STRENGTH ANALYSIS, INCLUDING MIDSHIP SECTION

FOR

LMG 35-CRV

Doc. No. 389017-RE-220-N-LMG-00001

Revision: 02

Bergen, June 2020

Client	:	HAVFORSKNINGSINSTITUTTET
Key person	:	ROY ÅGE KLEPSVIK
Document title	:	STRENGTH ANALYSIS, INCLUDING MIDSHIP SECTION
Category	:	GENERAL STRENGTH VERIFICATION REPORT (MAIN HULL SCANTLINGS)
Project number	:	389017
Internal document number	:	389017- RE-220-N-LMG-00001
External distribution	:	SHIP YARD, MAIN VENDORS, BROKER AND SHIP OWNER ONLY
Classification	:	CONFIDENTIAL

THIS DOCUMENT DESCRIBES LMG 35-CRV A LMG MARIN DEVELOPED COASTAL RESEARCH VESSEL.

BY BUSINESS COMPETITIVE REASONS THIS DOCUMENT IS GRADED "CONFIDENTIAL", AND SHALL BE HANDLED BY THE RECEIVING PARTY THEREAFTER. IT SHALL NOT BE FORWARDED TO A THIRD PARTY WITHOUT PRIOR WRITTEN CONSENT BY LMG MARIN. IN PARTICULAR, THIS DOCUMENT SHALL NOT BE FORWARDED TO COMPETING DESIGNERS, SHIP OWNER DESIGN DEPARTMENTS OR SHIPYARD DESIGN DEPARTMENTS.

UNAUTHORISED DISTRIBUTION OR USE OF THIS DOCUMENT CAN RESULT IN CRIMINAL LIABILITY AND LIABILITY COMPENSATION.

02	18.06.20	HLE	PEMA	VOK	Utgitt for anbud
R01	27.06.19	BZY	GHA	WO	Issued for approval
Revision	**Date**	**By**	**Checked**	**Approved**	**Comments**

CONTENTS

1. INTRODUCTION ---------- 1

2. MAIN PARTICULAR AND RULE REFERENCE ---------- 1

2.1 MAIN PARTICULRS 1

2.2 GENERAL SHIP DATA 1

2.3 RULE REFERENCE 2

2.4 REFERENCE DOCUMENTS 2

2.5 SOFTWARE AND METHODOLOGY 2

3. NAUTICUS HULL, SECTION SCANTINGS ---------- 3

3.1 GLOBAL LOADS 3

3.2 DESIGN LOADS AND LOAD CONDITIONS 5

3.2.1 ACCOMMODATION AREA 6
3.2.2 LANDING AREA 6
3.2.3 EXTERNAL SEA PRESSURES AND ACCELERATIONS 6
3.2.4 MODELS 7
3.2.5 RESULTS 8
FRAME 35 (MIDSHIP) 8

4. PILLARS AND WATERTIGHT BULKHEADS ---------- 10

4.1 WATERTIGHT BULKHEAD FR. 3 11

4.2 WATERTIGHT BULKHEAD FR. 26 13

4.3 WATERTIGHT BULKHEAD FR. 38 15

4.4 WATERTIGHT BULKHEAD FR. 61 17

5. 3D-BEAM TRANSVERSE FRAME ANALYSES ---------- 19

BRIEF SUMMARY 19
FRAME (MIDSHIP SECTION) 19
RESULTS 20

6. CONCLUSION ---------- 24

APPENDIX A CROSS SECTION ANALYSIS RESULLTS ---------- 25

FRAME 5 25
FRAME 25 26
FRAME 45 28
FRAME 51 29

APPENDIX B PLATES THICKNESS AND STIFFENERS SIZE ----------31

APPENDIX C 3D-BEAM TRANSVERSE FRAME ANALYSES FULL RAPORT-----34

APPENDIX D NAUTICUS HULL REPORT #35----------64

1. INTRODUCTION

The strength calculations have been performed for the new LMG 35-CRV intended for scientific research in coast of Norway.

Purpose of this report is strength analysis and verification of hull structure including midship section according to DNVGL Rules for Ships (July 2018).

The LMG 35-CRV is a 35m long vessel, equipped with stern A-frames, telescopic cranes onboard winches and cranes (deck), scientific hangar (with lifting equipment for handling CTD). The vessel also has a capacity for 14 persons onboard.

The material used everywhere is normal steel grade(VLA) with a yield stress of 235 N/mm2, giving a material factor k equal to 1. Part of wheelhouse (above bridge deck 8600) is made of aluminium (i.e 5083 grade).

This report presents the structural dimensioning using DNV Nauticus Hull and manual calculations and (additionally) in Nauticus 3d-beam software. All the calculations are based on DNVGL Rules for Ships (July 2018) Part 3 Hull.

The vessel is generally to be constructed with transversal stiffening of decks and shell, and with deck transverse web frames on every 2000mm. Stiffener spacing in decks is in general 500mm.

2. MAIN PARTICULAR AND RULE REFERENCE

2.1 MAIN PARTICULRS

Length overall	LOA:	35.0	m
Length between perpendiculars	Lbp:	32.2	m
Breadth moulded	B:	10.00	m
Depth (to Main Deck), moulded	D:	4.60	m
Draught , scantling	T:	3.5	m

2.2 GENERAL SHIP DATA

Maximum service speed	V:	11	kn
Frame spacing		500	mm
Main transverse frame spacing (steel)		2000	mm
Longitudinal frame spacing (steel)	Decks:	2000	mm

2.3 RULE REFERENCE

The class notation for the vessel is: DNVGL +1A R2.

The calculations are based on design loads and acceptance criteria from the following rules:

- DNVGL Rules for ships (July 2018) :
  Part 3 Hull, especialy:
  Part 3 Hull Chapter 4: Loads

2.4 REFERENCE DOCUMENTS

The basis for information is taken from the following documents:

389017-DW-101-C-LMG-00001 General arrangement preliminary (dated 13.03.2019)
389017-TS-101-Z-LMG-00001 Technical Specification
Drawings: 389017-DW-220-N-LMG-00001 Shell Expansion,
389017-DW-220-N-LMG-00002 Midship Section,
389017-DW-220-N-LMG-00003 Profile and plan,
389017-DW-220-N-LMG-00004 Watertight bulkheads

2.5 SOFTWARE AND METHODOLOGY

Nauticus Hull is computer program provided by DNVGL for efficient hull design and verification of compliance with Class Ruless (DNVGL Rules for Ships July 2018).
Nauticus Hull64 (ver. 20.7.102.) is used for purpose of this report.

Global hull girder strength and hull local scantling for midship section (fr. #35 and other cross sections fr. #5, #25, #45, 51) are verified with using of NauticusHull according to DNVGL Rules for Ships (July 2018). Results of analysis are presented in this report.
Models in NauticusHull consist of plating (shell plates, deck plates) and transversal stiffeners.
Hull's structure parts as: watertight bulkhead, tanks, pillars not included in cross sections are checked manually (acc. to the rules) and also included in this report.

3. NAUTICUS HULL, SECTION SCANTINGS

This part presents global verification of hull girder and the dimensioning of longitudinal elements, including plates and stiffeners in hull, ship sides, decks and bulkheads. For these calculations DNV Nauticus Hull software has been used.

3.1 GLOBAL LOADS

The design stillwater bending moments amidships are found to be 2617 KNm(Sagging) and 3919 kNm (Hogging) The max design wave bending moments is found to be 4742 kNm (Hogging) and 5581 kNm (Sagging).
The global hull moments used in the design process is distributed over the ship length as follows:

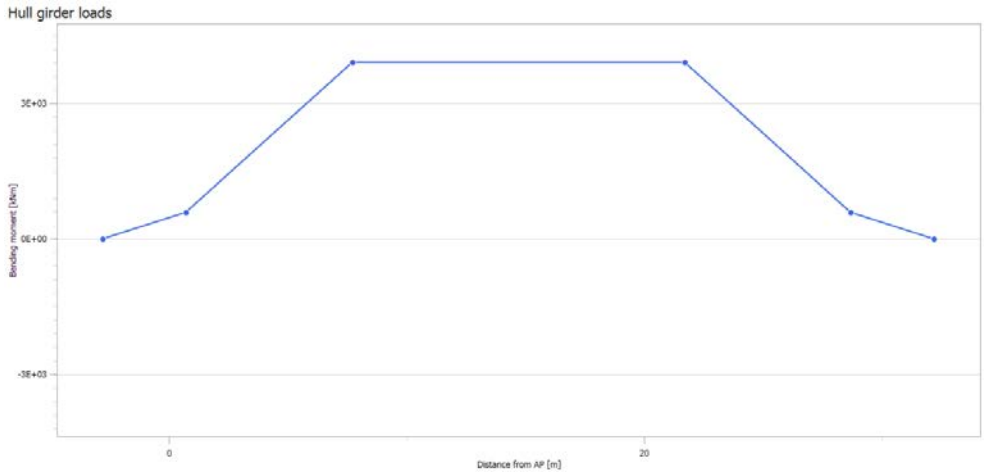


Figure 1. Stillwater bending moment (Hogging).

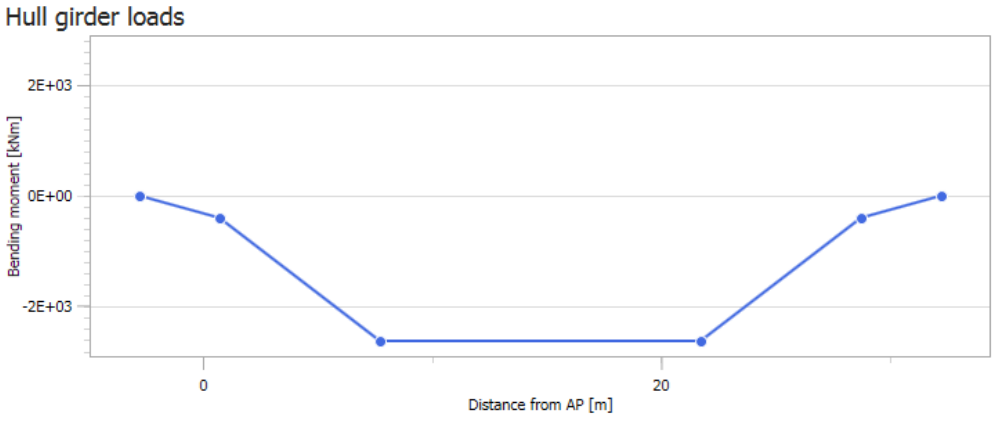


Figure 2. Stillwater bending moment (Sagging).

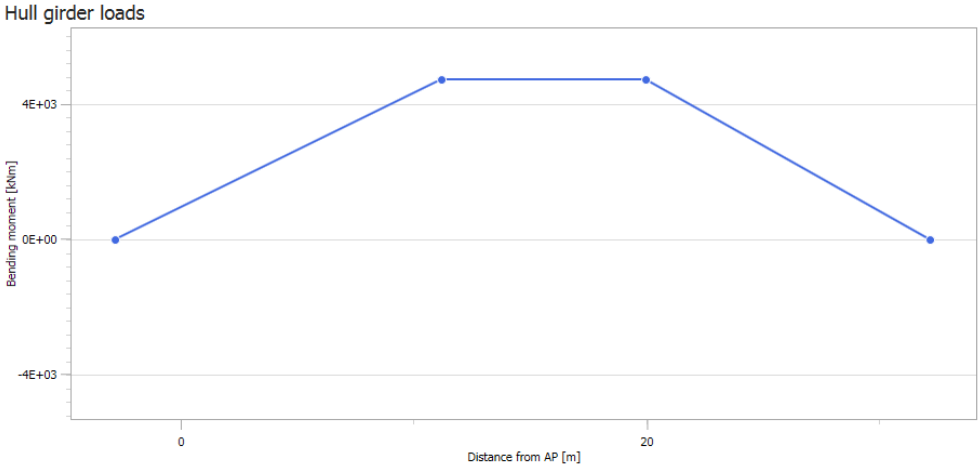


Figure 3. Wave bending moment in Hogging.

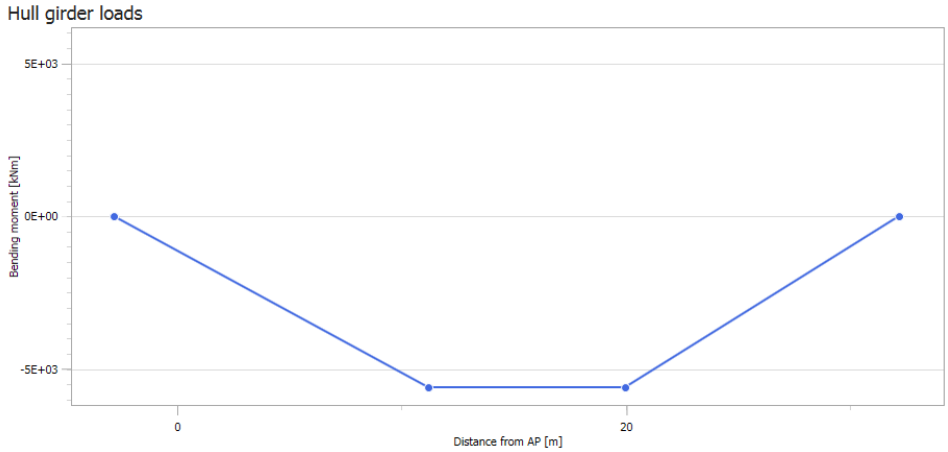


Figure 4. Wave bending moment in Sagging.

3.2 DESIGN LOADS AND LOAD CONDITIONS

Load conditions with defined compartments definition, external, and internal deck loads were applied in NauticusHull as below . User defined deck loads application is shown below. All required dynamic load cases are then next calculated and verified by the program.

Figure 5. Load conditions, compartment and user defined loads on decks.

Deck loads are defined according to DNVGL Rules for Ship (July 2018) Part3, Chapter 4 Section 5 (2.3 Loads carried on decks and platforms) as:

Distributed load for the static plus dynamic (S+D) is taken as:

$$\mathbf{P_{dl} = P_{dl\text{-}s} + P_{dl\text{-}d}}$$

Where:

$\mathbf{P_{dl\text{-}s}}$ = static pressure due to the distributed load, to be definied by the designer
$\mathbf{P_{dl\text{-}d}}$ = dynamic pressure due to the distributed load = $\mathbf{P_{dl\text{-}s} * a_z / g}$,
where $\mathbf{a_z}$ vertical acceleration

3.2.1 ACCOMMODATION AREA

The pressure on decks in the accommodation areas shall be taken according to DNVGL PT.3 CH.4 Sec.6 . For accommodation decks minimum static load shall be not less than 2.5 kN/m2 thus design load (S+D, Static =0.25 t/m2 + Dynamic=0.5* 0.25 t/m2 and conservatively taken as 0.5 t/m2) is defined as:

a_z/g	P_{dl}[kN/m2]
0.5	5

3.2.2 LANDING AREA

Load (from container, trawls, bottom samples, etc) on main deck or hangar in the landing area (i.e frame 5) is taken as distributed load (static + dynamic where static load is 20 kN/m2 as indicated on the general arrangement drawing) acc. to DNVGL PT.3 CH.4 Sec.5

a_z/g	P_{dl}[kN/m2]
0.5	30

3.2.3 EXTERNAL SEA PRESSURES AND ACCELERATIONS

External Sea pressure is calculated in Nauticus program giving the result all along the ship length, height and at any single point. At bottom position x= Fr #35, y=0, z=0 sea pressure and acceleration are depicted below:

Input:	
X-position, LCP [Frame No.]	#35
Y-position, LCP [mm]	0
Z-position, LCP [mm]	0
Select position for load application	Bottom
Select associated PSM (if applicable)	<------->
Select compartment 1	External
Select compartment 2	External
Load scenario	-All-
Results:	
Information	
Design cases for Comp. 1	**ExtremeSea_SD, SEA-1...**
Design pressure, P, for Comp.1 [kN/m2]	**42.0**
Design cases for Comp. 2	**ExtremeSea_SD, SEA-1...**
Design pressure, P, for Comp.2 [kN/m2]	**42.0**
Max static+dynamic design press. [kN/m2]	**42.0**
Max static design press. [kN/m2]	**35.2**

Input:	
X-Position, calc. point [Frame No.]	#35
Y-Position, calc. point [mm]	0
Z-Position, calc. point [mm]	0
Load Scenario	-All-
Maximize	aZ
Results:	
Critical loadcase	**BWExchange_SD, Full Loa**
a_x [m/s2]	-0.537
a_y [m/s2]	-3.683
a_z [m/s2]	4.774
Max a_{x_env} [m/s2]	1.822
Max a_{y_env} [m/s2]	6.353
Max a_{z_env} [m/s2]	5.880
Max $a_{z\_env\_pitch}$ [m/s2]	5.880
Max $a_{z\_env\_roll}$ [m/s2]	5.752

Figure 6. External sea pressure and acceleration.

NOTES : For the analyse in the 3d-beam model applied sea pressure is based on sea pressure calculated by Nauticus. All pressures loads are multiplied by width of load area, which gives a line load in kN/m used in the 3d-beam model.

3.2.4 MODELS

For the midship sections, decks, transverse stiffeners and longitudinal girders have been modelled to check the global requirements of section modulus.

The Main Deck at 4600 mm above baseline has been defined as strength deck.

The following structures have been included as longitudinal strength elements with 100% bending and shear efficiency:
Outer Hull
Tank Top (TankTopp) 2000 mm
Main Deck (Hoveddekk) 4600 mm
1 Deck (1.Dekk) 7200 mm
All frames forward and aft of midship area have been modelled to determine where requirements for plate thicknesses and stiffener dimension changes due to higher accelerations.

All the transverse stiffeners are bulb profiles (HP). Bulb profiles varies in size as HP140x7 , HP120x6, HP180x10, HP100x6, HP80x6.

The stiffener spacing on decks and hull is 500 mm, The main transverse web frame spacing is 2000 mm. Longitudinal deck girder size is typically 400x7/100x10.

Minimum plate thickness (gross) is 6.5 mm – 7 mm (i.e. decks, internal walls, sides above el. 4600). Used bottom plates are min 8. mm (gross), decks in landing areas are also 8 mm.

Thickness of plates and size of stiffeners are presented in Appendix B

3.2.5 RESULTS

Hull girder and Midship section (frame 35) were check according to DNVGL rules with using of NAUTICUS/ hull. Hull girder /Midship section , all the plates and stiffeners are sized to be in compliance with the rules as presented below (for other cross sections see Appendix A).

FRAME 35 (MIDSHIP)

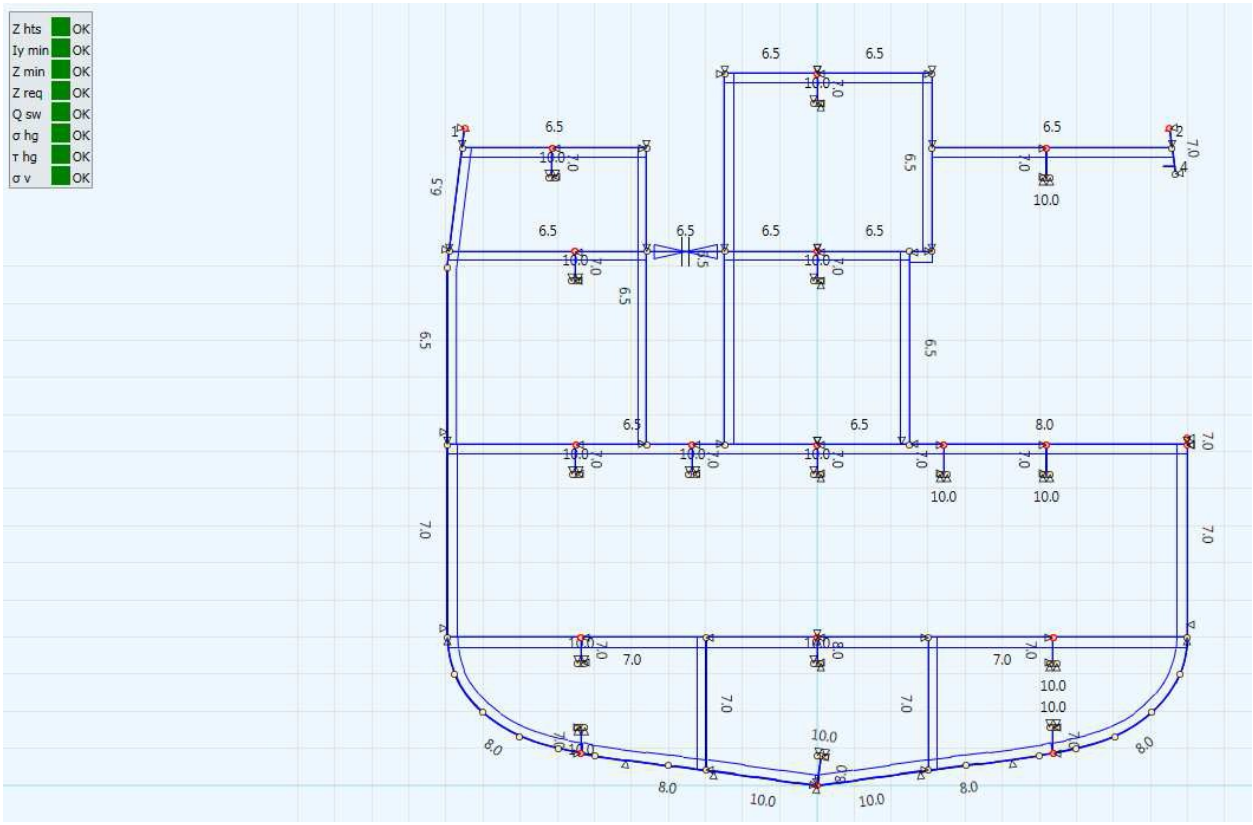


Figure 7. Hull girder minimum requirements in midship part is OK

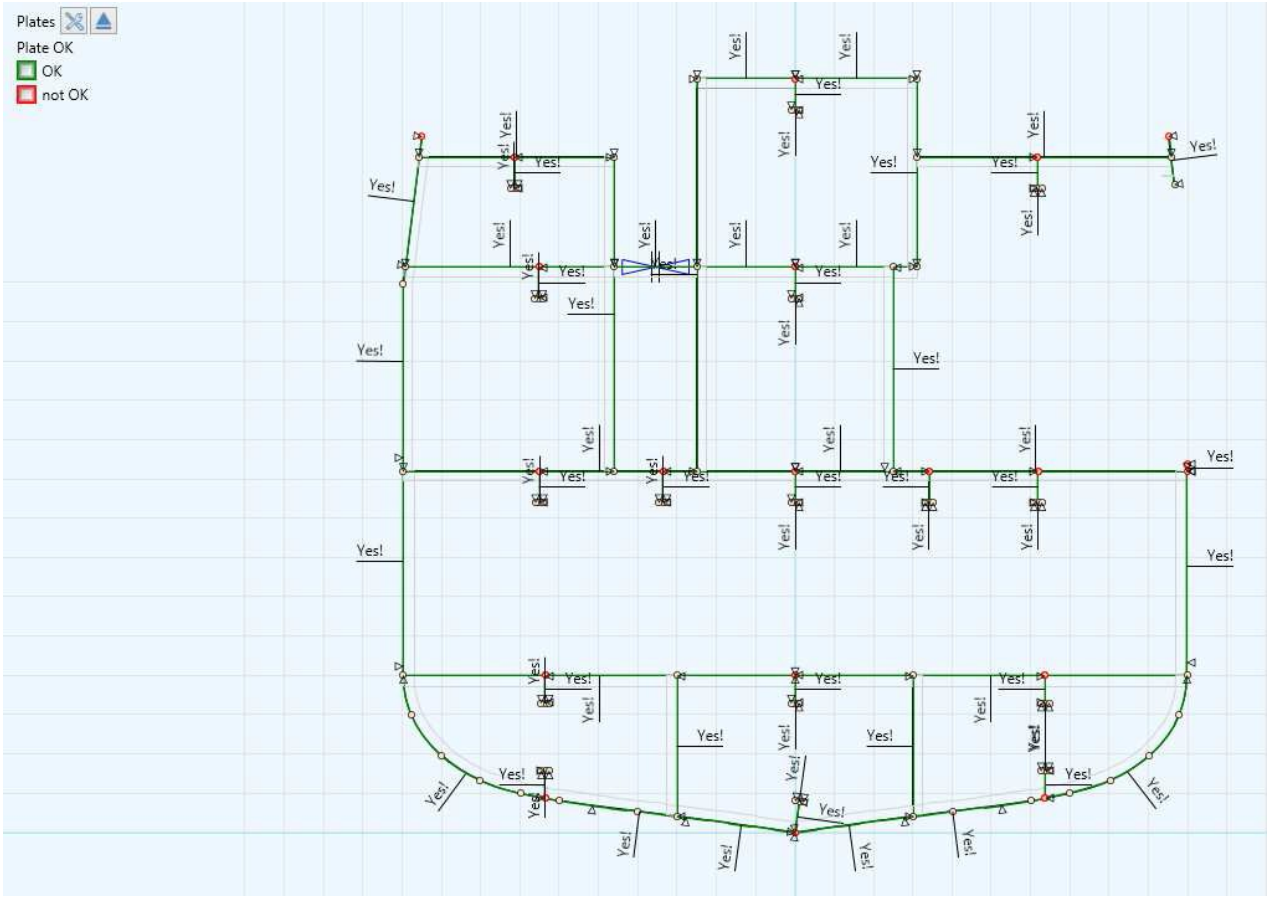


Figure 8. Midship section plates verification is OK.

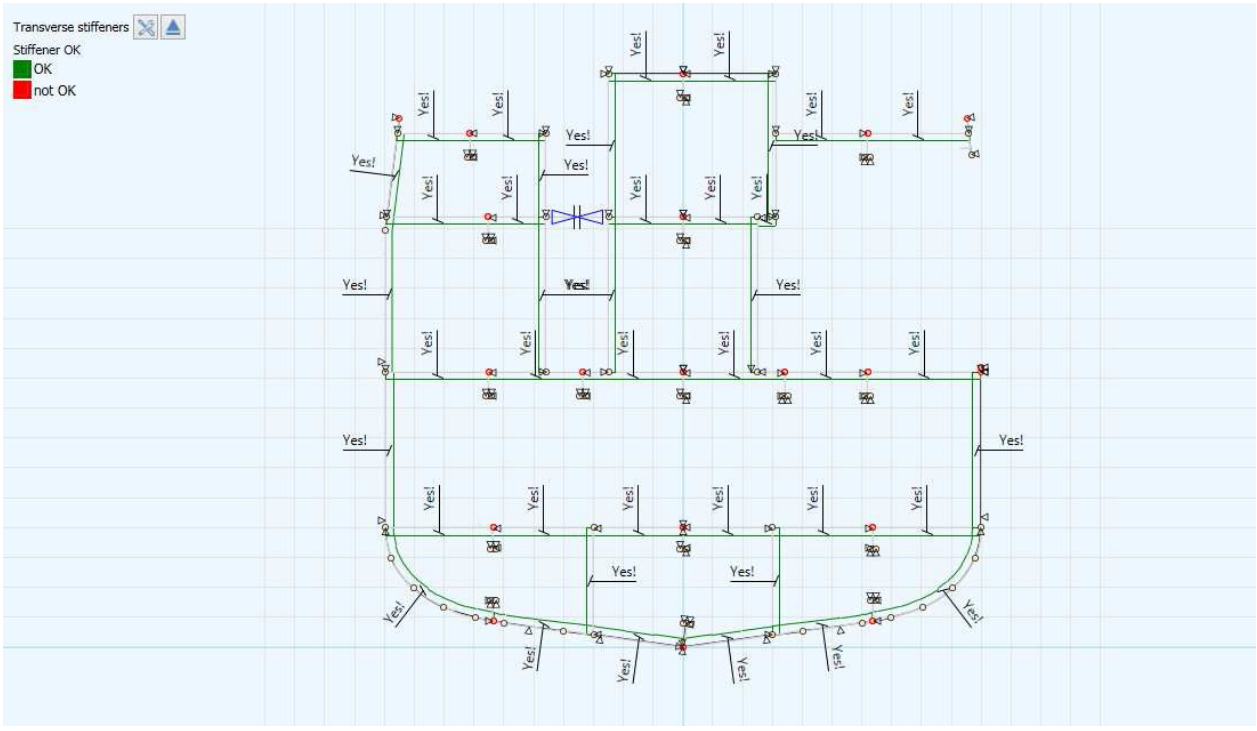
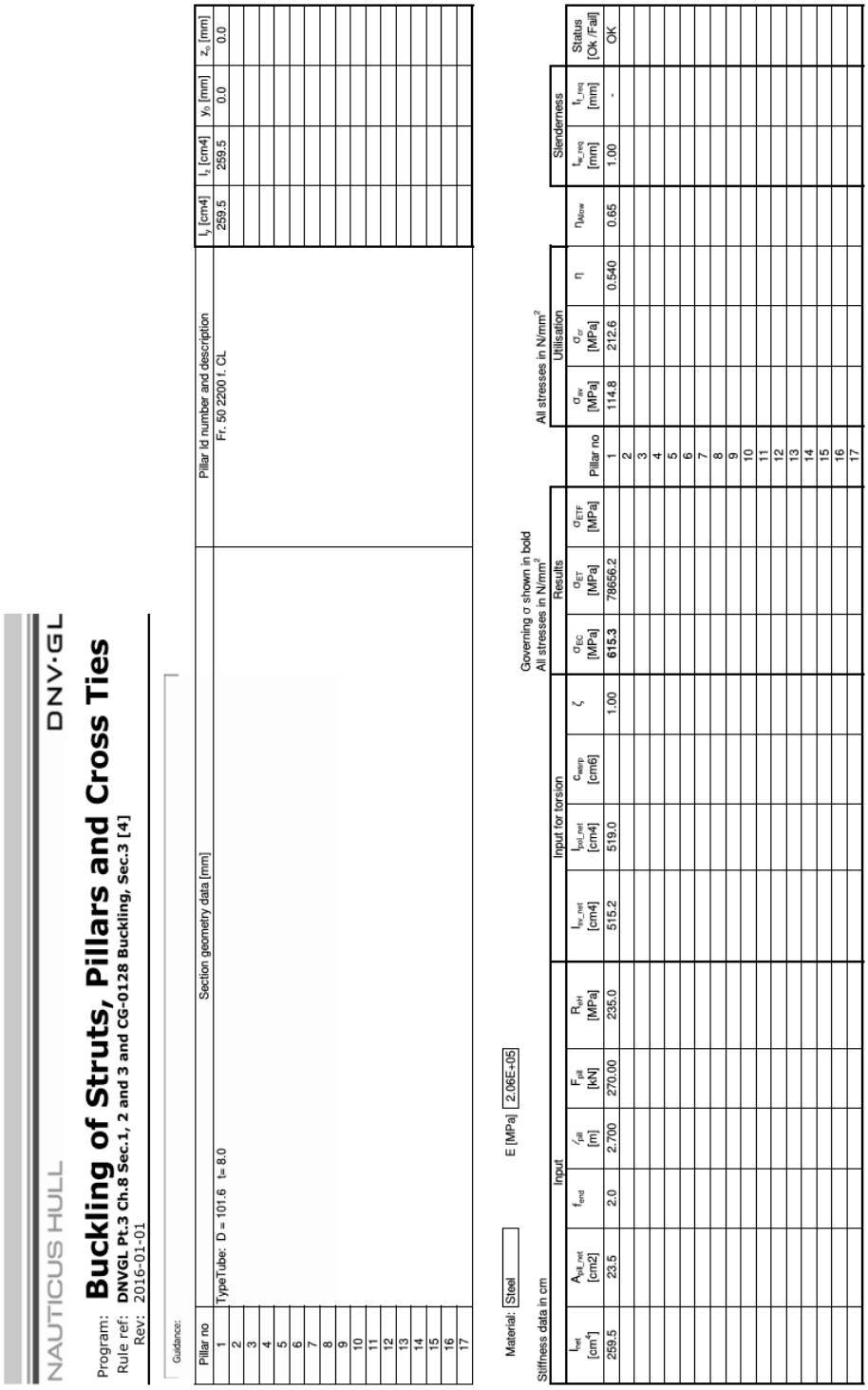


Figure 9. Midship section stiffeners verification is OK.

4. PILLARS AND WATERTIGHT BULKHEADS

The buckling of pillars are checked directly according to Part 3 Chapter 8, Section 3 and Part 3 Chapter 6, Section 6 3.1. One pillar is intended to support a surface of 3 x 3 m. Location of pillar is between tank top (TANKTOPP) and main deck (HOVEDDEKK), 2200 mm of CL, frame 50 . The results are presented below.



NAUTICUS HULL DNV·GL

Buckling of Struts, Pillars and Cross Ties

Program: **DNVGL Pt.3 Ch.8 Sec.1, 2 and 3 and CG-0128 Buckling, Sec.3 [4]**
Rule ref: 2016-01-01
Rev:

Guidance:

Material: Steel E [MPa] 2.06E+05

Governing σ shown in bold
All stresses in N/mm²

Pillar no	Section geometry data [mm]	Pillar id number and description	I_y [cm4]	I_z [cm4]	y_0 [mm]	z_0 [mm]
1	TypeTube: D = 101.6 t= 8.0	Fr. 50 2200 f. CL	259.5	259.5	0.0	0.0
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

Stiffness data in cm

I_{net} [cm⁴]	A_{sft_net} [cm2]	f_{end}	r_{gir} [m]	F_{sft} [kN]	R_{eH} [MPa]	Input for torsion: I_{tor_net} [cm4]	I_{pol_net} [cm4]	c_{warp} [cm6]	ζ	Results: σ_{EC} [MPa]	σ_{ET} [MPa]	σ_{ETF} [MPa]	Pillar no	Utilisation: σ_{av} [MPa]	σ_{cr} [MPa]	η	n_{Alow}	Slenderness: t_{w_req} [mm]	t_{f_req} [mm]	Status [Ok /Fail]
259.5	23.5	2.0	2.700	270.00	235.0	515.2	519.0		1.00	**615.3**	78656.2		1	114.8	212.6	0.540	0.65	1.00	-	OK
													2							
													3							
													4							
													5							
													6							
													7							
													8							
													9							
													10							
													11							
													12							
													13							
													14							
													15							
													16							
													17							

4.1 WATERTIGHT BULKHEAD FR. 3

The design pressures on watertight bulkheads and tanks (tank top) are calculated according to Part.3, Chapter 4, Section 6. The side part of watertight bulkhead on fr. 3 from 2000 from CL is also the tank boundary thus is used pressure loads as for the tank (the tank testing pressure shall be taken). Tank test pressure is calculated according to Part 3 Chapter 4, Section 6 , 1.2.5 Tank Testing:

$$P_{ls\text{-}ST} = 10(z_{ST} - z) \ \ kN/m^2$$

where:

$z_{ST} = z_{top} + h_{air} = 5{,}36$ m - testing load height
$z = 2{,}43$ m - distance from baseline to load point
$z_{top} = 4{,}6$ m – Tanktop

Height of air pipe h_{air} is 0,76 m above the Tanktop. Density of fluid 1.025 t/m3.

Max pressure is :

	p[kN/m2]
Bulkhead (z = 2170 - 4600)	29,3

The dimensioning of plates and stiffeners has been checked according to above.

