X 50 X TRIM X TANK

WINDM

AFT

FWD

REMARKS

0.30 2.987 0.30 2.22 0.30

0.50

Observer draft

3m aft of FB 3m aft of FB 3m aft of FB

Draft marks

$0.10 \times 0.10 \times 0.10 \times 0.10 \times 0.10 \times 0.10 \times 0.10 \times 0.10 \times 0.10 \times 0.10$

Correction

$132.16 \times 2 = 264.32$

1.6. opt. trim

$100.0 - 0.005 = 99.995$

Trim

$100.0 - 0.005 = 99.995$

Corrected draft

$100.0 - 0.005 = 99.995$

$100.0 - 0.005 = 99.995$

True displacement =

$M + A + F =$

8

$100.0 - 0.005 = 99.995$

8

$100.0 - 0.005 = 99.995$

2nd trim correction

$(100 - 98) \times \frac{100}{2}$

$100 - 98 = 2$

$(100 - 98) \times \frac{100}{2}$

108

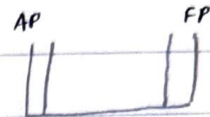
Observed draft: F: 9.20m } Trim = 0.10m
A: 9.30m

M: 9.30m

Draft marks are: 3m aft of FP

5m fwd of AP

1.5m aft of midship



LBM = 143.16 - 3 - 5

True displacement = 135.16m

Remarks	FWD	AFT	MIDSHIP
Observed draft	9.20	9.30	9.30
Draft marks	3m aft of FP	5m fwd of AP	1.5m aft of midship
Correction i.e. obs trim x dist	$\frac{0.10}{135.16} \times 3$	$\frac{0.10}{135.16} \times 5$	$\frac{0.10}{135.16} \times 1.5$
LBM	$= 0.002$	$= 0.004$	$= 0.001$
Corrected draft	$9.20 - 0.002$	$9.30 + 0.004$	$9.30 - 0.001$
$= 9.198m$	$= 9.198m$	$= 9.304$	$= 9.299$

Corrected draft F: 9.198m } TRIM = 0.106m

True displacement = A: 9.304m

M: 9.299m

$$\text{Quarter mean draft} = \frac{F + A + 6 \cdot M}{8}$$

$$= \frac{9.198 + 9.304 + 6(9.299)}{8}$$

$$= 9.287m$$

1st Trim correction

$$\frac{\text{TRIM}}{\text{LBP}} \times \left(\frac{\text{LBP}}{2} - \text{LCF} \right)$$

$$\text{LCF at } 9.287m = 69.555$$

$$\frac{0.106}{143.16} \times \left(\frac{143.16}{2} - 69.555 \right)$$

$$9.20 \quad 69.611$$

$$0.2 \quad 0.128$$

$$9.40 \quad 69.483$$

$$\frac{0.128}{0.2} \times 0.087 = 0.056$$

$$= 0.001$$

Corrected draft = M₄ draft + 1st trim correction

$$= 9.287 + 0.001$$

$$= 9.288 \text{ m}$$

9.2

19537

Displacement at 9.288m = 19751.28 t

9.4

20024

$$\frac{9.87}{0.2} \times 0.088 = 214.28$$

2nd Trim correction

$$\frac{(MCTC_{+50} - MCTC_{-50}) \times 50 \times \text{TRIM} \times \text{TRIM}}{\text{LBP}}$$

$$9.287 + 0.5 = 9.787$$

$$9.287 - 0.5 = 8.787$$

$$\text{MCTC at } 9.787 \text{ m} = 222.431$$

9.6

220

$$\frac{2.6}{0.2} \times 0.187$$

$$\text{MCTC at } 8.787 \text{ m} = 208.805$$

9.8

222.6

0.2

$$= \frac{(222.431 - 208.805) \times 50 \times 0.106 \times 0.106}{143.16}$$

$$= 13.626 \times 50 \times 0.106 \times 0.106$$

$$\text{LBM} = 143.16 = 2 + 143.16$$

$$= 0.053 \text{ t}$$

True displacement = corrd disp + 2nd trim correction

$$= 19751.28 + 0.053$$

$$= 19751.333 \text{ t in SW}$$

Initial displacement in DW RD 1.005 = $\frac{19751.333 \times 1.005}{1.025}$

1.025

$$= 19365.941 \text{ t}$$

Final draft, F: 6.00m

A: 6.00m

$$M: 6 - 0.1 = 5.9 \text{ m (Hog by 10cm)}$$

$$M_q \text{ draft} = M + \frac{1}{4} HOG$$

$$= 5.9 + \frac{1}{4} \times 0.10$$

$$= 5.925 \text{ m}$$

$$\text{Displacement at } 5.925 \text{ m} = 11850.25 \text{ t}$$

$$\text{Final disp. in SW RD } 1.005 = \frac{11850.25 \times 1.005}{1.025}$$

$$= 11619.026 \text{ t}$$

$$\text{Amount of cargo req. to discharge} = 19365.941 - 11619.026$$

$$= 7746.9 \text{ t}$$

Observed draft F: 6.65m } Trim = 0.30m Draft marks are 2m fwd of FP
 A: 6.95m } 3m aft of AP
 M: 6.76m } 2m aft of midship

$$\text{LBM} = 143.16 + 2 + 3 = 148.16 \text{ m}$$

2nd trim correction

Remarks	FWD	AFT	MIDSHIP
Observed draft	6.65	6.95	6.76
Draft marks	2m fwd of FP	3m aft of AP	2m fwd of midship
Correction	$\frac{0.30}{148.16} \times 2$	$\frac{0.30}{148.16} \times 3$	$\frac{0.30}{148.16} \times 2$
i.e. $\frac{\text{Obs trim}}{\text{LBM}} \times \text{dist}$	$= 0.004$	$= 0.006$	$= 0.004$
Corrected draft	$6.65 + 0.004$ $= 6.654 \text{ m}$	$6.95 - 0.006$ $= 6.944$	$6.76 + 0.004$ $= 6.764$

