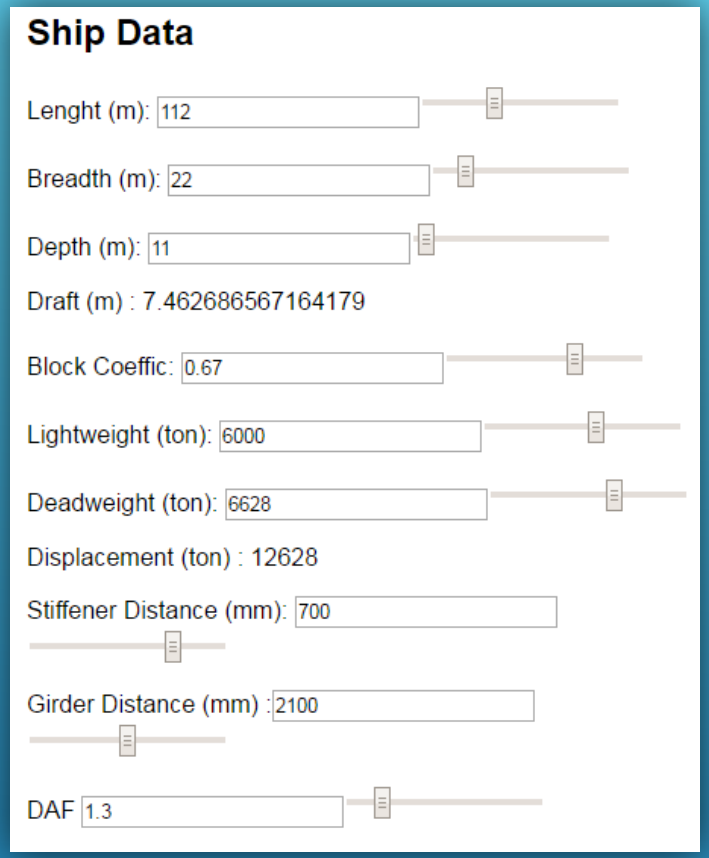
LOCAL AND GLOBAL STRESS ANALYSIS



SHIP DATA

- Draft: $D = \frac{\nabla}{L*B*CB*\rho}$
- Displacement: $\nabla = Lw + Dw$
- DAF = Dynamic Amplification Factor
- Stiffener distance = s
- Girder distance = l
- Normal stress: $\sigma = 160\ MPa$

LOCAL STRENGTH

Local Strength of Bottom Plating

Pressure (N/mm^2): 0.0975509328358209

Stiffener

Section Modulus (cm^3): 156.8436092000933

Inertia (cm^4): 1783

Profile (mm) : 160x9

Girder

Section Modulus (cm^3): 15492.307520988807

Plate

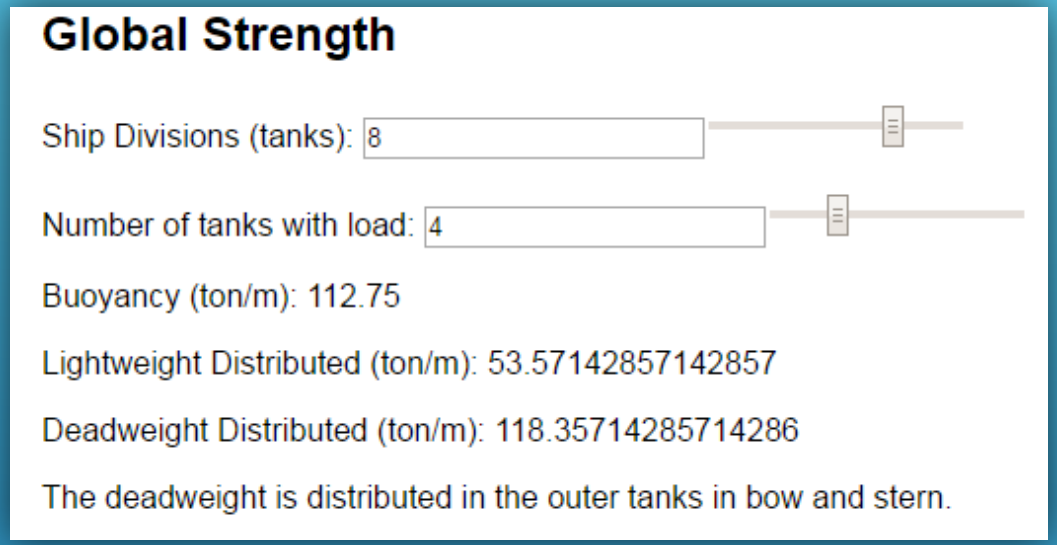
Plate Thickness (mm): 8.642189129637547

Equivalent Plate Thickness (mm): 10.699331986780404

Inertia (mm^4): 3547541842416.8228

Section Modulus (cm^3): 506791.69177383184

- Pressure: $P = \rho * g * D * \frac{DAF}{1000}$
- Stiffener
  - Section Modulus: $Z = \frac{P*S*l^2}{12*\sigma} * \frac{1}{1000}$
  - Inertia and Profile from Table 1
- Girder
  - Section Modulus : $Z_g = \frac{P*l*B^2}{10*\sigma} * \frac{1}{1000}$
- Plate
  - Thickness: $t = \frac{s}{2}\sqrt{\frac{P}{\sigma}}$
  - Equivalent Thickness: $t_{eq} = t + \frac{A_{profile}}{s}$
  - Neutral Axis: $NA = \frac{L}{ST} * 2 * 1000$
  - Inertia: $I = \frac{l}{2} * t_{eq} * NA^2 * 2 + \frac{1}{12}\frac{L}{ST}^3 * t_{eq}$
  - Section Modulus: $Z_{plat} = \frac{I}{NA} * \frac{1}{1000}$