Thus minimal required plate thickness (without corrosion addition) is 5 mm, 7 mm plate (plate with corrosion addition) is used on watertight bulkhead, stiffener calculation length is taken as l=2,36 m (see figure 10). The required Z net section modulus of bulkhead stiffener is 37,6 cm^3. The calculated Z net section modulus for stiffeners HP 120x6 with attached plate (7x500 mm) is 48,4 cm^3.

The side part of the watertight bulkhead on fr. 3, 2000 from CL should be also check, as a watertight bulkhead in the damaged condition and used the internal pressure in flooded condition on watertight bulkheads shall be taken . The internal pressure in flooded condition on watertight bulkheads is calculated according to Part 3 Chapter 4, Section 6 , 1.2.7 Flooding:

$$P_{fs} = \rho g h_{fs} \ \ kN/m^2$$

where:

$\rho = 1{,}025$ t/m^3
$g = 9{,}81$ m/s^2
$Y = 4$ m - distance from CL to load point
$Z = 2{,}55$ m - distance from BL to load point
$Z_{fd} = 4{,}6$ m - distance from BL to the freeboard deck
$Z_{dam} = 4{,}55$ m - distance from BL to the deepest equilibrium waterline at center line in the damaged condition

Θ_{dam} = 15° - angle between the deepest equilibrium waterline in the damaged condition (or in intermediate stages of flooding) and the base line.
$h_{fs} = Z_{fd} - Z$ = 2,05 m - pressure height in flooded condition angle 0°,
$h_{fs} = Y*\sin\Theta_{dam} + (Z_{dam} - Z)*\cos\Theta_{dam}$ = 2,97 m - pressure height in flooded condition angle 15°,

Max pressure is :

	p[kN/m2]
Angle 0° Bulkhead(z = 0-4600)	20,61
Angle 15° Bulkhead(z = 0-4600)	29,83

The dimensioning of plates and stiffeners has been checked according to above.

Thus minimal required plate thickness (without corrosion addition) is 5 mm, 7 mm plate (plate with corrosion addition) is used on watertight bulkhead, stiffener calculation length is taken as l=2530 m (see figure10). The required Z net section modulus of bulkhead stiffener is 41,85 cm^3. The calculated Z net section modulus for stiffeners HP 120x6 with attached plate (7x500 mm) is 48,4 cm^3.

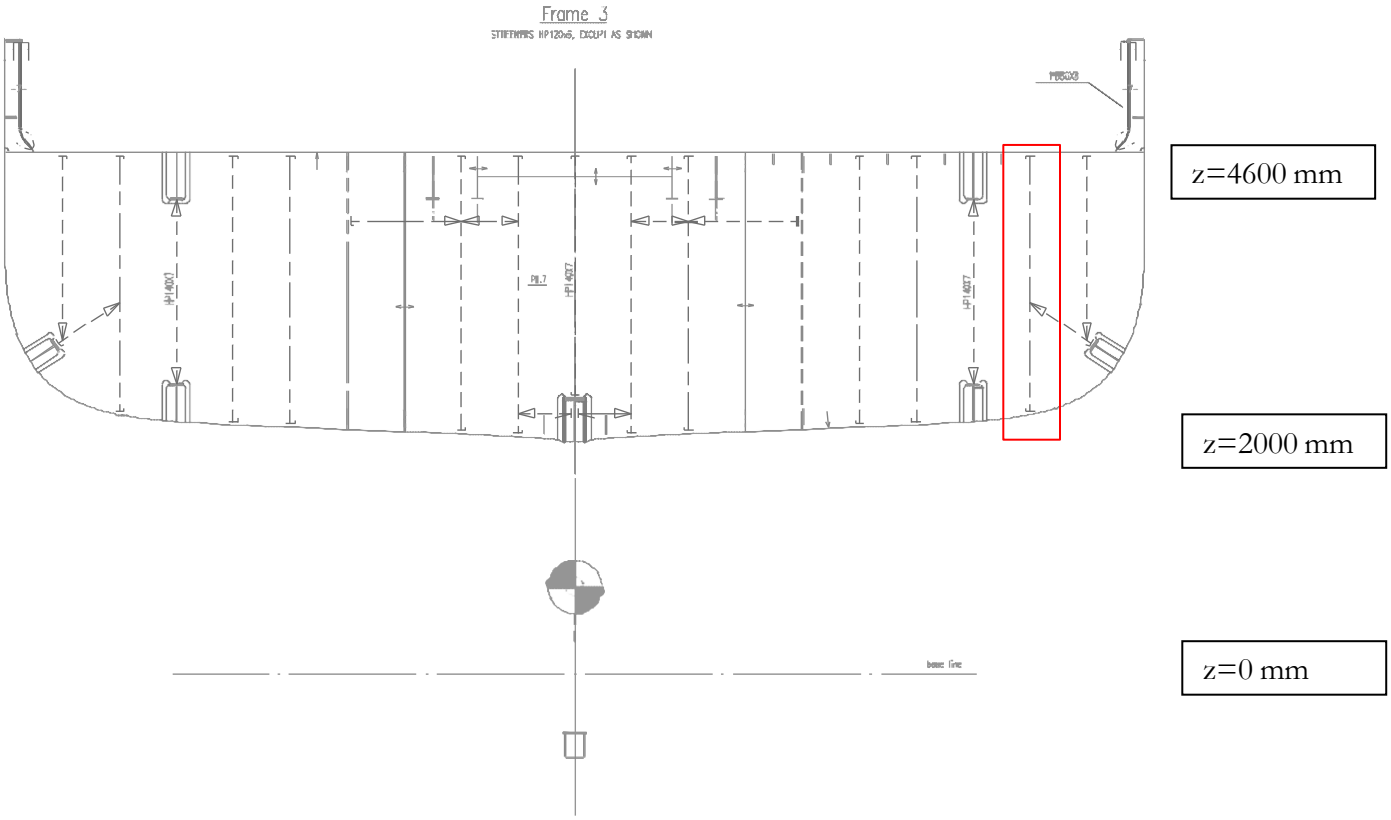


Figure 10. Frame #3 Bulkhead plate thickness and stiffeners size.

4.2 WATERTIGHT BULKHEAD FR. 26

The design pressures on watertight bulkheads and tanks (tank top) are calculated according to Part.3, Chapter 4, Section 6. The lower part of watertight bulkhead on fr. 26 below tanktop 2000 from BL is also the tank boundary thus is used pressure loads as for the tank (the tank testing pressure shall be taken). Tank test pressure is calculated according to Part 3 Chapter 4, Section 6 , 1.2.5 Tank Testing:

$$P_{ls\text{-}ST} = 10(z_{ST} - z) \ \ kN/m^2$$

where:

$z_{ST} = z_{top} + h_{air} = 7{,}96$ m - testing load height
$z = 1$ m - distance from baseline to load point
$z_{top} = 2$ m – Tanktop

Height of air pipe h_{air} is 5,96 m above the Tanktop. Density of fluid 1.025 t/m^3.

Max pressure is :

	p[kN/m2]
Bulkhead (z = 0-2000)	69,6

The dimensioning of plates and stiffeners has been checked according to above.

Thus minimal required plate thickness (without corrosion addition) is 5 mm, 7 mm plate (plate with corrosion addition) is used on watertight bulkhead, stiffener calculation length is taken as l=1,25 m (see figure 11). The required Z (net section modulus) of bulkhead stiffener is 25,1 cm^3. The calculated Z net section modulus for stiffeners HP 120x6 with attached plate (7x250 mm) is 43,4 cm^3.

The upper part of watertight bulkhead on fr. 26 above tanktop 2000 from BL is not the tank boundary thus is used pressure loads as for the watertight bulkhead(the internal pressure in flooded condition on watertight bulkheads shall be taken). The internal pressure in flooded condition on watertight bulkheads is calculated according to Part 3 Chapter 4, Section 6 , 1.2.7 Flooding:

$$P_{fs} = \rho g h_{fs} \ \ kN/m^2$$

where:

$\rho = 1{,}025$ t/m^3
$g = 9{,}81$ m/s^2
$Y = 4{,}5$ m - distance from CL to load point
$Z = 2{,}25$ m - distance from BL to load point
$Z_{fd} = 4{,}6$ m - distance from BL to the freeboard deck
$Z_{dam} = 4{,}55$ m - distance from BL to the deepest equilibrium waterline at center line in the damaged condition
$\Theta_{dam} = 15°$ - angle between the deepest equilibrium waterline in the damaged condition (or in intermediate stages of flooding) and the base line.
$h_{fs} = Z_{fd} - Z = 2{,}35$ m - pressure height in flooded condition angle 0°,

$\mathbf{h_{fs}}$ =Y*sinΘ_{dam} + (Z_{dam} – Z)*cosΘ_{dam} = 3,39 m - pressure height in flooded condition angle 15°,

Max pressure is :

	p[kN/m2]
Angle 0° Bulkhead(z = 2000-4600)	23,63
Angle 15° Bulkhead(z = 2000-4600)	34,09

The dimensioning of plates and stiffeners has been checked according to above.

Thus minimal required plate thickness (without corrosion addition) is 5 mm, 7 mm plate (plate with corrosion addition) is used on watertight bulkhead, stiffener calculation length is taken as l=2,53 m (see figure11). The required Z (net section modulus) of bulkhead stiffener is 47,8 cm^3. The calculated Z net section modulus for stiffeners HP 120x6 with attached plate (7x500 mm) is 48,4 cm^3.

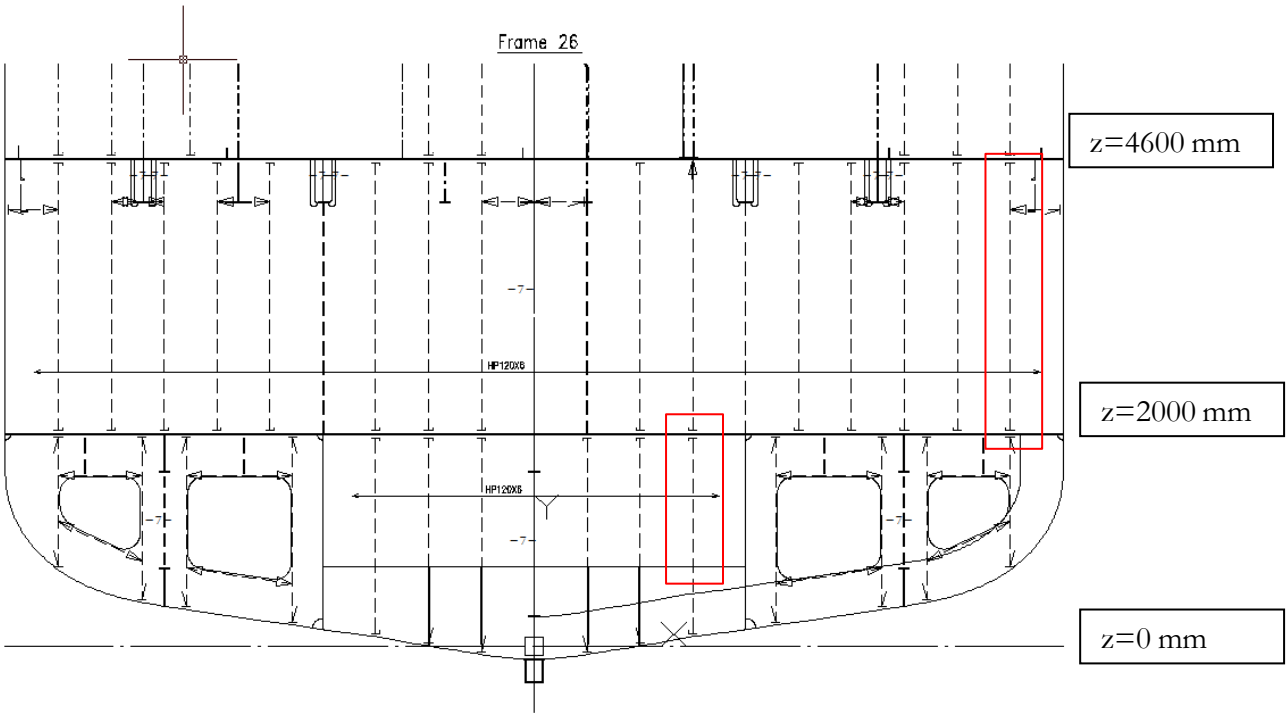


Figure 11. Frame #26 Bulkhead plate thickness and stiffeners size.

4.3 WATERTIGHT BULKHEAD FR. 38

The design pressures on watertight bulkheads and tanks (tank top) are calculated according to Part.3, Chapter 4, Section 6. The lower part of watertight bulkhead on fr. 38 below tanktop 2000 from BL is also the tank boundary thus is used pressure loads as for the tank (the tank testing pressure shall be taken). Tank test pressure is calculated according to Part 3 Chapter 4, Section 6 , 1.2.5 Tank Testing:

$$\mathbf{P_{ls\text{-}ST} = 10(z_{ST} - z)\ \ kN/m^2}$$

where:

$\mathbf{z_{ST}} = z_{top} + h_{air} = 7{,}96$ m - testing load height
$\mathbf{z} = 0{,}63$ m - distance from baseline to load point
$\mathbf{z_{top}} = 2$ m – Tanktop

Height of air pipe $\mathbf{h_{air}}$ is 5,96 m above the Tanktop. Density of fluid 1.025 t/m^3.

Max pressure is :

	p[kN/m2]
Bulkhead (z = 0-2000)	73,3

The dimensioning of plates and stiffeners has been checked according to above.

Thus minimal required plate thickness (without corrosion addition) is 5 mm, 7 mm plate (plate with corrosion addition) is used on watertight bulkhead, stiffener calculation length is taken as l=1,56 m (see figure 12). The required Z net section modulus of bulkhead stiffener is 41,2 cm^3. The calculated Z net section modulus for stiffeners HP 120x6 with attached plate (7x315 mm) is 44,1 cm^3.

The upper part of watertight bulkhead on fr. 38 above tanktop 2000 from BL is not the tank boundary thus is used pressure loads as for the watertight bulkhead(the internal pressure in flooded condition on watertight bulkheads shall be taken). The internal pressure in flooded condition on watertight bulkheads is calculated according to Part 3 Chapter 4, Section 6 , 1.2.7 Flooding:

$$\mathbf{P_{fs} = \rho g h_{fs}\ \ kN/m^2}$$

where:

Y = 4,5 m - distance from CL to load point
Z= 2,25 m - distance from BL to load point
$Z_{fd} = 4{,}6$ m - distance from BL to the freeboard deck
$Z_{dam} = 4{,}55$ m - distance from BL to the deepest equilibrium waterline at center line in the damaged condition
$\Theta_{dam} = 15°$ - angle between the deepest equilibrium waterline in the damaged condition (or in intermediate stages of flooding) and the base line.
$\mathbf{h_{fs}} = Z_{fd} - Z = 2{,}35$ m - pressure height in flooded condition angle 0°,
$\mathbf{h_{fs}} = Y*\sin\Theta_{dam} + (Z_{dam} - Z)*\cos\Theta_{dam} = 3{,}39$ m - pressure height in flooded condition angle 15°,

Max pressure is :

	p[kN/m2]
Angle 0° Bulkhead(z = 2000-4600)	23,63
Angle 15° Bulkhead(z = 2000-4600)	34,09

The dimensioning of plates and stiffeners has been checked according to above.

Thus minimal required plate thickness (without corrosion addition) is 5 mm, 7 mm plate (plate with corrosion addition) is used on watertight bulkhead, stiffener calculation length is taken as l=2,53 m (see figure12). The required Z net section modulus of bulkhead stiffener is 47,74 cm3. The calculated Z net section modulus for stiffeners HP 120x6 with attached plate (7x500 mm) is 48,4 cm3

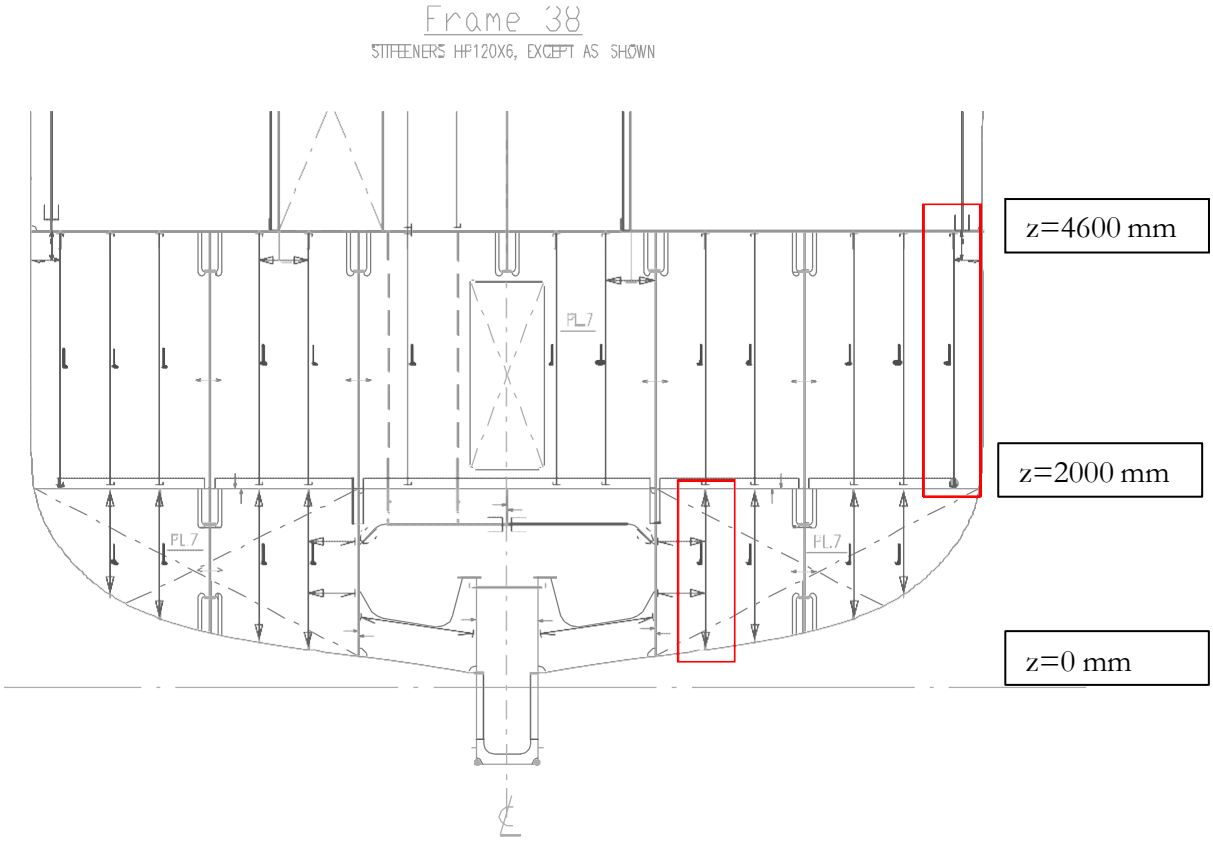


Figure 12. Frame #38 Bulkhead plate thickness and stiffeners size.

4.4 WATERTIGHT BULKHEAD FR. 61

The design pressures on watertight bulkheads and tanks (tank top) are calculated according to Part.3, Chapter 4, Section 6. Watertight bulkhead on fr. 61 below tanktop 5000 from BL is also the tank boundary thus is used pressure loads as for the tank (the tank testing pressure shall be taken). Tank test pressure is calculated according to Part 3 Chapter 4, Section 6 , 1.2.5 Tank Testing:

$$\mathbf{P_{ls\text{-}ST} = 10(z_{ST} - z)\ \ kN/m^2}$$

where:

$\mathbf{z_{ST}} = z_{top} + h_{air} = 7{,}96$ m - testing load height
$\mathbf{z} = 2{,}25$ m - distance from baseline to load point
$\mathbf{z_{top}} = 5$ m – Tanktop

Height of air pipe h_{air} is 2,96 m above the Tanktop. Density of fluid 1.025 t/m^3.

Max pressure is :

	p[kN/m2]
Bulkhead (z = 0-5000)	57,1

The dimensioning of plates and stiffeners has been checked according to above.

Thus minimal required plate thickness (without corrosion addition) is 5 mm, 7 mm plate (plate with corrosion addition) is used on watertight bulkhead, stiffener calculation length is taken as l=1 m (see figure 12). The required Z net section modulus of bulkhead stiffener is 13,2 cm^3. The calculated Z net section modulus for stiffeners HP 120x6 with attached plate (7x200 mm) is 42,6 cm^3.

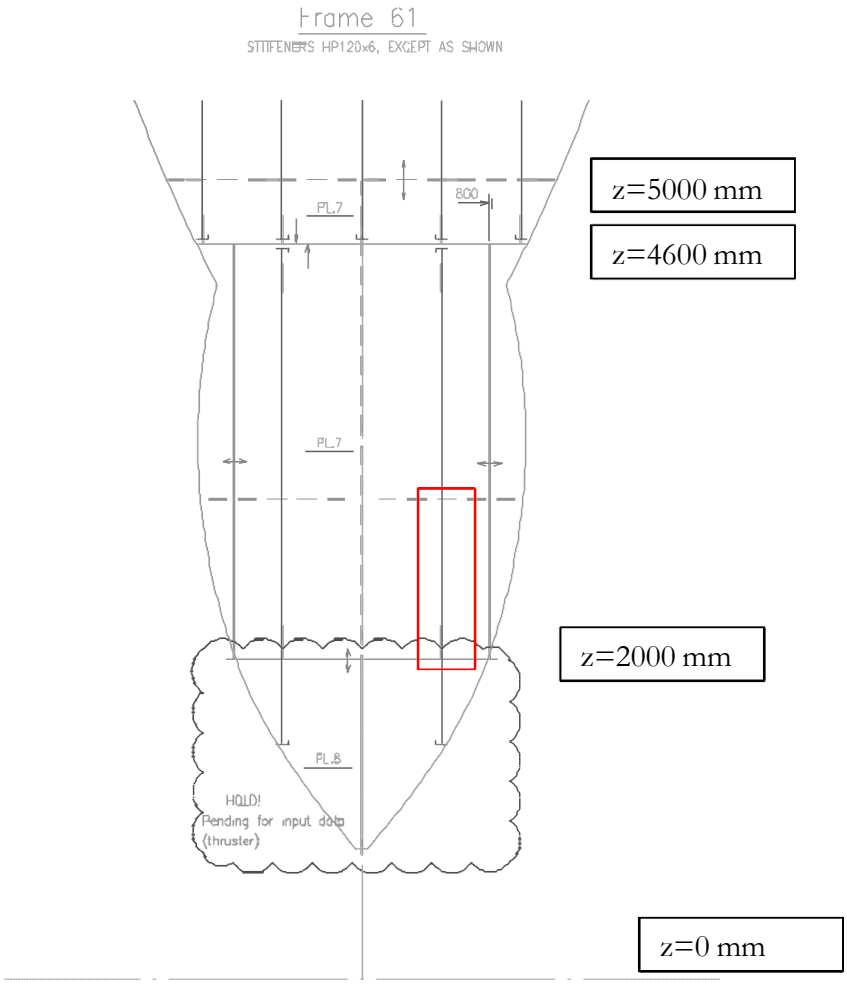


Figure 13. Frame #61 Bulkhead plate thickness and stiffeners size.

5. 3D-BEAM TRANSVERSE FRAME ANALYSES

BRIEF SUMMARY

Midship Section frame model (see below) was calculated in 3D-BEAM analysis program according to DNVGL-CG-0127 Sec.5. For this section, the input loads are calculated according to section 3.2 of this document..
Following load have been applied:
- LC 1 Dynamic sea pressures + self-weight + accommodation/landing (trawls, containers, etc) loads on decks + weather (DNVGL rules) as previously defined in section 3.2.

FRAME (MIDSHIP SECTION)

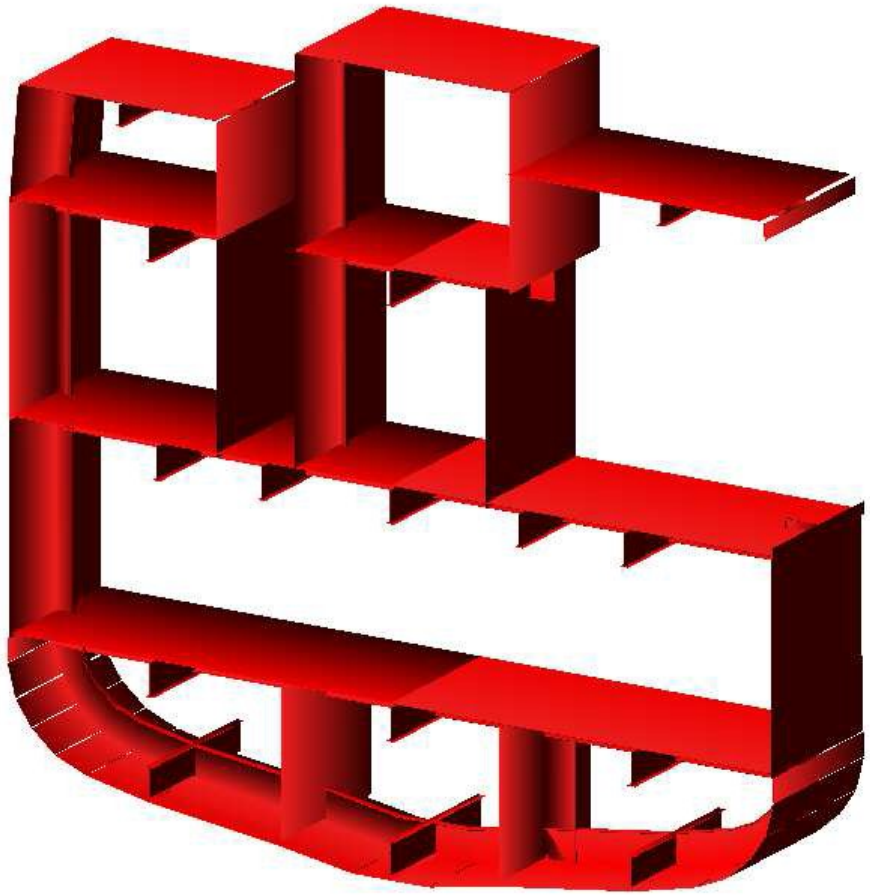


Figure 14. Midship Section, 3D-Beam Model

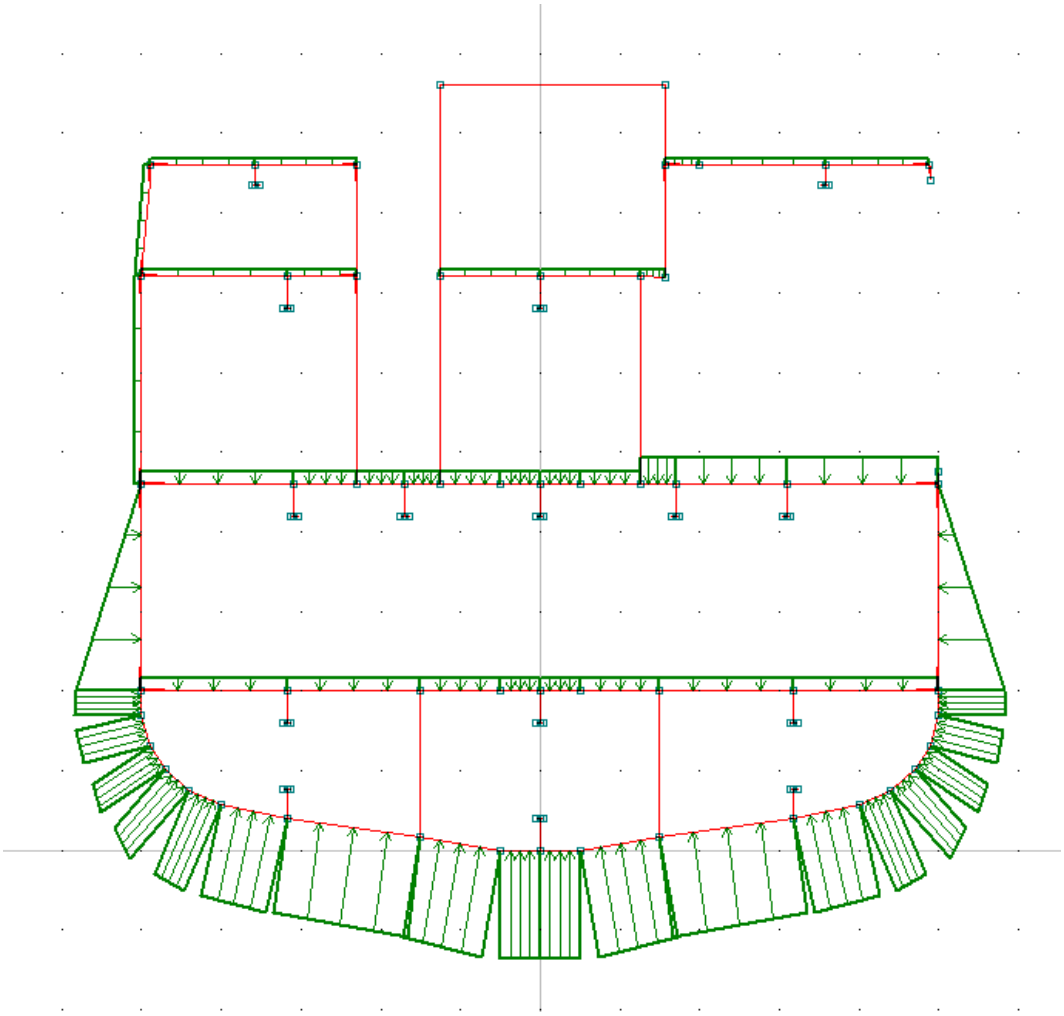


Figure 15. Midship Section, Applied Loads

RESULTS

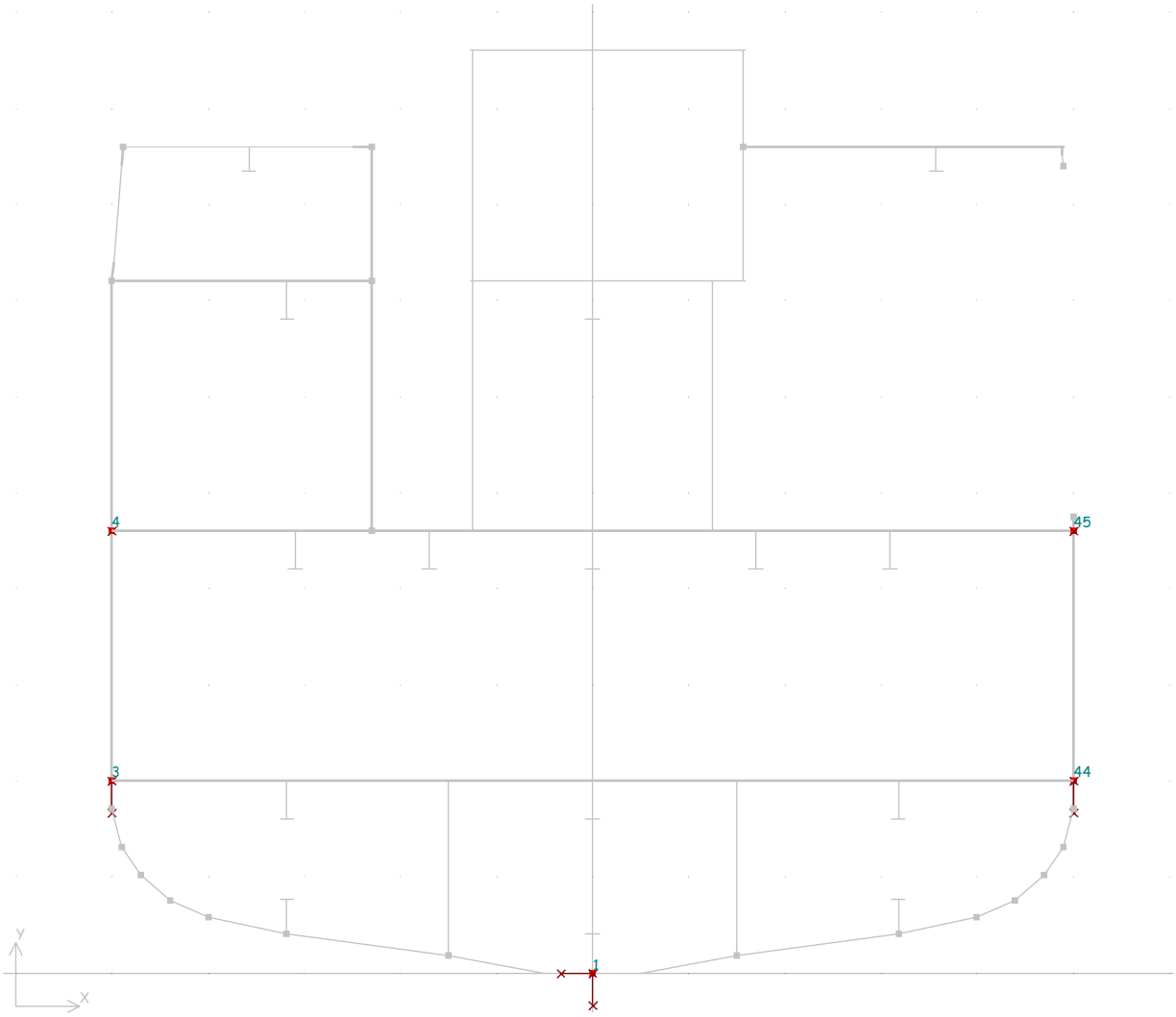
To comply with the rules requirements, the calculated stress should for relevant beam members not exceed:

- $\sigma_b \leq C_s R_{eH}$
- $\tau \leq C_t \tau_{eH}$

where C_s is permissible bending stress coefficient (C_s , C_t max is 0.7), according to (DNVGL Part3, Chapter 6, Section 6, Point 2.2 Direct Strength –beam analysis)

	C_s	R_{eH} [MPa]	τ_{eH} [MPa]	Limit [MPa]
Normal bending stress	*0.7*	235	-	165
Shear stress	*0.7*	-	135	95

Boundary Conditions, deformation plots (as black wire lines), are shown below.