Corrected draft F: 6.654m } 0.29m
 A: 6.944m }
 M: 6.764m }

(21)

$$\text{Water mean draft, } M_d \text{ draft} = \frac{F + A + 6 \cdot M}{8}$$

$$= \frac{6.654 + 6.944 + 6(6.764)}{8}$$

$$M_d \text{ draft} = 6.773 \text{ m}$$

1st Trim correction

$$\frac{\text{TRIM}}{\text{LBP}} \times \left(\frac{\text{LBP} - \text{LCF}}{2} \right)$$

$$6.6 \quad 72.005$$

$$M_d \text{ LCF at } 6.773 = 71.833 \text{ m}$$

$$\frac{0.29}{143.16} \times \left(\frac{143.16 - 71.833}{2} \right)$$

$$6.8 \quad 71.806$$

$$\frac{0.199}{0.2} \times 0.173 = 0.172$$

$$= -0.0005$$

$$\frac{45.7}{6.2} \times 0.172 =$$

$$\text{Corrected draft} = M_d \text{ draft} - 1^{\text{st}} \text{ trim correction}$$

$$\text{Displacement at } 6.773 - 0.0005$$

$$= 6.772 \text{ m}$$

$$\text{Displacement at } 6.772 \text{ m} = 13776.02 \text{ t}$$

2nd trim correction

$$(\text{MCTC}_{+50} - \text{MCTC}_{-50}) \times 50 \times \text{TRIM} \times \frac{\text{TRIM}}{\text{LBP}}$$

$$\text{Total cargo on board } 6069.917 \text{ t LBP}$$

$$\text{MCTC at } 7.273 \text{ m} = 187.349$$

$$\text{MCTC at } 6.273 \text{ m} = 176.357$$

$$(187.349 - 176.357) \times 50 \times 0.29 \times \frac{0.29}{143.16}$$

$$\text{Final displacement } 143.16$$

$$= 10.992 \times 50 \times 0.29 \times \frac{0.29}{143.16}$$

$$= 0.323 \text{ t}$$

$$\text{True displacement} = \text{corr'd disp.} + 2^{\text{nd}} \text{ trim correction}$$

$$= 13776.02 + 0.323$$

$$= 13776.343 \text{ t}$$

$$\text{displacement in DW RD 1.005} = \frac{13776.343 \times 1.010}{1.025}$$

$$= 13574.738 \text{ t}$$

Final condition: i.e. summer zone insw, sag of 8cm

$$\text{DF: } 9.233 - 0.08 = 9.153 \text{ m}$$

$$\text{DA: } 9.233 - 0.08 = 9.153 \text{ m}$$

$$\text{DM: } 9.233 \text{ m}$$

$$M \& \text{ draft} = M - \frac{1}{4} \text{ sag}$$

$$= 9.233 - \frac{1}{4} \times 0.08$$

Corrected draft at perpendicular

$$= 9.213 \text{ m}$$

$$\text{Displacement at } 9.213 \text{ m} = 19568.655 \text{ t}$$

9.2	19537	
9.23		$\frac{487}{0.2} \times 0.013$
9.4	20024	

$$\text{cargo can load} = 19568.655 - 13574.738$$

$$= 5993.917$$

we are loading

$$\text{Fuel \& FW (+) 56}$$

The amount we consume is amount we can load more

$$\text{Manoeuvring (+) 20}$$

$$\text{Total cargo can load: } 6069.917 \text{ t}$$

To calculate sailing draft F&A in DW

$$\text{Final displacement: } 19568.655 \text{ t}$$

$$\text{Fuel for manoeuvring: (+) 20 t}$$

$$\text{Departure displacement: } 19588.655 \text{ t}$$

$$\text{To refer in particular, equiv. disp.: } \frac{19588.655 \times 1.025}{1.010}$$

$$= 19879.575 \text{ t}$$

Note:- Since, vessel on even keel. Hence there is no trim correction

$\therefore$ Draft at 19879.575 = M_4 draft = 9.341m

$$M_4 \text{ draft} = F + A + 6(M)$$

$$9.341 = x + x + 6(x + 0.08)$$

$$9.341 = M - \frac{1}{4} \times 0.08$$

$$9.341 = M - 0.02$$

$$74.728 = 2x + 6x + 0.48$$

$$8x = 74.248$$

Since vessel is sag.

$$x = 9.281m$$

$$\text{Displacement at } 9.281m = 17791.2t$$

Corrected draft at perpendicular

At 9.281m draft

$$A : 9.281m$$

$$M : 9.281 + 0.08 = 9.361m$$

Equivalent draft in SW (for reference to particular) M_4 : M

Ques:- M.V Hindship arrives on even keel with maximum draft 8.5m with 8 cm sag in DW RD 1.005. Find DWT available if she needs to sail in a

- a) Summer zone with 10cm sag.
- b) with max^m draft 9.4 with sag of 10cm at berth.

