OCT 2020

A vessel of length 84m, displacement 3000 t, TPC = 12t, KM = 4.5m, KG = 4.05m, MCTC = 80 mtm, CF = 2m abaft of mid-ship at a draft of F 4m, A 4.5m is dry-docked. Calculate

(i) The residual GM on taking blocks all over

(ii) Her drafts F & A

Soln:-

Draft Fwd : 4.0m
Aft : 4.5m } Trim : 0.5m

$$LCF = \frac{l}{2} - d$$

$$= \frac{84}{2} - 2$$

$$= 40\,m$$

For sitting overall, $Trim = \frac{P \times LCF}{MCTC \times 100}$

$$0.5 = \frac{P \times 40}{80 \times 100}$$

$$P = \frac{0.5 \times 80 \times 100}{40}$$

$$P = 100\,ts$$

Virtual loss of GM

FORMULA A

$$\frac{P \times KG}{W - P}$$

$$= \frac{100 \times 4.05}{3000 - 100}$$

$$= 0.140\,m$$

FORMULA B

$$\frac{P \times KM(Final)}{W(Initial)}$$

$$= \frac{100 \times 4.5}{3000}$$

$$= 0.150\,m$$ → proceed with greater loss

$$GM = KM - KG$$

$$= 4.5 - 4.05$$

$$= 0.45$$

Hence, Residual GM =

Initial GM − virtual loss of GM

$$= 0.45 - 0.15$$

$$\boxed{= 0.30\,m}$$ Ans

(ii) Her draft F&A

① Find Initial H.S draft

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

$= \frac{0.5 \times 40}{84}$

$= 0.238\,m$

Aft draft : 4.500m

Corrn : 0.238 m

H.S draft : 4.262 m

② Rise = $\frac{P}{TPC \times 100}$

$= \frac{100}{12 \times 100}$

$= 0.083\,m$

③ Final draft F & A = H.S draft − rise

$= 4.262 - 0.083$

$\boxed{= 4.179\,m}$ Ans

SEP 2022 A vessel of L = 150m arrives dry dock drawing 5.0m forwards and 7.0m aft. Her W = 12019t, KG = 7.0m, FSM = 800 tm, TPC = 22.47, MCTC = 174, LCB = 72.962m, LCF = 72.476m, KM = 8.438m, ~~If the declivity of the dock 20cm per 100m~~, find the following when water level drops to 5.5m above the blocks at the after end. a) GM

b) Draft Forward and Aft

Soln:-

Draft Aft : 7.0 m

WL : 5.5 m

Reduction in aft draft: 1.5 m = 150 cm

Reduction in aft draft = $\frac{P}{TPC} + \frac{P \times LCF^2}{MCTC \times LBP}$

$150 = \frac{P}{22.47} + \frac{P \times 72.476^2}{174 \times 150}$

$150 = 0.0445P + 0.20126P$

$150 = 0.24576P$

$P = 150/0.24576$

For sitting overall

$$\text{Trim} = \frac{P \times LCF}{MCTC \times 100}$$

This will change in case of deciivity

$$2.0 = \frac{P \times 72.476}{174 \times 100}$$

$$72.476\,P = 34800$$

$$P = 480.16 \text{ ts}$$

Step ①: Check vessel is sitting overall or still afloat

P(reduction) > P(sitting overall)

That means vessel is sitting overall

Step ②: Find value of P

*If sitting overall, use, $\text{Rise} = \frac{P}{TPC}$ to get value of P

(2.1) To find Rise, Calⁿ Initial H.S draft

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

$$= \frac{2 \times 72.476}{150}$$

$$= 0.966 \text{ m}$$

Aft draft : 7.000 m

Corrⁿ : 0.966 m

Initial H.S draft : 6.034 m

(2.2) Find rise

Initial H.S draft : 6.034 m

(Final H.S draft) water level : 5.500 m

Rise : 0.534 m = 53.4 cm

(2.3) Find P

$$\text{Rise} = \frac{P}{TPC}$$

$$53.4 = \frac{P}{22.47}$$

$$P = 53.4 \times 22.47$$

$$P = 1199.9 \text{ ts}$$

Step ③ Find virtual loss of GM

Virtual loss of GM

FORMULA A

$$\frac{P \times KG(solid)}{W - P}$$

$$= \frac{1199.9 \times 7}{12019 - 1199.9}$$

$$= 0.776m$$

FORMULA B

$$\frac{P \times KM(Final)}{W(Initial)}$$

$$= \frac{1199.9 \times 8.438}{12019}$$

$$= 0.842m$$ → Proceed with greater loss

Step ④ Find Initial GM

KM : 8.438 m

KG : 7.000 m

GM (solid) : 1.438 m

FSC : 0.067 m ($FSM/W = 800/12019$)

GM (Fluid) : 1.371 m

Step ⑤ Find residual GM

Initial GM : 1.371m

V. Loss of GM : 0.842m

Residual GM : 0.529 m

b) To find draft forward & aft

Since, vessel is sitting overall & water level is 5.5m above the blocks

Draft F & A = 5.5mtr E.K

~~However due to decurity, there will be some trim~~

~~Decurity given : 20cm/100m~~

~~LBP = 150m~~

~~Hence, decurity i.e. T_E = 30 cm~~

Note: This solution is done considering there is no decurity.
We will solve again with decurity

JULY 2021

A vessel of displacement 24000, LBP = 180, LCF = 85, TPC = 20, MCTC = 200 arrives in D.D with draft F = 8.20m, A = 9.00m. Determine the residual GM when water level falls by 40cms after the stern touches the block.
KG = 7.90m, KM = 8.30m, FSM initial = 2000 Tm

Soln:-

For afloat,

Reduction in aft draft $= \frac{P}{TPC} + \frac{P \times LCF^2}{MCTC \times LBP}$

$$40 = \frac{P}{20} + \frac{P \times 85^2}{200 \times 180}$$

$$40 = 0.05P + 0.201P$$

$$40 = 0.251P$$

$$P = 159.556 \text{ ts}$$

For sitting overall Trim $= \frac{P \times LCF}{MCTC \times 100}$

$$0.8 = \frac{P \times 85}{200 \times 100}$$

$$85P = 16000$$

$$P = 188.235 \text{ ts}$$

P(afloat) < P(sitting overall)

Hence, vessel is still afloat

So, P = 159.556 ts

Virtual loss of GM =

FORMULA A

$$\frac{P \times KG(\text{solid})}{W - P}$$

$$= \frac{159.556 \times 7.90}{24000 - 159.556}$$

$$= 0.053m$$

FORMULA B

$$\frac{P \times KM(\text{Final})}{W(\text{Initial})}$$

$$= \frac{159.556 \times 8.30}{24000}$$

$$= 0.055m$$

Find initial GM

KM : 8.30 m

KG : 7.90 m

GM(solid) : 0.40 m

FSC : 0.084 m ($FSM/_{W-P} = 2000/_{23840.444}$) (If afloat)

GM(Fluid) : 0.316 m

Initial GM: 0.316 m
V. Loss of GM: 0.055 m
Residual GM: 0.261 m Ans

→ In above question, find draft F & A

$$T_c = \frac{P \times LCF}{MCTC \times 100}$$

$$T_c = \frac{159.556 \times 85}{200 \times 100}$$

$$T_c = 0.678 m$$

$$T_a = \frac{T_c \times LCF}{LBP}$$

$$T_a = \frac{0.678 \times 85}{180}$$

$$T_a = 0.320 m$$

$$T_f = T_c - T_a$$

$$T_f = 0.678 - 0.320$$

$$T_f = 0.358 m$$

$$Rise = \frac{P}{TPC \times 100}$$

$$= \frac{159.556}{20 \times 100}$$

$$= 0.08 m$$

Draft	Fwd	Aft
Initial	8.20	9.00
Rise	(−) 0.08	(−) 0.08
Tf/Ta	(+) 0.358	(+) 0.320
Final	8.478m	8.600m

(bcz stern already touched, now fwd draft with increase)

Ans.