	Node	Name	X [mm]	Y [mm]	Z [mm]	X trans.	Y trans.	Z trans.	X rot.	Y rot.	Z rot.
1	1		0	0	0	Fixed	Fixed	Fixed	Free	Free	Free
2	3		-5000	2000	0	Free	Fixed	Fixed	Free	Free	Free
3	4		-5000	4600	0	Free	Free	Fixed	Free	Free	Free
4	44		5000	2000	0	Free	Fixed	Fixed	Free	Free	Free
5	45		5000	4600	0	Free	Free	Fixed	Free	Free	Free

Figure 16. Midship Section Boundary Conditions

Frame model is restrained in X, Y, Z translational directions in two nodes and rotational X in one node as depicted below:

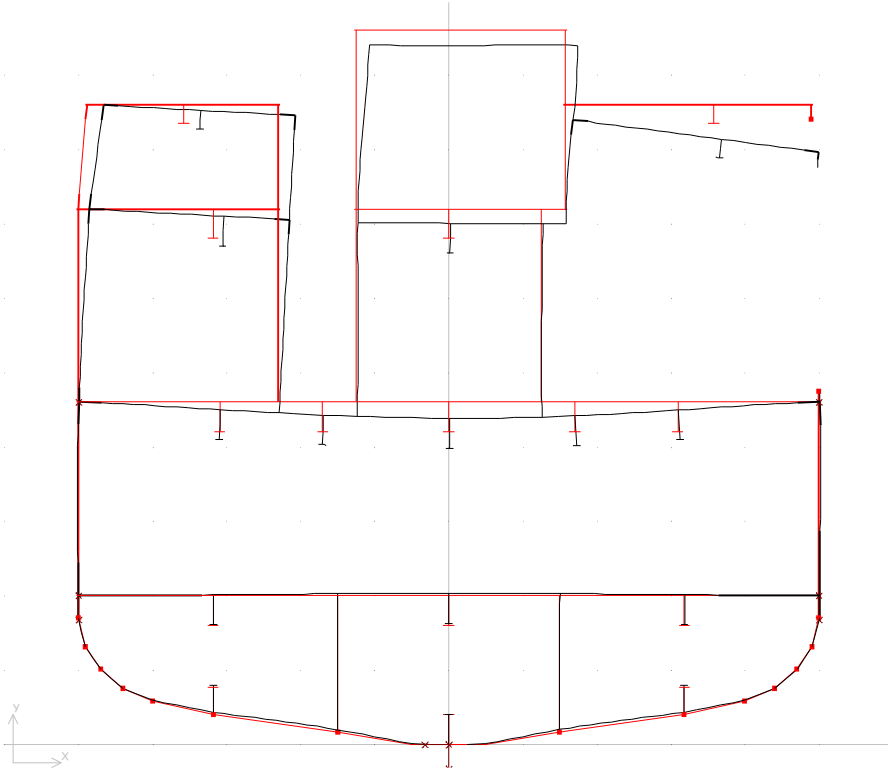


Figure 17. Midship Section, Deformation

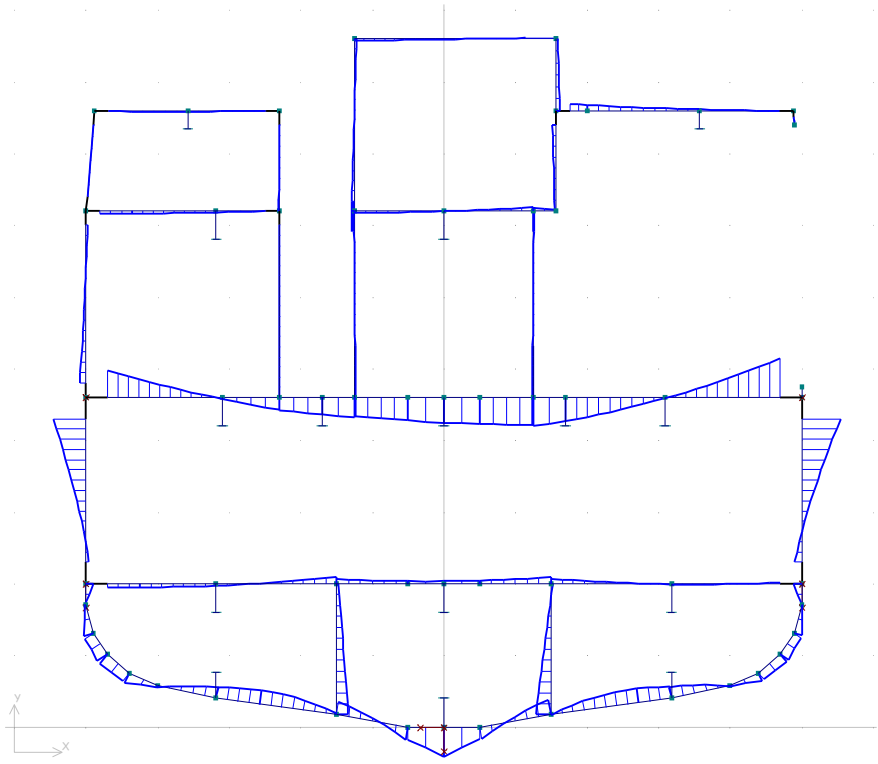
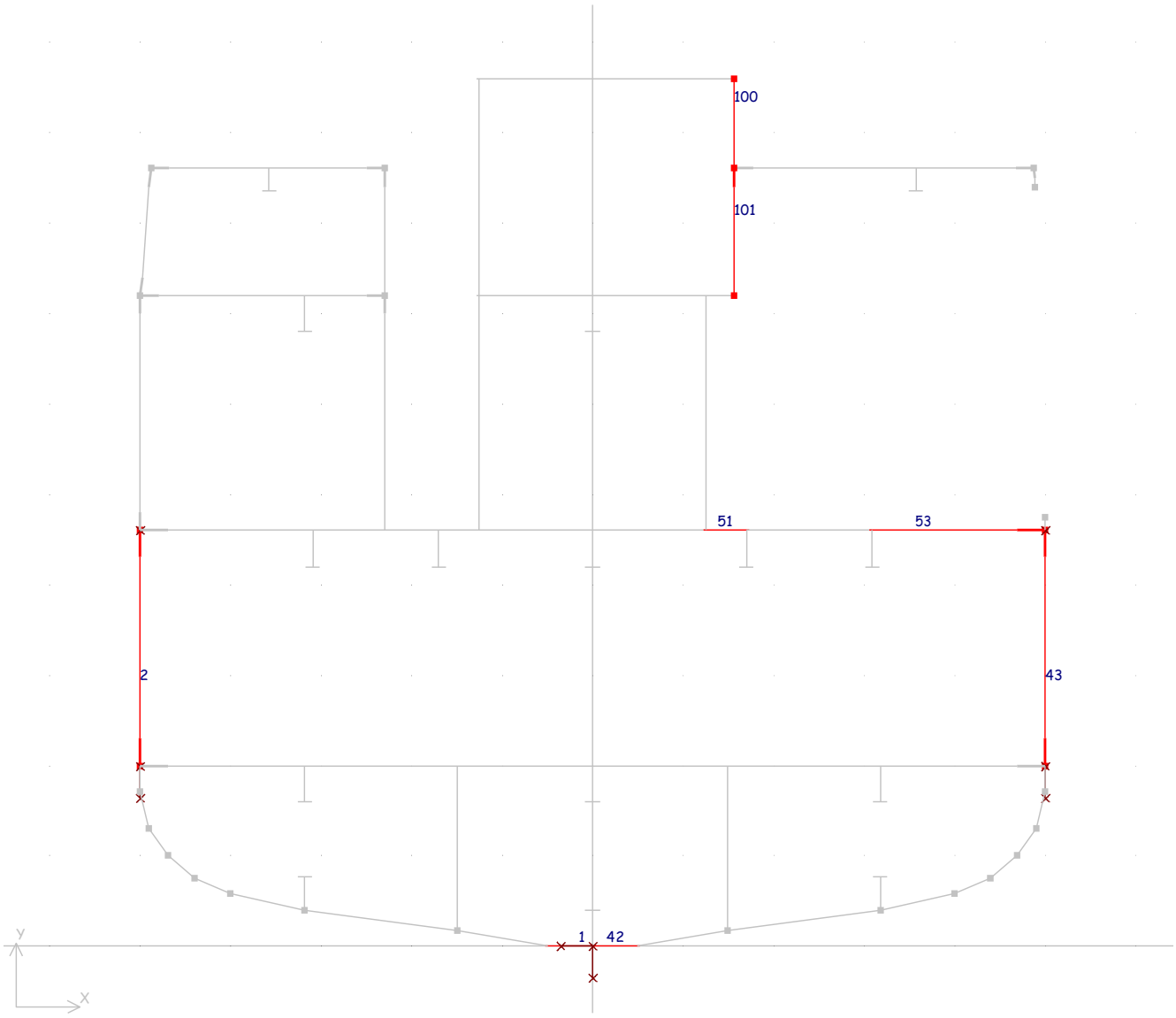


Figure 18. Midship Section, Frame members bending moments



	Beam	Name	SigmaHg [N/m	Sig-My [N/m	Allowed [N/m	Tau-Qz [N/mm	Allowed [N/m	Usage, Norma	Ok / Not ok
1	43		0	-198	200	-39	115	0,99	Ok
2	53		0	-190	200	-44	115	0,95	Ok
3	2		0	-186	200	-43	115	0,93	Ok
4	100		0	-161	200	10	115	0,81	Ok
5	1		0	-145	200	-59	115	0,73	Ok
6	42		0	-145	200	62	115	0,73	Ok
7	51		0	141	200	-19	115	0,71	Ok
8	101		0	170	200	10	115	0,85	Ok

Figure 19. Midship Section, Frame member Stress Check

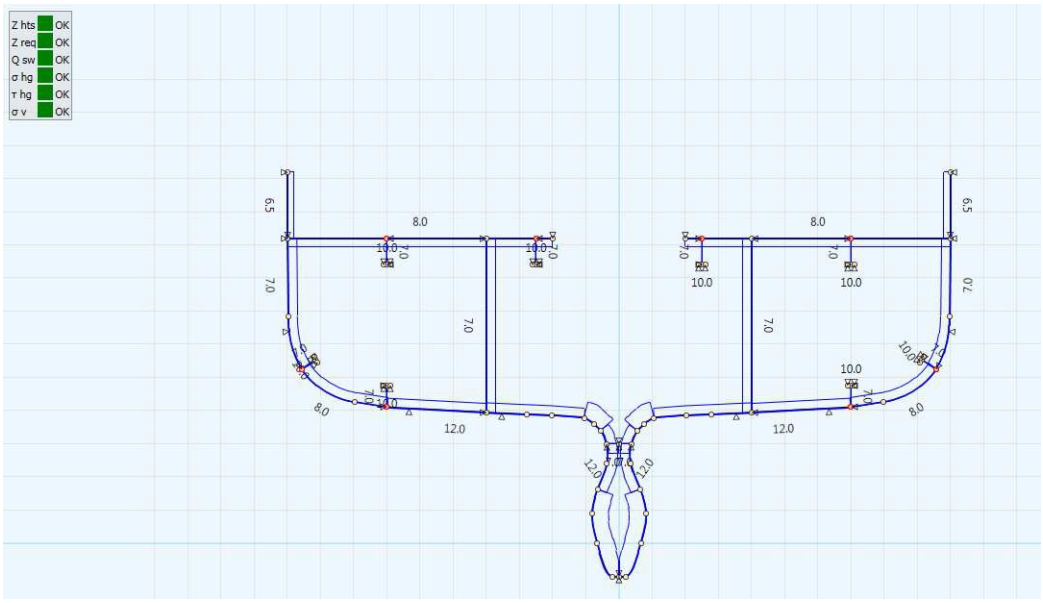
For more information see APPENDIX C.

6. CONCLUSION

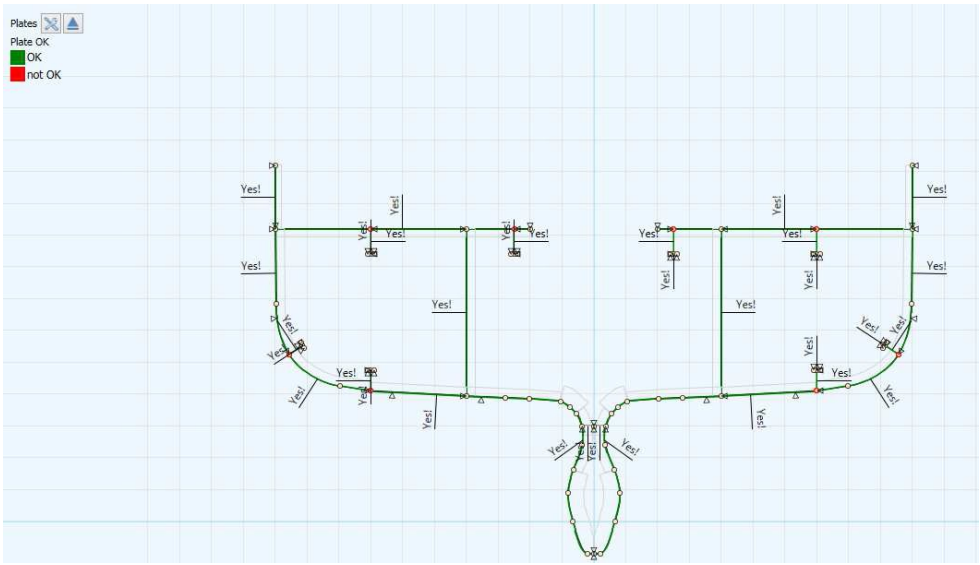
Verification of hull girder strength and midship section for applied load conditions fulfill DNVGL (July 2018) requirements. Calculations identified all the plates and stiffeners are sized to be in compliance with the rules.

APPENDIX A CROSS SECTION ANALYSIS RESULLTS

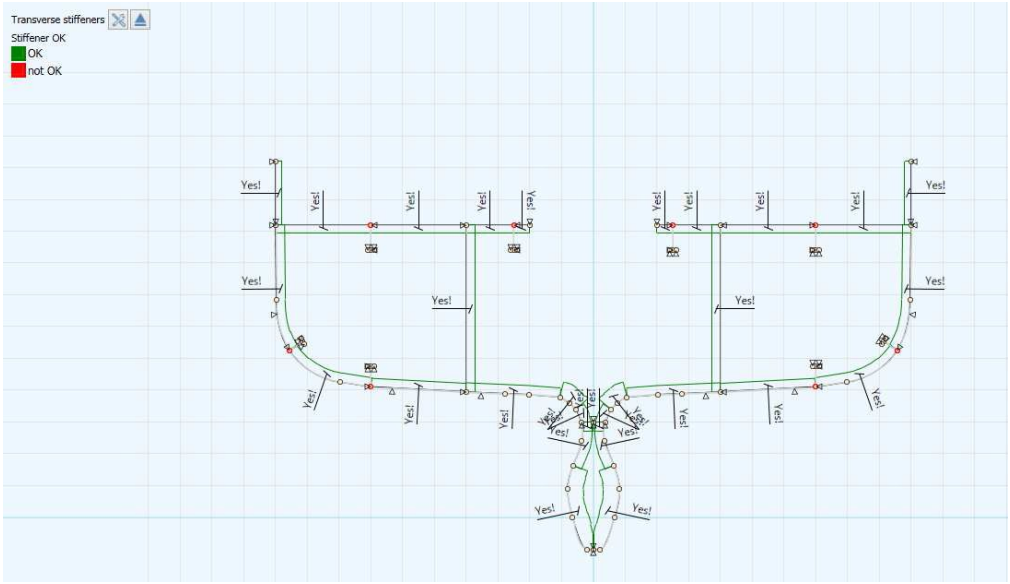
FRAME 5



Frame #5 Hull girder strength OK

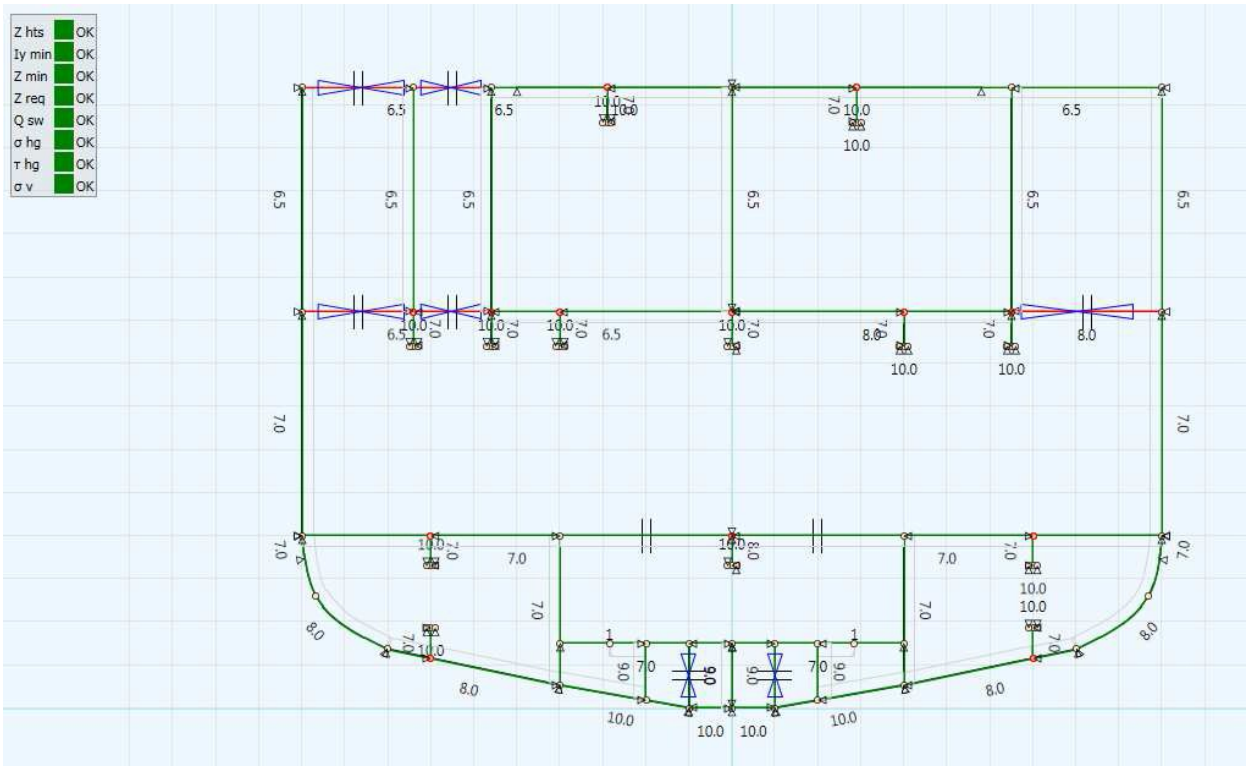


Frame #5 Plates verification is OK.

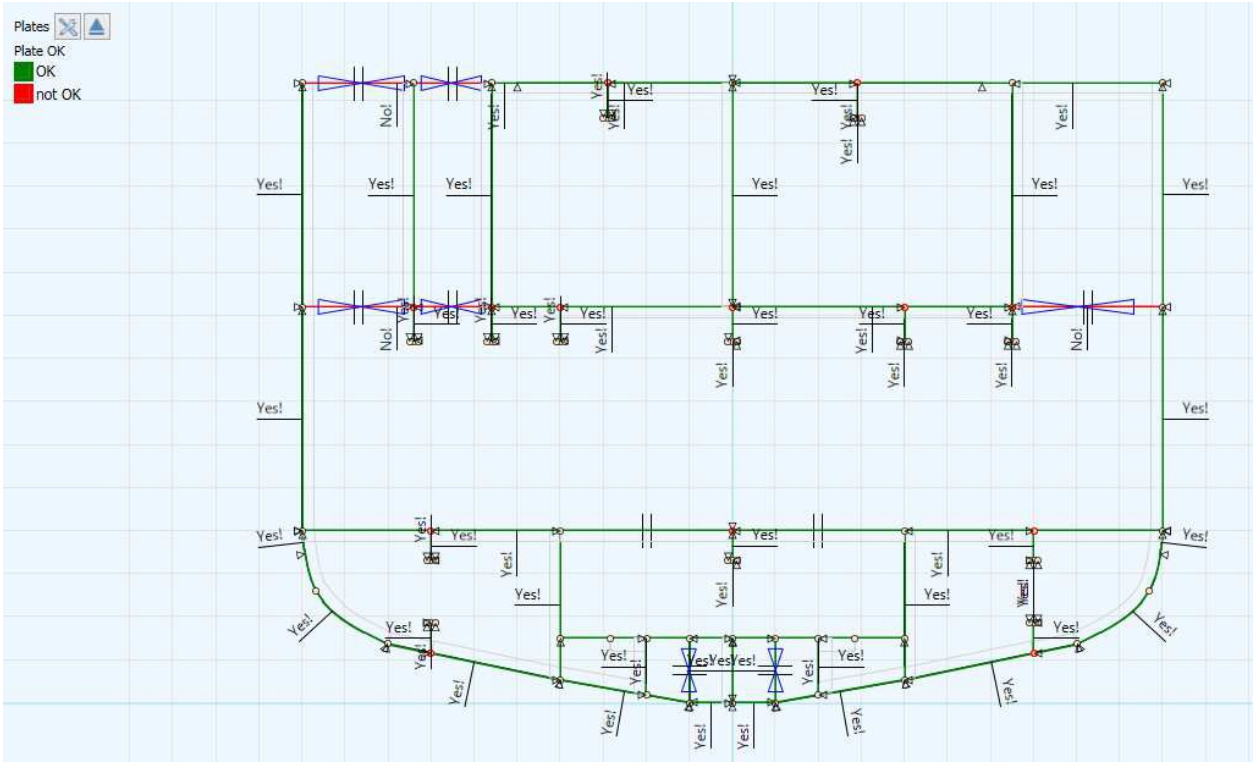


Frame #5 Stiffeners verification is OK.

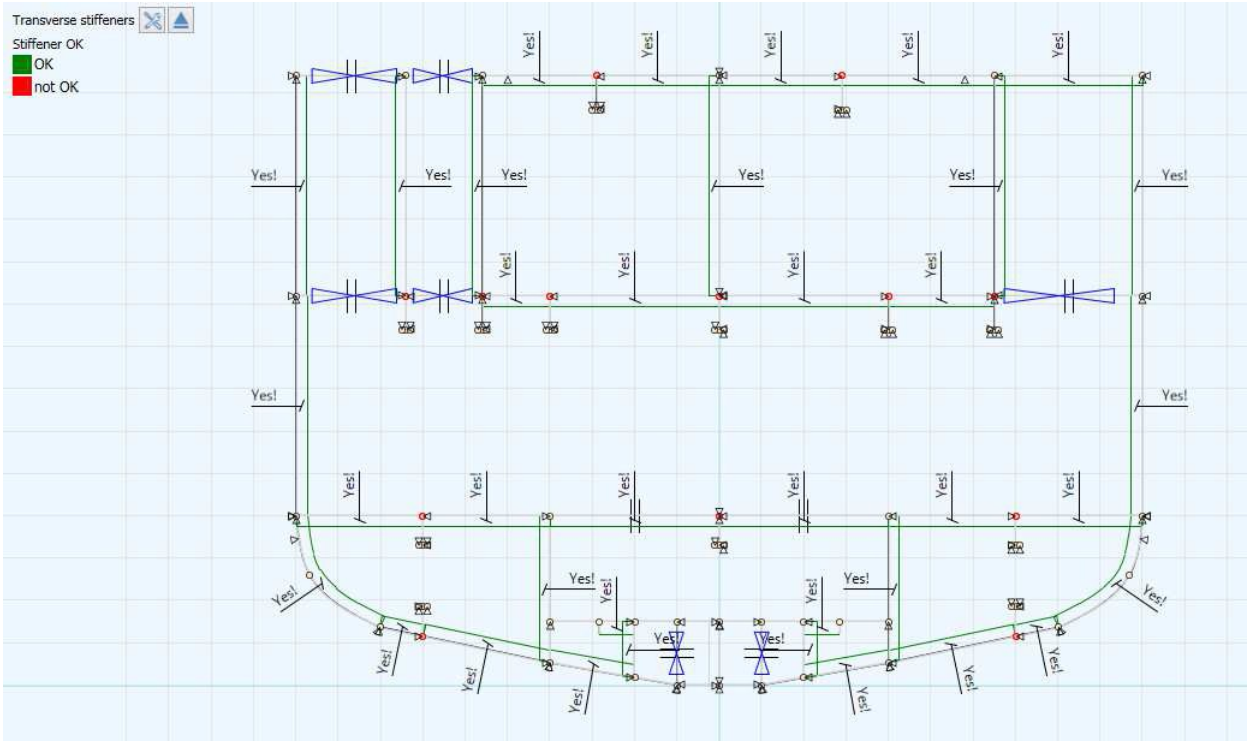
FRAME 25



Frame #25 Hull girder strength OK

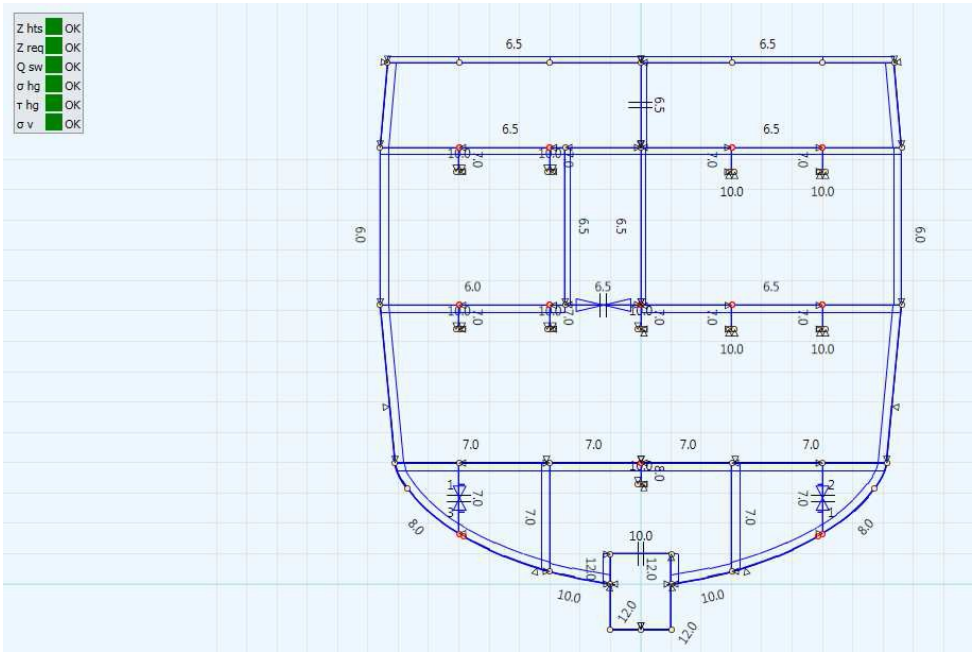


Frame #25 Plates verification is OK.

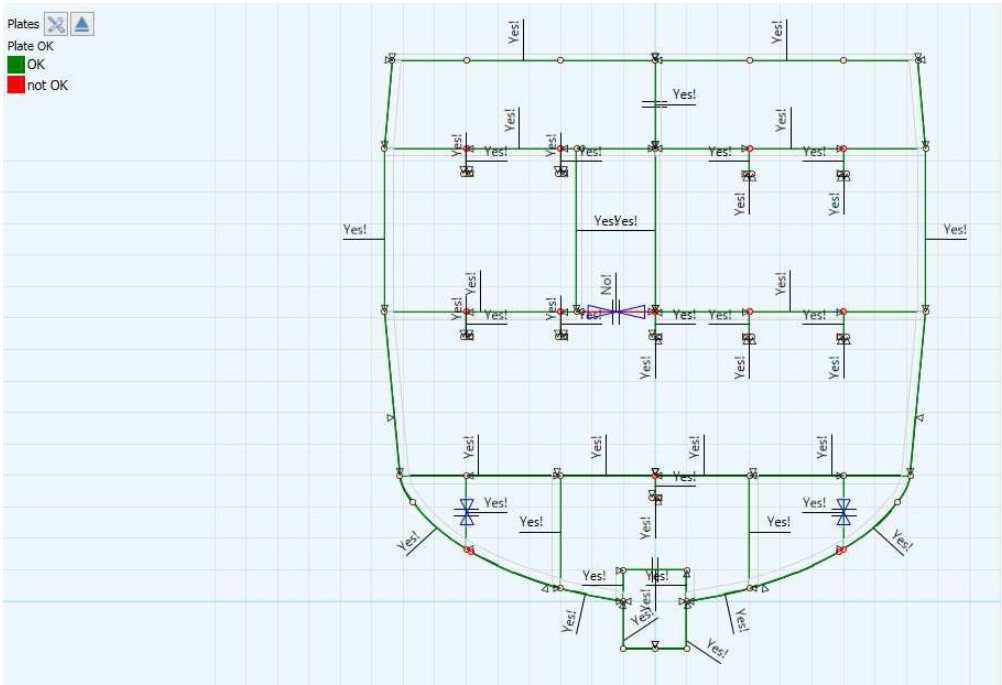


Frame #25 Stiffeners verification is OK.

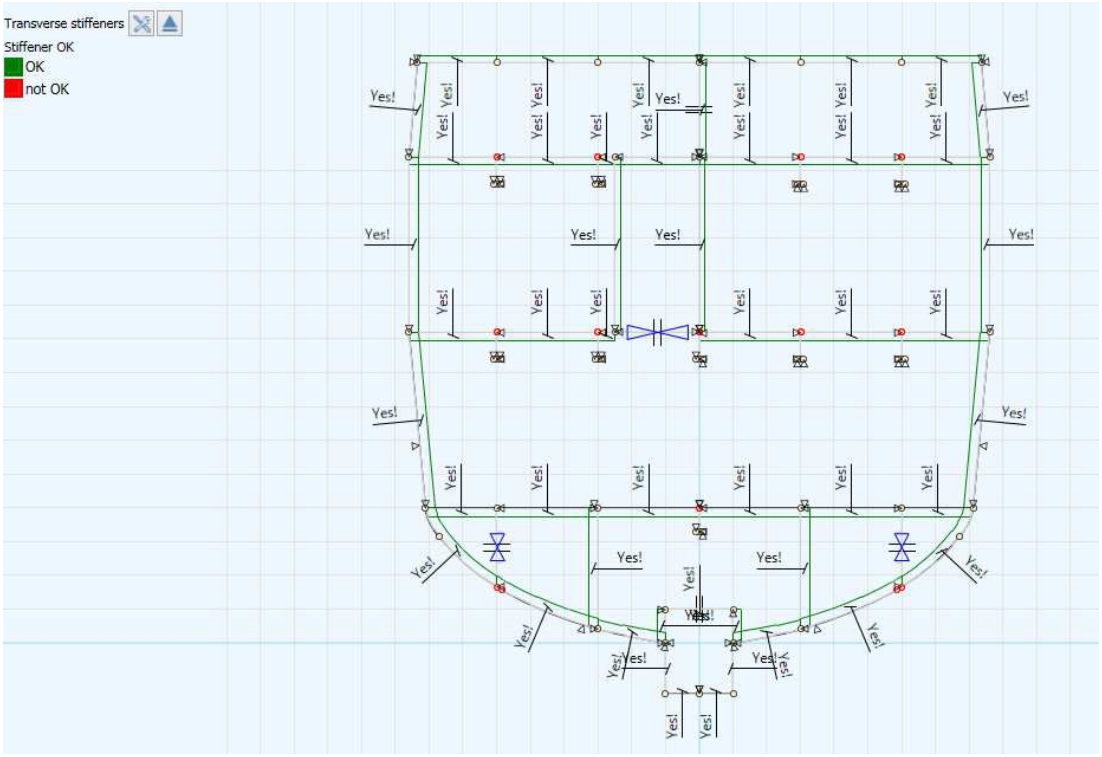
FRAME 45



Frame #45 Hull girder strength OK

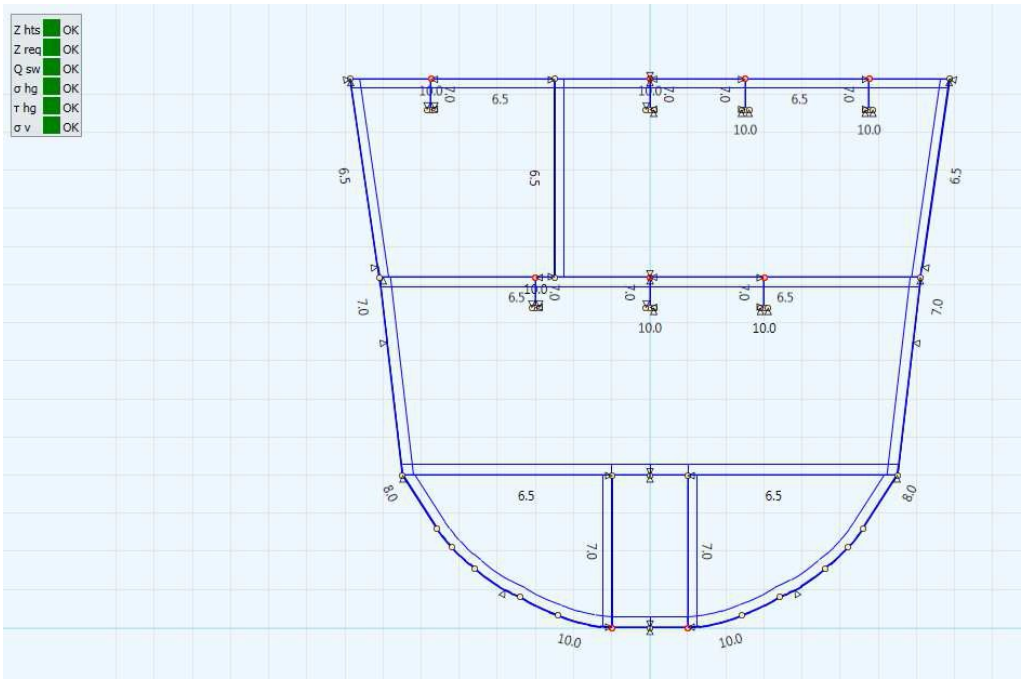


Frame #45 Plates verification is OK.

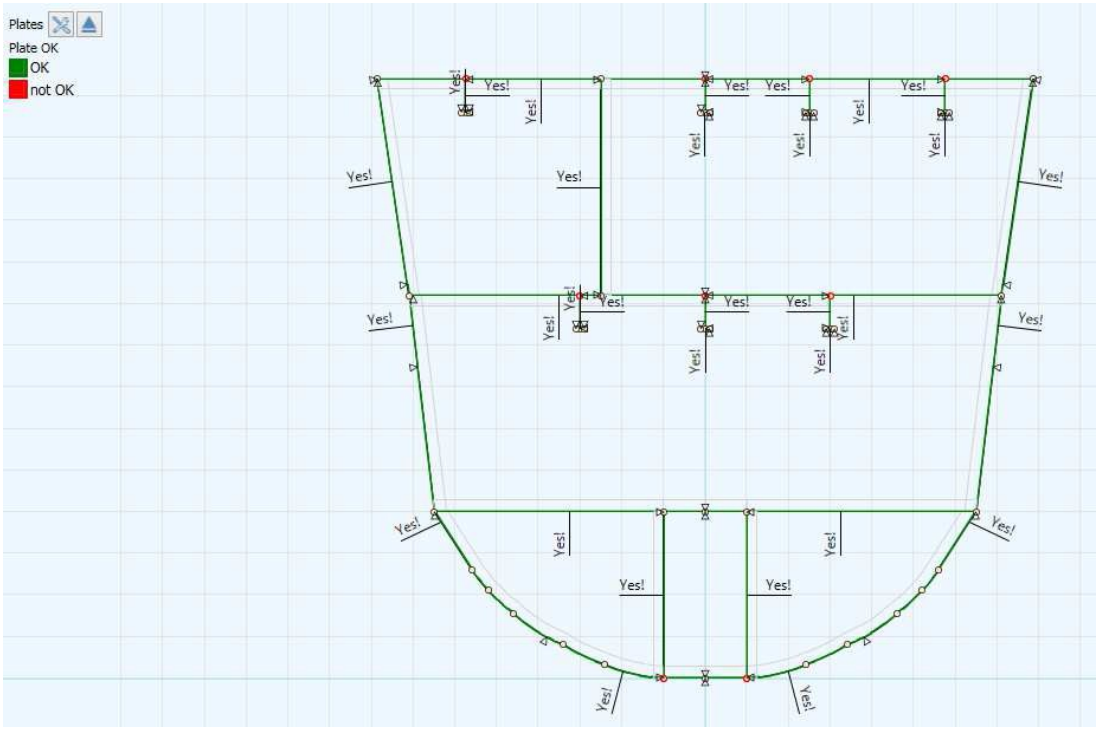


Frame #45 Stiffeners verification is OK.