Soln:- DF : $8.50 - 0.08 = 8.42m$

$$DA : 8.50 - 0.08 = 8.42m$$

$$DM : 8.50m$$

$$M_4 \text{ draft} = M - \frac{1}{4} \text{SAG}$$

$$= 8.5 - \frac{1}{4} \times 0.08 =$$

$$= 8.48m$$

$$\text{Displacement at } 8.48m = 17791.2t \text{ (SW)}$$

$$\text{Disp. in DW RD } 1.005 = \frac{17791.2 \times 1.005}{1.025} = 17444.055t$$

a) summer zone with 10 cm sag

$$F: 9.233 - 0.10 = 9.133m$$

$$A: 9.233 - 0.10 = 9.133m$$

$$M: 9.233$$

$$(M) \frac{1}{2} + A + A = 19016 \text{ tM}$$

$$M_{\text{draft}} = M - \frac{1}{4} SAG$$

$$= 9.233 - \frac{1}{4} \times 0.10 \times 8 = 1PE \cdot E$$

$$= 9.208m$$

$$\text{Displacement at } 9.208m = 19556.48t$$

$$8PE \cdot PF = x8$$

$$DWT \text{ available} = 19556.48 - 17444.055 \cdot E = x$$

$$= 2112.425t$$

b) with maximum draft 9.4m with sag of 10cm at berth

$$F: 9.40 - 0.10 = 9.30m \quad m \cdot 185 \cdot E : A$$

$$A: 9.40 - 0.10 = 9.30m \quad 0.0 + 185 \cdot E : M$$

$$M: 9.40m$$

$$M_{\text{draft}} = M - \frac{1}{4} SAG$$

$$9.40 - \frac{1}{4} \times 0.10 \times 8 = 9.375m$$

$$= 9.375m$$

$$\text{Displacement at } 9.375 = 19963.125 \text{ t}$$

$$\text{Displacement in DW RD } 1.005 = \frac{19963.125 \times 1.005}{1.028} = 19573.601t$$

$$= 19573.601t$$

$$DWT \text{ available} = 19573.601 - 17444.055$$

$$= 2129.546t$$

$$m8 \cdot 8 =$$

$$\text{Displacement at } 8.48m = 17444.055t$$

$$\text{Displacement in DW RD } 1.005 = \frac{17444.055 \times 1.005}{1.028} = 17011.102t$$

$$210.1$$

Ques:- M.V Hindship arrives at berth in DW RD 1.008 with maximum 8m even keel draft and sag 8cm. Find her sailing draft forward, aft and midship at even keel if a) she discharged 2000T at berth and hogged 16cm
b) she loaded 2000T and sagged 10cm

Sol:- Initial Draft Fwd: $8.0 - 0.08 = 7.92m$

$$250.1 \times \text{Aft} = 180 - 0.08 = 7.92m$$

$$\text{Midship: } 8.00m$$

$$M_4 \text{ draft} = M - \frac{1}{4} \text{SAG}$$

$$= 8.0 - \frac{1}{4} \times 0.08$$

$$= 7.98m$$

$$\text{Displacement at } 7.98m = 16587.6t \text{ (SWM)}$$

$$\text{Disp. in DW RD } 1.008 = \frac{16587.6 \times 1.008}{1.025} = 16312.489t$$

$$1.025 \times 1.0 \times \frac{1}{1.025} = 1.0$$

a)

$$\text{Disch: } (-) 2000$$

$$\text{Final disp.} = 14312.489t$$

Equivalent disp in SW (for referring to particulars) M

$$= \frac{14312.489 \times 1.025}{1.025}$$

$$14312.489 \times 1.025 = 14672.281$$

$$14672.281 \times 1.025 = 15041.108$$

$$\text{H.s draft / } M_4 \text{ draft of } 14553.87 = 7.110m$$

$$M_4 = M + \frac{1}{4} \text{HOG}$$

$$7.110 = M + \frac{1}{4} \times 0.06$$

$$7.110 = M + 0.015$$

$$M = 7.095m$$

$$\text{Draft Fwd: } 7.095 + 0.06 = 7.155m$$

$$\text{HOG LHM Aft: } 7.095 + 0.06 = 7.155m$$

$$\text{Mid: } 7.095m$$

(25)

b) Initial displacement 18312.489 t Added to buoy displacement 18312.489 t
 Load draft (+) 2000