JULY 2017, APR 2012, JAN 2020 A vessel of following particulars enters a seawater drydock LBP: 140m, Draft forward 3.4m, Aft 5.8m, KG: 8.0m, KM: 9.02m, displacement = 8930t, TPC: 21.9t, LCF 72.2m from A.P, MCTC 162.5 tm. Find the virtual GM and drafts F & A when level of water has fallen one meter after the stem has taken to the blocks. Given KM at this displacement = 9.18m

Soln. For afloat, Reduction in aft draft $= \frac{P}{TPC} + \frac{P \times LCF^2}{MCTC \times LBP}$

$$100 = \frac{P}{21.9} + \frac{P \times 72.2^2}{162.5 \times 140}$$

$$100 = 0.046P + 0.2291P$$

$$0.2751P = 100$$

$$P = 363.504 \text{ ts}$$

For sitting overall, Trim = $\frac{P \times LCF}{MCTC \times 100}$

$$2.4 = \frac{P \times 72.2}{162.5 \times 100}$$

$$72.2P = 39000$$

$$P = 540.166 \text{ ts}$$

P(afloat) < P(sitting overall)

Hence, vessel is still afloat

So, P = 363.504 ts

Virtual LOSS of GM

FORMULA A

$$\frac{P \times KG(\text{solid})}{W - P}$$

$$= \frac{363.504 \times 8}{8930 - 363.504}$$

$$= 0.340 m$$

FORMULA B

$$\frac{P \times KM(\text{Final})}{W(\text{Initial})}$$

$$= \frac{363.904 \times 9.18}{8930}$$

$$= 0.374 m$$ ✓

Final initial GM

KM : 9.18 m

KG : 8.00 m

GM : 1.18 m

Find residual GM

Initial GM : 1.18 m

V. Loss of GM : 0.374 m

Residual GM : 0.806 m = Ans.

→ To find draft F & A

$$T_c = \frac{P \times LCF}{MCTC \times 100}$$

$$T_c = \frac{363.504 \times 72.2}{162.5 \times 100}$$

$$T_c = 1.617 m$$

$$T_a = \frac{T_c \times LCF}{LBP}$$

$$= \frac{1.617 \times 72.2}{140}$$

$$= 0.83\ m$$

$$T_f = T_c - T_a$$

$$= 1.617 - 0.834$$

$$= 0.783\ m$$

$$\text{Rise} = \frac{P}{TPC}$$

$$= \frac{363.9}{21.9}$$

$$= 0.166\ m$$

Drafts	Fwd	Aft
Initial	3.4	5.8
Rise	(-) 0.166	(-) 0.166
Tf/Ta	(+) 0.783	(-) 0.834
Final	4.017m	4.800m

= Ans.

SEPT 2022, NOV 2021

A vessel of L 150m arrives drydock drawing 5.0m forward and 7.0m aft. Her W = 12019t, KG = 7.0m, FSM = 800 tm, TPC = 22.47, MCTC = 174, LCB = 72.962m, LCF = 72.476m, KM = 8.438m. If the decivity of the dock 20cm per 100m, Find the following when water level drops to 5.5m above the blocks at the after end. a) GM

b) Draft fwd & aft

Soln:-

Draft Aft: 7.0m

Water level: 5.5m

Reduction in aft draft: 1.5m = 150 cm

For afloat,

$$\text{Reduction in aft draft} = \frac{P}{TPC} + \frac{P \times LCF^2}{MCTC \times LBP}$$

$$150 = \frac{P}{22.47} + \frac{P \times 72.476^2}{174 \times 150}$$

$$150 = 0.0445P + 0.20126P$$

$$150 = 0.24576P$$

$$P = 150/0.24576$$

$$P = 610.35\ ts$$

For sitting overall,

$$\text{Trim} = \frac{P \times LCF}{MCTC \times 100}$$

Note:- Due to declivity trim change, and,
The declivity will be final trim when vessel sits overall

Initial trim : 2.0m
Final trim : 0.3m
Tc = 1.7m

Declivity = 20cm/100m
For 150m length = 30cm = 0.3m

Due to declivity ← 1.7 = $\frac{P \times 72.476}{174 \times 100}$

P = 408.135 ts

P(afloat) > P(sitting overall)
Hence, vessel is sitting overall

So, Find 'P' by

$$\text{Rise} = \frac{P}{TPC}$$

Initial H.S draft
(-) Final H.S draft
Rise

For Initial H.S draft,

$$\text{corr}^n \text{ to aft draft} = \frac{\text{trim} \times LCF}{LBP}$$
$$= \frac{2 \times 72.476}{150}$$
$$= 0.966m$$

Initial Aft draft : 7.000m
Corr^n : 0.966 m
Initial H.S draft : 6.034m

For Final H.S draft,

Draft (aft) : 5.5m
Draft (fwd) : 5.5 − 0.3 = 5.2m

Ans

$$\text{Correction to aft draft} = \frac{\text{Trim} \times LCF}{LBP}$$
$$= \frac{0.3 \times 72.476}{150}$$

Final aft draft: 5.500m
Corrn : (-) 0.145m
Final H.S draft: 5.355m

Initial H.S draft: 6.034m
Final H.S draft: 5.355m
Rise = 0.679

$$\text{Rise} = \frac{P}{TPC \times 100}$$

$$0.679 = \frac{P}{22.47 \times 100}$$

$$P = 1525.713 \text{ ts}$$

Virtual loss of GM

FORMULA (A)

$$\frac{P \times KG(\text{solid})}{W-P}$$

$$\frac{1525.713 \times 7}{12019 - 1525.713}$$

$= 1.018m$

FORMULA (B)

$$\frac{P \times KM(\text{Final})}{W}$$

$$\frac{1525.713 \times 8.438}{12019}$$

$= 1.071m$

KM: 8.438m
KG: 7.000m
GM(solid): 1.438m
FSC : 0.076m $\left(FSM/_{W-P} = 800/_{12019-1525.713} \right)$
GM (F): 1.362m

Initial GM: 1.362m
Virtual loss of GM: 1.071m
Residual GM: 0.291m

JAN 2024

A Ship of length 200m, beam 32m, draft Fwd 6.05m, Aft 6.75m is to be dry docked, CF = 3m aft of midship, MCTC = 400 tm, KM = 8.45m, KG = 7.8m, TPC = 29t. Calculate her residual GM and draft fwd & aft when trim has reduced to 10cm.

