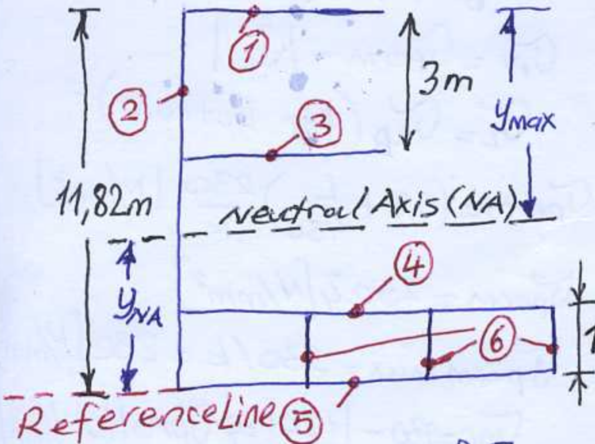
SHIP STRUCTURE - VISA EXAM 02/12/2020

Q1: $L=130[m]$; $B=130/7=18{,}57[m]$; $T=B/2{,}5=7{,}43[m]$; $D=L/11=11{,}82[m]$

$\Leftarrow B/3=6{,}19m$ $\quad t=\sqrt{L}=\sqrt{130}=11{,}4[mm] \Rightarrow t=11{,}5[mm] \Rightarrow t=12[mm]$ assumed!

$C_B=0{,}70$



	Dimensions m×m	A_i	y_i	$A_i \times y_i$
(1) Deck Plating	6,19×0,012	0,074	11,82	0,878
(2) Side plating	0,012×11,82	0,142	5,91	0,8383
(3) 2nd Deck Plating	6,19×0,012	0,074	8,82	0,6551
(4) Inner Bottom "	9,285×0,012	0,114	1,5	0,1671
(5) Bottom "	9,285×0,012	0,114	0,006	0,0007
(6) Centre, Side girders	0,030×1,5	0,045	0,75	0,0337
		~~0,563~~ $\Sigma_1=0{,}563$		$\Sigma_2=2{,}573$

	I_i	d_i	d_i^2	$A_i \times d_i^2$
(1)	≈0	7,25	52,56	3,8896
(2)	1,6514	1,34	1,7956	0,255
(3)	≈0	4,25	18,06	1,3366
(4)	≈0	−3,07	9,425	1,0744
(5)	≈0	−4,564	20,83	2,3746
(6)	0,0084	−3,82	14,59	0,6566
	$\Sigma_3=1{,}6598$			$\Sigma_4=9{,}5868$

$y_{NA}=\Sigma_2/\Sigma_1=4{,}57[m]$

$y_{max}=D-y_{NA}=7{,}25[m]$

$d_i=y_i-y_{NA}$

$I_{NA}=2\times(\Sigma_3+\Sigma_4)=22{,}49[m^4]$

$SM=I_{NA}/y_{max}=3{,}1[m^3]$

(Let us compare this SM with W_{min} by GL!!)

$$W_{min}=k\cdot C_o\cdot L^2\cdot B\cdot(C_B+0{,}7)\cdot C_{RS}\cdot 10^{-6}[m^3]$$ $C_{RS}=1{,}0$ for unlimited service!

$$C_o=\left[10{,}75-\left(\frac{300-L}{100}\right)^{1{,}5}\right]\cdot C_{RS} \Rightarrow C_o=\left[10{,}75-\left(\frac{300-130}{100}\right)^{1{,}5}\right]\cdot 1{,}0=8{,}533$$

$$W_{min}=1{,}0\cdot 8{,}533\cdot 130^2\cdot 18{,}57\cdot(0{,}7+0{,}7)\cdot 1{,}0=3{,}75[m^3] > SM=3{,}1[m^3]$$

Q2: ?1: Solid (plate) floor (Longitudinal framing)

?2: Bottom longitudinals

?3: Inner bottom longitudinals

?1: Plate (solid) floors (Section 8, B. Double Bottom, 7.3.4)

Scantlings of plate floors are to be determined according to Section 8, B. 6.2.1

$t_{pf}=t_m-2{,}0\cdot\sqrt{k}$ $\quad h_a=1{,}5[m]$ (as built, already given in Figure!)

$t_m=\frac{h}{h_a}\left(\frac{h}{100}+1\right)\sqrt{k}$ $\quad k=1$ $(k=295/R_{eH}+60)$ $R_{eH}=235\left[\frac{N}{mm^2}\right]$

$t_m=\frac{1186}{1500}\left(\frac{1186}{100}+1\right)\sqrt{1}=10{,}2[mm]$

$h=350+45\cdot l$

$l=B=18{,}57[m]$ $\quad t_m=11[mm]$ assumed!