Final displacement = 18312.489 t

Equivalent disp. in SW (to refer to particular)

$$= 18312.489 \times 1.025$$

$$= 18621.331 \text{ t}$$

$$80.0 \times \frac{1}{4} - 0.8 =$$

$$\text{H.S draft / M draft} = 8.823 \text{ m}$$

$$M = \frac{1}{4} \text{ SAC} = 18621.331 \times \frac{1}{4} = 4655.333$$

$$8.823 = M - \frac{1}{4} \times 0.10$$

$$8.823 = M - 0.025$$

$$M = 8.848 \text{ m}$$

$$\text{Draft, Fwd} = 8.848 - 0.10 = 8.748 \text{ m}$$

$$\text{Draft, Aft} = 8.848 - 0.10 = 8.748 \text{ m}$$

$$\text{Draft, Mid} = 8.848 - 0.10 = 8.748 \text{ m}$$

$$\text{Draft, Fwd} = 8.748 \text{ m}$$

$$\text{Draft, Aft} = 8.748 \text{ m}$$

$$\text{Draft, Mid} = 8.748 \text{ m}$$

$$\text{Draft, Fwd} = 8.748 \text{ m}$$

$$\text{Draft, Aft} = 8.748 \text{ m}$$

$$\text{Draft, Mid} = 8.748 \text{ m}$$

$$\text{Draft, Fwd} = 8.748 \text{ m}$$

$$\text{Draft, Aft} = 8.748 \text{ m}$$

JULY 2022
MAY 2022

M.V HINDSHIP arrived port with following draft F(P): 8.60m, F(S): 8.70m, A(P): 8.85m, A(S): 8.93m, Mid(P): 8.75m and Mid(S): 8.87m in dock water RD 1.018. After discharging part cargo she has to shift to another berth with a hog of 5 cm. where maximum draft allowed is 5.90. Calculate the minimum ^{quantity} of cargo to discharge. During the stay at first berth she consumed 10t of DO and 14t of fresh water. Draft marks are located 2m aft of FP, 4m forward of AP and 1m forward of midship.

Soln:- Observed drafts.

$$\text{Fwd} = \frac{FP + FS}{2} = \frac{8.60 + 8.70}{2} = 8.65\text{m}$$

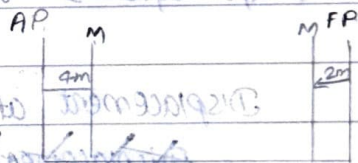
$$\text{Aft} = \frac{AP + AS}{2} = \frac{8.85 + 8.93}{2} = 8.89\text{m}$$

$$\text{Midship} = \frac{MP + MS}{2} = \frac{8.75 + 8.87}{2} = 8.81\text{m}$$

Draft marks are 2m aft of FP

4m fwd of AP

1m fwd of Midship



$$\text{LBM} = 143.16 - (4 + 2) \\ = 137.16$$

REMARKS	FWD	AFT	MIDSHIP
Observed draft	8.65	8.89	8.81
Draft mark	2m aft of FP	4m fwd of AP	1m fwd of Midship
Correction	0.24	0.24	0.24
ie. $\frac{\text{Obs trlm}}{\text{LBM}} \times \text{dist.}$	$\frac{0.24}{137.16} \times 2$	$\frac{0.24}{137.16} \times 4$	$\frac{0.24}{137.16} \times 1$
	= 0.003m	= 0.007m	= 0.002m
Corrected draft	8.65 - 0.003 = 8.647m	8.89 + 0.007 = 8.907m	8.81 + 0.002 = 8.812m

Corrected draft, Fwd: 8.647m } Trim = 0.25m
 Aft: 8.897m }

Midship: 8.812m

$$M_4 \text{ draft} = \frac{F + A + 6M}{8} = \frac{8.647 + 8.897 + 6(8.812)}{8} = 8.802m$$

1st trim correction

$$\frac{TRIM}{LBP} \times \left(\frac{LBP - LCF}{2} \right)$$

LCF at M_4 draft 8.802m = 69.910m

$$\frac{0.25}{143.16} \times \left(\frac{143.16 - 69.910}{2} \right) = 0.003m$$

Draft after 1st trim correction = 8.802 + 0.003 = 8.805m

Displacement at draft 8.805m = 18577.15m

~~Displacement in SW at 8.805m = 18577.15m~~

$$\begin{aligned} & \times 1.025 \\ & = 18950.28T \end{aligned}$$

2nd TRIM CORRECTION

$$\frac{(MCTC_{+50} - MCTC_{-50}) \times 50 \times TRIM \times TRIM}{LBP}$$

$$MCTC @ 9.302 (8.802 + 0.5) = 215.979$$

$$MCTC @ 8.302 (8.802 - 0.5) = 201.679$$

$$(215.979 - 201.679) \times 50 \times 0.25 \times 0.25 =$$

$$= \frac{14.3 \times 50 \times 0.25 \times 0.25}{143.16}$$

$$= 0.312T$$

mini so, displacement after 2nd trim correction = $18577.15 + 0.312$ m.t

1st of 1st to 2nd correction = 18577.462 m.t

3rd corrⁿ - list correction

$$(MP - MS) \times \left(\frac{TPC_{MP} - TPC_{MS}}{100} \right) \times 6$$

$$(8.87 - 8.75) \times (24.062 - 23.99) \times 6$$

$$= 0.052$$

Displacement after 3rd corrⁿ:

$$18577.462 + 0.052 = 18577.514$$

$$= 18577.514$$

Displacement in DW RD 1.018 = $\frac{18577.514 \times 1.018}{1.025} = 18450.643$ T — ①