Soln:-

Draft Fwd : 6.05m
Draft Aft : 6.75m

Trim : 0.70m

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

$$= \frac{0.70 \times 97}{200}$$

$$= 0.340m$$

Aft draft : 6.75m
Corrn : (-) 0.340m
H.S draft : 6.410m

$$\text{Displacement} = L \times B \times D \times \text{density}$$

$$= 200 \times 32 \times 6.410 \times 1.025$$

$$= 42049.6 \ t$$

Initial trim = 0.70m
Final trim = 0.10m
T_c = 0.60m

For intermediate,

$$T_c = \frac{P \times LCF}{MCTC \times 100}$$

$$0.60 = \frac{P \times 97}{400 \times 100}$$

$$P = 247.423 \ ts$$

Virtual loss of GM

Formula A

$$\frac{P \times KG(\text{solid})}{W - P}$$

$$= \frac{247.423 \times 7.8}{42049.6 - 247.423}$$

$$= 0.046m$$

Formula B

$$\frac{P \times KM(\text{Final})}{W(\text{Initial})}$$

$$= \frac{247.423 \times 8.45}{42049.6}$$

$$= 0.050m$$

KM : 8·450 m

KG : 7·800 m

GM(solid): 0·650 m

Initial GM : 0·650m

Virtual loss of GM: 0·046 m

Residual GM : 0·604m

Initial GM : 0·650m

Virtual loss of GM: 0·050m

Residual GM : 0·600m

Trim caused $T_c = 0·60m$

$$T_a = \frac{T_c \times LCF}{LBP} = \frac{0·60 \times 97}{200} = 0·291m$$

$$T_f = T_c - T_a = 0·60 - 0·291$$

$$= 0·309m$$

$$\text{Rise} = \frac{P}{TPC}$$

$$= \frac{247·423}{29 \times 100}$$

$$= 0·085m$$

Draft	Fwd	Aft
Initial	6·050	6·750
Rise	(-) 0·085	(-) 0·085
Tf/Ta	(+) 0·309	(-) 0·291
Final	6·274m	6·374m

JAN 2016

A vessel of L = 150 mt, CF = 2m fwd of midship, W = 8000t, KM = 7.5m, KG = 6.8m, TPC = 20t, MCTC = 160 mt at a draft of 5.20m fwd and 6.89m aft, is floating in a dry dock, where the water level is 7.4m above the top of the blocks. Calculate her virtual GM and draft Fwd and Aft when the water level is lowered by 1.4m.

Soln.

Initial WL : 7.4 m
lowered by : 1.4 m
Final WL : 6.0 m

Aft draft : 6.89m

Reduction in aft draft : 0.89m = 89 cm

For afloat,

$$\text{Reduction in aft draft} = \frac{P}{TPC} + \frac{P \times LCF^2}{MCTC \times LBP}$$

$$89 = \frac{P}{20} + \frac{P \times 77^2}{160 \times 150}$$

$$89 = 0.05P + 0.247P$$

$$89 = 0.297P$$

$$P = 299.62 \text{ ts}$$

For sitting overall

$$TRIM = \frac{P \times LCF}{MCTC \times 100}$$

$$1.69 = \frac{P \times 77}{160 \times 100}$$

$$P = 351.169 \text{ ts}$$

P(afloat) < P(sitting overall)

Hence, vessel is still afloat

Hence, P = 299.62 ts

Virtual loss of GM

FORMULA A

$$\frac{P \times KG(\text{solid})}{W - P}$$

FORMULA B

$$\frac{P \times KM(\text{Final})}{W(\text{Initial})}$$

$$= \frac{299.62 \times 6.8}{8000 - 299.62}$$

$$= 0.265m$$

$$= \frac{299.62 \times 7.5}{8000}$$

$$= 0.281m$$

KM : 7.5m
KG : 6.8m
GM : 0.7m

Initial GM: 0.700m
Virtual loss of GM: 0.265m
Residual GM: 0.435m

Initial GM: 0.700m
Virtual loss of GM: 0.281m
Residual GM: 0.419m

$$Rise = \frac{P}{TPC}$$

$$= \frac{299.62}{20 \times 100}$$

$$= 0.150m$$

$$T_c = \frac{P \times LCF}{MCTC \times 100}$$

$$= \frac{299.62 \times 77}{160 \times 100}$$

$$= 1.442m$$

$$T_a = \frac{T_c \times LCF}{LBP} = \frac{1.442 \times 77}{150}$$

$$= 0.740m$$

$$T_f = T_c - T_a$$

$$= 1.442 - 0.740$$

$$= 0.702m$$

Drafts	Fwd	Aft
Initial	5.200	6.890
Rise	(-) 0.150	(-) 0.150
Tf/Ta	(+) 0.702	(-) 0.740
Final	5.752m	6.000m

JULY 2024

A vessel displacing 14000 tonnes enters dry-dock with a clearance of 0.50m over the blocks. Draft while entering drydock are 5.35m forward, 6.77m aft, MCTC 120, TPC 22 tonne, LCF 4.00m aft of midship, length 150m, KG 6.25M, KM 6.40m. Assume the hydrostatic data to remain constant. Determine

a) The drop in water level required before the vessel takes the block forward and aft

b) The GM at the instant of taking the blocks

c) The further drop in water before the GM reduces to zero.

Ans:- a) For sitting overall

$$\text{Trim} = \frac{P \times LCF}{MCTC \times 100}$$

$$1.42 = \frac{P \times 71}{120 \times 100}$$

$$P = 240 \text{ tm}$$

$$\text{Rise} = \frac{P}{TPC \times 100}$$

$$= \frac{240}{22 \times 100} = 0.109 \text{ m}$$

Rise : 0.109m

Clearance : 0.500m

Drop in WL required for sitting overall : 0.609m = Ans

b) Virtual loss of GM

FORMULA A

$$\frac{P \times KG(\text{solid})}{W - P}$$

$$= \frac{240 \times 6.25}{14000 - 240}$$

$$= 0.109$$

FORMULA B

$$\frac{P \times KM(\text{Final})}{W(\text{Initial})}$$

$$= \frac{240 \times 6.40}{14000}$$

$$= 0.110 \text{ m}$$

KM : 6.40m

KG : 6.25m

GM : 0.15m

Initial GM : 0.150m
V. loss of GM : 0.109m
Residual GM : 0.041m =

Initial GM : 0.150m
V. loss of GM : 0.110m
Residual GM : 0.040m = Ans

(c) For GM to be zero
virtual loss of GM will be same as Initial GM
virtual loss of GM = 0.150m

FORMULA A

$$\text{V. loss of GM} = \frac{P \times KG(\text{solid})}{W - P}$$

$$0.15 = \frac{P \times 6.25}{14000 - P}$$

$$2100 - 0.15P = 6.25P$$

$$6.40P = 2100$$

$$P = 328.125 \text{ tn}$$

FORMULA B

$$\text{V. loss of GM} = \frac{P \times KM(\text{solid})}{W}$$

$$0.15 = \frac{P \times 6.40}{14000}$$

$$2100 = 6.40P$$

$$P = 328.125 \text{ tn}$$

$$\text{Rise} = \frac{P}{TPC \times 100}$$

$$= \frac{328.125}{22 \times 100}$$

$$= 0.149\text{m}$$

Rise : 0.149m
clearance : 0.500m

Drop in WL required for GM to be zero : 0.649m = Ans

JAN 2015

A vessel of length 140 mts, COF = 2.5 mtr fwd of midship, MCTC = 150 tm, TPC = 19, KM = 7.6m, KG = 6.8m, W = 11,100 T, at a draft F = 3.70m, A = 5.69m is floating in a drydock where depth of water is 6.6m above the top of the blocks. Calculate vessel residual GM and drafts F & A

When a) vessel is at critical instant

b) water level is lowered by 1.6m.