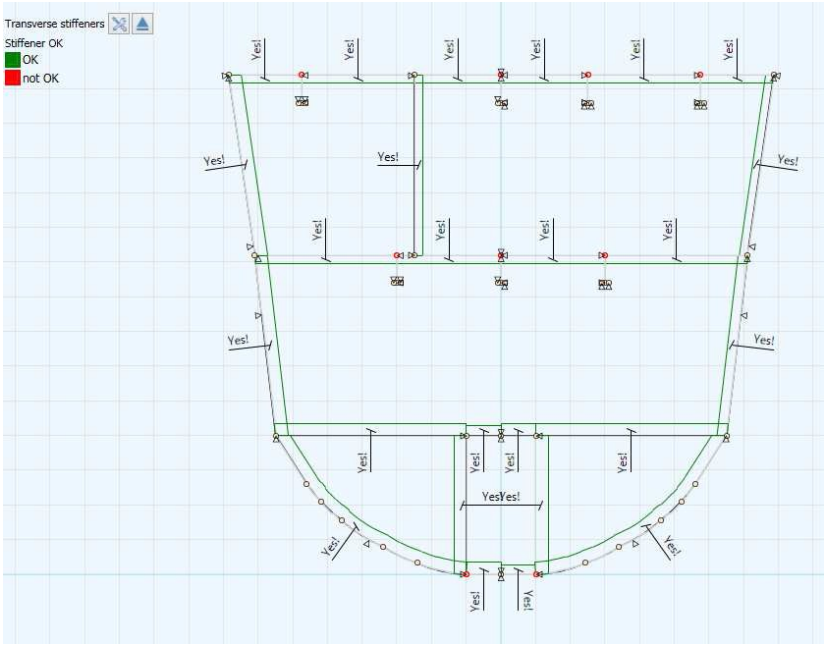
FRAME 51



Frame #51 Hull girder strength OK

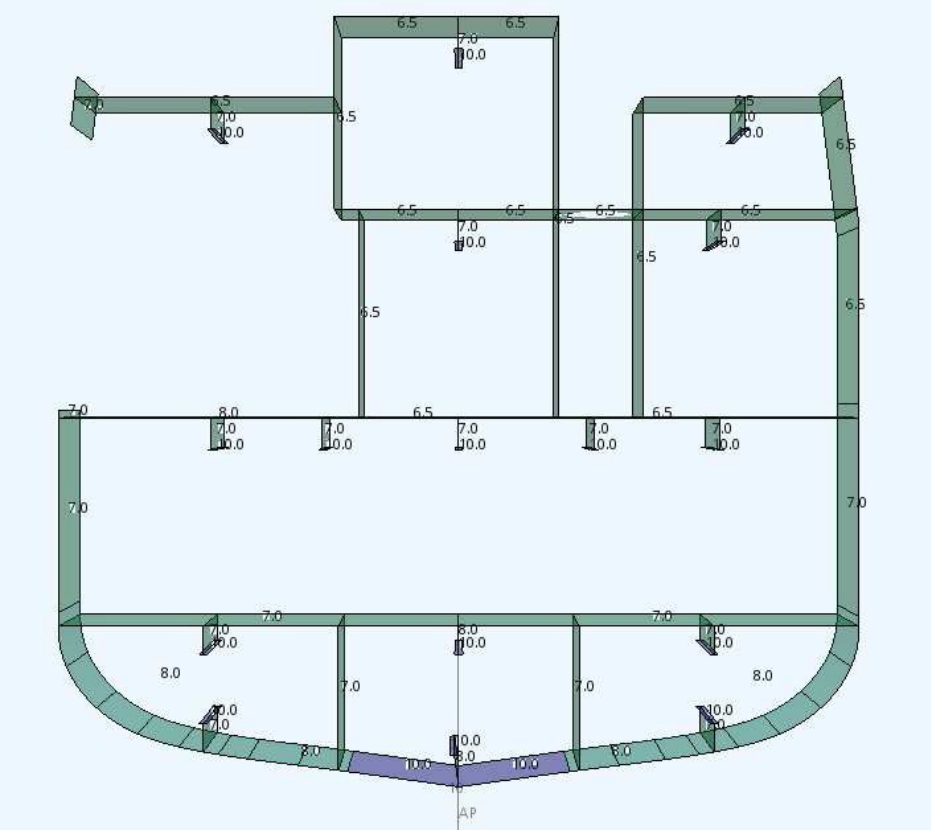


Frame #51 Plates verification is OK.

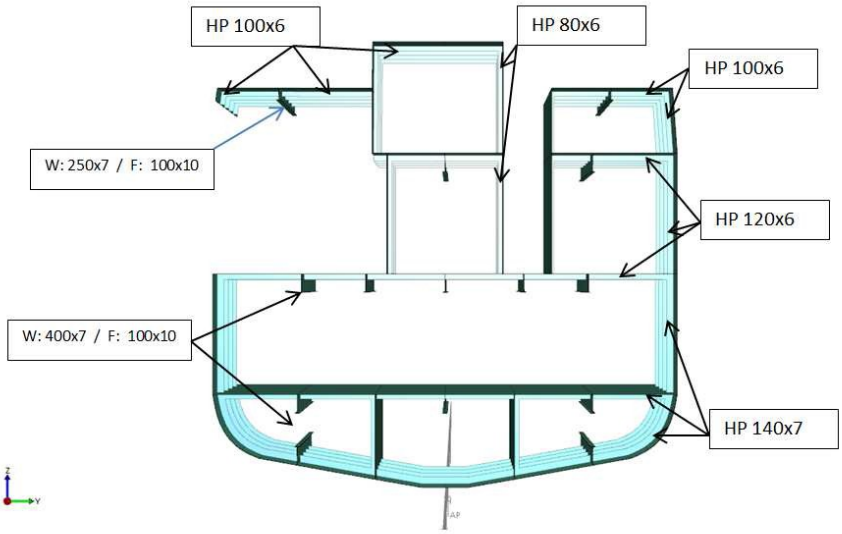


Frame #51 Stiffeners verification is OK.

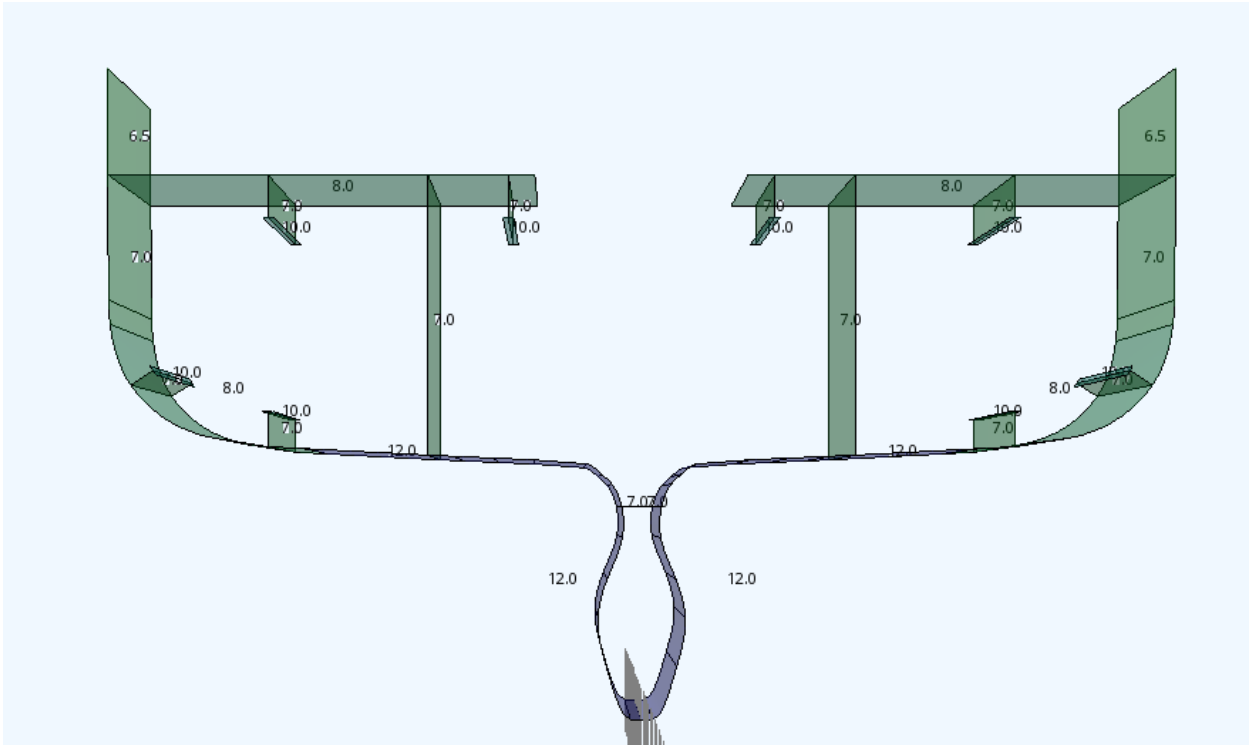
APPENDIX B PLATES THICKNESS AND STIFFENERS SIZE



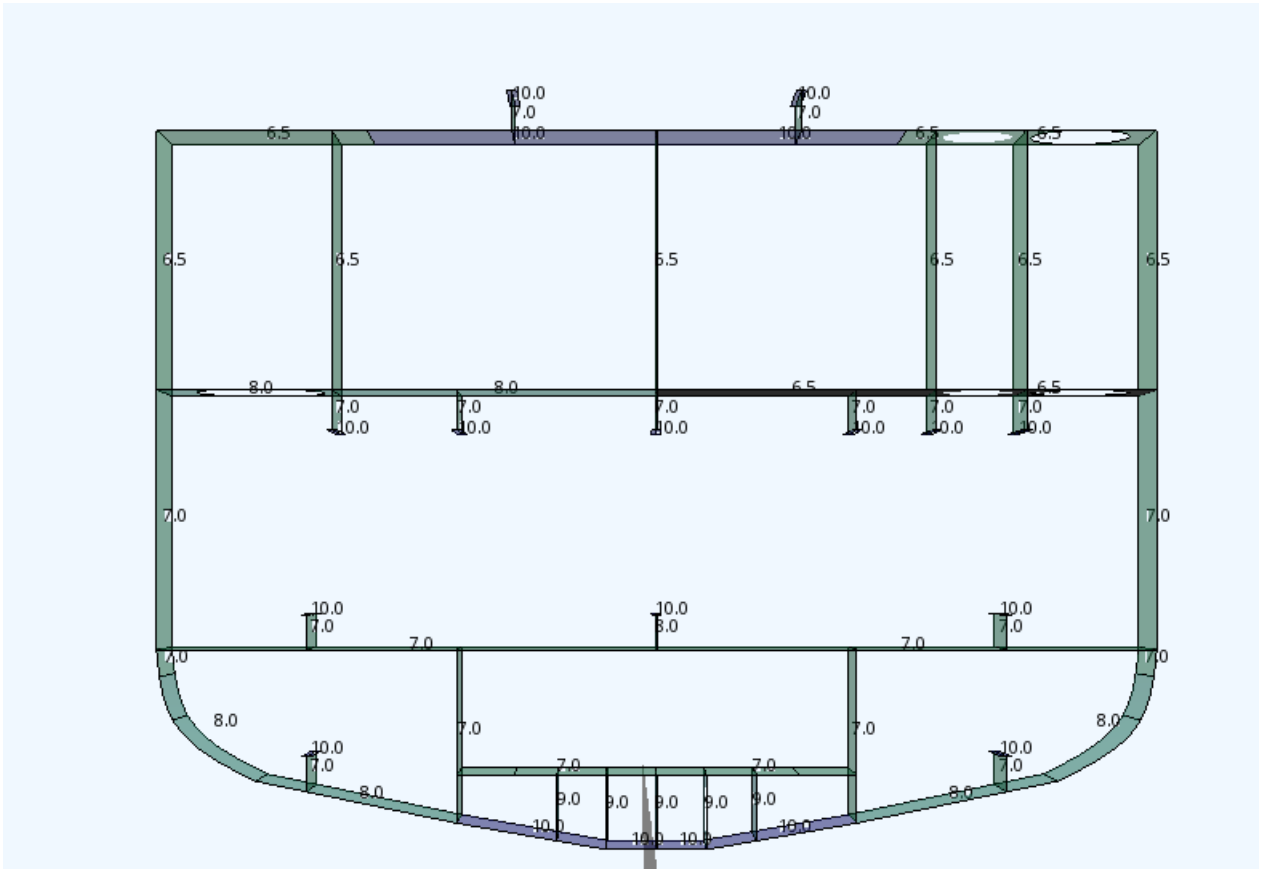
Frame #35 Plates thickness



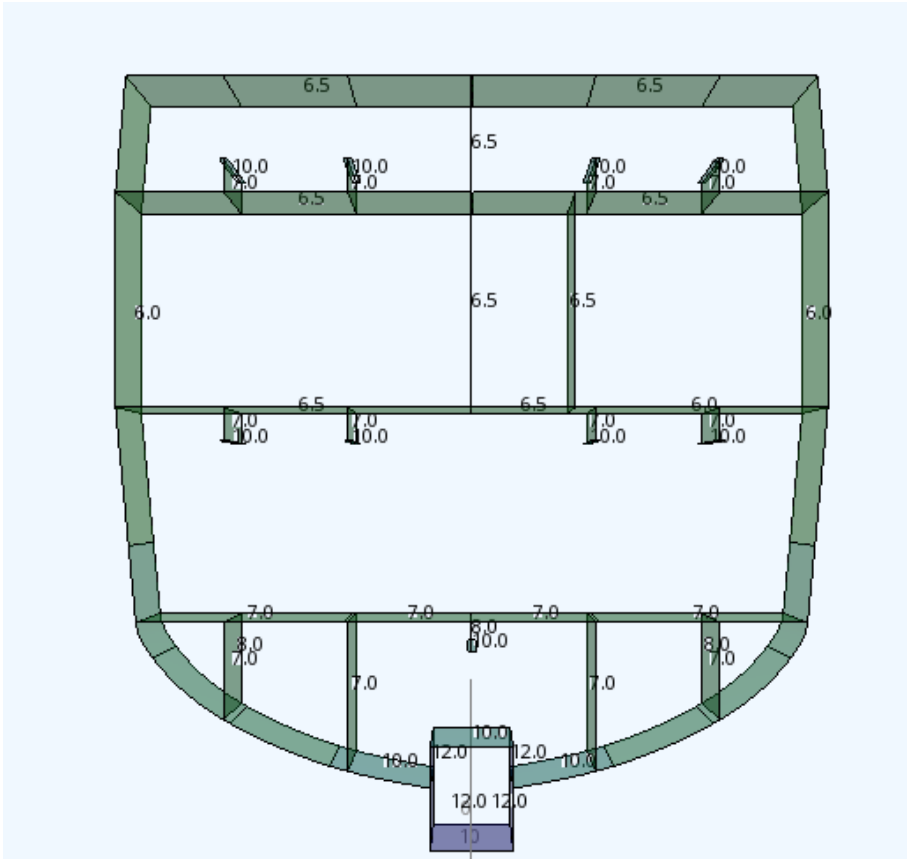
Frame #35 Typpical Frames and Stiffeners Size



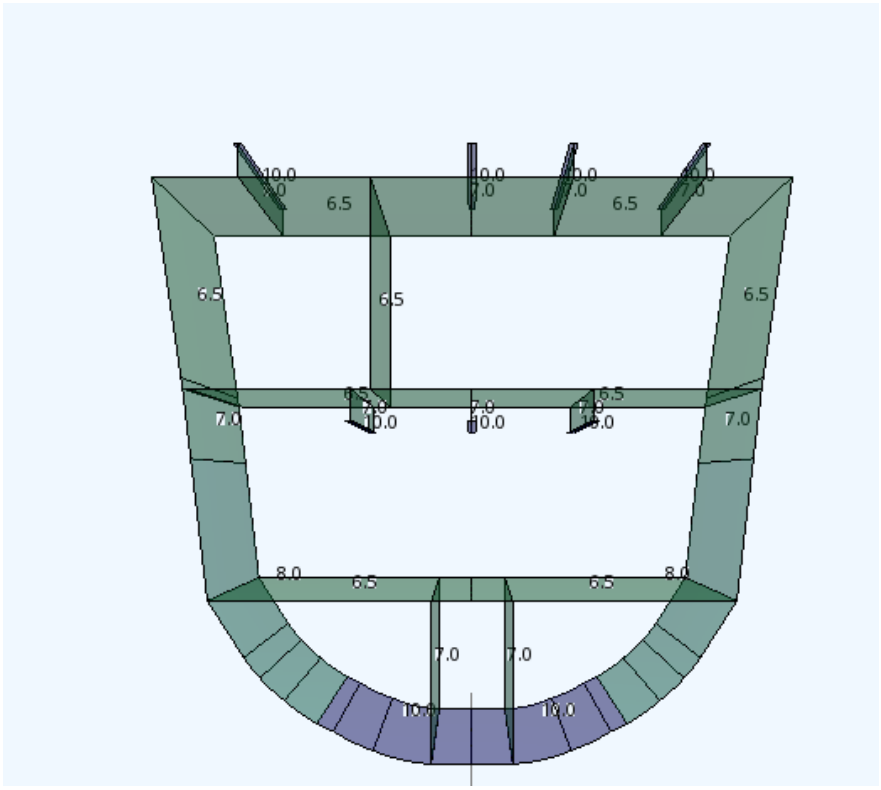
Frame #5 Plates thickness



Frame #25 Plates thickness



Frame #45 Plates thickness



Frame #51 Plates thickness

APPENDIX C 3D-BEAM TRANSVERSE FRAME ANALYSES FULL RAPORT

Beam information, sorted by Beam in Ascending order

Beam	Beam Name	Start Node	End Node	Elastic Length [mm]	Mass [kg]	Profile	Angle [deg]	Rigid Start [mm]	Rigid End [mm]	Hinged at Start	Hinged at End	Non Linearities
1		1	2	500	69	4	270.0	0	0			
2		3	4	2000	261	7	270.0	300	300			
3		6	7	1825	253	4	270.0	0	0			
4		8	6	1000	139	4	90.0	0	0			
5		9	8	500	69	4	90.0	0	0			
6		10	11	500	69	4	90.0	0	0			
7		11	12	750	104	4	90.0	0	0			
8		12	13	2600	313	9	270.0	0	0			
9		14	13	1250	174	4	90.0	0	0			
10		15	16	1620	225	4	90.0	0	200			
11		16	4	2200	281	8	90.0	200	200			
12		12	5	450	62	4	90.0	0	0			
13		5	93	600	83	4	90.0	0	0			
14		17	4	1610	224	4	90.0	0	300			
15		16	18	1004.7	129	8	270.0	200	200			
16		18	19	1110	145	7	270.0	200	0			
17		19	20	1075	140	7	270.0	0	200			
18		7	78	1695	235	4	270.0	0	0			
19		3	23	295	41	4	90.0	0	0			
20		6	24	1680	233	4	90.0	0	0			
21		24	3	1520	211	4	90.0	0	300			
22		22	25	434.63	60	4	270.0	0	0			
23		25	26	398.3	55	4	270.0	0	0			
24		26	27	358.89	50	4	270.0	0	0			
25		27	23	407.46	57	4	270.0	0	0			
26		13	21	2400	289	9	270.0	0	0			
27		24	28	400	44	6	0.0	0	0			
28		29	28	50	5	6	0.0	0	0			
29		28	30	50	5	6	0.0	0	0			
30		5	31	400	44	6	0.0	0	0			
31		17	32	400	44	6	0.0	0	0			
32		33	31	50	5	6	0.0	0	0			
33		31	34	50	5	6	0.0	0	0			
34		35	32	50	5	6	0.0	0	0			
35		32	36	50	5	6	0.0	0	0			
36		15	37	400	44	6	0.0	0	0			
37		19	38	250	27	6	0.0	0	0			
38		39	37	50	5	6	0.0	0	0			
39		40	38	50	5	6	0.0	0	0			
40		37	41	50	5	6	0.0	0	0			
41		38	42	50	5	6	0.0	0	0			
42		1	43	500	69	4	90.0	0	0			
43		44	45	2000	289	10	90.0	300	300			
44		46	47	1825	253	4	90.0	0	0			
45		48	46	1000	139	4	270.0	0	0			
46		9	48	500	69	4	270.0	0	0			
47		10	49	500	69	4	270.0	0	0			
48		49	50	750	104	4	270.0	0	0			
49		50	51	2600	313	9	90.0	0	0			

Beam information, sorted by Beam in Ascending order

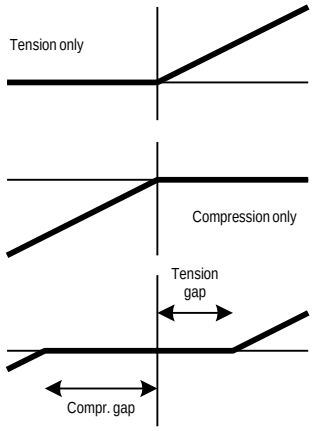
Beam	Beam Name	Start Node	End Node	Elastic Length [mm]	Mass [kg]	Profile	Angle [deg]	Rigid Start [mm]	Rigid End [mm]	Hinged at Start	Hinged at End	Non Linearities
50		14	51	1250	174	4	270.0	0	0			
51		50	52	450	62	4	270.0	0	0			
52		52	53	1390	193	4	270.0	0	0			
53		53	45	1610	224	4	270.0	0	300			
54		54	55	1110	145	7	90.0	200	0			
55		55	56	1575	206	7	90.0	0	0			
56		56	57	230	30	7	90.0	0	200			
57		44	58	295	41	4	270.0	0	0			
58		47	82	1695	235	4	90.0	0	0			
59		46	60	1680	233	4	270.0	0	0			
60		60	44	1520	211	4	270.0	0	300			
61		59	61	434.63	60	4	90.0	0	0			
62		61	62	398.3	55	4	90.0	0	0			
63		62	63	358.89	50	4	90.0	0	0			
64		63	58	407.46	57	4	90.0	0	0			
65		60	64	400	44	6	0.0	0	0			
66		65	64	50	5	6	0.0	0	0			
67		64	66	50	5	6	0.0	0	0			
68		52	67	400	44	6	0.0	0	0			
69		53	68	400	44	6	0.0	0	0			
70		69	67	50	5	6	0.0	0	0			
71		67	70	50	5	6	0.0	0	0			
72		71	68	50	5	6	0.0	0	0			
73		68	72	50	5	6	0.0	0	0			
74		55	73	250	27	6	0.0	0	0			
75		74	73	50	5	6	0.0	0	0			
76		73	75	50	5	6	0.0	0	0			
77		45	76	150	21	4	90.0	0	0			
78		54	77	100.25	14	4	270.0	100	0			
79		78	22	839.52	117	4	270.0	0	0			
80		79	78	367.4	40	6	0.0	0	0			
81		79	80	50	5	6	0.0	0	0			
82		81	79	50	5	6	0.0	0	0			
83		82	59	839.52	117	4	90.0	0	0			
84		83	82	367.4	40	6	0.0	0	0			
85		83	84	50	5	6	0.0	0	0			
86		85	83	50	5	6	0.0	0	0			
87		43	47	1015.2	141	4	90.0	0	0			
88		2	7	1015.2	141	4	270.0	0	0			
89		9	86	400	44	6	0.0	0	0			
90		86	87	50	5	6	0.0	0	0			
91		86	88	50	5	6	0.0	0	0			
92		10	89	400	44	6	0.0	0	0			
93		89	90	50	5	6	0.0	0	0			
94		89	91	50	5	6	0.0	0	0			
95		92	15	680	94	4	90.0	200	0			
96		93	17	790	110	4	90.0	0	0			
97		93	92	2400	289	9	90.0	0	200			
98		20	92	1200	145	9	270.0	200	0			
99		21	94	2820	340	9	270.0	0	0			
100		94	57	1000	120	9	270.0	0	0			
101		57	95	1200.7	145	9	270.0	200	0			
102		51	95	317.92	44	4	270.0	0	0			

Beam information, sorted by Beam in Ascending order

Beam	Beam Name	Start Node	End Node	Elastic Length [mm]	Mass [kg]	Profile	Angle [deg]	Rigid Start [mm]	Rigid End [mm]	Hinged at Start	Hinged at End	Non Linearities
103		14	96	400	44	6	0.0	0	0			
104		96	97	50	5	6	0.0	0	0			
105		96	98	50	5	6	0.0	0	0			
106		1	99	400	44	6	0.0	0	0			
107		99	100	50	5	6	0.0	0	0			
108		99	101	50	5	6	0.0	0	0			

Abbreviations

Beam information:
Beam: Beam identification number
Beam Name: User's beam identification
Start/End Node: Node numbers for the start and end nodes respectively
Elastic length: Elastic length of beam, excluding possible rigid ends
Mass: Mass of the elastic length of beam
Profile: Profile identification number
Angle: Angle between the profile's z-axis and the plane through the beam and the global Z-axis. Positive for clockwise rotation when seen in positive local x-direction.
Rigid Start/End: Length of possible rigid part of the beam at the start and end ends respectively
Hinged at Start/End: Possibly defined hinge at the start and end nodes respectively, where hinges are defined as:
dX, dY, dZ: Hinged with respect to translation in the global X-, Y-, and Z-direction respectively
rX, rY, rZ: Hinged with respect to rotation about the global X-, Y-, and Z-axis respectively
Non Linearities: Possibly specified non-linear properties for the beam. For definition see figure below.



Node information, sorted by Node in Ascending order

Node No	Name	X [mm]	Y [mm]	Z [mm]	Boundary Conditions					
					X transl	Y transl	Z transl	X rot	Y rot	Z rot
1		0	0	0	Fixed	Fixed	Fixed	Free	Free	Free
2		-500	0	0						
3		-5000	2000	0	Free	Fixed	Fixed	Free	Free	Free
4		-5000	4600	0	Free	Free	Fixed	Free	Free	Free
5		-1700	4600	0						
6		-1500	2000	0						
7		-1500	175	0						
8		-500	2000	0						
9		0	2000	0						
10		0	4600	0						
11		-500	4600	0						
12		-1250	4600	0						
13		-1250	7200	0						
14		0	7200	0						
15		-3180	7200	0						
16		-5000	7200	0						
17		-3090	4600	0						
18		-4885	8600	0						
19		-3575	8600	0						
20		-2300	8600	0						
21		-1250	9600	0						
22		-4000	580	0						
23		-5000	1705	0						
24		-3180	2000	0						
25		-4400	750	0						
26		-4700	1012	0						
27		-4900	1310	0						

Node No	Name	X [mm]	Y [mm]	Z [mm]	Boundary Conditions					
					X transl	Y transl	Z transl	X rot	Y rot	Z rot
28		-3180	1600	0						
29		-3130	1600	0						
30		-3230	1600	0						
31		-1700	4200	0						
32		-3090	4200	0						
33		-1650	4200	0						
34		-1750	4200	0						
35		-3040	4200	0						
36		-3140	4200	0						
37		-3180	6800	0						
38		-3575	8350	0						
39		-3130	6800	0						
40		-3525	8350	0						
41		-3230	6800	0						
42		-3625	8350	0						
43		500	0	0						
44		5000	2000	0	Free	Fixed	Fixed	Free	Free	Free
45		5000	4600	0	Free	Free	Fixed	Free	Free	Free
46		1500	2000	0						
47		1500	175	0						
48		500	2000	0						
49		500	4600	0						
50		1250	4600	0						
51		1250	7200	0						
52		1700	4600	0						
53		3090	4600	0						
54		4885	8600	0						

Node No	Name	X [mm]	Y [mm]	Z [mm]	Boundary Conditions					
					X transl	Y transl	Z transl	X rot	Y rot	Z rot
55		3575	8600	0						
56		2000	8600	0						
57		1570	8600	0						
58		5000	1705	0						
59		4000	580	0						
60		3180	2000	0						
61		4400	750	0						
62		4700	1012	0						
63		4900	1310	0						
64		3180	1600	0						
65		3130	1600	0						
66		3230	1600	0						
67		1700	4200	0						
68		3090	4200	0						
69		1650	4200	0						
70		1750	4200	0						
71		3040	4200	0						
72		3140	4200	0						
73		3575	8350	0						
74		3525	8350	0						
75		3625	8350	0						
76		5000	4750	0						
77		4895	8400	0						
78		-3180	400	0						
79		-3180	767.4	0						
80		-3230	767.4	0						
81		-3130	767.4	0						

Node No	Name	X [mm]	Y [mm]	Z [mm]	Boundary Conditions					
					X transl	Y transl	Z transl	X rot	Y rot	Z rot
82		3180	400	0						
83		3180	767.4	0						
84		3130	767.4	0						
85		3230	767.4	0						
86		0	1600	0						
87		50	1600	0						
88		-50	1600	0						
89		0	4200	0						
90		50	4200	0						
91		-50	4200	0						
92		-2300	7200	0						
93		-2300	4600	0						
94		1570	9600	0						
95		1567.9	7199.3	0						
96		0	6800	0						
97		-50	6800	0						
98		50	6800	0						
99		0	400	0						
100		50	400	0						
101		-50	400	0						

Abbreviations

Node No: Node identification number
Name: User's node identification
X, Y, Z: Node coordinates in the global coordinate system
X transl, Y transl, Z transl: Boundary conditions w.r.t. translation along the global axes
X rot, Y rot, Zrot: Boundary conditions w.r.t. rotation about the global axes

Where:
Free: The node is free
Fixed: The node is fixed
FD: The node has a prescribed displacement or rotation
Spring: The node is supported by a spring

Profiles used in the model

Profiles

Profile	Profile Name	Type	Material	Ignore S. C.	Shear factor fy	Shear factor fz	Profile parameters
4	BuiltUpTbar 400 x 100 x 7 x 10	40	1 VL-NS Mild Steel		1.00	1.00	Effective plate Width=2000 [mm], Plate Thickness, pT=7 [mm], Web Height, hw=400 [mm], Web Thickness, t=7 [mm], Flange width (incl. web), bf=100 [mm], Flange thickness, tf=10 [mm], Angle Between Profile & Plate=90 [Degrees], FlipY=True, Neglectlyz=True
6	FlatBar 2000 x 7	61	1 VL-NS Mild Steel		1.00	1.00	Effective plate Width=0 [mm], Plate Thickness=0 [mm], Flatbar Height=2000 [mm], Flatbar Width=7 [mm], Angle between Plate and profile=90 [Degrees], Neglectlyz=True
7	BuiltUpTbar 300 x 150 x 7 x 10	40	1 VL-NS Mild Steel		1.00	1.00	Effective plate Width=2000 [mm], Plate Thickness, pT=7 [mm], Web Height, hw=300 [mm], Web Thickness, t=7 [mm], Flange width (incl. web), bf=150 [mm], Flange thickness, tf=10 [mm], Angle Between Profile & Plate=90 [Degrees], FlipY=True, Neglectlyz=True
8	BuiltUpTbar 200 x 100 x 7 x 10	40	1 VL-NS Mild Steel		1.00	1.00	Effective plate Width=2000 [mm], Plate Thickness, pT=7 [mm], Web Height, hw=200 [mm], Web Thickness, t=7 [mm], Flange width (incl. web), bf=100 [mm], Flange thickness, tf=10 [mm], Angle Between Profile & Plate=90 [Degrees], FlipY=True, Neglectlyz=True
9	BuiltUpTbar 400 x 100 x 7 x 10	40	1 VL-NS Mild Steel		1.00	1.00	Effective plate Width=2000 [mm], Plate Thickness, pT=7 [mm], Web Height, hw=80 [mm], Web Thickness, t=9 [mm], Flange width (incl. web), bf=80 [mm], Flange thickness, tf=9 [mm], Angle Between Profile & Plate=90 [Degrees], FlipY=True, Neglectlyz=True
10	BuiltUpTbar 300 x 150 x10 x 10	40	1 VL-NS Mild Steel		1.00	1.00	Effective plate Width=2000 [mm], Plate Thickness, pT=7 [mm], Web Height, hw=300 [mm], Web Thickness, t=10 [mm], Flange width (incl. web), bf=150 [mm], Flange thickness, tf=10 [mm], Angle Between Profile & Plate=90 [Degrees], FlipY=True, Neglectlyz=True

Profile properties

Profile	Axial			Local x-z plane				Local x-y plane				Shear Centre	
	Ax [mm2]	Wx [mm3]	Ix [mm4]	Az [mm2]	Wy_t [mm3]	Wy_b [mm3]	Iy [mm4]	Ay [mm2]	Wz+ [mm3]	Wz- [mm3]	Iz [mm4]	e_y [mm]	e_z [mm]
4	17800	43120	3.0184e+005	2395	4557891	743175	2.6646e+008	15130	4667511	4667511	4.6675e+009	0	54.89
6	14000	32667	2.2867e+005	9333	4666667	4666667	4.6667e+009	9333	16333	16333	57167	0	0
7	17600	43868	3.0707e+005	1921	3596849	643519	1.7304e+008	14960	4669488	4669488	4.6695e+009	0	44.42
8	16400	39853	2.7897e+005	1285	2219119	289585	5.5586e+007	13940	4667506	4667506	4.6675e+009	0	21.51
9	15440	29268	2.6341e+005	713	706338	78774	6.8035e+006	13124	4667056	4667056	4.6671e+009	0	6.125
10	18500	37237	3.7237e+005	2677	3556562	720575	1.8994e+008	15725	4669504	4669504	4.6695e+009	0	49.72

Materials

Material	Material Name	E [N/mm2]	Density [kg/m3]	Poisson	Thermal Coefficient [mm/mm/C]	Yield Stress [N/mm2]	Ultimate Strength [N/mm2]
1	VL-NS Mild Steel	210000	7800.0	0.30	1.26e-005	235	400

Abbreviations

Profiles:

Profile:	Profile identification number
Profile Name:	User's profile identification
Type:	Profile type
Material:	Material identification
Ignore S.C.:	If ticked "X", then the program ignores the possible shear centre offset for the profile.

Shear factors fy, fz: The shear factor may be < 1.0 for beams with large cut-outs. The factors affect the beam stiffness but not the computed shear stress.
Profile parameters: Input parameters defining the profile.