→ Maxⁿ draft = 5.90m with hog of 5cm

$$\text{Draft midship} = 5.90\text{m} - 0.05\text{m}$$

$$= 5.85\text{m}$$

$$M_4 = M + \frac{1}{4} \text{HOG}$$

$$M_4 = 5.85 + \frac{1}{4} \times 0.05 = 5.8625$$

① Final $M_4 = 5.8625\text{m}$

Final displacement

$$\text{Displacement at } 5.8625\text{m} = 11709.625\text{ T}$$

$$\text{Displacement in DW OF RD 1.018}$$

$$= 11709.625 \times 1.018$$

$$(102 + 25) \times 1.025$$

$$= 11629.657\text{ T} — ②$$

$$\text{Initial disp: } 18450.643\text{ T}$$

$$\text{Final disp: } 11629.657\text{ T}$$

$$\text{Cargo to disch: } 6820.986$$

$$\text{Consumption at port: } 10 + 14 = 24$$

$$\text{Final cargo qty to disch: } 6796.986$$

Ans

Ques:- M.V HINDSHIP arrives at berth of SW density 1.002 with draft maximum 9.4m Even keel draft & sag of 8cm. Given consumption at berth FO: 76T, FW: 25T, on river passage to sea consumption 50T FO. Find her sailing draft F&A&M at Even keel at berth & the cargo quantity to be loaded or discharged if she is to load maximum cargo for sailing in Tropical zone with sag 10cm

Soln:- Initial:- Maxm draft: 9.4m with sag 8cm

Draft mid: 9.4m

$$M_4 = M - \frac{1}{4} \text{SAG}$$

$$M_4 = 9.4 - \frac{1}{4} \times 0.08$$

$$M_4 = 9.38 \text{m}$$

Displacement at draft 9.38m = 19975.3T

$$\text{Displacement in SW RD } 1.002 = \frac{19975.3 \times 1.002}{1.025} = 19527.1 \text{ T} \quad \text{--- (I)}$$

Final:- Maximum midship draft = 9.425m (SAG 10cm) at berth

$$M_4 = M - \frac{1}{4} \text{SAG}$$

$$M_4 = 9.425 - \frac{1}{4} \times 0.10$$

$$M_4 = 9.4 \text{m}$$

Displacement at draft 9.4m = 20024 T --- (II)

Final disp: 20024 T

Initial disp: 19527.1 T

$$496.9 \text{ T}$$

Consumption: + (76 + 25 + 50)

$$\text{Final cargo to load} = \boxed{647.9 \text{ T}}$$

To calculate her sailing draft at berth:

Final displacement: 20024 T

consumption for river passage: (+) 50 (time of sailing, this is still on-board)

Disp. at time of sailing: 20074 T

Equivalent disp in sw (for referring in table):

$$\text{Observed draft } 250.1 \times 8512581 \quad 20074 \times 1.025 = 20534.78$$

$$\text{Draft } 20074 \times 1.002$$

$$\text{Draft at disp } 20534.78 : 9.608 \text{ m}$$

i.e. M_4 draft

$$M_4 = M - \frac{P}{4} \text{ SAG}$$

Corrected

$$\text{draft } 9.608 = M - \frac{1}{4} \times 0.10$$

$$\text{Draft Mid} = 9.633 \text{ m}$$

$$\text{Draft F&A} = 9.633 - 0.10 = 9.533 \text{ m}$$

$$M = 9.533 \text{ m}$$

$$01.0 + 5.5 = 6.5$$

⑤ She is to discharge minimum cargo for sailing in winter zone hogged by 10cm.

Final:- Draft midship: 9.041 m

$$M_4 = M + \frac{1}{4} \text{ HOG}$$

$$M_4 = 9.041 + \frac{1}{4} \times 0.10$$

$$M_4 = 9.066 \text{ m}$$

Displacement at draft 9.066 m = 19211.38 T

$$\text{Displacement at draft } 9.066 \text{ m} = 19211.38 \text{ T} \quad (11)$$

$$\text{Initial displacement: } 19527.1 \text{ T}$$

$$\text{Final displacement: } 19211.38 \text{ T}$$

$$\text{To disch: } 315.62 \text{ T}$$

$$\text{Consumption (76+25+50): } (-) 151$$

$$\text{Final qty to disch: } 164.62 \text{ T}$$

To find draft at time of sailing

$$\text{Final displ: } 19211.38 \text{ T}$$

$$\text{QTY ON-BOARD FOR CONSUMPTION IN RIVER PASSAGE: } (+) 50$$

$$\text{Disp. at time of sailing: } 19261.38 \text{ T}$$

Equivalent disp in SW for referring to table:

$$19261.38 \times 1.025$$

$$1.002$$

$$m_{803} = 19703.5T$$

$$\text{Draft at disp } 19703.5T = 9.268m$$

i.e. M_4 draft

$$M_4 = M + \frac{1}{4}400$$

$$9.268 = M + \frac{1}{4} \times 0.10$$

$$\text{Draft Mid} : 9.268 - 0.025$$

$$= 9.243m$$

$$\text{Draft F\&A} = 9.243 + 0.10$$

$$= 9.343m$$

NOVEMBER
2021

M.V Hindship arrived port with draft: F 5.60m, A 6.60m, M 6.20m in water of density $1.012 t/m^3$. Calculate the quantity of cargo she can load if she is to sail into Tropical zone on an even keel in SW with expected Sag of 5cm. 60T of fuel & FW is expected to be consumed in port and she is to receive 300T of FW. The fwd draft marks are 2m fwd of FP, 2m aft of midship and 1m fwd of AP.