Soln:- a) For sitting overall,

$$\text{Trim} = \frac{P \times LCF}{MCTC \times 100}$$

Draft Fwd: 3.70m

Draft Aft : 5.69m

Trim : 1.99m

$$LCF = \frac{140}{2} + 2.5 = 72.5m$$

$$1.99 = \frac{P \times 72.5}{150 \times 100}$$

$$P = 411.724 \text{ tm}$$

Virtual loss of GM

Formula A

$$\frac{P \times KG(\text{solid})}{W - P}$$

$$\frac{411.724 \times 6.8}{11100 - 411.724}$$

$$= 0.262m$$

Formula B

$$\frac{P \times KM(\text{Final})}{W(\text{initial})}$$

$$\frac{411.724 \times 7.6}{11100}$$

$$= 0.282m$$

KM : 7.600m

KG : 6.800m

GM : 0.800m

Initial GM : 0.800m

V. loss of GM : 0.262m

Residual GM : 0.538m

Initial GM : 0.800m

V. loss of GM : 0.282m

Residual GM : 0.518m

$$\text{Rise} = \frac{P}{TPC \times 100}$$

$$= \frac{411.724}{19 \times 100} = 0.217m$$

$$T_c = \frac{P \times LCF}{MCTC \times 100} = \frac{411.724 \times 72.5}{150 \times 100} = 1.990m$$

$$T_a = \frac{T_c \times LCF}{LBP} = \frac{1.990 \times 72.5}{140} = 1.031m$$

$$T_f = T_c - T_a = 1.990 - 1.031$$
$$= 0.959m$$

Draft	Fwd	Aft
Initial	3.700	5.690
Rise	(-) 0.217	(-) 0.217
Tf/Ta	(+) 0.959	(-) 1.031
Final	4.442m	4.442m

(b) Initial WL : 6.6m
WL lowered by : 1.6m
Present WL : 5.0m
Draft Aft : 5.69m

Reduction in aft draft = 0.69m = 69cm

For afloat

$$\text{Reduction in aft draft} = \frac{P}{TPC} + \frac{P \times LCF^2}{MCTC \times LBP}$$

$$69 = \frac{P}{19} + \frac{P \times 72.5^2}{150 \times 140}$$

$$69 = 0.053P + 0.250P$$

$$69 = 0.303P$$

$$P = 227.723 \text{ ts}$$

For sitting overall

$$\text{Trim} = \frac{P \times LCF}{MCTC \times 100}$$

$$1.99 = \frac{P \times 72.5}{150 \times 100}$$

$$P = 411.724 \text{ tm}$$

P(afloat) < P(sitting overall)

Hence, vessel is still afloat

Hence, P = 227.723 ts

Virtual loss of GM

Formula A

$$\frac{P \times KG(solid)}{W-P}$$

$$\frac{227.723 \times 6.8}{11100 - 227.723}$$

$= 0.142m$

Formula B

$$\frac{P \times KM(Final)}{W(Initial)}$$

$$= \frac{227.723 \times 7.6}{11100}$$

$= 0.156m$

Initial GM: 0.800m
V. Loss of GM: 0.142m
Residual GM: 0.658m

Initial GM: 0.800m
V. loss of GM: 0.156m
Residual GM: 0.644m

$$Rise = \frac{P}{TPC \times 100}$$

$$= \frac{227.723}{19 \times 100}$$

$= 0.120m$

$$T_c = \frac{P \times LCF}{MCTC \times 100} = \frac{227.723 \times 72.5}{150 \times 100} = 1.100m$$

$$Ta = \frac{T_c \times LCF}{LBP} = \frac{1.100 \times 72.5}{140} = 0.570m$$

$$Tf = T_c - Ta = 1.100 - 0.570$$

$= 0.530m$

Draft	Fwd	Aft
Initial	3.700	5.690
Rise	(-) 0.120	(-) 0.120
Tf/Ta	(+) 0.530	(-) 0.570
Final	4.110m	5.000m

JULY 2014
APRIL 2017
MARCH 2022

A ship of length 130m, Displacement = 5200t, CF = 2m aft of midship, MCTC = 140 tm, KM = 6.5m, KG = 6.0m, TPC = 20t, Draft Fwd = 4.35m, Aft = 5.41m is dry-docked. Calculate her residual GM and the draft F & A

(i) When the trim has reduced to 35 cms

(ii) When the water level has been lowered 1.2m after she has taken the blocks all over

Soln:- (i)

Initial trim = 1.060m

Final trim = 0.350m

T_c = 0.710m

For intermediate,

$$T_c = \frac{P \times LCF}{MCTC \times 100}$$

$$0.710 = \frac{P \times 63}{140 \times 100}$$

$$P = 157.778 \text{ ts}$$

Virtual loss of GM

FORMULA A

$$\frac{P \times KG(\text{solid})}{W - P}$$

$$= \frac{157.778 \times 6}{5200 - 157.778}$$

$$= 0.188\text{m}$$

FORMULA B

$$\frac{P \times KM(\text{Final})}{W(\text{Initial})}$$

$$= \frac{157.778 \times 6.5}{5200}$$

$$= 0.197\text{m}$$

KM : 6.5m

KG : 6.0m

GM : 0.5m

Initial GM : 0.500m

V. loss of GM : 0.188m

Residual GM : 0.312m

Initial GM : 0.500m

V. Loss of GM : 0.197m

Residual GM : 0.303m

$$Ta = \frac{T_c \times LCF}{LBP} = \frac{0.710 \times 63}{130} = 0.344\text{m}$$

$$Tf = T_c - Ta = 0.710 - 0.344$$

$$= 0.366\text{m}$$

$$\text{Rise} = \frac{P}{\text{TPC}} = \frac{157.778}{20} = 0.079\text{m}$$

Draft	Fwd	Aft
Initial	4.350	5.410
Rise	(-) 0.079	(-) 0.079
Tf/Ta	(+) 0.366	(-) 0.344
Final	4.637m	4.987m

(ii) For sitting overay

$$\text{Trim} = \frac{P \times LCF}{MCTC \times 100}$$

$$1.060 = \frac{P \times 63}{140 \times 100}$$

$$P = 235.556 \text{ ts}$$

+

After sitting overay W/L lowered by 1.2m

i.e. Mean Rise = 1.2m

$$\text{Rise} = \frac{P}{TPC \times 100}$$

$$1.2 = \frac{P}{20 \times 100}$$

$$P = 2400 \text{ ts}$$

=

$$\text{Total } P = 235.556 + 2400$$

$$= 2635.556 \text{ ts}$$

Virtual loss of GM

Formula A

$$\frac{P \times KG(\text{solid})}{W - P}$$

$$= \frac{2635.556 \times 6}{5200 - 2635.556}$$

$$= 6.166 \text{ m}$$

Initial GM: 0.5m
V. Loss of GM: 6.166m
Residual GM: -5.666m

Formula B

$$\frac{P \times KM(\text{Final})}{W(\text{Initial})}$$

$$= \frac{2635.556 \times 6.5}{5200}$$

$$= 3.294 \text{m}$$

Initial GM: 0.5m
V. loss of GM: 3.294m
Residual GM: -2.794m

Find initial H.S draft = ?

