

ANTWOORDEN LES 7 graanberekeningen

Opgave 7.1

“Samsun Carrier” SK 1989

Gegevens:

$T_v = T_a = 3.50 \text{ m}$ (sm water = 1015 kg/m^3)
 $KG = 5.95 \text{ m}$
 $VSTM = 190 \text{ tm}$

a.

Waterverplaatsing 3461.5 m³
 Displacement 3513.4 Ton

graan lh 3451 m³ sf 1.50 m³/t
 2300.7 ton

graan uh 4712 m³ sf 1.55 m³/t
 3040.0 ton

Momentenstelling

Item	Gewicht [t]	kg [m]	Moment [tm]
Schip	3513.4	5.95	20904.73
graan lh	2301	3.44	7914.293
graan uh	3040	8.86	26934.4
fsm			190
Totaal	8854.1	KG	55943.42

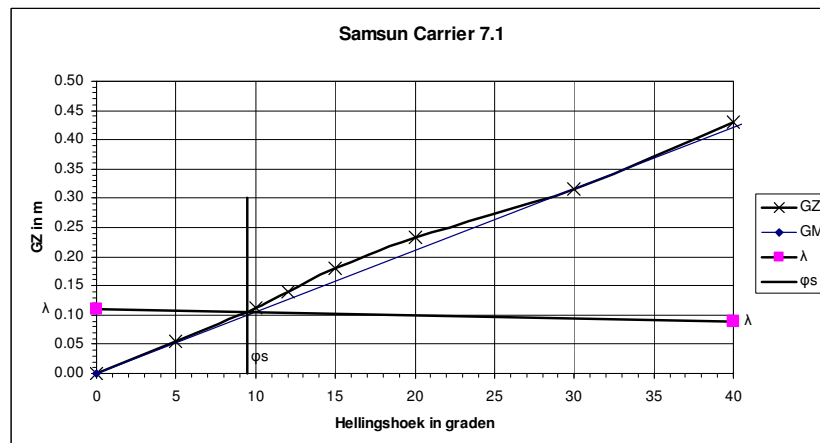
$KG' = \frac{55943.42}{8854.1} = 6.32 \text{ m}$

Nieuwe waterverplaatsing $8854.1 / 1.015 = 8723.3 \text{ m}^3$

$T = 8.06 \text{ m}$

$KM_0 = 6.923 \text{ m}$

Φ [°]	0	5	10	12	15	20	30	40
$KN \sin(\phi)$ [m]	0	0.605	1.21	1.453	1.816	2.393	3.475	4.492
$KG \sin(\phi)$ [m]	0.000	0.551	1.097	1.314	1.635	2.161	3.159	4.061
GZ [m]	0.000	0.054	0.113	0.139	0.181	0.232	0.316	0.431



b.

$$\text{Graanarm } \lambda_0 = \frac{\frac{\text{vol.k.moment}}{sf} + \frac{\text{vol.k.moment}}{sf}}{\Delta} = \frac{\frac{639}{1.50} + \frac{830}{1.55}}{8854.2} = \frac{961.5}{8854.2} = 0.11 \text{ m}$$

$$\Lambda_{40} = 0.8 * 0.11 = 0.09 \text{ m}$$

c. $\Phi_s = 9.5^\circ \gg$ voldoet

d. Rest dynamische weg $\approx 0.093 \text{ mrad} \gg$ voldoet

e. $G'M_0 = KM_0 - KG' = 6.923 - 6.32 = 0.60 \text{ m} \gg$ voldoet

Opgave 7.2

“Samsun Carrier” SK 1991

Gegevens:

$$T_v = 2.90 \text{ m} \quad T_a = 3.80 \text{ m} \quad (\text{sm water} = 1025 \text{ kg/m}^3)$$

$$KG = 6.00 \text{ m}$$

$$FSM = 2 \cdot 11.89 + 2 \cdot 186 + 2 \cdot 21.75 = 439.2 \text{ tm}$$

a.