7:25

Soln:-

$$\text{Observed draft: F: } 5.60m$$

$$A: 6.60m$$

$$M: 6.20m$$

$$\text{Trim} = 1.0m$$

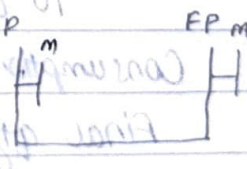
Draft marks are, 2m fwd of FP

1m fwd of AP

2m aft of MP

$$LBM = 143.16 + 2 - 1$$

$$= 144.16m$$



Remarks	Fwd	Aft	Mid
Observed draft	5.60	6.60	6.20
Draft marks	2m fwd of FP	1m fwd of AP	2m aft of MP
Correction i.e. $\frac{\text{Obs trim}}{\text{LBM}} \times \text{dist}$	$\frac{1}{144.16} \times 2$	$\frac{1}{144.16} \times 1$	$\frac{1}{144.16} \times 2$
LBM	= 0.014m	= 0.007m	= 0.014m
Corrected draft	5.60 + 0.014 = 5.614m	6.60 + 0.007 = 6.607m	6.20 + 0.014 = 6.186m

expected to Drafts F: 5.614m } Trim = 0.993m

A: 6.607m

M: 6.186m

M4 draft = $\frac{F + A + 6M}{8}$

8

$\frac{5.614 + 6.607 + (6 \times 6.186)}{8} = 6.167m$

① — Draft after 1st trim corr = 6.167m

6.0 72.476

1st Trim correction

6.2 72.333

$$\frac{\text{TRIM}}{\text{LBP}} \times \left(\frac{\text{LBP} - \text{LCF}}{2} \right)$$

LCF at 6.167m = 72.357m

$$= \frac{0.993}{143.16} \times \left(\frac{143.16 - 72.357}{2} \right) = -0.005m$$

= -0.005m

Draft after 1st trim corr = 6.167 + (-0.005) = 6.162m

Displacement at 6.162m : 12385.99T

6.2 12472

2nd TRIM CORRECTION

$$(\text{MCTC}_{+50} - \text{MCTC}_{-50}) \times 50 \times \text{TRIM} \times \frac{\text{TRIM}}{\text{LBP}}$$

1801.482F

MCTC @ 6.667m : 180.004

MCTC @ 5.667m : 171.469

$$(180.004 - 171.469) \times 50 \times 0.993 \times 0.993$$

$$8.535 \times 50 \times 0.993 \times 0.993$$

$$2.939 \text{ T}$$

Displacement after 2nd trim correction: $12385.93 + 2.939$

No trim corr will be applicable

$$\text{displacement in } 20^\circ \text{ RDT} = \frac{12388.869 \times 1.012}{1.025}$$

$$12231.742 \text{ T} \quad \text{--- (1)}$$

Final: Tropical draft: 9.425m (SAG 51cm)

Midship draft: 9.425m

$$M_4 = M - \frac{1}{4} \text{SAG}$$

$$M_4 = 9.425 - \frac{1}{4} \times 0.05$$

$$M_4 = 9.413 \text{ m}$$

Displacement at draft 9.413m: $20055.85 \text{ T} \quad \text{--- (11)}$

Final disp: 20055.85

Initial disp: 12231.742

cargo can load: 7824.108

consumption : (+) 60

Recieve : (-) 300

Final qty can load: 7584.108 T

35 MINS

MARCH 2021

M.V Hindship arrives in D.W of density 1.005 & the draft were observed as,

	Port	Starb	
F	9.090	9.110	Draft marks located 4m aft of FP
M	9.280	9.420	Draft marks located 3m aft of midlength
A	9.380	9.480	Draft marks located 5m forward of AP

After discharge vessel is expected to enter winter zone after 3 days of passage. Consumption is estimated to be 40T per day during passage. Determine minimum quantity of cargo to discharge if after 3 days passage, trim is expected to be 10 cms by stern & a hog of 8 cm.

Soln:-

$$\text{Drafts Fwd} = \frac{9.090 + 9.110}{2} = 9.100 \text{ m}$$

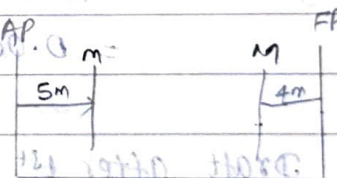
$$\text{Drafts Aft} = \frac{9.380 + 9.480}{2} = 9.430 \text{ m}$$

$$\text{Trim} = 0.330 \text{ m}$$

$$\text{Midship} = \frac{9.280 + 9.420}{2} = 9.350 \text{ m}$$

Drafts marks, 4m aft of FP
5m fwd of AP

203m aft of MP



$$\text{LBM} = 143.16 - (5 + 4)$$

$$= 134.16 \text{ m}$$

Remarks	Fwd	Aft	Mid
Observed draft	9.100	9.430	9.350
Draft marks	4m aft of FP	5m fwd of AP	3m aft of MP
Correction	$\frac{0.33}{2} \times 4$	$\frac{0.33}{2} \times 5$	$\frac{0.33}{2} \times 3$
i.e. $\frac{\text{obs trim}}{\text{LBM}} \times \text{dist}$	$\frac{0.33}{134.16} \times 4$	$\frac{0.33}{134.16} \times 5$	$\frac{0.33}{134.16} \times 3$
	$= 0.010$	$= 0.012$	$= 0.007$
Corrected	$9.100 - 0.010$	$9.430 + 0.012$	$9.350 - 0.007$
drafts	$= 9.091 \text{ m}$	$= 9.442 \text{ m}$	$= 9.343 \text{ m}$