Profile properties:
Profile: Profile identification number
Ax: Axial area (total profile area)
Wx: Torsion section modulus
Ix: Torsional moment of inertia
Az: Shear area in local z-direction ($I_y\ t_p / S_y$)
Wy_t: Section modulus about local y-axis at top of profile
Wy_b: Section modulus about local y-axis at bottom of profile
Iy: Moment of inertia about local y-axis
Ay: Shear area in local y-direction ($I_z\ t_p / S_z$)
Wz+: Section modulus about local z-axis on positive y-side of profile
Wz-: Section modulus about local z-axis on negative y-side of profile
Iz: Moment of inertia about local z-axis
Note: $Wz_t = Wz_b = Wz_{min}$ for all profile types except I - types
e_y: Shear centre distance from vertical neutral axis
e_z: Shear centre distance from horizontal neutral axis
f_y: Shear factor in local y-direction
f_z: Shear factor in local z-direction
Note: The shear factor is used for shear stiffness of beam, but not for calculation of shear stress
Where:
S_y, S_z: 1^{st} area moment about y- and z- axis respectively
t_p: value for profile thickness depending on profile type

Materials:
Material: Material identification
Material Name: User's material identification
E: Young's Modulus
Density: Density
Poisson: Poisson's ratio for transverse contraction
Thermal Coefficient: Coefficient of thermal expansion
Yield Stress: Nominal yield stress
Ultimate Strength: Nominal ultimate tensile strength

Beam Loads in local coordinate system, sorted by Beam in Ascending order

Beam No	Distributed Loads						Temperature Loads		
	Px1 [N/mm]	Py1 [N/mm]	Pz1 [N/mm]	Px2 [N/mm]	Py2 [N/mm]	Pz2 [N/mm]	Gy [C/mm]	Gz [C/mm]	Temperature [C]
1	0	0	-84	0	0	-84			
2	0	0	-50.8	0	0	0			
4	0	0	-10	0	0	-10			
5	0	0	-10	0	0	-10			
6	0	0	-10	0	0	-10			
7	0	0	-10	0	0	-10			
9	0	0	-5	0	0	-5			
10	0	0	-5	0	0	-5			
11	0	0	-5	0	0	-5			
12	0	0	-10	0	0	-10			
13	0	0	-10	0	0	-10			
14	0	0	-10	0	0	-10			
15	0	0	-5	0	0	-5			
16	0	0	-5	0	0	-5			

Beam Loads in local coordinate system, sorted by Beam in Ascending order

Beam No	Distributed Loads						Temperature Loads		
	Px1 [N/mm]	Py1 [N/mm]	Pz1 [N/mm]	Px2 [N/mm]	Py2 [N/mm]	Pz2 [N/mm]	Gy [C/mm]	Gz [C/mm]	Temperature [C]
17	0	0	-5	0	0	-5			
18	0	0	-79.2	0	0	-74.4			
19	0	0	-50.8	0	0	-52			
20	0	0	-10	0	0	-10			
21	0	0	-10	0	0	-10			
22	0	0	-73.2	0	0	-70.4			
23	0	0	-70.4	0	0	-60			
24	0	0	-60	0	0	-53.08			
25	0	0	-53.08	0	0	-52			
42	0	0	-84	0	0	-84			
43	0	0	-50.8	0	0	0			
45	0	0	-10	0	0	-10			
46	0	0	-10	0	0	-10			
47	0	0	-10	0	0	-10			
48	0	0	-10	0	0	-10			
50	0	0	-5	0	0	-5			
51	0	0	-20	0	0	-20			
52	0	0	-20	0	0	-20			
53	0	0	-20	0	0	-20			
54	0	0	-5	0	0	-5			
55	0	0	-5	0	0	-5			
56	0	0	-5	0	0	-5			
57	0	0	-50.8	0	0	-52			
58	0	0	-79.2	0	0	-74.4			
59	0	0	-10	0	0	-10			
60	0	0	-10	0	0	-10			
61	0	0	-73.2	0	0	-70.4			
62	0	0	-70.4	0	0	-60			
63	0	0	-60	0	0	-53.08			
64	0	0	-53.08	0	0	-52			
79	0	0	-74.4	0	0	-73.2			
83	0	0	-74.4	0	0	-73.2			
87	0	0	-84	0	0	-79.2			
88	0	0	-84	0	0	-79.2			
95	0	0	-5	0	0	-5			
96	0	0	-10	0	0	-10			
102	0	0	-5	0	0	-5			

Abbreviations

Beam No:	Beam identification number
Px1, Px2:	Load intensity in local x-direction at the start and end ends of the beam respectively
Py1, Py2:	Load intensity in local y-direction at the start and end ends of the beam respectively
Pz1, Pz2:	Load intensity in local z-direction at the start and end ends of the beam respectively
Gy, Gz:	Temperature gradients in local y- and z-directions
Temperature:	Mean temperature. NB! Any non-zero value is regarded as a temperature load

Forces, Moments and Deflections, Signed values, sorted by Beam in Ascending order

Beam No.	N_x [N]	Q_y [N]	Q_z [N]	M_x [Nmm]	M_y [Nmm]	M_z [Nmm]	δ [mm]	δ_x [mm]	δ_y [mm]	δ_z [mm]
1	-212127	0	-141799	0	108111414	0	0.48234	0.028374	0.4815	0
2	-83197	0	-84202	0	144609446	0	0.53883	-0.53815	-0.04502	0
3	-40252	0	18893	0	43059899	0	1.7152	0.41395	1.6709	0
4	103392	0	12577	0	16288099	0	1.8285	0.14014	1.8231	0
5	103392	0	2577	0	8711539	0	1.8694	0.15396	1.863	0
6	-101747	0	18013	0	-92230579	0	14.067	0.68417	-14.051	0
7	-101747	0	25513	0	-84474108	0	13.692	0.70459	-13.675	0
8	6816	0	-2455	0	-4114930	0	12.495	1.6002	-12.394	0
9	-9591	0	-8646	0	-7925173	0	12.848	1.3307	-12.779	0
10	1929	0	-6106	0	-8734412	0	11.811	9.876	-6.4779	0
11	-8904	0	19389	0	26760512	0	9.1457	9.1456	-0.050708	0
12	-104202	0	23197	0	-72266831	0	12.414	0.71713	-12.394	0
13	-104202	0	29197	0	-62840678	0	11.301	0.73386	-11.279	0
14	-103591	0	74293	0	117848934	0	6.5271	0.80037	-6.4832	0
15	-5525	0	4929	0	-1341675	0	14.245	14.239	-0.41078	0
16	-2540	0	5335	0	-3749411	0	15.797	14.95	-5.1043	0
17	-2540	0	-7590	0	-3601853	0	17.328	14.949	-8.7634	0
18	-207063	0	-86704	0	-51785275	0	2.2272	0.41318	2.1885	0
19	-195931	0	119285	0	-27827651	0	0.1201	-0.1191	0.015463	0
20	122285	0	-27675	0	24868456	0	1.655	0.11248	1.6512	0
21	122285	0	-10875	0	-13428014	0	0.64204	0.057516	0.63946	0
22	-222618	0	79031	0	36478567	0	0.88701	0.23846	0.85435	0
23	-236155	0	31901	0	44150495	0	0.34961	0.050508	0.34594	0
24	-236365	0	30312	0	44150495	0	0.21213	-0.21147	0.095536	0
25	-219214	0	88959	0	36987413	0	0.21213	-0.21147	0.016728	0
26	4420	0	7136	0	10193060	0	17.006	11.654	-12.388	0
27	0	0	0	0	0	-0	0.69186	0.26413	0.63946	0
28	0	0	0	0	0	0	0.7158	0.26413	0.66529	0
29	0	0	0	0	0	0	0.69186	0.26413	0.63946	0
30	0	0	0	0	0	0	11.301	0.71713	-11.279	0
31	0	0	0	0	0	0	6.5271	0.75575	-6.4832	0
32	0	0	0	0	0	0	11.415	-0.33739	-11.41	0
33	0	0	0	0	0	0	11.284	-0.33739	-11.279	0
34	0	0	0	0	0	0	6.6986	-0.68594	-6.6634	0
35	0	0	0	0	0	0	6.5194	-0.68594	-6.4832	0
36	0	0	0	0	0	-0	11.811	9.876	-6.4779	0
37	0	0	0	0	0	0	15.797	14.949	-5.1043	0
38	0	0	0	0	0	0	10.797	8.5067	-6.6491	0
39	0	0	0	0	0	0	15.039	14.082	-5.2777	0
40	0	0	0	0	0	0	10.692	8.5067	-6.4779	0
41	0	0	0	0	0	0	14.979	14.082	-5.1043	0
42	-192131	0	149451	0	108111414	0	0.54569	-0.0257	0.54509	0
43	-111968	0	-104199	0	174098831	0	1.5292	1.5287	-0.057641	0
44	-37896	0	33420	0	55762600	0	1.8149	-0.34215	1.7855	0
45	103392	0	-17423	0	23558418	0	1.8837	0.19545	1.8762	0
46	103392	0	-7423	0	11134978	0	1.8837	0.16779	1.8763	0
47	-101747	0	13013	0	-97487051	0	14.1	0.67056	-14.085	0
48	-101747	0	8013	0	-100684258	0	14.019	0.65695	-14.004	0
49	-37481	0	-2451	0	-4470452	0	13.185	1.3243	-13.119	0
50	-9591	0	-14896	0	13689086	0	13.185	1.3275	-13.119	0
51	-104199	0	-45968	0	-105154709	0	13.104	0.63654	-13.089	0

Forces, Moments and Deflections, Signed values, sorted by Beam in Ascending order

Beam No.	N_x [N]	Q_y [N]	Q_z [N]	M_x [Nmm]	M_y [Nmm]	M_z [Nmm]	δ [mm]	δ_x [mm]	δ_y [mm]	δ_z [mm]
52	-104199	0	-73768	0	-86494284	0	11.968	0.62399	-11.952	0
53	-104199	0	-111968	0	174098831	0	6.7437	0.58525	-6.7183	0
54	0	0	6550	0	4290250	0	40.936	7.2504	-40.289	0
55	0	0	14425	0	20808062	0	31.331	7.2504	-30.48	0
56	0	0	16575	0	27473062	0	18.345	7.2504	-16.851	0
57	-190635	0	113816	0	-31658622	0	0.34698	0.34665	0.015045	0
58	-200939	0	91227	0	-52248331	0	2.3603	-0.41477	2.3235	0
59	136812	0	20473	0	18328783	0	1.7778	0.25694	1.767	0
60	136812	0	-14527	0	7924703	0	0.8971	0.31258	0.85952	0
61	-215513	0	-76296	0	28989069	0	1.029	-0.238	1.0011	0
62	-228553	0	-31510	0	36505055	0	0.46029	-0.034826	0.45898	0
63	-228920	0	28722	0	36505055	0	0.33404	0.33128	0.16362	0
64	-212738	0	84958	0	29912508	0	0.34698	0.34665	0.042857	0
65	0	0	0	0	0	0	0.8971	0.25694	0.85952	0
66	0	0	0	0	0	0	0.88672	0.051086	0.88525	0
67	0	0	0	0	0	0	0.86103	0.051086	0.85952	0
68	0	0	0	0	0	-0	12.072	1.6984	-11.952	0
69	0	0	0	0	0	-0	7.0502	2.1376	-6.7183	0
70	0	0	0	0	0	0	12.205	1.6984	-12.086	0
71	0	0	0	0	0	0	12.072	1.6984	-11.952	0
72	0	0	0	0	0	0	7.2353	2.1376	-6.9123	0
73	0	0	0	0	0	0	7.0502	2.1376	-6.7183	0
74	0	0	0	0	0	0	31.331	7.2504	-30.48	0
75	0	0	0	0	0	0	30.897	5.0565	-30.48	0
76	0	0	0	0	0	0	31.33	5.0565	-30.919	0
77	0	0	0	0	0	0	0.54343	0.54037	-0.057641	0
78	0	0	0	0	-0	0	42.577	6.3688	-42.098	0
79	-209953	0	88123	0	-39177680	0	1.887	0.40711	1.8426	0
80	0	0	0	0	0	0	1.887	0.40711	1.8426	0
81	0	0	0	0	0	0	1.8489	0.15334	1.8426	0
82	0	0	0	0	0	0	1.8834	0.15334	1.8771	0
83	-203476	0	-84123	0	-42120211	0	2.0419	-0.41053	2.0002	0
84	0	0	0	0	0	-0	2.0419	-0.41053	2.0002	0
85	0	0	0	0	0	0	2.0409	-0.15534	2.035	0
86	0	0	0	0	0	0	2.0062	-0.15534	2.0002	0
87	-170732	0	138962	0	-54725717	0	1.8089	-0.28985	1.7855	0
88	-191748	0	-134871	0	47712037	0	1.6957	0.28938	1.6709	0
89	0	0	0	0	0	0	1.8709	0.17089	1.863	0
90	0	0	0	0	0	0	1.873	0.17089	1.8652	0
91	0	0	0	0	0	0	1.8709	0.17089	1.863	0
92	0	0	0	0	0	0	14.067	0.67056	-14.051	0
93	0	0	0	0	0	0	14.076	0.56208	-14.065	0
94	0	0	0	0	0	0	14.062	0.56208	-14.051	0
95	1929	0	-10506	0	-5005935	0	13.204	9.8764	-8.7642	0
96	-103591	0	55193	0	-46291815	0	9.4577	0.75575	-9.4292	0
97	-18096	0	-611	0	-830659	0	13.182	9.1979	-9.4426	0
98	-7590	0	-2540	0	2011000	0	17.11	14.267	-9.4454	0
99	7136	0	-4420	0	-6933515	0	17.881	11.66	-13.56	0
100	-4420	0	7136	0	12667611	0	17.699	11.66	-13.316	0
101	-21006	0	7105	0	-14805451	0	14.451	5.6236	-13.312	0
102	-7088	0	22601	0	11786113	0	13.363	1.3243	-13.298	0

Forces, Moments and Deflections, Signed values, sorted by Beam in Ascending order

Beam No.	N_x [N]	Q_y [N]	Q_z [N]	M_x [Nmm]	M_y [Nmm]	M_z [Nmm]	δ [mm]	δ_x [mm]	δ_y [mm]	δ_z [mm]
103	0	0	0	0	0	0	12.848	1.3275	-12.779	0
104	0	0	0	0	0	0	12.836	1.2088	-12.779	0
105	0	0	0	0	0	0	12.851	1.2088	-12.794	0
106	0	0	0	0	0	0	0.018663	-0.018663	0	0
107	0	0	0	0	0	0	0.018808	-0.018663	0.0023328	0
108	0	0	0	0	0	0	0.018808	-0.018663	-0.0023328	0

Abbreviations

N_x: Axial force (Positive gives tension)
Q_y: Shear force in local y-direction (Positive rotates an isolated piece clockwise)
Q_z: Shear force in local z-direction (Positive rotates an isolated piece counter-clockwise)
M_x: Torsional moment (Positive produces a right-handed screw)
M_y: Bending moment about local y-axis (Positive gives tension at local positive Z-axis side of profile)
M_z: Bending moment about local z-axis (Positive gives tension at local positive Y-axis side of profile)
δ: Maximum total deflection of beam ($\sqrt{(\delta_x^2 + \delta_y^2 + \delta_z^2)}$)
δ_x , δ_y , δ_z : Maximum deflection of beam in global X-, Y-, and Z- directions

Node Deflections, Reaction Forces and Moments, Signed values, sorted by Node in Ascending order

Node No.	δ_x [mm]	δ_y [mm]	δ_z [mm]	r_x [deg]	r_y [deg]	r_z [deg]	P_x [N]	P_y [N]	P_z [N]	M_x [Nmm]	M_y [Nmm]	M_z [Nmm]
1	0	0	0	0	0	0.002673	-19996	-291249	0	0	0	0
2	0.028374	0.4815	0	0	0	-0.03632	0	0	0	0	0	0
3	0.0077908	0	0	0	0	0.01103	0	-105410	0	0	0	0
4	0.80037	-0.04502	0	0	0	-0.1357	0	0	0	0	0	0
5	0.71713	-11.279	0	0	0	-0.151	0	0	0	0	0	0
6	0.11248	1.6512	0	0	0	0.01871	0	0	0	0	0	0
7	0.28938	1.6709	0	0	0	-0.02954	0	0	0	0	0	0
8	0.14014	1.8231	0	0	0	0.006768	0	0	0	0	0	0
9	0.15396	1.863	0	0	0	0.002425	0	0	0	0	0	0
10	0.67056	-14.051	0	0	0	-0.01554	0	0	0	0	0	0
11	0.68417	-13.675	0	0	0	-0.06088	0	0	0	0	0	0
12	0.70459	-12.394	0	0	0	-0.1198	0	0	0	0	0	0
13	1.3307	-12.388	0	0	0	-0.02355	0	0	0	0	0	0
14	1.3275	-12.779	0	0	0	-0.01699	0	0	0	0	0	0
15	9.876	-6.4779	0	0	0	-0.1961	0	0	0	0	0	0
16	9.8752	-0.050708	0	0	0	-0.209	0	0	0	0	0	0
17	0.75575	-6.4832	0	0	0	-0.2065	0	0	0	0	0	0
18	14.95	-0.4692	0	0	0	-0.2044	0	0	0	0	0	0
19	14.949	-5.1043	0	0	0	-0.1987	0	0	0	0	0	0
20	14.949	-9.4454	0	0	0	-0.1954	0	0	0	0	0	0
21	11.654	-12.385	0	0	0	-0.1804	0	0	0	0	0	0
22	0.23846	0.85435	0	0	0	0.05633	0	0	0	0	0	0
23	-0.1191	0.015463	0	0	0	0.007486	0	0	0	0	0	0
24	0.057516	0.63946	0	0	0	0.02959	0	0	0	0	0	0
25	0.050508	0.34594	0	0	0	0.04674	0	0	0	0	0	0
26	-0.13477	0.095536	0	0	0	0.03065	0	0	0	0	0	0
27	-0.21147	0.016728	0	0	0	0.01597	0	0	0	0	0	0
28	0.26413	0.63946	0	0	0	0.02959	0	0	0	0	0	0
29	0.26413	0.66529	0	0	0	0.02959	0	0	0	0	0	0
30	0.26413	0.61363	0	0	0	0.02959	0	0	0	0	0	0
31	-0.33739	-11.279	0	0	0	-0.151	0	0	0	0	0	0

Node Deflections, Reaction Forces and Moments, Signed values, sorted by Node in Ascending order

Node No.	δ_x [mm]	δ_y [mm]	δ_z [mm]	r_x [deg]	r_y [deg]	r_z [deg]	P_x [N]	P_y [N]	P_z [N]	M_x [Nmm]	M_y [Nmm]	M_z [Nmm]
32	-0.68594	-6.4832	0	0	0	-0.2065	0	0	0	0	0	0
33	-0.33739	-11.41	0	0	0	-0.151	0	0	0	0	0	0
34	-0.33739	-11.147	0	0	0	-0.151	0	0	0	0	0	0
35	-0.68594	-6.6634	0	0	0	-0.2065	0	0	0	0	0	0
36	-0.68594	-6.303	0	0	0	-0.2065	0	0	0	0	0	0
37	8.5067	-6.4779	0	0	0	-0.1961	0	0	0	0	0	0
38	14.082	-5.1043	0	0	0	-0.1987	0	0	0	0	0	0
39	8.5067	-6.6491	0	0	0	-0.1961	0	0	0	0	0	0
40	14.082	-5.2777	0	0	0	-0.1987	0	0	0	0	0	0
41	8.5067	-6.3068	0	0	0	-0.1961	0	0	0	0	0	0
42	14.082	-4.9308	0	0	0	-0.1987	0	0	0	0	0	0
43	-0.0257	0.54509	0	0	0	0.04069	0	0	0	0	0	0
44	0.31258	0	0	0	0	-0.0281	0	-64140	0	0	0	0
45	0.54037	-0.057641	0	0	0	0.1156	0	0	0	0	0	0
46	0.19545	1.767	0	0	0	-0.01945	0	0	0	0	0	0
47	-0.28985	1.7855	0	0	0	0.02777	0	0	0	0	0	0
48	0.16779	1.8762	0	0	0	-0.002539	0	0	0	0	0	0
49	0.65695	-14.004	0	0	0	0.03313	0	0	0	0	0	0
50	0.63654	-13.089	0	0	0	0.1096	0	0	0	0	0	0
51	1.3243	-13.119	0	0	0	-0.02426	0	0	0	0	0	0
52	0.62399	-11.952	0	0	0	0.1539	0	0	0	0	0	0
53	0.58525	-6.7183	0	0	0	0.2224	0	0	0	0	0	0
54	7.2504	-42.054	0	0	0	-0.5058	0	0	0	0	0	0
55	7.2504	-30.48	0	0	0	-0.5028	0	0	0	0	0	0
56	7.2504	-16.851	0	0	0	-0.4742	0	0	0	0	0	0
57	7.2504	-13.314	0	0	0	-0.4661	0	0	0	0	0	0
58	0.34665	0.015045	0	0	0	-0.02315	0	0	0	0	0	0
59	-0.238	1.0011	0	0	0	-0.06052	0	0	0	0	0	0
60	0.25694	0.85952	0	0	0	-0.02949	0	0	0	0	0	0
61	-0.034826	0.45898	0	0	0	-0.05401	0	0	0	0	0	0
62	0.19078	0.16362	0	0	0	-0.041	0	0	0	0	0	0
63	0.33128	0.042857	0	0	0	-0.02902	0	0	0	0	0	0
64	0.051086	0.85952	0	0	0	-0.02949	0	0	0	0	0	0
65	0.051086	0.88525	0	0	0	-0.02949	0	0	0	0	0	0
66	0.051086	0.83379	0	0	0	-0.02949	0	0	0	0	0	0
67	1.6984	-11.952	0	0	0	0.1539	0	0	0	0	0	0
68	2.1376	-6.7183	0	0	0	0.2224	0	0	0	0	0	0
69	1.6984	-12.086	0	0	0	0.1539	0	0	0	0	0	0
70	1.6984	-11.818	0	0	0	0.1539	0	0	0	0	0	0
71	2.1376	-6.9123	0	0	0	0.2224	0	0	0	0	0	0
72	2.1376	-6.5242	0	0	0	0.2224	0	0	0	0	0	0
73	5.0565	-30.48	0	0	0	-0.5028	0	0	0	0	0	0
74	5.0565	-30.041	0	0	0	-0.5028	0	0	0	0	0	0
75	5.0565	-30.919	0	0	0	-0.5028	0	0	0	0	0	0
76	0.23765	-0.057641	0	0	0	0.1156	0	0	0	0	0	0
77	5.485	-42.142	0	0	0	-0.5058	0	0	0	0	0	0
78	0.40711	1.8426	0	0	0	0.03957	0	0	0	0	0	0
79	0.15334	1.8426	0	0	0	0.03957	0	0	0	0	0	0
80	0.15334	1.808	0	0	0	0.03957	0	0	0	0	0	0
81	0.15334	1.8771	0	0	0	0.03957	0	0	0	0	0	0
82	-0.41053	2.0002	0	0	0	-0.0398	0	0	0	0	0	0

Node Deflections, Reaction Forces and Moments, Signed values, sorted by Node in Ascending order

Node No.	δ_x [mm]	δ_y [mm]	δ_z [mm]	r_x [deg]	r_y [deg]	r_z [deg]	P_x [N]	P_y [N]	P_z [N]	M_x [Nmm]	M_y [Nmm]	M_z [Nmm]
83	-0.15534	2.0002	0	0	0	-0.0398	0	0	0	0	0	0
84	-0.15534	2.035	0	0	0	-0.0398	0	0	0	0	0	0
85	-0.15534	1.9655	0	0	0	-0.0398	0	0	0	0	0	0
86	0.17089	1.863	0	0	0	0.002425	0	0	0	0	0	0
87	0.17089	1.8652	0	0	0	0.002425	0	0	0	0	0	0
88	0.17089	1.8609	0	0	0	0.002425	0	0	0	0	0	0
89	0.56208	-14.051	0	0	0	-0.01554	0	0	0	0	0	0
90	0.56208	-14.065	0	0	0	-0.01554	0	0	0	0	0	0
91	0.56208	-14.038	0	0	0	-0.01554	0	0	0	0	0	0
92	9.8764	-9.4426	0	0	0	-0.1944	0	0	0	0	0	0
93	0.73386	-9.4292	0	0	0	-0.185	0	0	0	0	0	0
94	11.66	-13.316	0	0	0	-0.1011	0	0	0	0	0	0
95	1.3233	-13.298	0	0	0	-0.02696	0	0	0	0	0	0
96	1.2088	-12.779	0	0	0	-0.01699	0	0	0	0	0	0
97	1.2088	-12.764	0	0	0	-0.01699	0	0	0	0	0	0
98	1.2088	-12.794	0	0	0	-0.01699	0	0	0	0	0	0
99	-0.018663	0	0	0	0	0.002673	0	0	0	0	0	0
100	-0.018663	0.0023328	0	0	0	0.002673	0	0	0	0	0	0
101	-0.018663	-0.0023328	0	0	0	0.002673	0	0	0	0	0	0

Abbreviations

δ_x, δ_y, δ_z: Translation in global X-, Y-, and Z- direction

r_x, r_y, r_z: Rotation about global X-, Y-, and Z- axis (positive for right-handed screw)

P_x, P_y, P_z: Reaction force in global X-, Y-, and Z- direction

M_x, M_y, M_z: Reaction moment about global X-, Y-, and Z- axis (positive for right-handed screw)

Beam Stresses, values, sorted by Beam in Ascending order

Beam No.	σ_{Nx} [N/mm2]	τ_{Qy} [N/mm2]	τ_{Qz} [N/mm2]	τ_{Mx} [N/mm2]	σ_{My} [N/mm2]	σ_{Mz} [N/mm2]
1	-12	0	-59	0	-145	0
2	-5	0	-43	0	-186	0
3	-2	0	8	0	-58	0
4	6	0	5	0	-22	0
5	6	0	1	0	-12	0
6	-6	0	8	0	124	0
7	-6	0	11	0	114	0
8	0	0	-3	0	52	0
9	-1	0	-4	0	11	0
10	0	0	-3	0	12	0
11	-1	0	14	0	-79	0
12	-6	0	10	0	97	0
13	-6	0	12	0	85	0
14	-6	0	30	0	-129	0
15	-0	0	3	0	5	0
16	-0	0	2	0	6	0
17	-0	0	-3	0	6	0
18	-12	0	-36	0	70	0
19	-11	0	50	0	37	0
20	7	0	-12	0	-33	0
21	7	0	-5	0	18	0
22	-13	0	33	0	-49	0
23	-13	0	13	0	-59	0

Beam Stresses, values, sorted by Beam in Ascending order

Beam No.	σNx [N/mm2]	τQy [N/mm2]	τQz [N/mm2]	τMx [N/mm2]	σMy [N/mm2]	σMz [N/mm2]
24	-13	0	13	0	-59	0
25	-12	0	37	0	-50	0
26	0	0	10	0	-129	0
27	0	0	0	0	0	0
28	0	0	0	0	0	0
29	0	0	0	0	0	0
30	0	0	0	0	0	0
31	0	0	0	0	0	0
32	0	0	0	0	0	0
33	0	0	0	0	0	0
34	0	0	0	0	0	0
35	0	0	0	0	0	0
36	0	0	0	0	0	0
37	0	0	0	0	0	0
38	0	0	0	0	0	0
39	0	0	0	0	0	0
40	0	0	0	0	0	0
41	0	0	0	0	0	0
42	-11	0	62	0	-145	0
43	-6	0	-39	0	-198	0
44	-2	0	14	0	-75	0
45	6	0	-7	0	-32	0
46	6	0	-3	0	-15	0
47	-6	0	5	0	131	0
48	-6	0	3	0	135	0
49	-2	0	-3	0	57	0
50	-1	0	-6	0	-18	0
51	-6	0	-19	0	141	0
52	-6	0	-31	0	116	0
53	-6	0	-44	0	-190	0
54	0	0	3	0	-7	0
55	0	0	8	0	-32	0
56	0	0	8	0	-38	0
57	-11	0	48	0	43	0
58	-11	0	38	0	70	0
59	8	0	9	0	-25	0
60	8	0	-5	0	-5	0
61	-12	0	-32	0	-39	0
62	-13	0	-13	0	-49	0
63	-13	0	12	0	-49	0
64	-12	0	35	0	-40	0
65	0	0	0	0	0	0
66	0	0	0	0	0	0
67	0	0	0	0	0	0
68	0	0	0	0	0	0
69	0	0	0	0	0	0
70	0	0	0	0	0	0
71	0	0	0	0	0	0
72	0	0	0	0	0	0
73	0	0	0	0	0	0
74	0	0	0	0	0	0

Beam Stresses, values, sorted by Beam in Ascending order

Beam No.	σNx [N/mm2]	τQy [N/mm2]	τQz [N/mm2]	τMx [N/mm2]	σMy [N/mm2]	σMz [N/mm2]
75	0	0	0	0	0	0
76	0	0	0	0	0	0
77	0	0	0	0	0	0
78	0	0	0	0	0	0
79	-12	0	37	0	53	0
80	0	0	0	0	0	0
81	0	0	0	0	0	0
82	0	0	0	0	0	0
83	-11	0	-35	0	57	0
84	0	0	0	0	0	0
85	0	0	0	0	0	0
86	0	0	0	0	0	0
87	-10	0	58	0	74	0
88	-11	0	-56	0	-64	0
89	0	0	0	0	0	0
90	0	0	0	0	0	0
91	0	0	0	0	0	0
92	0	0	0	0	0	0
93	0	0	0	0	0	0
94	0	0	0	0	0	0
95	0	0	-4	0	7	0
96	-6	0	23	0	62	0
97	-1	0	-1	0	11	0
98	-0	0	-4	0	20	0
99	0	0	-6	0	88	0
100	-0	0	10	0	-161	0
101	-1	0	10	0	170	0
102	-0	0	9	0	-16	0
103	0	0	0	0	0	0
104	0	0	0	0	0	0
105	0	0	0	0	0	0
106	0	0	0	0	0	0
107	0	0	0	0	0	0
108	0	0	0	0	0	0

Combined Element stresses

Beam No.	σNy (min) [N/mm2]	σNy (max) [N/mm2]	σNz (min) [N/mm2]	σNz (max) [N/mm2]
1	-157	12	-12	-12
2	-190	28	-5	-5
3	-60	7	-2	-2
4	-16	9	6	6
5	-6	8	6	6
6	-26	118	-6	-6
7	-24	108	-6	-6
8	-28	53	0	0
9	-2	10	-1	-1
10	-2	12	0	0
11	-80	18	-1	-1
12	-22	91	-6	-6

Combined Element stresses

Beam No.	σ_{Ny} (min) [N/mm2]	σ_{Ny} (max) [N/mm2]	σ_{Nz} (min) [N/mm2]	σ_{Nz} (max) [N/mm2]
13	-20	79	-6	-6
14	-135	15	-6	-6
15	-1	4	-0	-0
16	-1	6	-0	-0
17	-1	5	-0	-0
18	-23	58	-12	-12
19	-18	26	-11	-11
20	-27	17	7	7
21	4	25	7	7
22	-62	-5	-13	-13
23	-73	-4	-13	-13
24	-73	-4	-13	-13
25	-62	-4	-12	-12
26	-129	88	0	0
27	0	0	0	0
28	0	0	0	0
29	0	0	0	0
30	0	0	0	0
31	0	0	0	0
32	0	0	0	0
33	0	0	0	0
34	0	0	0	0
35	0	0	0	0
36	0	0	0	0
37	0	0	0	0
38	0	0	0	0
39	0	0	0	0
40	0	0	0	0
41	0	0	0	0
42	-156	13	-11	-11
43	-204	34	-6	-6
44	-77	10	-2	-2
45	-26	11	6	6
46	-9	8	6	6
47	-27	125	-6	-6
48	-28	130	-6	-6
49	-27	54	-2	-2
50	-19	2	-1	-1
51	-29	136	-6	-6
52	-25	111	-6	-6
53	-196	25	-6	-6
54	-7	1	0	0
55	-32	6	0	0
56	-38	7	0	0
57	-18	32	-11	-11
58	-23	59	-11	-11
59	-17	12	8	8
60	2	11	8	8
61	-51	-6	-12	-12
62	-62	-5	-13	-13
63	-62	-5	-13	-13

Combined Element stresses

Beam No.	σ_{Ny} (min) [N/mm2]	σ_{Ny} (max) [N/mm2]	σ_{Nz} (min) [N/mm2]	σ_{Nz} (max) [N/mm2]
64	-52	-5	-12	-12
65	0	0	0	0
66	0	0	0	0
67	0	0	0	0
68	0	0	0	0
69	0	0	0	0
70	0	0	0	0
71	0	0	0	0
72	0	0	0	0
73	0	0	0	0
74	0	0	0	0
75	0	0	0	0
76	0	0	0	0
77	0	0	0	0
78	0	0	0	0
79	-24	41	-12	-12
80	0	0	0	0
81	0	0	0	0
82	0	0	0	0
83	-21	45	-11	-11
84	0	0	0	0
85	0	0	0	0
86	0	0	0	0
87	-69	64	-10	-10
88	-75	52	-11	-11
89	0	0	0	0
90	0	0	0	0
91	0	0	0	0
92	0	0	0	0
93	0	0	0	0
94	0	0	0	0
95	-1	7	0	0
96	-16	56	-6	-6
97	-9	9	-1	-1
98	-20	19	-0	-0
99	-70	88	0	0
100	-161	18	-0	-0
101	-20	169	-1	-1
102	-16	2	-0	-0
103	0	0	0	0
104	0	0	0	0
105	0	0	0	0
106	0	0	0	0
107	0	0	0	0
108	0	0	0	0

Abbreviations

Principal stresses:

σ_{Nx}: Axial stress (N_x/A_x)
τ_{Mx}: Torsional stress (M_x/W_x)
τ_{Qy}: Shear stress in local y-direction (Q_y/A_y)
τ_{Qz}: Shear stress in local z-direction (Q_z/A_z)
σ_{My}: Bending stress about local y-axis (M_y/W_y)
σ_{Mz}: Bending stress about local z-axis (M_z/W_z)

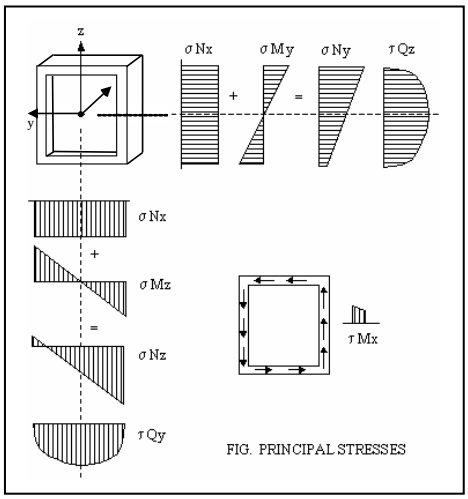


FIG. PRINCIPAL STRESSES

Stress combinations:

σ_{Ny}(min): Normal stress in local xz-plane, max of ($\sigma_{Nx} + \sigma_{My\,(min)}$)
σ_{Ny}(max): Normal stress in local xz-plane, max of ($\sigma_{Nx} + \sigma_{My\,(max)}$)
σ_{Nz}(min): Normal stress in local xy-plane, max of ($\sigma_{Nx} + \sigma_{Mz\,(min)}$)
σ_{Nz}(max): Normal stress in local xy-plane, max of ($\sigma_{Nx} + \sigma_{Mz\,(max)}$)

Where:

A_x: Axial area (total profile area)
A_y: Shear area in local y-direction ($I_z\ t_p\ /\ S_z$)
A_z: Shear area in local z-direction ($I_y\ t_p\ /\ S_y$)
W_x: Torsion section modulus
W_y: Minimum section modulus about local y-axis
W_z: Minimum section modulus about local z-axis
N_x: Axial force
Q_y: Shear force in local y-direction
Q_z: Shear force in local z-direction
M_x: Torsional moment
M_y: Bending moment about local y-axis
M_z: Bending moment about local z-axis
S_y, S_z: 1st area moment about y- and z- axis respectively
t_p: profile thickness value depending on profile type