$$\Delta t(\text{begin}) = T_a - T_v = 3.80 - 2.90 = 0.90 \text{ m}$$

$$T_{\text{gem}} = \frac{T_a + T_v}{2} = \frac{3.80 + 2.90}{2} = 3.35 \text{ [m]}$$

Opzoeken bij T_{gem} :

$$\Delta = 3384 \text{ ton}$$

$$X_a = 44.59 \text{ m}$$

$$\Delta \Delta_2 = 10.92 \text{ t/cm}$$

$$T_{\text{corr}} = T_{\text{gem}} + \frac{\Delta t(1/2L_{ll} - X_a)}{L_{ll}} = 3.35 + \frac{0.90(42.62 - 44.59)}{85.24} = 3.33 \text{ m [m]}$$

$$\Delta_{\text{corr}} = \Delta_{\text{gem}} + \frac{\Delta t(1/2L_{ll} - X_a)}{L_{ll}} * \Delta \Delta_2 = 3384 + \frac{90(42.62 - 44.59)}{85.24} * 10.92 = 3361.3 \text{ t}$$

graan lh	3451 m3	sf	1.38 m3/t
	2500.7 ton		
graan uh	4712 m3	sf	1.50 m3/t
	3141.3 ton		

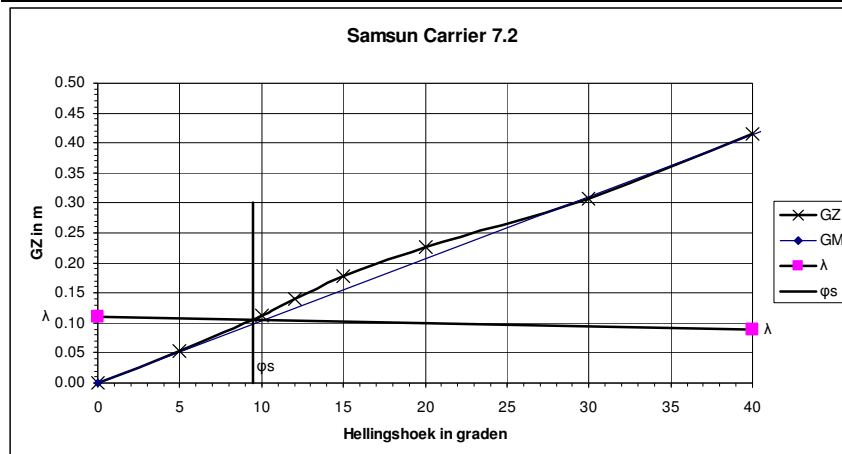
Momentenstelling

Item	Gewicht [t]	KG [m]	Moment [tm]
Schip	3361.3	6.00	20167.8
graan lh	2500.7	3.44	8602.493
graan uh	3141.3	8.86	27832.21
fsm			439.2
Totaal	9003.4	6.34	57041.7

$$T = 8.10 \text{ m} \quad KM_0 = 6.934 \text{ m}$$

$$G'M_0 = KM_0 - KG' = 6.934 - 6.34 = 0.59 \text{ m}$$

Φ [°]	0	5	10	12	15	20	30	40
KNsin(ϕ) [m]	0	0.606	1.212	1.456	1.818	2.393	3.475	4.488
KGsin(ϕ) [m]	0.000	0.552	1.100	1.317	1.640	2.167	3.168	4.072
GZ [m]	0.000	0.054	0.112	0.139	0.178	0.226	0.307	0.416



$$b. \text{ Graanarm } \lambda_0 = \frac{\frac{\text{vol.k.moment}}{sf} + \frac{\text{vol.k.moment}}{sf}}{\Delta} = \frac{\frac{639}{1.38} + \frac{830}{1.50}}{9003.4} = \frac{1016.4}{9003.4} = 0.11m$$

$$\Lambda_{40} = 0.8 * 0.11 = 0.9 \text{ m}$$

c. Snijpunt 10°

d. Rest dynamische weg ≈ 0.083 mrad

e. Heeling moment = 1016.4 tm. Maximum permissible grain heeling mom: 1261 tm

f. Hoek $\varphi_s = 10^\circ \gg$ voldoet (12°)

Rest dyn.weg voldoet

G'M=0.59 m > 0.30 m voldoet

Opgave 7.3

“Samsun Carrier” SK 1993

Gegevens:

Tv= Ta = 3.40 m (sm water = 1025 kg/m³)

KG = 6.00 m

VSTM = 750 tm

a.