$h=1186[mm]\leq 1200[mm]$ $\quad t_{pf}=11-2\sqrt{1} \Rightarrow \boxed{t_{pf}=9[mm]}$

22: Bottom Longitudinals

Section 8, B.7.2.1 says that "The scantlings are to be calculated according to Section 9, B.3.1"

$$W_L = \frac{83}{\sigma_{pr}} \cdot m \cdot a \cdot l^2 \cdot p \ [cm^3]$$

$p = p_B$ (for bottom longitudinals)

$p_B = 10 \cdot T + p_0 \cdot C_F \ [kN/m^2]$ (Sec. 4, B.3)

$p_0 = 2{,}1 \cdot (C_B + 0{,}7) \cdot C_0 \cdot C_L \cdot f \ [kN/m^2]$

$C_0 = 8{,}533$ (earlier found for this ship!)

$C_L = 1{,}0$ (for $L \geq 90$ m)

$f = 0{,}75$ (for frames)

$p_0 = 2{,}1 (0{,}7 + 0{,}7) \cdot 8{,}533 \cdot 1{,}0 \cdot 0{,}75$

$p_0 = 18{,}8 \ [kN/m^2]$; $C_F = 1{,}0$ (for midship)

$p_B = 93{,}1 \ [kN/m^2]$

$m = m_k^2 - m_a^2$ (Sec. 9, A.1.2)

$m_a = 0{,}204 \frac{a}{l} \left[4 - \left(\frac{a}{l}\right)^2\right]$ (sec. 3, A.4)

$l = e$ (distance between solid floors)

$m_a = 0{,}204 \cdot \frac{0{,}74}{2{,}96} \left[4 - \left(\frac{0{,}74}{2{,}96}\right)^2\right] = 0{,}2$

$m = 1{,}0^2 - 0{,}2^2 = 0{,}96$

$\sigma_{LB} = 120/k$ (Sec. 6, B.1.2)

$\sigma_{pr} = \sigma_{perm} - |\sigma_L|$

$\sigma_L = \sigma_{LB}$ (for bottom)

$\sigma_{perm} = \left(0{,}8 + \frac{L}{450}\right) \frac{230}{k} \ [N/mm^2]$

$\sigma_{perm} = 250{,}\bar{4} \ [N/mm^2]$

$\sigma_{perm\,max} = 230/k = 230 \ [N/mm^2]$

$\sigma_{pr} = 230 - |120| \Rightarrow \sigma_{pr} = 110 \ [N/mm^2]$

$a = L/500 + 0{,}48 \ [m]$

$a = 130/500 + 0{,}48$

$a = 0{,}74 \ [m]$

$e = 4 \cdot a = 2{,}96 \ [m]$

$m_k = 1 - \frac{l_{KI} + l_{KJ}}{10^3 \cdot l}$

(Section 3, C.1)

With no brackets assumption!

$l_{KI} = l_{KJ} = 0 \Rightarrow m_k = 1{,}0$

$W_L = \frac{83}{110} \cdot 0{,}96 \cdot 0{,}74 \cdot (2{,}96)^2 \cdot 93{,}1 = 437 \ [cm^3]$

260x11 Bulb Section chosen! 450 $[cm^3]$

23: Inner Bottom Longitudinals

Now, $p = p_i$ or $p = 10(T - h_{DB})$, because this is a dry cargo ship!

In case of a damage, we calculate: $p = 10(7{,}43 - 1{,}5) = 59{,}3 \ [kN/m^2]$

$p_i = 9{,}81 \cdot (G/V) \cdot h \cdot (1 + a_v) \ [kN/m^2]$ (Sect. 4, C.2.1)

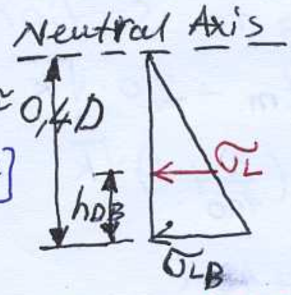
$a_v = F \cdot m$; $F = 0{,}11 \cdot V_0 / \sqrt{L} = 0{,}11 \cdot 15 / \sqrt{130} = 0{,}145$; $m = 1{,}0$ (for midship)

(G/V) is assumed to be 0,7!!

$h = D - h_{DB} = 11{,}82 - 1{,}5 = 10{,}32 \ [m]$

$p_i = 9{,}81 \cdot 0{,}7 \cdot 10{,}32 (1 + 0{,}145) = 81{,}1 \ [kN/m^2]$

$p = p_i$ because $p_i > 59{,}3 \ [kN/m^2]$



From the similarity!

$\sigma_L = 81{,}9 \ [N/mm^2]$

$\sigma_{pr} = 148 \ [N/mm^2]$

$W_L = \frac{83}{148} \cdot 0{,}96 \cdot 0{,}74 \cdot 2{,}96^2 \cdot 81{,}1 = 283 \ [cm^3]$

180x90x12 Angle Section or 200x100x10 Angle Section