Corrected drafts $F: 9.091m$
 $A: 9.442m$ } $Trim = 0.351m$

$M: 9.343m$

Quater mean draft, M_4 draft = $\frac{F+A+6 \cdot M}{4}$

$= \frac{9.091 + 9.442 + (6 \times 9.343)}{4}$

$= 9.324m$

1st TRIM CORRECTION

$\frac{TRIM}{LBP} \times \left(\frac{LBP - LCF}{2} \right)$

LCF at $9.324m = 69.532$

$\frac{0.351}{143.16} \times \left(\frac{143.16 - 69.532}{2} \right)$

$= 0.005m$

Draft after 1st correction: $9.324 + 0.005$

$= 9.329m$

Displacement at $9.329m = 19851.115$

2nd TRIM CORRECTION

$(MCTC_{+50} - MCTC_{-50}) \times 50 \times TRIM \times \frac{TRIM}{LBP}$

$MCTC @ 9.824m = 222.888$

$MCTC @ 8.824m = 209.336$

$(222.888 - 209.336) \times 50 \times 0.351 \times \frac{0.351}{143.16}$

$= 0.583T$

Displacement after 2nd correction: $19851.115 + 0.583$
 $= 19851.698T$

3RD LIST CORRECTION

$(MP \sim MS) \times (TPC_{MP} \sim TPC_{MS}) \times 6$

TPC @ 9.280 = 24.30

TPC @ 9.420 = 24.37

$(9.420 - 9.280) \times (24.37 - 24.30) \times 6$

$= 0.059T$

Displacement after 3rd correction: $19851.698 + 0.059$

Observed draft 8.90 = $19851.757T$

Displacement in SW density 1.005 = 19851.757×1.005

LBM = $19464.406T$ — ①

Final:-

winter draft: 9.041m

Maximum mid draft: 9.041m

$M_4 = M + \frac{1}{4} H_{04}$

$M_4 = 9.041 + \frac{1}{4} \times 0.08$

$M_4 = 9.061m$

1st TRIM CORRECTION:

$\frac{TRIM}{LBP} \times \left(\frac{LBP}{2} - LCF \right)$

$= \frac{0.10}{143.16} \times \left(\frac{143.12}{2} - 69.720 \right)$

$= 0.001m$

LCF at 9.061m = 69.720

Draft after 1st correction = $9.061 + 0.001$
 $= 9.062m$

Displacement at 9.062m = 19201.66 T₂₀ $\times 0.062$
 1888.188 E1 =

2ND TRIM CORRECTION

$$(MCTC_{+50} - MCTC_{-50}) \times 50 \times \text{TRIM} \times \text{TRIM}$$

$$2 \times (MCTC_{+50} - MCTC_{-50}) \times (2M + 9M) \quad 9.4 \quad 217.4$$

$$MCTC @ 9.561m = 219.493$$

$$OE \cdot PS = 0.85 \text{ E} \cdot 220$$

$$MCTC @ 8.561m = 205.435$$

$$FE \cdot PS = 0.54 \text{ E} \cdot 297$$

$$2 \times (OE \cdot PS - FE \cdot PS) \times (0.85 \text{ E} - 0.54 \text{ E}) \quad 8.4 \quad 203.1$$

$$(219.493 - 205.435) \times 50 \times 0.10 \times 0.10$$

$$TE 20.0 \quad 8.6 \quad 206$$

$$143.16$$

$$= 0.0507 \text{ E} 20.0 + 8.6 \cdot 188.188 \text{ E1} : \text{Displacement after 2nd correction}$$

$$1888.188 \text{ E1} =$$

Displacement after 2nd correction = 19201.66 + 0.0507

$$200.1 \times 1888.188 \text{ E1} = 200.1 \times 19201.709 \quad \text{--- (11)}$$

$$250.1$$

① Initial displacement: 19464.406

Final displacement: 19201.709

Cargo can disch : 262.697 E 140.0 E : 140.0 E

Consumption : -120.140 E : 140.0 E

QTY WE DISCH : 142.697 E 140.0 E + M = 140.0 E

$$20.0 \times \frac{1}{2} + 140.0 \text{ E} = 140.0 \text{ E}$$

$$140.0 \text{ E} = 140.0 \text{ E}$$

② Displacement after 2nd correction = 19201.709

$$(140.0 - 140.0) \times \text{MCTC}$$

$$0.85 \text{ E} \cdot 220 = 188.188 \text{ E1}$$

$$0.54 \text{ E} \cdot 297 = 159.18 \text{ E1}$$

$$(0.85 \text{ E} \cdot 220 - 0.54 \text{ E} \cdot 297) \times (0.85 \text{ E} - 0.54 \text{ E})$$

$$20.0 \times \frac{1}{2} + 140.0 \text{ E} = 140.0 \text{ E}$$

$$140.0 \text{ E} = 140.0 \text{ E}$$

$$100.0 + 140.0 \text{ E} = 240.0 \text{ E}$$

$$140.0 \text{ E} =$$

AUG
2022

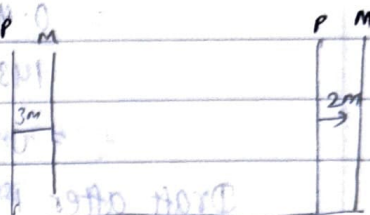
Forward draft: $\frac{FP+FS}{2} = \frac{8.88+8.92}{2} = 8.90m$ } Obstr'n = 0.4m