GLOBAL STRENGTH DATA

- Ship divisions: Ship equally divided in number of tanks (ST).
- Tanks with load: Paired number of tanks in each end of the ship (LT)
- $Bouyancy = \frac{\nabla}{L}$
- $LW\ distributed = \frac{LW}{L}$
- $DW\ distributed = \frac{DW}{L * \frac{LT}{ST}}$

Resulting Load

Load Full Tanks (ton/m): -59.17857142857143

Load Empty Tanks (ton/m): 59.17857142857143

Established conditions: Always hogging.

Maximum Force (N*m): 1657

Maximum Moment (MN*m): 463.96

DNV Rules

Wave Coefficient (Cw) : 8.172273870249207

Stillwater Bending Moment (kN*m): 253606.91918153374

Wave Bending Moment (kN*m): 287097.917401594

Worst case scenario, seagoing condition.

GLOBAL STRENGTH DATA

- *Resulting load*
  - $L_{full} = Buoyancy - LW_d - DW_d$
  - $L_{empty} = Buoyancy - LW_d$
  - Always hogging condition, loaded tanks on the sides of the ship
  - $F_{max}\ and\ M_{max}$ from applying resulting loads to the ship
- DNV rules
  - CW: Table in pag 53.
  - $M_{so} = C_w * L^2 * B * (0.1225 - 0.015 * Cb)$ Pag 69.
  - $M_{wo} = 0.19 * C_w * L^2 * B * Cb$ Pag 70

GLOBAL STRENGTH DATA

Strenght Evaluation

Stillwater Bending Moment (kN*m): 463960

Total Bending Moment (kN*m): 751057.917401594

Midship Section Modulus (cm^3): 429175.9528009108

Conclusion: Plate holds

- *Strength evaluation*
  - *Comparison between DNV rules and values obtained in Resulting load*
  - *Maximum value is used*
  - $M_{tot} = M_{so} + M_{wo}$
  - $Z_{midship} = \frac{M_{tot}}{175}$
- *Conclusion*
  - *Check:* $Z_{plat} > Z_{midship}$

BIBLIOGRAPHY

- http://rules.dnvgl.com/docs/pdf/dnv/rulesship/2016-01/ts301.pdf

Table B1 Wave coefficient C_W	
L	C_W
$L \leq 100$	$0.0792\ L$
$100 < L < 300$	$10.75 - [\ (300 - L)/100\ ]^{3/2}$
$300 \leq L \leq 350$	10.75
$L > 350$	$10.75 - [\ (L - 350)/150\ ]^{3/2}$

Table C1 Moment of inertia I and section modulus Z for bulbprofile (HP) with attached plate. Profile (mm)

Profile (mm)	*I (cm⁴)*	*Z (cm³)*	*Plate included (mm)*
80 × 5	165	21	600 × 7
80 × 6	181	24	
80 × 7	196	26	
100 × 6	338	36	
100 × 7	365	39	
100 × 8	391	43	
120 × 6	567	52	
120 × 7	610	56	
120 × 8	653	61	
140 × 7	968	78	
140 × 8	1 025	83	
140 × 9	1 082	89	
160 × 7	1 590	110	600 × 10
160 × 8	1 684	117	
160 × 9	1 783	125	
180 × 8	2 477	157	
180 × 9	2 594	166	
180 × 10	2 733	177	
180 × 11	2 863	187	
200 × 9	3 630	214	
200 × 10	3 779	225	
200 × 11	3 950	238	
200 × 12	4 110	250	
220 × 10	5 177	288	
220 × 11	5 353	300	
220 × 12	5 500	311	
240 × 10	6 721	351	
240 × 11	7 031	371	
240 × 12	7 236	385	
260 × 11	9 015	450	
260 × 12	9 269	467	
260 × 13	9 511	483	
280 × 11	11 312	537	
280 × 12	11 657	559	
280 × 13	11 955	578	
300 × 11	14 073	639	
300 × 12	14 481	664	
300 × 13	14 589	688	
300 × 14	15 199	709	
300 × 11	14 961	653	600 × 12
300 × 12	15 412	678	
300 × 13	15 833	703	
300 × 14	16 209	725	
320 × 12	18 780	792	
320 × 13	19 272	820	
320 × 14	19 742	847	
320 × 15	20 157	871	
340 × 12	22 568	915	
340 × 13	23 165	947	
340 × 14	23 691	976	
340 × 15	24 195	1 004	