Trim = 1.060m

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

$= \frac{1.060 \times 63}{130}$

$= 0.517m$

Aft draft : 5.410m

Corrn : (-) 0.517m

H.S draft : 4.896m

Rise = $\frac{P}{TPC}$

Rise = $\frac{2635.556}{20 \times 100}$

$= 1.318m$

Initial H.S draft : 4.896m

Total mean rise : (-) 1.318m

Final draft : 3.578m = Ans

JULY 2013

A vessel of displacement 4740t, mean draft 4.22m, length 120m, KM 6m, KG 5.5m, CF amidship, TPC 10t, MCTC 79 tm, is to be dry-docked. If the GM on taking the block F & A is to be not less than 0.3m, what is the maximum permissible trim by the stern? At what draft F & A vessel would become unstable?

Soln:- (a)

KM : 6.0m

KG : 5.5m

Initial GM : 0.5m

Residual GM : 0.3m

virtual loss of GM : 0.2m

Virtual loss of GM

FORMULA (A)

$$\frac{P \times KG(\text{solid})}{W - P}$$

$$0.2 = \frac{P \times 5.5}{4740 - P}$$

$$948 - 0.2P = 5.5P$$

$$948 = 5.7P$$

$$P = 166.316 \text{ ts}$$

FORMULA (B)

$$\frac{P \times KM(\text{Final})}{W(\text{initial})}$$

$$0.2 = \frac{P \times 6}{4740}$$

$$948 = 6P$$

$$P = 158 \text{ ts}$$

$$T_c = \frac{P \times LCF}{MCTC \times 100}$$

$$T_c = \frac{166.316 \times 60}{79 \times 100}$$

$$T_c = 1.263\text{m}$$

$$T_c = \frac{158 \times 60}{79 \times 100}$$

$$= 1.200\text{m} \times$$

So, max^m permissible trim is $\boxed{1.263\text{m}}$

(b)

Initial GM : 0.5m

Residual GM : 0.0m

V. loss of GM : 0.5m

Virtual loss of GM

FORMULA A

$$\frac{P \times KG(\text{solid})}{W-P}$$

$$0.5 = \frac{P \times 5.5}{4740-P}$$

$$2370 - 0.5P = 5.5P$$

$$2370 = 6.0P$$

$$P = 395 \text{ ts}$$

FORMULA B

$$\frac{P \times KM(\text{Final})}{W(\text{initial})}$$

$$0.5 = \frac{P \times 6}{4740}$$

$$2370 = 6P$$

$$P = 395 \text{ ts}$$

$$\text{Rise} = \frac{P}{TPC \times 100}$$

$$\text{Rise} = \frac{395}{10 \times 100}$$

$$\text{Rise} = 0.395\text{m}$$

Since CF is amidship

H.S draft = mean draft

H.S draft = 4.220m

Initial H.S draft = 4.220m

Rise = (-) 0.395m

Final draft = $\boxed{3.805\text{m}}$ Ans

APRIL 2013
JAN 2014

A vessel of following particulars is to be dry-docked.
Displacement = 28200t, LBP = 174m, KM = 11.43m, KG = 10.9m, DF = 7.92m, DA = 9.30m, LCF = 88.5m fwd of AP, MCTC = 400.5 tm, TPC = 28.1 t/cm.
The depth of water in the dock is initially 10m. Find the effective GM of the vessel after the water level has fallen by 1.2m in dock. Also find the draft F & A after the fall of water level.

Soln:-

Initial depth : 10m
WL dropped : 1.2m
Final depth : 8.8m
Draft Aft : 9.30m

Reduction in aft draft : 0.50m = 50cm

For afloat,

$$\text{Reduction in aft draft} = \frac{P}{TPC} + \frac{P \times LCF^2}{MCTC \times LBP}$$

$$50 = \frac{P}{28.1} + \frac{P \times 88.5^2}{400.5 \times 174}$$

$$50 = 0.036P + 0.112P$$

$$50 = 0.148P$$

$$P = 337.838 \text{ ts}$$

For sitting overall,

$$\text{Trim} = \frac{P \times LCF}{MCTC \times 100}$$

$$1.38 = \frac{P \times 88.5}{400.5 \times 100}$$

$$P = 624.508 \text{ ts}$$

P(afloat) < P(sitting overall)
Hence, vessel is still afloat

$$P = 337.838 \text{ ts}$$

Virtual loss of GM

FORMULA (A)

$$\frac{P \times KG(\text{solid})}{W - P}$$

FORMULA (B)

$$\frac{P \times KM(\text{final})}{W(\text{initial})}$$

$= \frac{337.838 \times 10.9}{28200 - 337.838}$

$= 0.132m$

$= \frac{337.838 \times 11.43}{28200}$

$= 0.137m$

KM : 11.43
KG : 10.90
Initial GM : 0.53m

Initial GM : 0.530m
V. Loss of GM : (-) 0.132 m
Residual GM : 0.398m

Initial GM : 0.530m
V. Loss of GM : (-) 0.137m
Residual GM : 0.393m

$$Rise = \frac{P}{TPC \times 100}$$

$$Rise = \frac{337.838}{28.1 \times 100} = 0.120m$$

$$T_c = \frac{P \times LCF}{MCTC \times 100} = \frac{337.838 \times 88.5}{400.5 \times 100} = 0.747m$$

$$T_a = \frac{T_c \times LCF}{LBP} = \frac{0.747 \times 88.5}{174} = 0.380$$

$$T_f = T_c - T_a = 0.747 - 0.380$$
$$= 0.367m$$

Draft	Fwd	Aft
Initial	7.920	9.300
Rise	(-) 0.120	(-) 0.120
Tf/Ta	(+) 0.367	(-) 0.380
Final	8.167m	8.800m

JULY 2016
OCT 2016

A vessel enters a SW dry dock drawing 4.4m forward and 5.8m aft, KG = 8.6m, FSM = 800 tm, AF = 72.056m, L = 140m, W = 8486.8t, MCTC = 160.952 tm, TPC = 21.72, KM = 9.570m. Assuming the hydrostatic particular remains unchanged over the range of draft in question. Find the GM when water level falls to 4.8m above the blocks.