Effective Stress, values, sorted by Beam in Ascending order

Beam No.	σ_{eff} [N/mm2]	Usage	x-pos [mm]	y-pos [mm]	z-pos [mm]	σ_{Nx} [N/mm2]	σ_{My} [N/mm2]	σ_{Mz} [N/mm2]	τ_{Mx} [N/mm2]	τ_{Qy} [N/mm2]	τ_{Qz} [N/mm2]
1	162	0.69	0	0	-353.5	-12	-143	0	0	0	26
2	192	0.82	2300	0	-263.9	-5	-182	0	0	0	27
3	60	0.26	1825	50	-358.5	-2	-58	0	0	0	0
4	16	0.07	1000	0	-353.5	6	-22	0	0	0	-2
5	8	0.03	500	0	54.96	6	2	0	0	0	-1
6	118	0.50	0	-50	-358.5	-6	124	0	0	0	0
7	108	0.46	0	50	-358.5	-6	114	0	0	0	0
8	53	0.22	0	-40	-86.37	0	52	0	0	0	0
9	10	0.04	1250	50	-358.5	-1	11	0	0	0	0
10	12	0.05	1215	50	-358.5	0	12	0	0	0	0
11	80	0.34	2400	-50	-192	-1	-79	0	0	0	0
12	91	0.39	0	50	-358.5	-6	97	0	0	0	0
13	79	0.33	0	50	-358.5	-6	85	0	0	0	0
14	135	0.57	1610	0	-353.5	-6	-127	0	0	0	-13
15	5	0.02	200	0	0	-0	0	0	0	0	-3
16	6	0.02	1032.5	-75	-268.9	-0	6	0	0	0	0
17	6	0.03	1075	0	0	-0	0	0	0	0	3
18	64	0.27	0	0	0	-12	0	0	0	0	36
19	87	0.37	295	0	0	-11	0	0	0	0	-50
20	28	0.12	0	0	-353.5	7	-33	0	0	0	5
21	25	0.11	1140	50	-358.5	7	18	0	0	0	0

Beam No.	σ_{eff} [N/mm2]	Usage	x-pos [mm]	y-pos [mm]	z-pos [mm]	σ_{Nx} [N/mm2]	σ_{My} [N/mm2]	σ_{Mz} [N/mm2]	τ_{Mx} [N/mm2]	τ_{Qy} [N/mm2]	τ_{Qz} [N/mm2]
22	66	0.28	434.63	0	-353.5	-13	-48	0	0	0	-14
23	73	0.31	398.3	50	-358.5	-13	-59	0	0	0	0
24	73	0.31	0	50	-358.5	-13	-59	0	0	0	0
25	68	0.29	0	0	-353.5	-12	-49	0	0	0	-16
26	129	0.55	0	40	-86.37	0	-129	0	0	0	0
27	N/A										
28	N/A										
29	N/A										
30	N/A										
31	N/A										
32	N/A										
33	N/A										
34	N/A										
35	N/A										
36	N/A										
37	N/A										
38	N/A										
39	N/A										
40	N/A										
41	N/A										
42	161	0.69	0	0	-353.5	-11	-143	0	0	0	-27
43	204	0.87	2300	75	-263.6	-6	-198	0	0	0	0
44	77	0.33	1825	50	-358.5	-2	-75	0	0	0	0
45	26	0.11	1000	0	-353.5	6	-31	0	0	0	3
46	10	0.04	500	0	54.96	6	2	0	0	0	3
47	125	0.53	500	50	-358.5	-6	131	0	0	0	0
48	130	0.55	750	50	-358.5	-6	135	0	0	0	0
49	54	0.23	0	40	-86.37	-2	57	0	0	0	0
50	19	0.08	1250	0	-353.5	-1	-18	0	0	0	3
51	136	0.58	0	50	-358.5	-6	141	0	0	0	0
52	111	0.47	0	50	-358.5	-6	116	0	0	0	0
53	196	0.84	1610	0	-353.5	-6	-188	0	0	0	19
54	7	0.03	1310	0	-263.9	0	-7	0	0	0	-2
55	33	0.14	1575	0	-263.9	0	-32	0	0	0	-5
56	38	0.16	230	0	-263.9	0	-37	0	0	0	-5
57	83	0.35	295	0	0	-11	0	0	0	0	-48
58	67	0.28	0	0	0	-11	0	0	0	0	-38
59	19	0.08	0	0	54.96	8	4	0	0	0	-8
60	12	0.05	1520	0	54.96	8	1	0	0	0	5
61	56	0.24	434.63	0	0	-12	0	0	0	0	32
62	62	0.26	398.3	0	-353.5	-13	-48	0	0	0	6
63	62	0.26	0	50	-358.5	-13	-49	0	0	0	0
64	63	0.27	0	0	0	-12	0	0	0	0	-35
65	N/A										
66	N/A										
67	N/A										
68	N/A										
69	N/A										
70	N/A										
71	N/A										
72	N/A										
73	N/A										

Beam No.	σ_{eff} [N/mm2]	Usage	x-pos [mm]	y-pos [mm]	z-pos [mm]	σ_{Nx} [N/mm2]	σ_{My} [N/mm2]	σ_{Mz} [N/mm2]	τ_{Mx} [N/mm2]	τ_{Qy} [N/mm2]	τ_{Qz} [N/mm2]
74	N/A										
75	N/A										
76	N/A										
77	0	0.00	0	50	-358.5	0	0	0	0	0	0
78	0	0.00	100	0	54.96	0	0	0	0	0	0
79	65	0.28	839.52	0	0	-12	0	0	0	0	-37
80	N/A										
81	N/A										
82	N/A										
83	62	0.26	839.52	0	0	-11	0	0	0	0	35
84	N/A										
85	N/A										
86	N/A										
87	101	0.43	0	0	0	-10	0	0	0	0	-58
88	98	0.42	0	0	0	-11	0	0	0	0	56
89	N/A										
90	N/A										
91	N/A										
92	N/A										
93	N/A										
94	N/A										
95	7	0.03	880	0	-353.5	0	7	0	0	0	1
96	58	0.25	0	0	-353.5	-6	61	0	0	0	-9
97	9	0.04	0	-40	-86.37	-1	11	0	0	0	0
98	20	0.08	200	40	-86.37	-0	-19	0	0	0	0
99	88	0.38	0	40	-86.37	0	88	0	0	0	0
100	161	0.69	1000	40	-86.37	-0	-161	0	0	0	0
101	169	0.72	200	40	-86.37	-1	170	0	0	0	0
102	18	0.07	0	0	-353.5	-0	-16	0	0	0	-4
103	N/A										
104	N/A										
105	N/A										
106	N/A										
107	N/A										
108	N/A										

Abbreviations

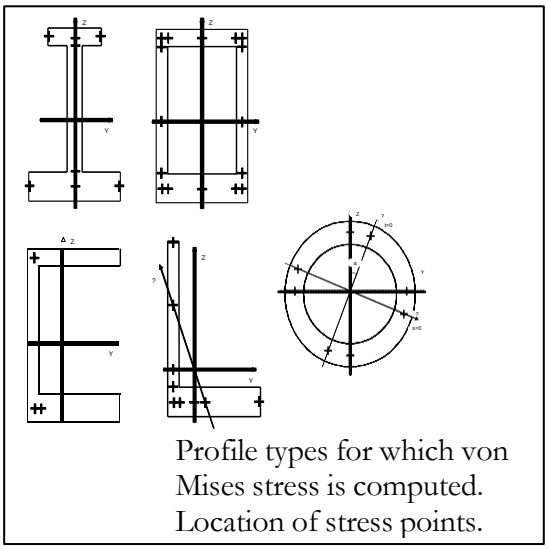
σ_{eff}: Effective stress according to von Mises, $\sigma_{eff} = \sqrt{(\sigma_{Nx} + \sigma_{My} + \sigma_{Mz})^2 + 3(|\tau_{Mx}| + |\tau_{Qy} + \tau_{Qz}|)^2}$

Usage: Usage factor = $\sigma_{eff} / (\sigma_{yield} / \gamma_M)$

σ_{yield} = specified yield stress
γ_M = material factor = 1.0 unless otherwise specified

Position of stress point where σ_{eff} is computed:
x-pos: Distance from start of beam
y-pos: y-coordinate on profile
z-pos: z-coordinate on profile

Stresses at the stress point:
σ_{Nx}: Axial stress
σ_{My}: Bending stress about local y-axis
σ_{Mz}: Bending stress about local z-axis
τ_{Mx}: Torsional stress
τ_{Qy}: Shear stress in local y-direction
τ_{Qz}: Shear stress in local z-direction



Profile types for which von Mises stress is computed. Location of stress points.

Primary Support Member

Stress Check:

PSM	Name	Axial stress [[N/mm2]	Hull girder stress [[N/mm2]	Bend. stress [[N/mm2]	Allow. Bend. [[mm]	Shear stress [[N/mm2]	Allow. Shear [[N/mm2]	Max Normalized usage factor	Is Ok ?
43			0	-198	200	-39	115	0.99	Ok
53			0	-190	200	-44	115	0.95	Ok
2			0	-186	200	-43	115	0.93	Ok
100			0	-161	200	10	115	0.81	Ok
1			0	-145	200	-59	115	0.73	Ok
42			0	-145	200	62	115	0.73	Ok
26			0	-129	200	10	115	0.65	Ok
14			0	-129	200	30	115	0.65	Ok
11			0	-79	200	14	115	0.40	Ok
44			0	-75	200	14	115	0.38	Ok
88			0	-64	200	-56	115	0.49	Ok
23			0	-59	200	13	115	0.30	Ok
24			0	-59	200	13	115	0.30	Ok
3			0	-58	200	8	115	0.29	Ok
25			0	-50	200	37	115	0.32	Ok
63			0	-49	200	12	115	0.25	Ok
62			0	-49	200	-13	115	0.25	Ok
22			0	-49	200	33	115	0.29	Ok
64			0	-40	200	35	115	0.31	Ok
61			0	-39	200	-32	115	0.28	Ok
56			0	-38	200	8	115	0.19	Ok
20			0	-33	200	-12	115	0.17	Ok
55			0	-32	200	8	115	0.16	Ok

Stress Check:

PSM	Name	Axial stress [[N/mm2]	Hull girder stress [[N/mm2]	Bend. stress [[N/mm2]	Allow. Bend. [[mm]	Shear stress [[N/mm2]	Allow. Shear [[N/mm2]	Max Normalized usage factor	Is Ok ?
45			0	-32	200	-7	115	0.16	Ok
59			0	-25	200	9	115	0.12	Ok
4			0	-22	200	5	115	0.11	Ok
50			0	-18	200	-6	115	0.09	Ok
102			0	-16	200	9	115	0.08	Ok
46			0	-15	200	-3	115	0.08	Ok
5			0	-12	200	1	115	0.06	Ok
54			0	-7	200	3	115	0.03	Ok
60			0	-5	200	-5	115	0.04	Ok
77			0	0	200	0	115	0.00	Ok
78			0	0	200	0	115	0.00	Ok
15			0	5	200	3	115	0.03	Ok
17			0	6	200	-3	115	0.03	Ok
16			0	6	200	2	115	0.03	Ok
95			0	7	200	-4	115	0.03	Ok
97			0	11	200	-1	115	0.05	Ok
9			0	11	200	-4	115	0.05	Ok
10			0	12	200	-3	115	0.06	Ok
21			0	18	200	-5	115	0.09	Ok
98			0	20	200	-4	115	0.10	Ok
19			0	37	200	50	115	0.43	Ok
57			0	43	200	48	115	0.41	Ok
8			0	52	200	-3	115	0.26	Ok
79			0	53	200	37	115	0.32	Ok
83			0	57	200	-35	115	0.30	Ok
49			0	57	200	-3	115	0.28	Ok
96			0	62	200	23	115	0.31	Ok
18			0	70	200	-36	115	0.35	Ok
58			0	70	200	38	115	0.35	Ok
87			0	74	200	58	115	0.50	Ok
13			0	85	200	12	115	0.42	Ok
99			0	88	200	-6	115	0.44	Ok
12			0	97	200	10	115	0.49	Ok
7			0	114	200	11	115	0.57	Ok
52			0	116	200	-31	115	0.58	Ok
6			0	124	200	8	115	0.62	Ok
47			0	131	200	5	115	0.66	Ok
48			0	135	200	3	115	0.68	Ok
51			0	141	200	-19	115	0.71	Ok
101			0	170	200	10	115	0.85	Ok

Abbreviations

Verification of beam stresses as specified in Rules for classification:
Ships – DNVGL-RU-SHIP Pt.3 Ch.6. [2.2.2], Edition Jan 2018 and later.
Direct strength - beam analysis, Acceptance criteria for beam analysis.

Stress check information:
PSM: Primary support member, Beam identification number
Name: User's beam identification
Hull girder stress: Average axial stress in member from global bending of hull girder, σ_{hg}, calculated by rule calculator.

Bend. stress: Worst Bending stress along the beam from local loads and beam node rotations.
Allow. Bend: Allowed bending stress = $C_s * R_{eH}$.
Shear stress: Worst average shear stress in the web-plate along the beam.
Allow. Shear: Allowed shear stress = $C_t * \tau_{eH}$.
Normalized usage: The maximum usage factor, calculated as stress divided with the allowable stress. A value < 1.0 means that the PSM is ok.
Is Ok: Text showing Ok or Not ok.

Pillars, beams and columns used in the model

Pillar buckling usage

Pillar	Name	Axial usage	Comb. usage	Normalized usage factor	x-pos [[mm]	$\sigma_{Cr, axial}$ [[N/mm2]	$\sigma_{Cr, bend}$ [[N/mm2]	σ_{Nx} [[N/mm2]	σ_{My} [[N/mm2]	σ_{Mz} [[N/mm2]	Buckl. Curve-y	Buckl. Curve-z
1		0.09	0.58	0.58	166.67	140	235	-12	-115	0	curve b	restrained
2		0.16	0.77	0.77	1966.7	29	235	-5	-143	0	curve b	restrained
3		0.11	0.33	0.33	1520.8	20	235	-2	-50	0	curve b	restrained
4		0.02	0.12	0.12	1000	52	235	6	-22	0	curve b	restrained
5		0.02	0.07	0.07	416.67	140	235	6	-11	0	curve b	restrained
6		0.04	0.12	0.12	166.67	140	235	-6	-20	0	curve b	restrained
7		0.07	0.15	0.15	0	82	235	-6	-19	0	curve b	restrained
8		0.00	0.07	0.07	2166.7	5	235	0	-15	0	curve b	restrained
9		0.01	0.02	0.02	1041.7	36	235	-1	-2	0	curve b	restrained
10		0.00	0.01	0.01	1215	24	235	0	-2	0	curve b	restrained
11		0.07	0.32	0.32	2033.3	8	235	-1	-57	0	curve b	restrained
12		0.04	0.10	0.10	150	154	235	-6	-15	0	curve b	restrained
13		0.05	0.11	0.11	200	113	235	-6	-13	0	curve b	restrained
14		0.24	0.68	0.68	1341.7	24	235	-6	-104	0	curve b	restrained
15		0.02	0.02	0.02	953.54	19	235	-0	-1	0	curve b	restrained
16		0.00	0.01	0.01	1088	76	235	-0	-1	0	curve b	restrained
17		0.00	0.01	0.01	358.33	79	235	-0	-1	0	curve b	restrained
18		0.52	0.57	0.57	1130	22	235	-12	-11	0	curve b	restrained
19		0.06	0.07	0.07	98.333	197	235	-11	-4	0	curve b	restrained
20		0.03	0.09	0.09	560	23	235	7	-15	0	curve b	restrained
21		0.03	0.04	0.04	1140	26	235	7	-3	0	curve b	restrained
22		0.08	0.29	0.29	434.63	159	235	-13	-49	0	curve b	restrained
23		0.08	0.33	0.33	398.3	169	235	-13	-59	0	curve b	restrained
24		0.07	0.33	0.33	0	180	235	-13	-59	0	curve b	restrained
25		0.07	0.29	0.29	0	167	235	-12	-50	0	curve b	restrained
26		0.00	0.24	0.24	800	5	235	0	-57	0	curve b	restrained
27		0.00	0.00	0.00	133.33	42	235	0	0	0	curve c	curve c
28		0.00	0.00	0.00	50	227	235	0	0	0	curve c	curve c
29		0.00	0.00	0.00	16.667	227	235	0	0	0	curve c	curve c
30		0.00	0.00	0.00	133.33	42	235	0	0	0	curve c	curve c
31		0.00	0.00	0.00	133.33	42	235	0	0	0	curve c	curve c
32		0.00	0.00	0.00	50	227	235	0	0	0	curve c	curve c
33		0.00	0.00	0.00	16.667	227	235	0	0	0	curve c	curve c
34		0.00	0.00	0.00	50	227	235	0	0	0	curve c	curve c
35		0.00	0.00	0.00	16.667	227	235	0	0	0	curve c	curve c
36		0.00	0.00	0.00	133.33	42	235	0	0	0	curve c	curve c
37		0.00	0.00	0.00	83.333	89	235	0	0	0	curve c	curve c
38		0.00	0.00	0.00	50	227	235	0	0	0	curve c	curve c
39		0.00	0.00	0.00	50	227	235	0	0	0	curve c	curve c
40		0.00	0.00	0.00	16.667	227	235	0	0	0	curve c	curve c
41		0.00	0.00	0.00	41.667	227	235	0	0	0	curve c	curve c

Pillar buckling usage

Pillar	Name	Axial usage	Comb. usage	Normalized usage factor	x-pos [[mm]	$\sigma_{Cr, axial}$ [[N/mm2]	$\sigma_{Cr, bend}$ [[N/mm2]	σ_{Nx} [[N/mm2]	σ_{My} [[N/mm2]	σ_{Mz} [[N/mm2]	Buckl. Curve-y	Buckl. Curve-z
42		0.08	0.56	0.56	166.67	140	235	-11	-114	0	curve b	restrained
43		0.20	0.84	0.84	1966.7	30	235	-6	-151	0	curve b	restrained
44		0.11	0.37	0.37	1520.8	20	235	-2	-61	0	curve b	restrained
45		0.02	0.16	0.16	1000	52	235	6	-32	0	curve b	restrained
46		0.02	0.09	0.09	416.67	140	235	6	-14	0	curve b	restrained
47		0.04	0.13	0.13	416.67	140	235	-6	-21	0	curve b	restrained
48		0.07	0.16	0.16	750	82	235	-6	-22	0	curve b	restrained
49		0.54	0.58	0.58	2166.7	5	235	-2	-11	0	curve b	restrained
50		0.01	0.08	0.08	1041.7	36	235	-1	-14	0	curve b	restrained
51		0.04	0.13	0.13	150	154	235	-6	-22	0	curve b	restrained
52		0.19	0.25	0.25	463.33	30	235	-6	-14	0	curve b	restrained
53		0.24	0.89	0.89	1341.7	24	235	-6	-153	0	curve b	restrained
54		0.00	0.03	0.03	1310	76	235	0	-7	0	curve b	restrained
55		0.00	0.11	0.11	1312.5	43	235	0	-27	0	curve b	restrained
56		0.00	0.16	0.16	230	224	235	0	-38	0	curve b	restrained
57		0.05	0.07	0.07	98.333	197	235	-11	-5	0	curve b	restrained
58		0.50	0.55	0.55	1130	22	235	-11	-11	0	curve b	restrained
59		0.03	0.08	0.08	560	23	235	8	-11	0	curve b	restrained
60		0.03	0.04	0.04	1266.7	26	235	8	-2	0	curve b	restrained
61		0.08	0.24	0.24	434.63	159	235	-12	-39	0	curve b	restrained
62		0.08	0.28	0.28	398.3	169	235	-13	-49	0	curve b	restrained
63		0.07	0.28	0.28	0	180	235	-13	-49	0	curve b	restrained
64		0.07	0.24	0.24	0	167	235	-12	-40	0	curve b	restrained
65		0.00	0.00	0.00	133.33	42	235	0	0	0	curve c	curve c
66		0.00	0.00	0.00	0	227	235	0	0	0	curve c	curve c
67		0.00	0.00	0.00	41.667	227	235	0	0	0	curve c	curve c
68		0.00	0.00	0.00	133.33	42	235	0	0	0	curve c	curve c
69		0.00	0.00	0.00	133.33	42	235	0	0	0	curve c	curve c
70		0.00	0.00	0.00	0	227	235	0	0	0	curve c	curve c
71		0.00	0.00	0.00	16.667	227	235	0	0	0	curve c	curve c
72		0.00	0.00	0.00	0	227	235	0	0	0	curve c	curve c
73		0.00	0.00	0.00	16.667	227	235	0	0	0	curve c	curve c
74		0.00	0.00	0.00	83.333	89	235	0	0	0	curve c	curve c
75		0.00	0.00	0.00	50	227	235	0	0	0	curve c	curve c
76		0.00	0.00	0.00	16.667	227	235	0	0	0	curve c	curve c
77		0.00	0.00	0.00	50	226	235	0	0	0	curve b	restrained
78		0.00	0.00	0.00	100	235	235	0	0	0	curve b	restrained
79		0.17	0.20	0.20	279.84	69	235	-12	-6	0	curve b	restrained
80		0.00	0.00	0.00	306.17	49	235	0	0	0	curve c	curve c
81		0.00	0.00	0.00	16.667	227	235	0	0	0	curve c	curve c
82		0.00	0.00	0.00	0	227	235	0	0	0	curve c	curve c
83		0.17	0.20	0.20	279.84	69	235	-11	-7	0	curve b	restrained
84		0.00	0.00	0.00	306.17	49	235	0	0	0	curve c	curve c
85		0.00	0.00	0.00	16.667	227	235	0	0	0	curve c	curve c
86		0.00	0.00	0.00	50	227	235	0	0	0	curve c	curve c
87		0.19	0.44	0.44	0	51	235	-10	-59	0	curve b	restrained
88		0.21	0.49	0.49	0	51	235	-11	-64	0	curve b	restrained
89		0.00	0.00	0.00	133.33	42	235	0	0	0	curve c	curve c
90		0.00	0.00	0.00	41.667	227	235	0	0	0	curve c	curve c
91		0.00	0.00	0.00	41.667	227	235	0	0	0	curve c	curve c

Pillar buckling usage

Pillar	Name	Axial usage	Comb. usage	Normalized usage factor	x-pos [[mm]	$\sigma_{Cr, axial}$ [[N/mm2]	$\sigma_{Cr, bend}$ [[N/mm2]	σ_{Nx} [[N/mm2]	σ_{My} [[N/mm2]	σ_{Mz} [[N/mm2]	Buckl. Curve-y	Buckl. Curve-z
92		0.00	0.00	0.00	133.33	42	235	0	0	0	curve c	curve c
93		0.00	0.00	0.00	16.667	227	235	0	0	0	curve c	curve c
94		0.00	0.00	0.00	16.667	227	235	0	0	0	curve c	curve c
95		0.00	0.00	0.00	766.67	95	235	0	-1	0	curve b	restrained
96		0.08	0.11	0.11	263.33	76	235	-6	-7	0	curve b	restrained
97		0.26	0.28	0.28	2000	5	235	-1	-5	0	curve b	restrained
98		0.09	0.18	0.18	200	5	235	-0	-19	0	curve b	restrained
99		0.00	0.30	0.30	2820	4	235	0	-70	0	curve b	restrained
100		0.05	0.74	0.74	1000	6	235	-0	-161	0	curve b	restrained
101		0.26	0.33	0.33	600.24	5	235	-1	-15	0	curve b	restrained
102		0.00	0.06	0.06	105.97	191	235	-0	-13	0	curve b	restrained
103		0.00	0.00	0.00	133.33	42	235	0	0	0	curve c	curve c
104		0.00	0.00	0.00	41.667	227	235	0	0	0	curve c	curve c
105		0.00	0.00	0.00	41.667	227	235	0	0	0	curve c	curve c
106		0.00	0.00	0.00	133.33	42	235	0	0	0	curve c	curve c
107		0.00	0.00	0.00	41.667	227	235	0	0	0	curve c	curve c
108		0.00	0.00	0.00	41.667	227	235	0	0	0	curve c	curve c

Profile properties of pillars

Pillar				Axial		Bending			Warping	Material		
No.	Length [mm]	f_{end-y} [-]	f_{end-z} [-]	Ax [mm2]	Ix [mm4]	Iy [mm4]	Iz [mm4]	Braced joint translation	C_w [cm6]	Yield Stress [N/mm2]	E [N/mm2]	Poisson
1	500	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
2	2000	1.00	1.00	17600	3.0707e+005	1.7304e+008	4.6695e+009	Yes	267511	235	210000	0.30
3	1825	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
4	1000	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Not braced	139035	235	210000	0.30
5	500	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
6	500	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
7	750	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Not braced	139035	235	210000	0.30
8	2600	1.00	1.00	15440	2.6341e+005	6.8035e+006	4.6671e+009	Yes	2973	235	210000	0.30
9	1250	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
10	1620	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
11	2200	1.00	1.00	16400	2.7897e+005	5.5586e+007	4.6675e+009	Yes	36220	235	210000	0.30
12	450	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
13	600	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
14	1610	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
15	1004.7	1.00	1.00	16400	2.7897e+005	5.5586e+007	4.6675e+009	Yes	36220	235	210000	0.30
16	1110	1.00	1.00	17600	3.0707e+005	1.7304e+008	4.6695e+009	Not braced	267511	235	210000	0.30
17	1075	1.00	1.00	17600	3.0707e+005	1.7304e+008	4.6695e+009	Yes	267511	235	210000	0.30
18	1695	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
19	295	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
20	1680	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
21	1520	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
22	434.63	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Not braced	139035	235	210000	0.30
23	398.3	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Not braced	139035	235	210000	0.30
24	358.89	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Not braced	139035	235	210000	0.30
25	407.46	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Not braced	139035	235	210000	0.30
26	2400	1.00	1.00	15440	2.6341e+005	6.8035e+006	4.6671e+009	Yes	2973	235	210000	0.30

Profile properties of pillars

Pillar				Axial		Bending			Warping	Material		
No.	Length [mm]	f_{end-y} [-]	f_{end-z} [-]	Ax [mm2]	Ix [mm4]	Iy [mm4]	Iz [mm4]	Braced joint translation	C_w [cm6]	Yield Stress [N/mm2]	E [N/mm2]	Poisson
27	400	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
28	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Not braced	76222	235	210000	0.30
29	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
30	400	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
31	400	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
32	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Not braced	76222	235	210000	0.30
33	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
34	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Not braced	76222	235	210000	0.30
35	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
36	400	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
37	250	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
38	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Not braced	76222	235	210000	0.30
39	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Not braced	76222	235	210000	0.30
40	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
41	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
42	500	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
43	2000	1.00	1.00	18500	3.7237e+005	1.8994e+008	4.6695e+009	Yes	267511	235	210000	0.30
44	1825	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
45	1000	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Not braced	139035	235	210000	0.30
46	500	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
47	500	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
48	750	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Not braced	139035	235	210000	0.30
49	2600	1.00	1.00	15440	2.6341e+005	6.8035e+006	4.6671e+009	Yes	2973	235	210000	0.30
50	1250	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
51	450	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
52	1390	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
53	1610	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
54	1110	1.00	1.00	17600	3.0707e+005	1.7304e+008	4.6695e+009	Not braced	267511	235	210000	0.30
55	1575	1.00	1.00	17600	3.0707e+005	1.7304e+008	4.6695e+009	Yes	267511	235	210000	0.30
56	230	1.00	1.00	17600	3.0707e+005	1.7304e+008	4.6695e+009	Not braced	267511	235	210000	0.30
57	295	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
58	1695	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
59	1680	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
60	1520	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
61	434.63	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Not braced	139035	235	210000	0.30
62	398.3	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Not braced	139035	235	210000	0.30
63	358.89	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Not braced	139035	235	210000	0.30
64	407.46	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Not braced	139035	235	210000	0.30
65	400	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
66	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Not braced	76222	235	210000	0.30
67	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
68	400	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
69	400	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
70	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Not braced	76222	235	210000	0.30
71	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
72	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Not braced	76222	235	210000	0.30
73	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
74	250	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
75	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Not braced	76222	235	210000	0.30

Profile properties of pillars

Pillar				Axial		Bending			Warping	Material		
No.	Length [mm]	f_{end-y} [-]	f_{end-z} [-]	Ax [mm2]	Ix [mm4]	Iy [mm4]	Iz [mm4]	Braced joint translation	C_w [cm6]	Yield Stress [N/mm2]	E [N/mm2]	Poisson
76	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
77	150	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
78	100.25	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Not braced	139035	235	210000	0.30
79	839.52	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
80	367.4	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
81	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
82	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Not braced	76222	235	210000	0.30
83	839.52	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
84	367.4	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
85	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
86	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Not braced	76222	235	210000	0.30
87	1015.2	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Not braced	139035	235	210000	0.30
88	1015.2	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Not braced	139035	235	210000	0.30
89	400	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
90	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
91	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
92	400	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
93	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
94	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
95	680	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
96	790	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
97	2400	1.00	1.00	15440	2.6341e+005	6.8035e+006	4.6671e+009	Yes	2973	235	210000	0.30
98	1200	1.00	1.00	15440	2.6341e+005	6.8035e+006	4.6671e+009	Not braced	2973	235	210000	0.30
99	2820	1.00	1.00	15440	2.6341e+005	6.8035e+006	4.6671e+009	Not braced	2973	235	210000	0.30
100	1000	1.00	1.00	15440	2.6341e+005	6.8035e+006	4.6671e+009	Not braced	2973	235	210000	0.30
101	1200.7	1.00	1.00	15440	2.6341e+005	6.8035e+006	4.6671e+009	Yes	2973	235	210000	0.30
102	317.92	1.00	1.00	17800	3.0184e+005	2.6646e+008	4.6675e+009	Yes	139035	235	210000	0.30
103	400	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
104	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
105	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
106	400	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
107	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30
108	50	1.00	1.00	14000	2.2867e+005	4.6667e+009	57167	Yes	76222	235	210000	0.30

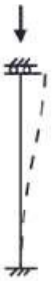
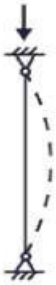
Abbreviations

Buckling information:

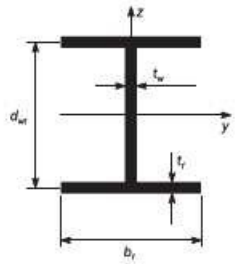
Pillar:	Beam identification number
Name:	User's beam identification
Axial usage:	Buckling usage factor for axial load only
Comb. usage:	Buckling usage factor for combined axial load and bending moments.
Allow. usage:	Allowable usage factor for the given load case acceptance criteria.
Normalized usage:	The buckling usage divided with the allowable usage factor. A value < 1.0 means that beam is ok.
x-pos:	Position along beam from where the largest bending moment is taken from.
$\sigma_{Cr, axial}$	Critical buckling stress for axial loads
$\sigma_{Cr, bend}$	Largest critical stress for bending moments.
σ_{Nx}	Axial stress.
σ_{My}	Bending stress about local y-axis.
σ_{Mz}	Bending stress about local z-axis.
Buckl. Curve-y	Buckling curve for buckling about y-axis.

Buckl. Curve-z Buckling curve for buckling about z-axis.
Available options according to DNVGL-CG-0128 Sec.3 [5.4] Figure 4 is: { a, b, c, e, restrained }, where restrained means that it is laterally restrained and not subjected to buckling.

Pillar properties:
No.: Beam identification number
Length: Elastic length, (total length minus rigid ends), of beam.
$f_{end\text{-}y}$: End constrain factor of the pillar, for bending about y-axis of beam.
$f_{end\text{-}z}$: End constrain factor of the pillar, for bending about z-axis of beam.
(see DNVGL-RU-CG-0128, sec.3 [4.2] Table 7)

Buckled shape of member						
f_{end}	4.0	2.0	1.0	1.0	0.25	0.25

Ax: Axial area (total profile area)
Ix: Torsional moment of inertia
Iy: Moment of inertia about local y-axis
Iz: Moment of inertia about local z-axis
Braced joint transl. Yes, if both beam ends are braced or otherwise supported against joint translation.
(Bending moments are then taken from within middle 1/3 of beam.)
Cw Warping constant.
Simplified warping factor calculated as given in DNVGL-RU-CG-0128, sec 3 [4.4] Table 8 formulas.
Example for I-beam shown below:

	$I_{sv} = \frac{1}{3}(2b_f t_f^3 + d_{wt} t_w^3)\ 10^{-4}$	cm⁴
	$c_{warp} = \frac{d_{wt}^2 b_f^3 t_f}{24}\ 10^{-6}$	cm⁶

E: Young's Modulus
Poisson: Poisson's ratio for transverse contraction
Yield Stress: Nominal yield stress

APPENDIX D NAUTICUS HULL REPORT #35

NAUTICUS™ HULL

Cross Section Analysis according to DNV GL rules

Rule edition.....: July 2018

Program version .....: Nauticus Hull V20 - © 2018

Build .....: 20.7.102.5468

Ship Identification

Project.....: LMG35

ID No .....: LMG 35

Date/Sign .....: 05/06/2019 7:51:19 AM / GHA

Analysis.....: (#35) 35 : #35

Main Dimensions

Length between perpendiculars, Lbp	[m]:	32.200
Rule length, L	[m]:	35.000
Freeboard length, Lll	[m]:	35.000
X-position for fwd. end of waterline for freeboard length.....	[m]:	35.000
Breadth moulded, B	[m]:	10.000
Draught moulded, T	[m]:	3.500
Depth moulded, D	[m]:	7.200
Freeboard depth moulded, Dll	[m]:	4.600
Block coefficient, C_b	:	0.680
Waterplane area coefficient, C_{wp}	:	0.000

Table of contents

1. RULE REFERENCE 3

2. INPUT DATA 5

2.1. General Ship Data 5

2.2. Class Notations as specified by user 5

2.3. Frame table 6

2.4. Transverse Bulkheads 6

3. CROSS SECTION OVERVIEW 7

3.1. Cross section identification data 7

3.2. Cross section analyses 7

3.3. Cross section properties 7

3.4. Cross section material 8

3.5. Torsion Characteristics 8

3.6. Cross section plot 9

3.7. Cross section plates 10

3.8. Cross section stiffeners 12

3.9. Cross section transverse stiffeners 12

4. DESIGN LOADS 14

4.1. Bending Moments and Shear Forces at frame 14

5. HULL GIRDER STRENGTH REQUIREMENTS 16

5.1. Hull Girder Requirements at frame 16

6. HULL GIRDER ULTIMATE STRENGTH 18

6.1. Requirements 18

6.2. Intact Condition at: Frame ..... **Błąd! Nie zdefiniowano zakładki.**

7. RULE REQUIREMENTS 19

7.1. Plates below requirements 19

7.2. Stiffeners below requirement 19

7.3. All plates 19

7.4. All longitudinal stiffeners 29

7.5. All transverse stiffeners 29

7.6. All main frames 36

7.7. All main frame brackets 38

8. COMPARTMENT DATA 39

8.1. General compartment data 39

8.2. Bulk cargo holds ..... **Błąd! Nie zdefiniowano zakładki.**

8.3. Other compartment data 40

8.4. Geometry 41

9. LOADING CONDITIONS 42

9.1. Prescriptive loading conditions 42

9.2. Flooding conditions 42

9.3. Fatigue conditions 44

1. RULE REFERENCE

DNV GL rules, July 2018.