Aft draft: $\frac{AP+AS}{2} = \frac{9.24+9.36}{2} = 9.30m$

Mid draft: $\frac{MP+MS}{2} = \frac{8.96+9.16}{2} = 9.06m$

LBM = 143.16 + 2 - 3

= 142.16 m



Remarks	Fwd	Aft	Mid 'P'	Mid's'
Observed draft	8.90	9.30	8.96	9.16
Draft marks	2m Fwd of AP	3m fwd of AP	1m fwd of mid	
Correction i.e.	$\frac{0.4 \times 2}{142.16}$	$\frac{0.4 \times 3}{142.16}$	$\frac{0.4 \times 1}{142.16}$	
Obstr'n x dist				
LBM	142.16	142.16	142.16	
Corrected drafts	8.9 + 0.006 = 8.906m	9.3 + 0.008 = 9.308m	8.96 + 0.003 = 8.963m	9.163m

corrected drafts are

$$\left. \begin{aligned} \text{Fwd} &: 8.906m \\ \text{Aft} &: 9.308m \end{aligned} \right\} \text{Trim} = 0.402m$$

$$\text{Mid} = \frac{MP+MS}{2} = \frac{8.963+9.163}{2} = 9.063m$$

Quarter mean draft, M_q draft = $\frac{F+A+6M}{8}$

= $\frac{8.906 + 9.308 + (9.063 \times 6)}{8}$

= $\frac{8.906 + 9.308 + 54.378}{8}$

= 9.074m

1st Trim correction

$$\frac{\text{TRIM}}{\text{LBP}} \times \left(\frac{\text{LBP} - \text{LCF}}{2} \right)$$

$$= \frac{0.402}{143.16} \times \left(\frac{143.16 - 69.710}{2} \right)$$

$$= \frac{0.402}{143.16} \times 1.87$$

$$= 0.005 \text{ m}$$

$$\text{Draft after 1st trim correction} = 9.074 + 0.005$$

$$= 9.079 \text{ m}$$

$$\text{Displacement after 1st trim correction} = 19242.97 \text{ t}$$

2nd Trim correction

$$\left(\text{MCTC}_{+50} - \text{MCTC}_{-50} \right) \times 50 \times \frac{\text{TRIM}}{\text{LBP}} \times \frac{\text{TRIM}}{\text{LBP}}$$

$$\text{MCTC at } (9.074 + 0.5) = 9.574 \text{ m} : 219.662$$

$$\text{MCTC at } (9.074 - 0.5) = 8.574 \text{ m} : 205.623$$

$$(219.662 - 205.623) \times 50 \times 0.402 \times 0.402$$

$$= 14.039 \times 50 \times 0.402 \times 0.402$$

$$= 0.792 \text{ t}$$

$$\text{Displacement after 2nd trim correction} = 19242.97 + 0.792$$

$$= 19243.762 \text{ t}$$

Trim correction

$$(\text{MP} \sim \text{MS}) \times (\text{TPC}_{\text{MP}} \sim \text{TPC}_{\text{MS}}) \times 6$$

$$\text{TPC at } 8.963 = 24.118$$

$$\text{TPC at } 9.163 = 24.238$$

$$\begin{aligned}
 & (9.163 - 8.963) \times (24.238 - 24.118) \times 6 \\
 &= 0.2 \times 0.12 \times 6 \\
 &= 0.144 \text{ t}
 \end{aligned}$$

$$\begin{aligned}
 \text{Displacement after trim correction} &= 19243.762 + 0.144 \\
 &= 19243.906 \text{ t}
 \end{aligned}$$

$$\begin{aligned}
 \text{Corrected displacement in DW RD } 1.016 &= \frac{19243.906 \times 1.016}{1.025} \\
 &= 19074.935 \text{ t} \quad \text{--- (1)}
 \end{aligned}$$

Final condition

Fwd draft : 6.00 m
 Aft draft : 6.00 m
 Mid draft : 6.04 m

From the vessel is SAG

$$M_4 = M - \frac{1}{4} SAG$$

$$M_4 = 6.04 - \frac{1}{4} \times 0.04$$

$$M_4 = 6.04 - 0.01$$

$$M_4 \text{ draft} = 6.030 \text{ m}$$

$$\text{Displacement at } 6.030 \text{ m} = 12086.95 \text{ t}$$

$$\begin{aligned}
 \text{corrected displacement in DW RD } 1.016 &= \frac{12086.95 \times 1.016}{1.025}
 \end{aligned}$$

$$= 11980.821 \text{ t} \quad \text{--- (11)}$$

$$\begin{aligned}
 \text{Cargo can discharge} &= 19074.935 - 11980.821 \\
 &= 7094.114 \text{ t}
 \end{aligned}$$

$$\text{consumption} = (-) 30.0 \text{ t } (25+5)$$

$$\text{Rcvd} = (+) 600 \text{ t } H.O$$

$$\begin{aligned}
 \text{Actual cargo discharge} &= 7664.114 \text{ t} \\
 &\quad \text{Ans}
 \end{aligned}$$