Soln:

Water level dropped to : 4.8m
Draft aft : 5.8m

Reduction in aft draft : 1.0m = 100 cm

For afloat,

$$\text{Reduction in aft draft} = \frac{P}{TPC} + \frac{P \times LCF^2}{MCTC \times LBP}$$

$$100 = \frac{P}{21.72} + \frac{P \times 72.056^2}{160.952 \times 140}$$

$$100 = 0.046P + 0.230P$$

$$100 = 0.276P$$

$$P = 362.319 \text{ ts}$$

For sitting overall,

$$\text{Trim} = \frac{P \times LCF}{MCTC \times 100}$$

$$1.4 = \frac{P \times 72.056}{160.952 \times 100}$$

$$P = 312.719 \text{ ts}$$

P(afloat) > P(sitting overall)

Hence, vessel is sitting overall

So find P by $\text{Rise} = \frac{P}{TPC \times 100}$

↓

Initial H.S draft
(-) Final H.S draft i.e. Final WL
Rise.

So, to calculate initial H.S draft

$$\text{corr}^n \text{ to Aft draft} = \frac{\text{Trim} \times LCF}{LBP}$$

$$corr^n = \frac{1.4 \times 72.056}{140}$$

$$= 0.721\ m$$

Draft aft : 5.800m

Corr^n : 0.721 m

Initial H.S draft : 5.079 m

Final H.S draft : 4.800 m

Rise = 0.279 m

$$Rise = \frac{P}{TPC \times 100}$$

$$0.279 = \frac{P}{21.72 \times 100}$$

$$P = 605.988\ ts$$

Virtual loss of GM

Formula (A)

$$\frac{P \times KG(solid)}{W-P}$$

$$= \frac{605.988 \times 8.6}{8486.8 - 605.988}$$

$$= 0.661$$

Formula (B)

$$\frac{P \times KM(Final)}{W}$$

$$= \frac{605.988 \times 9.570}{8486.8}$$

$$= 0.683\ m$$

KM : 9.570m

KG : 8.600 m

GM(s): 0.970 m

FSC : 0.102m $\left(800/8486.8 - 605.988\right)$

GM(F): 0.868m

Initial GM: 0.868m

V. loss of GM : 0.661m

Residual GM : 0.207m

Initial GM: 0.868 m

V. loss of GM: (-) 0.683m

Residual GM : 0.185 m

Ans.

MARCH 2021 A vessel of length 141 metres, COF = 2.6 metres, forward of midship, MCTC = 144 tm, TPC = 19t, KM = 7.7m, KG = 6.9m, W = 11300T, at draft F = 3.80m, A = 5.68m is floating in a dry dock where depth of water is 6.5m above the top of the block. Calculate vessel's residual GM and draft F & A when.

a) W/L is lowered by 1.75m, and

b) vessel is unstable

Soln:- (a)

Initial WL : 6.5m

WL lowered by : 1.75m

Final WL : 4.75m

Aft draft : 5.68m

Reduction in aft draft : 0.93m = 93 cm

In afloat,

$$\text{Reduction in aft draft} = \frac{P}{TPC} + \frac{P \times LCF^2}{MCTC \times LBP}$$

$$93 = \frac{P}{19} + \frac{P \times 73.1^2}{144 \times 141}$$

$$93 = 0.053P + 0.263P$$

$$93 = 0.316P$$

$$P = 294.304 \text{ ts}$$

In sitting overall

$$\text{Trim} = \frac{P \times LCF}{MCTC \times 100}$$

$$1.88 = \frac{P \times 73.1}{144 \times 100}$$

$$P = 370.342 \text{ ts}$$

P(afloat) < P(sitting overall)

Hence, vessel is afloat

$$P = 294.304 \text{ ts}$$

Virtual loss of GM

FORMULA (A)

$$\frac{P \times KG(\text{solid})}{W - P}$$

FORMULA (B)

$$\frac{P \times KM(\text{Final})}{W(\text{Initial})}$$

$$= \frac{294.304 \times 6.9}{11300 - 294.304}$$

$$= 0.185m$$

$$= \frac{294.304 \times 7.7}{11300}$$

$$= 0.201m$$

KM : 7.7m
KG : 6.9m
GM : 0.8m

Initial GM : 0.800m
V. loss of GM : 0.185m
Residual GM : 0.615m

Initial GM : 0.800m
V. loss of GM : 0.201m
Residual GM : 0.599m

$$\text{Rise} = \frac{P}{TPC \times 100}$$

$$= \frac{294.304}{19 \times 100}$$

$$= 0.155m$$

$$T_c = \frac{P \times LCF}{MCTC \times 100} = \frac{294.304 \times 73.1}{144 \times 100} = 1.494m$$

$$T_a = \frac{T_c \times LCF}{LBP} = \frac{1.494 \times 73.1}{141} = 0.775m$$

$$T_f = T_c - T_a = 1.494 - 0.775$$

$$= 0.719m$$

Draft	Fwd	Aft
Initial	3.800	5.680
Rise	(-) 0.155	(-) 0.155
Tf / Ta	(+) 0.719	(-) 0.775
Final	4.364m	4.750m

(b) Since vessel is unstable

Residual GM = 0

Initial GM : 0.800m
Residual GM : 0
V. loss of GM : 0.800m

Virtual loss of GM

FORMULA A

$$\frac{P \times KG\,(solid)}{W-P}$$

$$0.8 = \frac{P \times 6.9}{11300 - P}$$

$$9040 - 0.8P = 6.9P$$

$$9040 = 7.7P$$

$$P = 1174.026\ ts$$

FORMULA B

$$\frac{P \times KM\,(Final)}{W}$$

$$0.8 = \frac{P \times 7.7}{11300}$$

$$9040 = 7.7P$$

$$P = 1174.026\ ts$$

$$Rise = \frac{P}{TPC \times 100}$$

$$= \frac{1174.026}{19 \times 100}$$

$$= 0.618\,m$$

As vessel is unstable, GM will be zero.
vessel is sitting on-block

Find initial H.S draft.

$$Corr^n\ to\ aft\ draft = \frac{Trim \times LCF}{LBP}$$

$$= \frac{1.88 \times 73.1}{141}$$

$$= 0.975\,m$$

Draft Aft : 5.680 m

Corrn : 0.975 m

H.S draft : 4.705 m

H.S draft : 4.705 m

Rise : 0.618 m

Final draft F&A : 4.087 m Ans.

JULY 2015

M.V Hindship enters a SW dry dock with draft fwd = 3.88m and draft aft = 5.30m, The water level in the dock is 6m above the blocks. If the water level in the dock is reduced by 1.5m. Find

a) virtual GM b) Draft Fwd and aft

Soln:-

Initial W.L : 6.0m
W.L reduced by : 1.5m
Present W.L : 4.50m
Draft (aft) : 5.30m

Reduction in aft draft: 0.80m = 80 cm

NOW, we require other data like LCF, MCTC etc.
For that we require H.S draft

$$\text{Mean draft} = \frac{3.88 + 5.30}{2} = 4.59m$$

LCF at mean draft 4.59m = 73.017m

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

$$= \frac{1.42 \times 73.017}{143.16} = 0.724m$$

Aft draft = 5.300m
Corrn = (-) 0.724m
H.S draft = 4.576m

Find displacement, TPC, MCTC, LCF

4.4	8473	21.82	162.4	73.060
4.6	8910	21.91	163.8	73.017

Disp : 8857.56
TPC : 21.899
MCTC : 163.632
LCF : 73.022

For afloat,

$$\text{Reduction in aft draft} = \frac{P}{TPC} + \frac{P \times LCF^2}{MCTC \times LBP}$$

$$80 = \frac{P}{21.899} + \frac{P \times 73.022^2}{163.632 \times 143.16}$$

$$80 = 0.046P + 0.228P$$

$$80 = 0.274P$$

$$P = 291.971 \text{ ts}$$

For sitting overall,

$$\text{Trim} = \frac{P \times LCF}{MCTC \times 100}$$

$$1.42 = \frac{P \times 73.022}{163.632 \times 100}$$

$$P = 318.183 \text{ ts}$$

P(afloat) < P(sitting overall)