The following parts of the Rules are covered in this document:

Part 3: Hull

- Chapter 5 Hull Girder Strength
  - Sec. 2 Vertical hull girder bending and shear strength
  - Sec. 3 Hull girder yield check
  - Sec. 4 Hull girder ultimate strength check
- Chapter 6 Hull Local Scantling
  - Sec. 3 Minimum thicknesses
  - Sec. 4 Plating
    - Not covered: [1.2] Plating of corrugated bulkheads
  - Sec. 5 Stiffeners
    - Not covered: [1.1.3] Grouping of stiffeners
    - Not covered: [1.1.4] Plating and stiffener of different material
    - Not covered: [1.1.5] Struts connecting stiffeners
  - Sec. 7 Intersection of stiffeners and PSM
    - [1.2.3]
    - [1.2.4]
  - Sec. 8 Superstructure, deckhouse and companionways
- Chapter 8 Buckling
  - Sec. 2 Slenderness requirements
  - Sec. 3 Hull girder buckling
- Chapter 9 Fatigue
- Chapter 10 Special Requirements
  - Sec. 1 Bow impact
  - Sec. 2 Bottom slamming
  - Sec. 3 Stern slamming
  - Sec. 4 Sloshing and liquid impact in tanks
    - Not covered: [2.4] Impact pressure in larger tanks
    - Not covered: [3.2] Scantling requirements due to liquid pressure
  - Sec. 5 Wheel loading
  - Sec. 6 Special hull structures
    - [8] Strengthening against berthing impact

Part 5: Ship types

- Chapter 1 Bulk carriers and dry cargo ships
  - Sec. 2 Common requirements
  - Sec. 3 Steel coil requirements
  - Sec. 5 General dry cargo ships and multi-purpose dry cargo ships
  - Sec. 6 Bulk carriers
  - Sec. 7 Ore carriers
    - Not covered: [6.1] Minimum thicknesses
    - Not covered: [6.3.2] and [6.3.3] Minimum moment of inertia of stiffeners.
  - Sec. 8 Ships specialised for the carriage of a single type of dry bulk cargo
- Chapter 7 Liquefied gas tankers
  - Sec. 20 Design with independent prismatic tanks of Type-A and Type-B
    - 1 Special consideration for single side hull
      - [1.6.3] and [1.6.4]
    - 3 Local strength of cargo tanks
  - Sec. 23 Design with membrane tanks
    - 2.2 Local scantling of inner hull

Part 6: Additional class notations

- Chapter 1 Structural strength and integrity
  - Sec. 1 Strengthened for grab loading and unloading - GRAB
  - Sec. 2 Strengthened for heavy cargo – STRENGTHENED
  - Sec. 3 Strengthened for heavy liquid – HL
  - Sec. 4 Strengthened for heavy cargo in bulk – HC
  - Sec. 5 Strengthened for ore cargo – OC
- Chapter 6 Cold climate
  - Sec. 1 Basic ice strengthening – ICE
  - Sec. 2 Strengthening of the northern Baltic – ICE
  - Sec. 5 Polar class - PC

Note: The following is not included:

- Primary Supporting Members and Pillars
- Hull Outfitting
- Impact pressures in larger tanks
- Strengthening for tug contact: plates and stiffeners
- Strengthening against berthing: stiffeners

2. INPUT DATA

2.1. General Ship Data

Length between perpendiculars, Lpp	[m]:	32.200
Rule length, L	[m]:	35.000
Freeboard length, Lll	[m]:	35.000
X-position for fwd. end of waterline for freeboard length	[m]:	35.000
Breadth moulded, B	[m]:	10.000
Depth moulded, D	[m]:	7.200
Freeboard depth moulded, Dll	[m]:	4.600
Scantling draught, Tsc	[m]:	3.500
Design draught, T_{Design}	[m]:	0.000
Minimum normal ballast draught	[m]:	3.500
Heavy ballast draught	[m]:	0.000
Design slamming draught at FP (any ballast tanks empty)	[m]:	3.500
Design slamming draught at FP (all ballast tanks full)	[m]:	3.500
Block coefficient, C_b	:	0.680
Maximum service speed, V	[knots]:	15.000
No of decks above 0.7D from baseline		1
Z coordinate of the bulkhead deck	[m]:	4.600
Deepest equlibrium WL in damaged condition	[m]:	4.550
Waterplane area coefficient, C_{wp}	:	0.000
Freeboard	:	A
Bilge keel?	:	Yes

2.2. Class Notations as specified by user

DNVGL

2.3. Frame table

Position of frame #0: 0 mm Aft of A.P.

Frame No	Spacing fwd [mm]	Distance from A.P. [m]
Stern	500	0.000

2.4. Transverse Bulkheads

Frame	Distance from A.P. [m]
#3	1.500
#26	13.000
#38	19.000
#61	30.500

3. CROSS SECTION OVERVIEW

3.1. Cross section identification data

Frame	Distance from A.P. [m]	Created on	Sign	Drawing	Revision
#35	17.500				

3.2. Cross section analyses

Frame	Prescriptive	Global ULS	Fatigue
#35			

3.3. Cross section properties

		Effective Cut-outs subtracted		Gross Cut-outs disregarded	
		as built	net (50% corr)	as built	net (50% corr)
Cross sectional area of the longitudinal elements	cm^2	5782	5348	5837	5396
Horizontal dist. from C.L. to vertical neutral axis, Yn	m	0.361	0.375	0.374	0.387
Vertical distance fom B.L. to horizontal neutral axis, Zn	m	4.428	4.446	4.455	4.470
Vertical moment of inertia, Iy	m^4	5.258	4.826	5.300	4.862
Horizontal moment of inertia , Iz	m^4	5.197	4.777	5.208	4.786
Product of inertia about the neutral axes, Iyz	m^4	0.468	0.451	0.489	0.470
Section Modulus, Bottom	m^3	1.187	1.085	1.190	1.088
Section Modulus, Strength deck at side (z = 4600mm)	m^3	30.625	31.239	36.438	37.540
Section Modulus, Equivalent deck line (z = 4600mm)	m^3	30.625	31.239	36.438	37.540
Section Modulus, at Side	m^3	0.971	0.890	0.971	0.890
First moment of the area above the neutral axis, S	m^3	0.754	0.693	0.761	0.699
I/S	m	6.972	6.968	6.965	6.961

3.4. Cross section material

		Bottom	Side	Deck	Above deck
Material strength group	-	VL-NS	VL-NS	VL-NS	VL-NS
Specified minimum yield stress, R_{eH}	N/mm^2	235	235	235	235
Material factor, k	-	1.00	1.00	1.00	DataNotFound
Vertical extent, z_{hts}	mm	0		0	

Note: Material for each individual plate is specified in chapter 3.7.

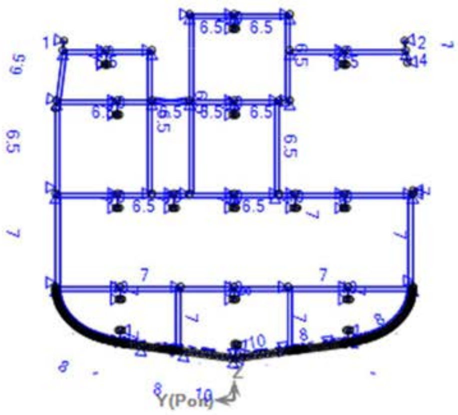
3.5. Torsion Characteristics

Shear centre distance from C.L. ..... [mm]: 1770
Shear centre distance above B.L ..... [mm]: 3114
Torsion constant, It ..... [m^4]: 3
Sectorial moment of inertia, Iωω ..... [m^6]: 19
Accumulated horizontal force, Fy .....[N]: 1.00
Accumulated vertical force, Fz .....[N]: 1.00
Accumulated torsion moment, Mx .....[Nm]: 1.00

Fy, Fz and Mx should all be = 1.0 for a correct shear flow distribution.

3.6. Cross section plot

(#35) 35



3.7. Cross section plates

Plate	Start Y [mm]	End Y [mm]	Start Z [mm]	End Z [mm]	Breadth [mm]	Thickness [mm]	Gross Area [cm²]	Cut-out Area [cm²]	Yield stress [N/mm²]
Outer Shell PS									
Plate0	0.0	1386.9	0.0	191.3	1400.0	10.0	140.0	0.0	235
Plate1	1386.9	2577.3	191.3	342.2	1200.0	8.0	96.0	0.0	235
Plate2	2577.3	4990.0	342.2	2122.3	3350.1	8.0	268.0	0.0	235
Plate3	4990.0	4990.0	2122.3	4772.3	2650.0	7.0	185.5	0.0	235
Plate4	4990.0	4960.0	4772.3	7220.4	2450.0	6.5	159.3	0.0	235
Plate5	4960.0	4755.0	7220.4	8860.0	1652.4	6.5	107.4	0.0	235
Inner bottom PS									
Plate0	0.0	4990.0	2000.0	2000.0	4990.0	7.0	349.3	0.0	235
Deck_4600_PS									
Plate0	0.0	4990.0	4600.0	4600.0	4990.0	6.5	324.4	0.0	235
Deck_7200_PS									
Plate0	0.0	1250.0	7200.0	7200.0	1250.0	6.5	81.3	0.0	235
Plate1	1250.0	2300.0	7200.0	7200.0	1050.0	6.5	68.3	55.3	235
Plate2	2300.0	4962.5	7200.0	7200.0	2662.5	6.5	173.1	0.0	235
Deck_8600_PS									
Plate0	2300.0	4787.5	8600.0	8600.0	2487.5	6.5	161.7	0.0	235
Long_Bhd_1500_f_CL_PS									
Plate0	1500.0	1500.0	206.2	2000.0	1793.8	7.0	125.6	0.0	235
Deck_9600_PS									
Plate0	0.0	1250.0	9600.0	9600.0	1250.0	6.5	81.3	0.0	235
Long_Bhd_2500_f_CL_PS									
Plate0	2300.0	2300.0	4600.0	8600.0	4000.0	6.5	260.0	0.0	235
Long_Bhd_1250_f_CL_PS									
Plate0	1250.0	1250.0	4600.0	9600.0	5000.0	6.5	325.0	0.0	235
Deck_9600_SB									
Plate0	-1550.0	0.0	9600.0	9600.0	1550.0	6.5	100.8	0.0	235
Inner bottom SB									
Plate0	-4990.0	0.0	2000.0	2000.0	4990.0	7.0	349.3	0.0	235
Deck_4600_SB									
Plate0	-4990.0	-1140.0	4600.0	4600.0	3850.0	8.0	308.0	0.0	235
Plate1	-1140.0	0.0	4600.0	4600.0	1140.0	6.5	74.1	0.0	235
Deck_7200_SB									
Plate0	-1550.0	0.0	7200.0	7200.0	1550.0	6.5	100.8	0.0	235
Long_Bhd_1500_f_CL_SB									
Plate0	-1500.0	-1500.0	206.2	2000.0	1793.8	7.0	125.6	0.0	235
Long_Bhd_1250_f_CL_SB									
Plate0	-1250.0	-1250.0	4600.0	7200.0	2600.0	6.5	169.0	0.0	235
Long_Bhd_1550_f_CL_SB									
Plate0	-1550.0	-1550.0	7200.0	9600.0	2400.0	6.5	156.0	0.0	235
Deck_8600_SB									
Plate0	-4787.5	-1550.0	8600.0	8600.0	3237.5	6.5	210.4	0.0	235
Outer Shell Starboard Split2									
Plate0	-4831.4	-4755.0	8249.0	8860.0	615.8	7.0	43.1	0.0	235
Outer Shell SB									

Plate0	0.0	-1386.9	0.0	191.3	1400.0	10.0	140.0	0.0	235
Plate1	-1386.9	-2626.9	191.3	348.9	1250.0	8.0	100.0	0.0	235
Plate2	-2626.9	-4990.0	348.9	2172.3	3350.1	8.0	268.0	0.0	235
Plate3	-4990.0	-4990.0	2172.3	4600.0	2427.7	7.0	169.9	0.0	235
Outer Shell Starboard Split1 Split2									
Plate0	-4990.0	-4990.0	4690.0	4600.0	90.0	7.0	6.3	0.0	235
Single-Skin Girder 0 Web									
Plate0	3182.0	3182.0	786.1	436.1	350.0	7.0	24.5	0.0	235
Single-Skin Girder 0 Flange									
Plate0	3132.0	3232.0	786.1	786.1	100.0	10.0	10.0	0.0	235
Single-Skin Girder 1 Web									
Plate0	-3182.0	-3182.0	786.1	436.1	350.0	7.0	24.5	0.0	235
Single-Skin Girder 1 Flange									
Plate0	-3232.0	-3132.0	786.1	786.1	100.0	10.0	10.0	0.0	235
Single-Skin Girder 2 Web									
Plate0	-3182.0	-3182.0	1650.0	2000.0	350.0	7.0	24.5	0.0	235
Single-Skin Girder 2 Flange									
Plate0	-3232.0	-3132.0	1650.0	1650.0	100.0	10.0	10.0	0.0	235
Single-Skin Girder 3 Web									
Plate0	3182.0	3182.0	1650.0	2000.0	350.0	7.0	24.5	0.0	235
Single-Skin Girder 3 Flange									
Plate0	3132.0	3232.0	1650.0	1650.0	100.0	10.0	10.0	0.0	235
Single-Skin Girder 4 Web									
Plate0	-55.7	0.0	396.1	0.0	400.0	8.0	32.0	0.0	235
Single-Skin Girder 4 Flange									
Plate0	-105.2	-6.2	389.1	403.1	100.0	10.0	10.0	0.0	235
Single-Skin Girder 5 Web									
Plate0	0.0	0.0	1650.0	2000.0	350.0	8.0	28.0	0.0	235
Single-Skin Girder 5 Flange									
Plate0	-50.0	50.0	1650.0	1650.0	100.0	10.0	10.0	0.0	235
Single-Skin Girder 6 Web									
Plate0	0.0	0.0	4200.0	4600.0	400.0	7.0	28.0	0.0	235
Single-Skin Girder 6 Flange									
Plate0	-50.0	50.0	4200.0	4200.0	100.0	10.0	10.0	0.0	235
Single-Skin Girder 7 Web									
Plate0	-1705.0	-1705.0	4200.0	4600.0	400.0	7.0	28.0	0.0	235
Single-Skin Girder 7 Flange									
Plate0	-1755.0	-1655.0	4200.0	4200.0	100.0	10.0	10.0	0.0	235
Single-Skin Girder 8 Web									
Plate0	-3090.0	-3090.0	4200.0	4600.0	400.0	7.0	28.0	0.0	235
Single-Skin Girder 8 Flange									
Plate0	-3140.0	-3040.0	4200.0	4200.0	100.0	10.0	10.0	0.0	235
Single-Skin Girder 9 Web									
Plate0	1682.0	1682.0	4200.0	4600.0	400.0	7.0	28.0	0.0	235
Single-Skin Girder 9 Flange									
Plate0	1632.0	1732.0	4200.0	4200.0	100.0	10.0	10.0	0.0	235
Single-Skin Girder 10 Web									
Plate0	3255.0	3255.0	4200.0	4600.0	400.0	7.0	28.0	0.0	235

Single-Skin Girder 10 Flange

Plate0	3205.0	3305.0	4200.0	4200.0	100.0	10.0	10.0	0.0	235

Single-Skin Girder 11 Web

Plate0	0.0	0.0	6800.0	7200.0	400.0	7.0	28.0	0.0	235

Single-Skin Girder 11 Flange

Plate0	-50.0	50.0	6800.0	6800.0	100.0	10.0	10.0	0.0	235

Single-Skin Girder 12 Web

Plate0	3263.0	3263.0	6800.0	7200.0	400.0	7.0	28.0	0.0	235

Single-Skin Girder 12 Flange

Plate0	3213.0	3313.0	6800.0	6800.0	100.0	10.0	10.0	0.0	235

Single-Skin Girder 13 Web

Plate0	3573.0	3573.0	8200.0	8600.0	400.0	7.0	28.0	0.0	235

Single-Skin Girder 13 Flange

Plate0	3523.0	3623.0	8200.0	8200.0	100.0	10.0	10.0	0.0	235

Single-Skin Girder 14 Web

Plate0	0.0	0.0	9200.0	9600.0	400.0	7.0	28.0	0.0	235

Single-Skin Girder 14 Flange

Plate0	-50.0	50.0	9200.0	9200.0	100.0	10.0	10.0	0.0	235

Single-Skin Girder 15 Web

Plate0	-3089.0	-3089.0	8200.0	8600.0	400.0	7.0	28.0	0.0	235

Single-Skin Girder 15 Flange

Plate0	-3139.0	-3039.0	8200.0	8200.0	100.0	10.0	10.0	0.0	235

3.8. Cross section stiffeners

ID From - To	Profile Type	Dimensions	Yield stress [N/mm^2]
Outer Shell PS			
1 - 1	Flatbar	60 x 8	235
Outer Shell Starboard Split2			
4 - 4	Flatbar	150 x 10	235
2 - 2	Flatbar	60 x 8	235

3.9. Cross section transverse stiffeners

Type	Profile Type	Dimensions	Span [mm]	Spacing [mm]	Yield stress [N/mm^2]
Outer Shell PS					
TSTIF	HPBulb	140 x 7	1514	500	235
TSTIF	HPBulb	140 x 7	1698	500	235
TSTIF	HPBulb	140 x 7	2214	500	235
TSTIF	HPBulb	140 x 7	2600	500	235
TSTIF	HPBulb	120 x 6	2600	500	235
TSTIF	HPBulb	120 x 6	1411	500	235
Inner bottom PS					
TSTIF	HPBulb	140 x 7	1500	500	235
TSTIF	HPBulb	140 x 7	1682	500	235
TSTIF	HPBulb	140 x 7	1808	500	235
Deck_4600_PS					
TSTIF	HPBulb	120 x 6	1682	500	235
TSTIF	HPBulb	120 x 6	1573	500	235
TSTIF	HPBulb	120 x 6	1735	500	235

Deck_7200_PS

TSTIF	HPBulb	120 x 6	1250	500	235
TSTIF	HPBulb	120 x 6	1050	500	235
TSTIF	HPBulb	120 x 6	963	500	235
TSTIF	HPBulb	120 x 6	1700	500	235

Deck_8600_PS

TSTIF	HPBulb	120 x 6	1273	500	235
TSTIF	HPBulb	120 x 6	1215	500	235

Long_Bhd_1500_f_CL_PS

TSTIF	HPBulb	140 x 7	1794	500	235

Deck_9600_PS

TSTIF	HPBulb	120 x 6	1250	500	235

Long_Bhd_2500_f_CL_PS

TSTIF	HPBulb	120 x 6	2600	500	235
TSTIF	HPBulb	120 x 6	1400	500	235

Long_Bhd_1250_f_CL_PS

TSTIF	HPBulb	120 x 6	2600	500	235
TSTIF	HPBulb	120 x 6	2400	500	235

Deck_9600_SB

TSTIF	HPBulb	120 x 6	1550	500	235

Inner bottom SB

TSTIF	HPBulb	140 x 7	1808	500	235
TSTIF	HPBulb	140 x 7	1682	500	235
TSTIF	HPBulb	140 x 7	1500	500	235

Deck_4600_SB

TSTIF	HPBulb	120 x 6	1900	500	235
TSTIF	HPBulb	120 x 6	1385	500	235
TSTIF	HPBulb	120 x 6	1705	500	235

Deck_7200_SB

TSTIF	Flatbar	150 x 10	300	500	235
TSTIF	HPBulb	120 x 6	1250	500	235

Long_Bhd_1500_f_CL_SB

TSTIF	HPBulb	120 x 6	1794	500	235

Long_Bhd_1250_f_CL_SB

TSTIF	HPBulb	120 x 6	2600	500	235

Long_Bhd_1550_f_CL_SB

TSTIF	HPBulb	120 x 6	2400	500	235

Deck_8600_SB

TSTIF	HPBulb	120 x 6	1699	500	235
TSTIF	HPBulb	120 x 6	1539	500	235

Outer Shell SB

TSTIF	HPBulb	140 x 7	1514	500	235
TSTIF	HPBulb	140 x 7	1698	500	235
TSTIF	HPBulb	140 x 7	2214	500	235
TSTIF	HPBulb	140 x 7	2600	500	235

4. DESIGN LOADS

4.1. Bending Moments and Shear Forces at Frame #35 (17500 mm from A.P.)

Stillwater Bending Moments [kNm]

Condition		Guidance values	User specified
Seagoing	Sagging	-2617	-2617
	Hogging	3919	3919
	Torsion	N/A	N/A
Harbour	Sagging	N/A	N/A
	Hogging	N/A	N/A
	Torsion	N/A	N/A
Fatigue	Homogenous		N/A
	Alternate		N/A
	Heavy ballast		N/A
	Ballast		N/A

Wave Bending Moments [kNm]

Condition		Rule values	User specified
Seagoing	Sagging	-5581	
	Hogging	4742	
Fatigue	Sagging	N/A	
	Hogging	N/A	
	Horizontal	553	
	Torsion	401	

Stillwater Shear Forces [kN]

Condition		Guidance values	User specified
Seagoing	Positive	N/A	448
	Negative	N/A	-448
Harbour	Positive	N/A	N/A
	Negative	N/A	N/A
Fatigue	Homogenous	N/A	N/A
	Alternate	N/A	N/A
	Heavy ballast	N/A	N/A
	Ballast	N/A	N/A

Wave Shear Forces [kN]

Condition		Rule values	User specified
Seagoing	Positive	306	
	Negative	-306	

5. HULL GIRDER STRENGTH REQUIREMENTS

5.1. Hull Girder Requirements at Frame #35 (17500 mm from A.P.)

Minimum Hull Girder Requirements

		Minimum Section Modulus [m3]	Steel grade	Yield strength R_{eH} [N/mm²]	Material factor
Section Modulus	Bottom	0.109	VL-NS	235	1.00
	Equivalent deck line	0.109	VL-NS	235	1.00
Minimum Moment of Inertia [m4]		0.000			

Section modulus

Operation	Position	Condition	M_{sw} [kNm]	M_{wv} [kNm]	σ_{perm} [N/mm²]	$Z_{requred}$ [m³]	Z_{actual} [m³]	OK?
Seagoing	Bottom	Sagging	-2617	-5581	175.00	0.05	1.19	Yes
		Hogging	3919	4742	175.00	0.05	1.19	Yes
	Equivalent deck line	Sagging	-2617	-5581	175.00	0.05	30.62	Yes
		Hogging	3919	4742	175.00	0.05	30.62	Yes

Note: Based on material data according to 3.4 Cross section material

Hull girder yield strength

Longitudinal normal stress, σ_{hg}

Operation	Decisive condition	Weakest Plate	σ_{hg} [N/mm²]	$\sigma_{hg\text{-}perm}$ [N/mm²]	OK?
Seagoing	ExtremeSea_SD, Full load, HSM_2	Deck_9600_PS: Plate0	9.25	205.00	Yes

Shear stress, τ_{hg}

Operation	Decisive condition	Weakest Plate	τ_{hg} [N/mm²]	$\tau_{hg\text{-}perm}$ [N/mm²]	OK?
Seagoing	ExtremeSea_SD, Full load, HSM_1	Outer Shell PS: Plate3	8.84	120.00	Yes

Equivalent stress, σ_v

Operation	Decisive condition	Weakest Plate	σ_v [N/mm²]	$\sigma_{v\text{-}perm}$ [N/mm²]	OK?
Seagoing	N/A, ,	:	0.00	0.00	N/A

Shear capacity

Operation	Weakest Plate	f_{har} [-]	Q_{sw} [kN]	Q_{wv} [kN]	Q_R [kN]	OK?
Seagoing	Outer Shell PS: Plate3	N/A	448	306	10071	Yes
Harbour	:	0.0	0	0	0	N/A

Minimum vertical extent of higher strength steel

Area	Condition	Actual z_{hts} [mm]	Required z_{hts} [mm]	OK?
Bottom	Sagging	0	0	Yes
	Hogging	0	0	Yes
Equivalent deck line	Sagging	0	0	Yes
	Hogging	0	0	Yes

Note: Based on material data according to 3.4 Cross section material

Abbreviations

M_{sw}	Permissible hogging and sagging vertical still water bending moment [kNm]
M_{wv}	Vertical wave bending moment [kNm]
σ_{perm}	Permissible hull girder bending stress [N/mm²]
$Z_{required}$	Required section modulus at deck or bottom [m³]
Z_{actual}	Section modulus at deck or bottom [m³]
Q_{sw}	Permissible positive or negative still water shear force [kN]
Q_{wv}	Vertical wave shear force [kN]
Q_R	Total vertical hull girder shear capacity [kN]
OK?	Whether requirement(s) are fulfilled

6. HULL GIRDER ULTIMATE STRENGTH

6.1. Requirements

The vertical hull girder ultimate bending capacity at any hull transverse section is to satisfy the following criteria:

Ultimate Strength in Intact Condition
$M_U \geq M \gamma_R$ where: $\gamma_R = \gamma_M \gamma_{DB}$ $M = \gamma_S M_{sw\text{-}U} + \gamma_W M_{wv}$

Abbreviations

γ_M	Partial safety factor for the vertical hull girder ultimate bending capacity, covering material, geometric and strength prediction uncertainties
γ_S	Partial safety factor for the still water bending moment
DLS	Design load scenario (S+D): A = Msw-h or Msw-s, B = Maximum sagging still water bending moment for operational seagoing homogeneous full load condition
H/S	Hogging or Sagging
Cond	Condition
γ_{DB}	Partial safety factor for the vertical hull girder ultimate bending capacity, covering the effect of double bottom bending,
γ_W	Partial safety factor for the vertical wave bending moment
γ_R	Partial safety factor for the vertical hull girder ultimate bending capacity
$M_{sw\text{-}U}$	Permissible still water bending moment, in kNm, in hogging and sagging conditions at the hull transverse section
M_{wv}	Vertical wave bending moment, in kNm, in hogging and sagging conditions at the hull transverse section
M	The vertical hull girder bending moment, M in hogging and sagging conditions, to be considered in the ultimate strength check
M_U	Vertical hull girder ultimate bending capacity
US	$100\ M_U / (M \gamma_R)$
OK?	No! if US < 100, else Yes

7. RULE REQUIREMENTS

7.1. Plates below requirements

Plate	ACT			t [mm]	t_c [mm]	α_p	C_a	X		Eff [%]		R_{eH} [N/mm²]			
	LOC	Load ref.		EPP	t_{loc} [mm]	t_{min} [mm]	Span [mm]	Spac [mm]	p [kN/m²]	y_l [mm]	z_l [mm]	Draught [m]	σ_{hg} [N/mm²]	F_{SC} [kN]	OK?
	BUC	Load ref.		EPP	$t_{s/t}$ t_{buc} [mm]	Stress comb. Radius [mm]	σ_x σ_y τ [N/mm²]	σ_E [N/mm²]	Asp. α F_{long}	Case σ Case τ	K_x K_y K_τ	C_x C_y C_τ	γ_c	η_{actual} η_{allow}	OK?

Plates below requirement at Frame #35 (17500 mm from A.P.)

7.2. Stiffeners below requirement

Stiff. No	ACT	Type Dimension		y z [mm]	Z_{net} [cm³]	Spacing t_{pl_net} [mm]	R_{eH} τ_{eH} [N/mm²]	t_{cw} t_{cf} [mm]	h_{w_net} b_f [mm]	t_w t_f [mm]	X	C_s C_t	l_{bdg} l_{shr} [mm]	
	LOC MIN	Load ref. for Z		Load ref. for t_w		Z_{req} [cm³]	$Z_{Rel.\ req}$ [%]	$t_{w\ min}$ $t_{f\ min}$ [mm]	$t_{w\ shear}$ $t_{pl\ min\_net}$ [mm]	draught$_z$ [m]	draught$_{tw}$ [m]	p_z [kN/m²] F_{sc} [kN]	p_{tw} [kN/m²]	OK?
	BUC SLN	Span b_{eff} [mm]	Est. Z_{req} est. [cm³]	Est. $h_{w\ req}$ Est. $t_{f\ req}$ [mm]	$b_{f\ sl}$ [mm]	I_{buc} I_{req} [cm⁴]		$t_{w\ min\ sl}$ $t_{f\ min\ sl}$ [mm]	p_{lat} [kN/m²]	σ_x σ_y [N/mm²]	σ_a σ_b [N/mm²]	τ σ_w [N/mm²]	η_{actual} η_{allow}	OK?
	FAT	ConnType	Double skin?	Web dist [mm]	L_{bdg} aft L_{bdg} fwd [mm]	X aft X fwd [mm]	K_a aft K_a fwd	K_b aft K_b fwd	D aft D fwd	T aft T fwd [years]	Damage	Fat.Life [years]	HotSpot	OK?

Frame #35 (17500 mm from A.P.)

7.3. All plates

Plate	ACT		t [mm]	t_c [mm]	α_p	C_a	X		Eff [%]		R_{eH} [N/mm²]			
	LOC	Load ref.	EPP	t_{loc} [mm]	t_{min} [mm]	Span [mm]	Spac [mm]	p [kN/m²]	y_l [mm]	z_l [mm]	Draught [m]	σ_{hg} [N/mm²]	Fsc [kN]	OK?
	BUC	Load ref.	EPP	$t_{s/t}$ t_{buc} [mm]	Stress comb. Radius [mm]	σ_x σ_y τ [N/mm²]	σ_E [N/mm²]	Asp. α F_{long}	Case σ Case τ	K_x K_y K_τ	C_x C_y C_τ	γ_c	η_{actual} η_{allow}	OK?

Frame #35 (17500 mm from A.P.)

Outer Shell PS at #35

Plate0	ACT		10.0	1.5	1.00	1	0		100.0		235			
	LOC	SEA-1, FSM_2	EPP1	5.0	8.0	1514.1	500.0	42.0	0	0	3.500	-2.0		Yes
	BUC	HSM_2	EPP1	5.5 2.5	1 2084013	0.0 8.4 -0.6	53.8	3.03 1.00	Case_2 Case_15	4.00 1.26 10.00	1.00 0.44 1.00	12.12	0.08 1.00	Yes
Plate1	ACT		8.0	1.5	1.00	1	0		100.0		235			
	LOC	SEA-1, BSR_1P	EPP3	5.0	7.0	1697.9	500.0	44.8	1500	206	3.500	2.6		Yes
	BUC	HSM_2	EPP3	5.5 3.0	1 271449	0.0 8.0 -1.3	31.5	3.40 1.00	Case_2 Case_15	4.00 1.21 9.85	1.00 0.31 0.96	8.92	0.11 1.00	Yes
Plate2	ACT		8.0	1.5	1.00	1	0		100.0		235			
	LOC	SEA-1, BSR_1P	EPP5	5.5	7.0	2615.8	500.0	52.8	3182	436	3.500	2.4		Yes
	BUC	OST_2P	EPP5	0.0 3.0	1 8002	0.0 7.3 -2.0	31.5	5.23 1.00	Case_2 Case_15	4.00 1.15 9.50	1.00 0.26 0.95	8.22	0.12 1.00	Yes

Plate	ACT		t [mm]	t_c [mm]	α_p	C_a	X		Eff [%]		R_{eH} [N/mm²]			
	LOC	Load ref.	EPP	t_{loc} [mm]	t_{min} [mm]	Span [mm]	Spac [mm]	p [kN/m²]	y_l [mm]	z_l [mm]	Draught [m]	σ_{hg} [N/mm²]	Fsc [kN]	OK?
	BUC	Load ref.	EPP	$t_{s/t}$ t_{buc} [mm]	Stress comb. Radius [mm]	σ_x σ_y τ [N/mm²]	σ_E [N/mm²]	Asp. α F_{long}	Case σ Case τ	K_x K_y K_τ	C_x C_y C_τ	γ_c	η_{actual} η_{allow}	OK?
Plate3	ACT		7.0	1.0	1.00	1	0		100.0		235			
	LOC	SEA-1, BSR_1P	EPP7	4.5	6.0	2600.0	500.0	46.8	4990	2122	3.500	1.2		Yes
	BUC	OST_2P	EPP7	5.0 3.0	1 0	0.0 6.3 -5.2	26.8	5.20 1.00	Case_2 Case_15	4.00 1.41 9.51	1.00 0.31 0.87	9.52	0.11 1.00	Yes
Plate4	ACT		6.5	1.0	1.00	1	0		100.0		235			
	LOC	SEA-1, BSP_1P	EPP9	3.5	6.0	2601.7	500.0	26.1	4990	4772	3.500	-0.3		Yes
	BUC	OST_1S	EPP9	4.0 2.5	1 0	0.0 6.2 2.9	22.5	5.20 1.00	Case_2 Case_15	4.00 1.36 9.51	1.00 0.27 0.80	9.38	0.11 1.00	Yes
Plate5	ACT		6.5	1.5	1.00	1	0		100.0		235			
	LOC	SEA-1, HSM_1	EPP11	2.0	6.5	1410.9	500.0	5.0	4960	7220	3.500	-4.7		Yes
	BUC	OST_1S	EPP11	3.0 2.0	1 0	0.0 7.7 1.3	22.5	2.82 1.00	Case_2 Case_15	4.00 1.40 10.12	1.00 0.31 0.83	9.34	0.11 1.00	Yes
Inner bottom PS at #35														
Plate0	ACT		7.0	1.5	1.00	1	0		100.0		235			
	LOC	TK-2, Static	EPP15	5.5	6.5	1682.0	500.0	59.6	3182	2000	3.500	1.3		Yes
	BUC	OST_2P	EPP16	5.5 3.0	1 0	0.0 6.3 -2.1	22.5	3.62 1.00	Case_2 Case_15	4.00 1.26 9.78	1.00 0.27 0.81	9.49	0.11 1.00	Yes
Deck_4600_PS at #35														
Plate0	ACT		6.5	1.0	0.81	1	0		100.0		235			
	LOC	SEA-1, HSM_1	EPP19	3.0	6.0	618.0	500.0	21.7	2300	4600	3.500	-0.3		Yes
	BUC	OST_1S	EPP21	5.0 2.0	1 0	0.0 3.1 -2.7	26.8	3.47 1.00	Case_2 Case_15	4.00 1.39 9.82	1.00 0.33 0.89	19.68	0.05 1.00	Yes
Deck_7200_PS at #35														
Plate0	ACT		6.5	0.5	1.00	1	0		100.0		235			
	LOC	UDL-1, BSP_1P	EPP22	2.0	5.5	1250.0	500.0	7.3	1250	7200	3.500	-2.8		Yes
	BUC	HSM_1	EPP22	3.5 1.5	1 0	0.0 5.0 -0.7	26.8	2.50 1.00	Case_2 Case_15	4.00 1.35 10.36	1.00 0.34 0.91	15.55	0.06 1.00	Yes
Plate1	ACT		6.5	1.5	0.97	1	0		100.0		235			
	LOC	UDL-1, BSP_1P	EPP23	3.0	6.5	1050.0	500.0	7.3	2300	7200	3.500	-2.8		Yes
	BUC	HSM_1	EPP23	4.5 2.5	1 0	0.0 5.0 -1.1	18.6	2.10 1.00	Case_2 Case_15	4.00 1.50 10.82	1.00 0.32 0.78	14.29	0.07 1.00	Yes
Plate2	ACT		6.5	0.5	1.00	1	0		100.0		235			
	LOC	UDL-1, BSP_1P	EPP25	2.0	5.5	1699.5	500.0	7.4	4963	7200	3.500	-2.8		Yes
	BUC	OST_1S	EPP25	3.5 1.5	1 0	0.0 6.2 -1.1	26.8	3.40 1.00	Case_2 Case_15	4.00 1.28 9.85	1.00 0.30 0.89	11.24	0.09 1.00	Yes
Deck_8600_PS at #35														
Plate0	ACT		6.5	1.0	1.00	1	0		100.0		235			
	LOC	SEA-1, HSM_1	EPP27	3.0	6.0	1214.5	500.0	13.2	4788	8600	3.500	-7.1		Yes
	BUC	HSM_1	EPP26	4.0 2.0	1 0	0.0 7.5 -0.2	22.5	2.55 1.00	Case_2 Case_15	4.00 1.33 10.32	1.00 0.30 0.84	9.47	0.11 1.00	Yes
Long_Bhd_1500_f_CL_PS at #35														