Displacement = 3438.6 ton

graan lh 3451 m³ sf 1.40 m³/t
 2465.0 Ton

graan uh 4712 m³ sf 1.45 m³/t
 3249.7 Ton

Momentenstelling

Item	Gewicht [t]	KG [m]	Moment [tm]
Schip	3438.6	6.00	20631.6
graan lh	2465.0	3.44	8479.6
graan uh	3249.7	8.86	28791.94
fsm			750
Totaal	9153.3	6.41	58653.14

KG' = 6.41 m

T = 8.22 m (ls heel diep beladen, zie merken) KM₀ = 6.967 m

G'M₀ = KM₀ - KG' = 6.967 - 6.41 = 0.56 m

Φ [°]	0	5	10	12	15	20	30	40
KNsin(φ) [m]	0	0.609	1.218	1.462	1.823	2.394	3.476	4.475
KGsin(φ) [m]	0.000	0.558	1.113	1.332	1.658	2.192	3.204	4.119
GZ [m]	0.000	0.051	0.105	0.130	0.165	0.202	0.272	0.356

b.

$$\text{Graanarm } \lambda_0 = \frac{\frac{\text{vol.k.moment}}{sf} + \frac{\text{vol.k.moment}}{sf}}{\Delta} = \frac{\frac{1.40}{1.40} + \frac{830}{1.45}}{9153.3} = \frac{1028.8}{9153.3} = 0.11m$$

$$\Lambda_{40} = 0.8 * 0.11 = 0.09 \text{ m}$$

c. Helling wordt 10° , dus voldoet.

d. Rest dynamische weg = 0.071 mrad, voldoet niet moet zijn 0.075 mrad

e. Nee, helaas net niet

Opgave 7.4

"Samsun Carrier" GZV 1997

Gegevens:

$$T_v = T_a = 4.80 \text{ m} \quad (\text{sm water} = 1025 \text{ kg/m}^3)$$

$$K_G = 5.00 \text{ m}$$

a.

Displacement = 4999.2 ton

Upperhold : 3000 ton graan, $sf = 1.50 \text{ m}^3/\text{ton}$

$$3000 * 1.5 = 4500 \text{ m}^3 \text{ graan.}$$

Uit grafiek: volume kentermoment = 1650 m^4

$$\text{Kg graan} = 8.75 \text{ m}$$

Momentenstelling

Item	Gewicht [t]	Kg [m]	Moment [tm]
Schip	4999.2	5.00	24996
Lading	3000.0	8.75	26250
DBTI	190.7	0.76	144.9016
DBTII	163.6	0.63	103.0932
Deept	240.1	4.85	1164.291
Side I	397.5	3.75	1490.55
Side II	250.3	3.76	941.2784
HO	-140.0	0.61	-85.4
GO	-4.0	1.28	-5.12
FW	-10.0	3.91	-39.1
fsm			467.9
Totaal	9087.38	6.10	55428.39