Hence, vessel is afloat

$$P = 291.971 \text{ ts}$$

W − P

$= 8857.56 - 291.971$

$= 8565.589$

Find HS draft, MCTC, LCF & KM at 8565.589

8473	4.4	162.4	73.060	9.386
8910	4.6	163.8	73.017	9.196

H.S draft = 4.442m

LCF = 73.051

MCTC = 162.697

KM = 9.346m

Virtual loss of GM

FORMULA (A)

$$\frac{P \times KG(\text{solid})}{W - P}$$

This formula can't be used Bcz KG is not given in question

FORMULA (B)

$$\frac{P \times KM(\text{Final})}{W(\text{Initial})}$$

$$= \frac{291.971 \times 9.346}{8857.56}$$

$$= \boxed{0.308 \text{ m}}$$ Ans

$$T_c = \frac{P \times LCF}{MCTC \times 100}$$

$$T_c = \frac{291.971 \times 73.051}{162.697 \times 100}$$

$$T_c = 1.311\,m$$

* Initial trim : 1.420m

T_c : 1.311 m

Final trim : 0.109 m

$$T_a = \frac{TRIM \times LCF}{LBP}$$

$$T_a = \frac{0.109 \times 73.051}{143.16}$$

$$T_a = 0.056\,m$$

$$T_f = Trim - T_a$$
$$= 0.109 - 0.056$$
$$= 0.053$$

Draft	Fwd	Aft
H.S draft	4.442	4.442
Tf/Ta	(-) 0.053	(+) 0.056
Final	4.389m	4.498m

4.5m i.e present W.L
As stern touches the block
Present W.L = Aft draft = 4.5m
Hence, answer is verified

APRIL 2023
JAN 2025

M.V Hindship displacement 12927 t, K.G 7.850m, FSM 1290 tm is trimmed 0.70 by the stern. She has to be dry-docked. Calculate:

(i) Virtual GM of the vessel when her keel takes the block all along the length of the vessel

(ii) Draft F and A when she sits overall on the blocks.

Soln:-

Trim = 0.70m

For sitting overall

$$\text{Trim} = \frac{P \times LCF}{MCTC \times 100}$$

Find, MCTC & LCF at 12927t

MCTC = 177.5
LCF = 72.176

$$0.70 = \frac{P \times 72.176}{177.5 \times 100}$$

P = 172.15 ts

W − P
= 12927 − 172.15
= 12754.85 ts

Find H.S draft, KM at 12754.85t

12472	6.20	8.384
12927	6.40	8.340

H.S draft = $\boxed{6.234m}$ i.e. final draft F & A
KM = 8.357m

Virtual loss of GM

Formula A

$$\frac{P \times KG\,(solid)}{W - P}$$

$$= \frac{172.15 \times 7.85}{12754.85}$$

= 0.106m

Formula B

$$\frac{P \times KM\,(Final)}{W\,(initial)}$$

$$= \frac{172.15 \times 8.357}{12927}$$

= 0.111m

KM: 8.357m
KG: 7.850m
GM(S): 0.507m
FSC: 0.101m (1290 ÷ 12754.85)
GM(F): 0.406m

Initial GM: 0.406m
V. loss of GM: 0.106m
Residual GM: 0.300m

Initial GM: 0.406m
V. loss of GM: 0.111m
Residual GM: 0.295m

OCT 2018 JULY 2024 NOV 2022 JAN 2018

M.V HINDSHIP displacing 9500t and trimmed 0.80m by stern is to be dry docked for bottom inspection. KG = 7.92m, FSM = 1600 tm. Calculate:

a) The GM(F) of the vessel before entering the dry-dock

b) The virtual GM of the vessel when her heel takes blocks all along the length of the vessel

c) F & A draft at which the virtual GM of the vessel becomes 0

Soln:-

Trim = 0.80m by stern

Find MCTC, LCF, KM at disp. 9500t

9348	165.4	72.974	9.032
9500	165.884		
9788	166.8	72.917	8.890

$\frac{1.4}{440} \times 152 =$

MCTC = 165.884 tm

LCF = 72.954 m

KM = 8.983 m

(a) GM(F) before entering dry dock

KM : 8.983 m

KG : 7.920 m

GM(S) : 1.063 m

FSC : 0.168 m (FSM/W = 1600/9500)

GM(F) : 0.895 m Ans

(b) For sitting overall,

$$\text{Trim} = \frac{P \times LCF}{MCTC \times 100}$$

$$0.80 = \frac{P \times 72.954}{165.884 \times 100}$$

$$P = 181.905 \text{ t}$$

W − P

= 9500 − 181.905

= 9318.095 t

Find KM at disp 9318.095 t

8910	9.196	
9318.095		9.043
9348	9.032	

KM at disp 9318.095 = 9.043 m

Virtual loss of GM

FORMULA (A)

$$\frac{P \times KG(solid)}{W-P}$$

$$= \frac{181.905 \times 7.92}{9318.095}$$

$$= 0.155m$$

FORMULA (B)

$$\frac{P \times KM(Final)}{W(Initial)}$$

$$= \frac{181.905 \times 9.043}{9500}$$

$$= 0.173m$$

KM : 9.043m

KG : 7.920m

GM(S) : 1.123m

FSC : 0.172 m ($FSM/_{W-P} = 1600/_{9318.095}$)

GM(F) : 0.951m

GM : 0.951 m

V. loss of GM : 0.155 m

Residual GM : 0.796 m = Ans

GM : 0.951

V. loss of GM : 0.173

Residual GM : 0.778 = Ans

(C)

Initial GM : 0.895m

Final GM : 0

V. loss of GM : 0.895 m

Virtual loss of GM

FORMULA (A)

$$\frac{P \times KG(solid)}{W-P}$$

$$0.895 = \frac{P \times 7.92}{9500 - P}$$

$$8502.5 - 0.895P = 7.92P$$

$$8502.5 = 8.815P$$

$$P = 964.55 ts$$

W - P

$$9500 - 964.55 = 8535.45$$

Draft at 8535.45t = 4.429 m = Ans

FORMULA (B)

$$\frac{P \times KM(Final)}{W(Initial)}$$

$$0.895 = \frac{P \times 8.983}{9500}$$

$$8502.5 = 8.983P$$

$$P = 946.51 ts$$

W - P

$$9500 - 946.51 = 8553.49$$

Draft at 8553.49 = 4.437m = Ans

JUNE 2022 M.V Hindship at a displacement 7000t in SW, KG 8.2m, FSM = 1200 tm. Find the maximum trim with which she may enter a dry dock, if the GM at the critical instant is not to be less than 0.5m.

Soln:-

To find Trim, we require P
↓
For P, we require v. Loss of GM
↓
For that, we require Initial GM

KM : 10.286 m (at disp. 7000)

KG : 8.200 m

GM(S) : 2.086 m

FSC : 0.171 m ($FSM/W = 1200/7000$)

GM(F) : 1.915 m

Final GM : 0.500 m

Max^m permissible v. Loss of GM : 1.415 m

Virtual loss of GM

FORMULA (A)

$$\frac{P \times KG(\text{solid})}{W-P}$$

$$1.415 = \frac{P \times 8.2}{7000-P}$$

$$9905 - 1.415P = 8.2P$$

$$9905 = 9.615P$$

$$P = 1030.161 \text{ ts}$$ → we will proceed with greater one.

FORMULA (B)

$$\frac{P \times KM(\text{Final})}{W(\text{Initial})}$$

$$1.415 = \frac{P \times 10.286}{7000}$$

$$9905 = 10.286P$$

$$P = 962.959 \text{ ts}$$

$W-P$

$7000 - 1030.161$

$= 5969.839 t$

For calculating trim, find LCF & MCTC at 5969.839t

5969.839	5897	73.145	150.7
	6320	73.145	153.2

LCF = 73.145

MCTC = 151.130

$$\text{Trim} = \frac{P \times LCF}{MCTC \times 100}$$

$$= \frac{1030.161 \times 73.145}{151.130 \times 100} = 4.986 m$$

Ans

In above question

ⓐ Her draft F & A when entering the dry dock

$$T_a = \frac{T_c \times LCF}{LBP}$$

$$= \frac{4.986 \times 73.145}{143.16}$$

$$= 2.548m$$

$$T_f = T_c - T_a$$

$$= 4.986 - 2.548$$

$$= 2.438m$$

H.S draft at 7000t = 3.719 m

Draft	Fwd	Aft
H.S	3.719	3.719
Tf/Ta	(-) 2.438	(+) 2.548
Final	1.281m	6.267m = Ans

ⓑ Draft (F) at which head will take the block

For sitting overall $Trim = \frac{P \times LCF}{MCTC \times 100}$

Find LCF & MCTC at disp 7000t

7000	6746	73.145	155.2
	7174	73.145	157.1

LCF = 73.145 m

MCTC = 156.328 tm

$$4.986 = \frac{P \times 73.145}{156.328 \times 100}$$

$$P = 1065.625 \text{ tn}$$

W − P

$$= 7000 - 1065.625$$

$$= 5934.375$$

H.S draft at 5934.375 = 3.218 m = Ans

i.e. draft (F) when head will take block

ⓒ Fall in WL b/w taking the block aft & taking block fwd.

The WL when aft touches the block = Aft draft = 6.267m

Draft at which fwd touches the block = 3.218 m

Drop in WL = 3.049m = Ans

APR 2024 M.V Hindship, displacement 9348t, KG 8.623m, FSM 935tm is to be dry-docked. When she sits overall on the blocks the residual GM(F) is to be not less than 0.15m. Determine (a) Maximum trim with which vessel can enter the dry dock
(b) Draft F & A with which vessel will enter dry-dock.

Soln:- (a)

KM at 9348t : 9.032m
KG : 8.623m
GM(S) : 0.409 m
FSC : 0.100 m ($FSM/W = 935/9348$)
GM(F) : 0.309m
Max^m GM perm. : 0.150 m
Max^m permissible v. loss of GM : 0.159m

Virtual loss of GM

FORMULA (A)

$$\frac{P \times KG(solid)}{W-P}$$

$$0.159 = \frac{P \times 8.623}{9348 - P}$$

$1486.332 - 0.159P = 8.623P$

$1486.332 = 8.782P$

$P = 169.248$ ts → proceed with greater value

FORMULA (B)

$$\frac{P \times KM(Final)}{W(initial)}$$

$$0.159 = \frac{P \times 9.032}{9348}$$

$1486.332 = 9.032P$

$P = 164.563$ ts

$W - P$

$9348 - 169.248$

$= 9178.752t$

For finding trim, Find : MCTC, LCF at 9178.752t

8910	163.8	73.017
9178.752		
9348	165.4	72.974

$\frac{1.6}{438} \times 268.752$

$= 0.982$

MCTC = 164.782 tm

LCF = 72.991m

$$Trim = \frac{P \times LCF}{MCTC \times 100}$$

$$\text{Trim} = \frac{169.248 \times 72.991}{164.782 \times 100}$$

$$= 0.750\text{m}$$

Hence, maximum trim with vessel can enter in dry dock = 0.750m Ans

(b) $$T_a = \frac{\text{Trim} \times LCF}{LBP}$$

$$= \frac{0.750 \times 72.991}{143.16}$$

$$= 0.382\text{m}$$

$$T_f = T_c - T_a$$

$$= 0.750 - 0.382$$

$$= 0.368\text{m}$$

H.S draft at disp 9348 t = 4.80m

Draft	Fwd	Aft
H.S	4.800	4.800
Tf/Ta	(-)0.368	(+) 0.382
Final	4.432m	5.182m

Ans

More similiar question:-
JULY 2023, November 2021

JULY 2019 M.V Hindship drawing 4m fwd and 5.2m aft enters a SW dry dock. KG 8.0m, FSM = 1000tm. Find the GM on taking the blocks overall

Soln:-

Draft (F) = 4.0m

Draft (A) = 5.2m

Trim = 1.2m

Mean draft = 4.6m

~~Find~~ LCF at mean draft = 73.017m

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

$$= \frac{1.2 \times 73.017}{143.16}$$

$$= 0.612m$$

Draft aft : 5.200m

Corrn : 0.612m

H.S draft : 4.588m

disp, LCF & MCTC at draft 4.588m

Draft	Disp	LCF	MCTC		
4.4	8473	73.060	162.4	8473	9.386
				8614.732	
4.6	8910	73.017	163.8	8910	9.196
	$\frac{437}{0.2} \times 0.188$				$\frac{0.19}{437} \times 141.732 = 0.062$

Disp = 8883.78t

LCF = 73.020

MCTC = 163.716

For sitting overall $\quad \text{Trim} = \frac{P \times LCF}{MCTC \times 100}$

$$1.2 = \frac{P \times 73.020}{163.716 \times 100}$$

$$P = 269.048 \text{ tn}$$

$$W - P = 8883.78 - 269.048 = 8614.732$$

KM at 8614.732 = 9.324m

Virtual loss of GM

FORMULA (A)

$$\frac{P \times KG(\text{solid})}{W - P}$$

$$= \frac{269.048 \times 8.0}{8883.78 - 269.048}$$

$$= 0.250m$$

FORMULA (B)

$$\frac{P \times KM(\text{Final})}{W(\text{initial})}$$

$$= \frac{269.048 \times 9.324}{8883.78}$$

$$= 0.282m$$

KM = 9.324 m

KG = 8.000 m

GM(S) = 1.324 m

FSC = 0.116 m $\left(FSM/_{W-P} = 1000/_{8614.732}\right)$

GM(F) = 1.208 m

GM(F) : 1.208 m

V. loss of GM : 0.250 m

Residual GM : 0.958 m

Ans

GM(F) : 1.208 m

V. loss of GM : 0.282 m

Residual GM : 0.926 m

Ans