$$T = 8.17 \text{ m} \quad KM_0 = 6.953 \text{ m} ; G'M_0 = 6.953 - 6.10 =$$

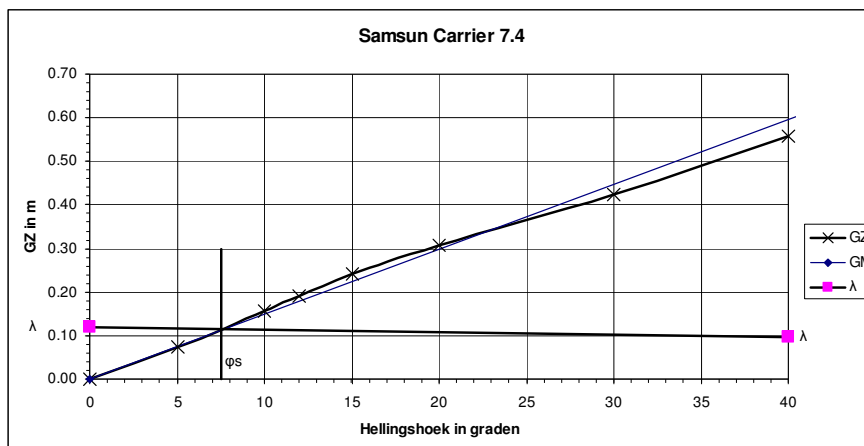
$$\frac{\text{vol.k.moment}}{\Delta} = \frac{1650}{9087.4}$$

$$\text{Graanarm } \lambda_0 = \frac{sf}{\Delta} = \frac{1.50}{9087.4} = \frac{1100}{9087.4} = 0.12 \text{ m}$$

$$\Lambda_{40} = 0.8 * 0.12 = 0.097 \text{ m}$$

b.

Φ [°]	0	5	10	12	15	20	30	40
$KN \sin(\phi)$ [m]	0	0.607	1.215	1.459	1.82	2.394	3.475	4.48
$KG \sin(\phi)$ [m]	0.000	0.532	1.059	1.268	1.579	2.086	3.050	3.921
GZ [m]	0.000	0.075	0.156	0.191	0.241	0.308	0.425	0.559



c.
 Max hoek $12^\circ \gg$ is $7.5^\circ \gg$ voldoet
 Rest dyn. Weg min $0.075 \text{ mrad} \gg$ is $0.137 \text{ mrad} \gg$ voldoet
 $G'M_0 > 0.30 \text{ m} \gg$ $G' M_0 = K M_0 - KG' = 6.953 - 6.10 = 0.85 \text{ m} \gg$ voldoet
 Max per. moment = $1900 \text{ tm} \gg$ is $1100 \text{ tm} \gg$ voldoet

Opgave 7.5

“Samsun Carrier” GZV 1998

Gegeven:

Displacement=6500 ton
 KG'= 4.75 m
 Graan met sg 0.6335 ton/m^3

a.
 Zomermerk T=8.13 ton, displacement= 9034 ton
 Graan te laden $9043-6500=2543 \text{ ton}$

b.
 sf graan $1/0.6335=1.579 \text{ m}^3/\text{ton}$
 Voor het bovenruim $2453 \times 1.579=4014 \text{ m}^3$
 Ullage=1.08 m

c.
 Kg=8.44m
 HM=3550 m^4
 HM=3550 / 1.579 = 2249 tm

d.
 Momentenstelling

Item	Gewicht [t]	KG [m]	Moment [tm]
Schip	6500	4.75	30875
graan uh	2543	8.44	21462.92
Totaal	9043.0	5.79	52337.92

Maximum permissible heeling moment $\approx 2400 \text{ tm}$

Opgave 7.6

“Passat”

a.
 $\text{tg } \varphi = 86/716 = 0.1202 \gg$ $\varphi = 6.86^\circ$
 b.
 Displacement=6503.4x1.021=6640 ton
 c.
 $(GM=(fxB/T)^2 \gg$ $GM=(0.87 \times 14.32/16.66)^2=0.56 \text{ m}$
 $(GM=(fxB/T)^2 \gg$ $GM=(0.90 \times 14.32/16.66)^2=0.60 \text{ m}$
 d.
 moment=depl.xGMxsin(φ)=6640x0.56xsin(7)=453 tonm
 e.

Ballastwater dieptank	100x3	300
Gewicht in ruim 1	40x3	120
Drinkwater	23.5x1.2	28
Dieselolie	11x 3.3	36
Totaal		484 tonm

Totaal graanhellend moment $484+453=937 \text{ tm}$

f.
 293 tm

g.
 De graanschotten waren niet dicht er is meer graan overgegaan.