Plate	ACT		t [mm]	t_c [mm]	α_p	C_a	X		Eff [%]		R_{eH} [N/mm²]			
	LOC	Load ref.	EPP	t_{loc} [mm]	t_{min} [mm]	Span [mm]	Spac [mm]	p [kN/m²]	y_l [mm]	z_l [mm]	Draught [m]	σ_{hg} [N/mm²]	Fsc [kN]	OK?
	BUC	Load ref.	EPP	$t_{s/t}$ t_{buc} [mm]	Stress comb. Radius [mm]	σ_x σ_y τ [N/mm²]	σ_E [N/mm²]	Asp. α F_{long}	Case σ Case τ	K_x K_y K_τ	C_x C_y C_τ	γ_c	η_{actual} η_{allow}	OK?
Plate0	ACT		7.0	1.5	1.00	1	0		100.0		235			
	LOC	TK-2, Static	EPP28	6.0	7.0	1793.8	500.0	77.5	1500	206	3.500	2.3		Yes
	BUC	HSM_2	EPP28	5.5 2.5	1 0	0.0 8.0 -0.6	22.5	3.59 1.00	Case_2 Case_15	4.00 1.44 9.79	1.00 0.31 0.81	8.97	0.11 1.00	Yes
Deck_9600_PS at #35														
Plate0	ACT		6.5	1.0	0.00	0	0		0.0		0			
	LOC			0.0	6.0	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_1	EPP29	4.0 2.5	1 0	0.0 9.4 -1.3	22.5	2.50 1.00	Case_2 Case_15	4.00 1.35 10.36	1.00 0.31 0.84	7.60	0.13 1.00	Yes
Long_Bhd_2500_f_CL_PS at #35														
Plate0	ACT		6.5	1.0	0.00	0	0		0.0		0			
	LOC			0.0	6.0	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_1	EPP31	5.0 2.0	1 0	0.0 7.5 0.4	22.5	2.80 1.00	Case_2 Case_15	4.00 1.52 10.13	1.00 0.34 0.83	10.51	0.10 1.00	Yes
Long_Bhd_1250_f_CL_PS at #35														
Plate0	ACT		6.5	1.0	0.00	0	0		0.0		0			
	LOC			0.0	6.0	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_1	EPP33	5.0 2.5	1 0	0.0 9.4 2.2	22.5	4.80 1.00	Case_2 Case_15	4.00 1.37 9.55	1.00 0.27 0.80	6.67	0.15 1.00	Yes
Deck_9600_SB at #35														
Plate0	ACT		6.5	1.0	0.00	0	0		0.0		0			
	LOC			0.0	6.0	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_1	EPP34	4.0 2.0	1 0	0.0 9.4 -0.2	22.5	3.10 1.00	Case_2 Case_15	4.00 1.22 9.97	1.00 0.27 0.82	6.68	0.15 1.00	Yes
Inner bottom SB at #35														
Plate0	ACT		7.0	1.5	1.00	1	0		100.0		235			
	LOC	TK-2, Static	EPP35	5.5	6.5	1808.0	500.0	59.6	-4990	2000	3.500	1.3		Yes
	BUC	OST_2S	EPP35	5.5 3.0	1 0	0.0 6.3 1.6	22.5	3.62 1.00	Case_2 Case_15	4.00 1.26 9.78	1.00 0.27 0.81	9.65	0.10 1.00	Yes
Deck_4600_SB at #35														
Plate0	ACT		8.0	1.0	1.00	1	0		100.0		235			
	LOC	SEA-1, BSP_1S	EPP38	4.0	6.0	1900.0	500.0	27.8	-4990	4600	3.500	-0.2		Yes
	BUC	OST_1P	EPP38	5.0 2.5	2 0	0.0 2.2 4.9	36.5	3.80 1.00	Case_2 Case_15	4.00 1.37 9.73	1.00 0.37 1.00	20.95	0.05 1.00	Yes
Plate1	ACT		6.5	0.5	1.00	1	0		100.0		235			
	LOC	UDL-1, BSP_1S	EPP42	2.0	5.5	1250.0	500.0	7.3	-1250	4600	3.500	-0.2		Yes
	BUC	OST_1P	EPP42	4.5 1.0	1 0	0.0 0.9 0.7	26.8	2.50 1.00	Case_2 Case_15	4.00 2.12 10.36	1.00 0.50 0.91	95.84	0.01 1.00	Yes
Deck_7200_SB at #35														
Plate0	ACT		6.5	1.0	1.00	1	0		100.0		235			
	LOC	UDL-1, BSP_1S	EPP44	2.0	6.0	1250.0	500.0	7.3	-1250	7200	3.500	-2.8		Yes
	BUC	HSM_1	EPP44	4.0 1.5	1 0	0.0 5.0 -0.2	26.8	2.50 1.00	Case_2 Case_15	4.00 1.35 10.36	1.00 0.34 0.91	15.77	0.06 1.00	Yes
Long_Bhd_1500_f_CL_SB at #35														

Plate	ACT		t [mm]	t_c [mm]	α_p	C_a	X		Eff [%]		R_{eH} [N/mm²]			
	LOC	Load ref.	EPP	t_{loc} [mm]	t_{min} [mm]	Span [mm]	Spac [mm]	p [kN/m²]	y_l [mm]	z_l [mm]	Draught [m]	σ_{hg} [N/mm²]	Fsc [kN]	OK?
	BUC	Load ref.	EPP	$t_{s/t}$ t_{buc} [mm]	Stress comb. Radius [mm]	σ_x σ_y τ [N/mm²]	σ_E [N/mm²]	Asp. α F_{long}	Case σ Case τ	K_x K_y K_τ	C_x C_y C_τ	γ_c	η_{actual} η_{allow}	OK?
Plate0	ACT		7.0	1.5	1.00	1	0		100.0		235			
	LOC	TK-2, Static	EPP45	6.0	7.0	1793.8	500.0	77.5	-1500	206	3.500	2.3		Yes
	BUC	HSM_2	EPP45	5.5 2.5	1 0	0.0 8.0 -0.6	22.5	3.59 1.00	Case_2 Case_15	4.00 1.44 9.79	1.00 0.31 0.81	8.98	0.11 1.00	Yes
Long_Bhd_1250_f_CL_SB at #35														
Plate0	ACT		6.5	1.0	0.00	0	0		0.0		0			
	LOC			0.0	6.0	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_1	EPP46	5.0 2.5	1 0	0.0 5.0 4.0	22.5	5.20 1.00	Case_2 Case_15	4.00 1.64 9.51	1.00 0.34 0.80	12.52	0.08 1.00	Yes
Long_Bhd_1550_f_CL_SB at #35														
Plate0	ACT		6.5	1.0	0.00	0	0		0.0		0			
	LOC			0.0	6.0	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_1	EPP47	4.0 2.5	1 0	0.0 7.5 3.3	22.5	2.80 1.00	Case_2 Case_15	4.00 1.52 10.13	1.00 0.34 0.83	9.49	0.11 1.00	Yes
Deck_8600_SB at #35														
Plate0	ACT		6.5	1.5	1.00	1	0		100.0		235			
	LOC	SEA-1, HSM_1	EPP49	3.5	6.5	1698.5	500.0	13.2	-4788	8600	3.500	-7.1		Yes
	BUC	HSM_1	EPP49	4.5 2.5	1 0	0.0 7.5 -0.9	18.6	3.40 1.00	Case_2 Case_15	4.00 1.18 9.85	1.00 0.23 0.74	6.97	0.14 1.00	Yes
Outer Shell Starboard Split2 at #35														
Plate0	ACT		7.0	1.5	0.96	1	0		100.0		235			
	LOC	SEA-1, HSM_1	EPP52	2.0	6.5	500.0	252.0	2.7	-4819	8350	3.500	-6.6		Yes
	BUC	OST_2P	EPP54	3.0 2.0	1 0	-8.8 0.0 0.0	6161.6	33.08 1.25	Case_1 Case_15	5.01 1.00 9.26	1.00 1.00 1.00	26.78	0.04 1.00	Yes
Outer Shell SB at #35														
Plate0	ACT		10.0	1.5	1.00	1	0		100.0		235			
	LOC	SEA-1, FSM_2	EPP55	5.0	8.0	1514.1	500.0	42.0	0	0	3.500	-2.0		Yes
	BUC	HSM_2	EPP55	5.5 2.5	1 2084013	0.0 8.4 -0.3	53.8	3.03 1.00	Case_2 Case_15	4.00 1.26 10.00	1.00 0.44 1.00	12.15	0.08 1.00	Yes
Plate1	ACT		8.0	1.5	1.00	1	0		100.0		235			
	LOC	SEA-1, BSR_1S	EPP57	5.0	7.0	1697.9	500.0	44.8	-1500	206	3.500	2.6		Yes
	BUC	HSM_2	EPP57	5.5 3.0	1 271449	0.0 8.0 -1.0	31.5	3.40 1.00	Case_2 Case_15	4.00 1.21 9.85	1.00 0.31 0.96	8.97	0.11 1.00	Yes
Plate2	ACT		8.0	1.5	1.00	1	0		100.0		235			
	LOC	SEA-1, BSR_1S	EPP59	5.5	7.0	2615.8	500.0	52.8	-3182	436	3.500	2.4		Yes
	BUC	OST_2S	EPP59	0.0 3.0	1 8002	0.0 7.3 -1.6	31.5	5.23 1.00	Case_2 Case_15	4.00 1.15 9.50	1.00 0.26 0.95	8.28	0.12 1.00	Yes
Plate3	ACT		7.0	1.0	1.00	1	0		100.0		235			
	LOC	SEA-1, BSP_1S	EPP61	4.5	6.0	2600.0	500.0	46.3	-4990	2172	3.500	2.3		Yes
	BUC	OST_2S	EPP61	5.0 2.5	1 0	0.0 6.3 -4.0	26.8	5.20 1.00	Case_2 Case_15	4.00 1.41 9.51	1.00 0.31 0.87	10.11	0.10 1.00	Yes

Outer Shell Starboard Split1 Split2 at #35

Plate	ACT		t [mm]	t_c [mm]	α_p	C_a	X		Eff [%]		R_{eH} [N/mm²]			
	LOC	Load ref.	EPP	t_{loc} [mm]	t_{min} [mm]	Span [mm]	Spac [mm]	p [kN/m²]	y_l [mm]	z_l [mm]	Draught [m]	σ_{hg} [N/mm²]	Fsc [kN]	OK?
	BUC	Load ref.	EPP	$t_{s/t}$ t_{buc} [mm]	Stress comb. Radius [mm]	σ_x σ_y τ [N/mm²]	σ_E [N/mm²]	Asp. α F_{long}	Case σ Case τ	K_x K_y K_T	C_x C_y C_T	γ_c	η_{actual} η_{allow}	OK?
Plate0	ACT		7.0	1.5	1.00	1	0		100.0		235			
	LOC	SEA-1, BSP_1S	EPP62	2.0	6.5	2000.0	90.0	27.8	-4990	4600	3.500	-0.2		Yes
	BUC	OST_2P	EPP62	2.0 2.0	1 0	-3.3 0.0 0.0	695.3	22.22 1.40	Case_1 Case_15	5.70 1.00 9.26	1.00 1.00 1.00	71.79	0.01 1.00	Yes

Single-Skin Girder 0 Web at #35

Plate0	ACT		7.0	1.5	1.00	1	0		100.0		235			
	LOC	INT-1, Static	EPP63	3.0	6.5	2000.0	350.0	12.0	3182	436	3.500	2.2		Yes
	BUC	HSM_2	EPP63	5.0 2.0	1 0	7.6 0.0 -0.1	46.0	5.71 1.40	Case_1 Case_15	5.84 1.06 9.46	0.93 1.00 1.00	28.82	0.03 1.00	Yes

Single-Skin Girder 0 Flange at #35

Plate0	ACT		10.0	2.0	1.00	1	0		100.0		235			
	LOC	INT-1, Static	EPP64	2.0	7.0	2000.0	50.0	12.0	3182	786	3.500	2.0		Yes
	BUC	HSM_2	EPP64	6.0 2.5	1 0	6.9 0.0 0.0	4766.3	40.00 1.40	Case_1 Case_15	5.60 1.00 9.25	1.00 1.00 1.00	33.92	0.03 1.00	Yes

Single-Skin Girder 1 Web at #35

Plate0	ACT		7.0	1.5	1.00	1	0		100.0		235			
	LOC	INT-1, Static	EPP66	3.0	6.5	2000.0	350.0	12.0	-3182	436	3.500	2.2		Yes
	BUC	HSM_2	EPP66	5.0 2.0	1 0	7.6 0.0 -0.1	46.0	5.71 1.40	Case_1 Case_15	5.84 1.06 9.46	0.93 1.00 1.00	28.83	0.03 1.00	Yes

Single-Skin Girder 1 Flange at #35

Plate0	ACT		10.0	2.0	1.00	1	0		100.0		235			
	LOC	INT-1, Static	EPP67	2.0	7.0	2000.0	50.0	12.0	-3232	786	3.500	2.0		Yes
	BUC	HSM_2	EPP67	6.0 2.5	1 0	6.9 0.0 0.0	4766.3	40.00 1.40	Case_1 Case_15	5.60 1.00 9.25	1.00 1.00 1.00	33.92	0.03 1.00	Yes

Single-Skin Girder 2 Web at #35

Plate0	ACT		7.0	1.5	1.00	1	0		100.0		235			
	LOC	INT-1, Static	EPP69	3.0	6.5	2000.0	350.0	12.0	-3182	1650	3.500	1.5		Yes
	BUC	OST_2S	EPP69	5.0 2.0	1 0	5.7 0.0 -0.1	46.0	5.71 1.40	Case_1 Case_15	5.83 1.06 9.46	0.93 1.00 1.00	38.66	0.03 1.00	Yes

Single-Skin Girder 2 Flange at #35

Plate0	ACT		10.0	2.0	1.00	1	0		100.0		235			
	LOC	INT-1, Static	EPP70	2.0	7.0	2000.0	50.0	12.0	-3232	1650	3.500	1.5		Yes
	BUC	OST_2S	EPP70	6.0 2.5	1 0	5.7 0.0 0.0	4766.3	40.00 1.40	Case_1 Case_15	5.61 1.00 9.25	1.00 1.00 1.00	41.32	0.02 1.00	Yes

Single-Skin Girder 3 Web at #35

Plate0	ACT		7.0	1.5	1.00	1	0		100.0		235			
	LOC	INT-1, Static	EPP72	3.0	6.5	2000.0	350.0	12.0	3182	1650	3.500	1.5		Yes
	BUC	OST_2P	EPP72	5.0 2.0	1 0	5.7 0.0 0.0	46.0	5.71 1.40	Case_1 Case_15	5.83 1.06 9.46	0.93 1.00 1.00	38.68	0.03 1.00	Yes

Single-Skin Girder 3 Flange at #35

Plate0	ACT		10.0	2.0	1.00	1	0		100.0		235			
	LOC	INT-1, Static	EPP73	2.0	7.0	2000.0	50.0	12.0	3182	1650	3.500	1.5		Yes
	BUC	OST_2P	EPP74	6.0 2.5	1 0	5.7 0.0 0.0	4766.3	40.00 1.40	Case_1 Case_15	5.61 1.00 9.25	1.00 1.00 1.00	41.32	0.02 1.00	Yes

Plate	ACT		t [mm]	t_c [mm]	α_p	C_a	X		Eff [%]		R_{eH} [N/mm²]			
	LOC	Load ref.	EPP	t_{loc} [mm]	t_{min} [mm]	Span [mm]	Spac [mm]	p [kN/m²]	y_l [mm]	z_l [mm]	Draught [m]	σ_{hg} [N/mm²]	Fsc [kN]	OK?
	BUC	Load ref.	EPP	$t_{s/t}$ t_{buc} [mm]	Stress comb. Radius [mm]	σ_x σ_y τ [N/mm²]	σ_E [N/mm²]	Asp. α F_{long}	Case σ Case τ	K_x K_y K_τ	C_x C_y C_τ	γ_c	η_{actual} η_{allow}	OK?

Single-Skin Girder 4 Web at #35

Plate0	ACT		8.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	6.0	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_2	EPP75	4.5 1.0	1 0	8.4 0.0 -0.1	65.5	5.00 1.40	Case_1 Case_15	5.85 1.08 9.53	1.00 1.00 1.00	27.89	0.04 1.00	Yes

Single-Skin Girder 4 Flange at #35

Plate0	ACT		10.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_2	EPP76	4.5 1.0	1 0	7.7 0.0 0.0	6721.3	40.00 1.40	Case_1 Case_15	5.60 1.00 9.25	1.00 1.00 1.00	30.60	0.03 1.00	Yes

Single-Skin Girder 5 Web at #35

Plate0	ACT		8.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_2	EPP78	4.0 1.0	1 0	5.3 0.0 0.0	85.5	5.71 1.40	Case_1 Case_15	5.96 1.06 9.46	1.00 1.00 1.00	44.40	0.02 1.00	Yes

Single-Skin Girder 5 Flange at #35

Plate0	ACT		10.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_2	EPP79	4.5 1.0	1 0	5.3 0.0 0.0	6721.3	40.00 1.40	Case_1 Case_15	5.60 1.00 9.25	1.00 1.00 1.00	44.41	0.02 1.00	Yes

Single-Skin Girder 6 Web at #35

Plate0	ACT		7.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_2	EPP81	4.5 1.0	1 0	0.5 0.0 0.0	49.2	5.00 1.40	Case_1 Case_15	21.74 1.08 9.53	1.00 1.00 1.00	505.59	0.00 1.00	Yes

Single-Skin Girder 6 Flange at #35

Plate0	ACT		10.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_2	EPP82	4.5 1.0	1 0	0.5 0.0 0.0	6721.3	40.00 1.40	Case_1 Case_15	5.60 1.00 9.25	1.00 1.00 1.00	505.60	0.00 1.00	Yes

Single-Skin Girder 7 Web at #35

Plate0	ACT		7.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	OST_2S	EPP84	4.5 1.0	1 0	1.3 0.0 0.0	49.2	5.00 1.40	Case_1 Case_15	6.94 1.08 9.53	1.00 1.00 1.00	175.68	0.01 1.00	Yes

Single-Skin Girder 7 Flange at #35

Plate0	ACT		10.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	OST_2S	EPP85	4.5 1.0	1 0	1.4 0.0 0.0	6721.3	40.00 1.40	Case_1 Case_15	5.66 1.00 9.25	1.00 1.00 1.00	171.90	0.01 1.00	Yes

Single-Skin Girder 8 Web at #35

Plate	ACT		t [mm]	t_c [mm]	α_p	C_a	X		Eff [%]		R_{eH} [N/mm²]			
	LOC	Load ref.	EPP	t_{loc} [mm]	t_{min} [mm]	Span [mm]	Spac [mm]	p [kN/m²]	y_l [mm]	z_l [mm]	Draught [m]	σ_{hg} [N/mm²]	Fsc [kN]	OK?
	BUC	Load ref.	EPP	$t_{s/t}$ t_{buc} [mm]	Stress comb. Radius [mm]	σ_x σ_y τ [N/mm²]	σ_E [N/mm²]	Asp. α F_{long}	Case σ Case τ	K_x K_y K_τ	C_x C_y C_τ	γ_c	η_{actual} η_{allow}	OK?
Plate0	ACT		7.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	OST_2S	EPP87	4.5 1.0	1 0	2.2 0.0 0.0	49.2	5.00 1.40	Case_1 Case_15	6.36 1.08 9.53	1.00 1.00 1.00	108.93	0.01 1.00	Yes
Single-Skin Girder 8 Flange at #35														
Plate0	ACT		10.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	OST_2S	EPP88	4.5 1.0	1 0	2.2 0.0 0.0	6721.3	40.00 1.40	Case_1 Case_15	5.64 1.08 9.25	1.00 1.00 1.00	107.61	0.01 1.00	Yes
Single-Skin Girder 9 Web at #35														
Plate0	ACT		7.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	OST_2P	EPP90	4.5 1.0	1 0	1.3 0.0 0.0	49.2	5.00 1.40	Case_1 Case_15	6.95 1.08 9.53	1.00 1.00 1.00	177.47	0.01 1.00	Yes
Single-Skin Girder 9 Flange at #35														
Plate0	ACT		10.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	OST_2P	EPP92	4.5 1.0	1 0	1.4 0.0 0.0	6721.3	40.00 1.40	Case_1 Case_15	5.66 1.00 9.25	1.00 1.00 1.00	173.62	0.01 1.00	Yes
Single-Skin Girder 10 Web at #35														
Plate0	ACT		7.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	OST_2P	EPP93	4.5 1.0	1 0	2.3 0.0 0.0	49.2	5.00 1.40	Case_1 Case_15	6.32 1.08 9.53	1.00 1.00 1.00	103.90	0.01 1.00	Yes
Single-Skin Girder 10 Flange at #35														
Plate0	ACT		10.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	OST_2P	EPP95	4.5 1.0	1 0	2.3 0.0 0.0	6721.3	40.00 1.40	Case_1 Case_15	5.63 1.00 9.25	1.00 1.00 1.00	103.02	0.01 1.00	Yes
Single-Skin Girder 11 Web at #35														
Plate0	ACT		7.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_2	EPP96	4.5 1.0	1 0	-5.2 0.0 0.0	49.2	5.00 1.40	Case_1 Case_15	6.02 1.08 9.53	1.00 1.00 1.00	45.07	0.02 1.00	Yes
Single-Skin Girder 11 Flange at #35														
Plate0	ACT		10.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_2	EPP97	4.5 1.0	1 0	-4.5 0.0 0.0	6721.3	40.00 1.40	Case_1 Case_15	5.60 1.00 9.25	1.00 1.00 1.00	52.73	0.02 1.00	Yes
Single-Skin Girder 12 Web at #35														
Plate0	ACT		7.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	OST_2S	EPP99	4.5 1.0	1 0	-5.6 0.0 0.0	49.2	5.00 1.40	Case_1 Case_15	5.87 1.08 9.53	1.00 1.00 1.00	41.59	0.02 1.00	Yes

Plate	ACT		t [mm]	t_c [mm]	α_p	C_a	X		Eff [%]		R_{eH} [N/mm²]			
	LOC	Load ref.	EPP	t_{loc} [mm]	t_{min} [mm]	Span [mm]	Spac [mm]	p [kN/m²]	y_l [mm]	z_l [mm]	Draught [m]	σ_{hg} [N/mm²]	Fsc [kN]	OK?
	BUC	Load ref.	EPP	$t_{s/t}$ t_{buc} [mm]	Stress comb. Radius [mm]	σ_x σ_y τ [N/mm²]	σ_E [N/mm²]	Asp. α F_{long}	Case σ Case τ	K_x K_y K_τ	C_x C_y C_τ	γ_c	η_{actual} η_{allow}	OK?

Single-Skin Girder 12 Flange at #35

Plate0	ACT		10.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	OST_2S	EPP101	4.5 1.0	1 0	-5.1 0.0 0.0	6721.3	40.00 1.40	Case_1 Case_15	5.62 1.00 9.25	1.00 1.00 1.00	45.73	0.02 1.00	Yes

Single-Skin Girder 13 Web at #35

Plate0	ACT		7.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_1	EPP102	4.5 1.0	1 0	7.5 0.0 -0.1	49.2	5.00 1.40	Case_1 Case_15	5.87 1.08 9.53	0.96 1.00 1.00	29.77	0.03 1.00	Yes

Single-Skin Girder 13 Flange at #35

Plate0	ACT		10.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	OST_2S	EPP104	4.5 1.0	1 0	-7.2 0.0 0.0	6721.3	40.00 1.40	Case_1 Case_15	5.61 1.00 9.25	1.00 1.00 1.00	32.57	0.03 1.00	Yes

Single-Skin Girder 14 Web at #35

Plate0	ACT		7.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_1	EPP105	4.5 1.0	1 0	9.4 0.0 -0.2	49.2	5.00 1.40	Case_1 Case_15	5.81 1.08 9.53	0.95 1.00 1.00	23.86	0.04 1.00	Yes

Single-Skin Girder 14 Flange at #35

Plate0	ACT		10.0	0.5	0.00	0	0		0.0		0			
	LOC			0.0	5.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_2	EPP106	4.5 1.0	1 0	-9.0 0.0 0.0	6721.3	40.00 1.40	Case_1 Case_15	5.60 1.00 9.25	1.00 1.00 1.00	26.11	0.04 1.00	Yes

Single-Skin Girder 15 Web at #35

Plate0	ACT		7.0	1.5	0.00	0	0		0.0		0			
	LOC			0.0	6.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_1	EPP108	5.5 2.0	1 0	7.5 0.0 -0.2	35.2	5.00 1.40	Case_1 Case_15	5.87 1.08 9.53	0.85 1.00 1.00	26.42	0.04 1.00	Yes

Single-Skin Girder 15 Flange at #35

Plate0	ACT		10.0	1.5	0.00	0	0		0.0		0			
	LOC			0.0	6.5	0.0	0.0	0.0	0	0	0.000	0.0		
	BUC	HSM_2	EPP109	5.5 2.0	1 0	-7.1 0.0 0.0	5380.7	40.00 1.40	Case_1 Case_15	5.60 1.00 9.25	1.00 1.00 1.00	33.06	0.03 1.00	Yes

Abbreviations for plate results

Plate	Plate identification
ACT	Actual plate properties
t	Gross plate thickness [mm]
t_c	Corrosion addition [mm]

α_p	Correction factor for panel aspect ratio
C_a	Permissible bending stress coefficient
X	Coefficient
Eff	Bending efficiency [%]
R_{eH}	Minimum yield stress for plate [N/mm^2]
LOC	Requirements due to local load and corresponding plate properties
Load ref.	Design Load Set, Load Case
EPP	EPP identification
t_{loc}	Required gross thickness of plate [mm]
t_{min}	Minimum gross thickness of plate [mm]
Span	Long side length of EPP [m]
Spac	Short side length of EPP [mm]
p	Lateral pressure [kN/m^2]
y_l	Y coordinate of LCP [mm]
z_l	Z coordinate of LCP [mm]
Draught	Draught [m]
σ_{hg}	Hull girder stress [N/mm^2]
F_{SC}	Steel coil load if decisive, i.e. BC-9 or BC-10 [kN]
OK?	Whether requirement(s) are fulfilled
BUC	Requirements due to buckling and corresponding plate properties
Load ref.	Design Load Set, Load Case
EPP	EPP identification
$t_{s/t}$	Minimum slenderness thickness requirement [mm]. Note: Slenderness requirement is based on proposed steel grade.
t_{buc} [1)]	Minimum estimated local gross plate thickness to get $\eta_{actual} = \eta_{allow}$
Stress comb	Stress combination case, 1 or 2
Radius	Plate radius [mm]
σ_x	Applied σ_x [N/mm^2]
σ_y	Applied σ_y [N/mm^2]
τ	Applied Shear stress [N/mm^2]
σ_E	Reference stress [N/mm^2]
Asp. α	Aspect ratio
F_{long}	Correction factor
Case σ	Relevant case in Table 1 or 2
Case τ	Relevant case in Table 1 or 2
K_x	Buckling factor
K_y	Buckling factor
K_τ	Buckling factor
C_x	Reduction factor
C_y	Reduction factor
C_τ	Reduction factor
γ_c	Stress multiplier at collapse
η_{actual}	Eta actual

η_{allow}	Eta allowed
OK?	Whether requirement(s) are fulfilled
Note: 1)	Local scantling estimate without optimisation of the whole cross section

7.4. All longitudinal stiffeners

Stiff. No	ACT	Type Dimension		y z [mm]	Z_{net} [cm³]	Spacing t_{pl_net} [mm]	R_{eH} τ_{eH} [N/mm²]	t_{cw} t_{cf} [mm]	h_{w_net} b_f [mm]	t_w t_f [mm]	X	C_s C_t	l_{bdg} l_{shr} [mm]	
	LOC MIN	Load ref. for Z		Load ref. for t_w		Z_{req} [cm³]	$Z_{Rel.\ req}$ [%]	$t_{w\ min}$ $t_{f\ min}$ [mm]	$t_{w\ shear}$ $t_{pl\ min\_net}$ [mm]	$draught_Z$ [m]	$draught_{tw}$ [m]	p_Z [kN/m²] F_{sc} [kN]	p_{tw} [kN/m²]	OK?
	BUC SLN	Span b_{eff} [mm]	Est. Z_{req} [cm³]	Est. $h_{w\ req}$ Est. $t_{f\ req}$ [mm]	$b_{f\ sl}$ [mm]	I_{buc} I_{req} [cm⁴]		$t_{w\ min\ sl}$ $t_{f\ min\ sl}$ [mm]	p_{lat} [kN/m²]	σ_x σ_y [N/mm²]	σ_a σ_b [N/mm²]	τ σ_w [N/mm²]	η_{actual} η_{allow}	OK?
	FAT	ConnType	Double skin?	Web dist [mm]	L_{bdg} aft L_{bdg} fwd [mm]	X aft X fwd [mm]	K_a aft K_a fwd	K_b aft K_b fwd	D aft D fwd	T aft T fwd [years]	Damage	Fat.Life [years]	HotSpot	OK?

Frame #35 (17500 mm from A.P.)

Outer Shell PS at #35

1	ACT	Flatbar 60 x 8		4759 8830	7.65	131.0 5.0	235 136	1.5 0.0	60.0 0.0	8.0 0.0	0.00	0.950 0.900	1000 934	
	LOC MIN	SEA-1, HSM_1		SEA-1, HSM_1		0.00	0	5.5 0.0	1.5 5.2	3.500	3.500	-2.5	-2.5	Yes
	BUC SLN	1000.0 126.2	0.0	0.0 0.0	0.0	39 0		4.0 0.0	-3	8 0	8 37	0 0	0.04 1.00	Yes
	FAT	0		0.0	0.0 0.0	0.0 0.0	0.00 0.00	0.00 0.00	0.00 0.00	0.0 0.0	0.00	0.0		N/A

Outer Shell Starboard Split2 at #35

4	ACT	Flatbar 150 x 10		-4819 8350	48.33	176.9 5.5	235 136	1.5 0.0	150.0 0.0	10.0 0.0	0.00	0.950 0.900	500 412	
	LOC MIN	SEA-1, HSM_1		SEA-1, HSM_1		0.00	0	5.5 0.0	1.5 4.9	3.500	3.500	-2.7	-2.7	Yes
	BUC SLN	500.0 110.1	0.0	0.0 0.0	0.0	494 0		8.5 0.0	-3	7 0	7 5	0 5	0.03 1.00	Yes
	FAT	0		0.0	0.0 0.0	0.0 0.0	0.00 0.00	0.00 0.00	0.00 0.00	0.0 0.0	0.00	0.0		N/A
2	ACT	Flatbar 60 x 8		-4759 8830	7.79	131.0 5.5	235 136	1.5 0.0	60.0 0.0	8.0 0.0	0.00	0.950 0.900	1000 934	
	LOC MIN	SEA-1, HSM_1		SEA-1, HSM_1		0.00	0	5.5 0.0	1.5 4.9	3.500	3.500	-2.5	-2.5	Yes
	BUC SLN	1000.0 126.2	0.0	0.0 0.0	0.0	40 0		4.0 0.0	-3	8 0	8 38	0 0	0.04 1.00	Yes
	FAT	0		0.0	0.0 0.0	0.0 0.0	0.00 0.00	0.00 0.00	0.00 0.00	0.0 0.0	0.00	0.0		N/A

7.5. All transverse stiffeners

Stiff. No	ACT	Type Dimension		y z [mm]	Z_{net} [cm³]	Spacing t_{pl_net} [mm]	R_{eH} τ_{eH} [N/mm²]	t_{cw} t_{cf} [mm]	h_{w_net} b_f [mm]	t_w t_f [mm]	X	C_s C_t	l_{bdg} l_{shr} [mm]	
	LOC MIN	Load ref. for Z		Load ref. for t_w		Z_{req} [cm³]	$Z_{Rel.\ req}$ [%]	$t_{w\ min}$ $t_{f\ min}$ [mm]	$t_{w\ shear}$ $t_{pl\ min\_net}$ [mm]	$draught_Z$ [m]	$draught_{tw}$ [m]	p_Z [kN/m²]	p_{tw} [kN/m²]	OK?
	BUC SLN	Span b_{eff} [mm]	Est. Z_{req} [cm³]	Est. $h_{w\ req}$ Est. $t_{f\ req}$ [mm]	$b_{f\ sl}$ [mm]	I_{buc} I_{req} [cm⁴]		$t_{w\ min\ sl}$ $t_{f\ min\ sl}$ [mm]	p_{lat} [kN/m²]	σ_x σ_y [N/mm²]	σ_a σ_b [N/mm²]	τ σ_w [N/mm²]	η_{actual} η_{allow}	OK?

Frame #35 (17500 mm from A.P.)

Outer Shell PS at #35

Transverse Stiffener1	ACT	HPBulb 140 x 7		750 105	73.14	500.0 8.5	235 136	0.5 0.5	140.5 0.0	7.0 0.0	0.00	0.950 0.900	1514.1 1264.1	
	LOC MIN	SEA-1. FSM 2		SEA-1. FSM 2		18.50	395	5.0 0.0	1.0 6.8	3.500	3.500	41.6	41.6	Yes
	BUC SLN	1514.1 326.4	0.0	13.4 1.4	0.0	872 3		3.5 0.0	0	0 8	0 231	0 4	0.01 1.00	Yes

Stiff. No	ACT	Type Dimension		y z [mm]	Z_{net} [cm³]	Spacing t_{pl_net} [mm]	R_{eH} τ_{eH} [N/mm²]	t_{cw} t_{cf} [mm]	h_{w_net} b_f [mm]	t_w t_f [mm]	*X*	C_s C_t	l_{bdg} l_{shr} [mm]	
	LOC MIN	Load ref. for Z		Load ref. for t_w		Z_{req} [cm³]	$Z_{Rel.\ req}$ [%]	$t_{w\ min}$ $t_{f\ min}$ [mm]	$t_{w\ shear}$ $t_{pl\ min\_net}$ [mm]	draught$_z$ [m]	draught$_{tw}$ [m]	p_z [kN/m²]	p_{tw} [kN/m²]	OK?
	BUC SLN	Span b_{eff} [mm]	Est. Z_{req} [cm³]	Est. $h_{w\ req}$ Est. $t_{f\ req}$ [mm]	$b_{f\ sl}$ [mm]	I_{buc} I_{req} [cm⁴]		$t_{w\ min\ sl}$ $t_{f\ min\ sl}$ [mm]	p_{lat} [kN/m²]	σ_x σ_y [N/mm²]	σ_a σ_b [N/mm²]	τ σ_w [N/mm²]	η_{actual} η_{allow}	OK?
Transverse Stiffener2	ACT	HPBulb 140 x 7		2342 312	62.39	500.0 6.5	235 136	1.5 2.5	139.5 0.0	7.0 0.0	0.00	0.950 0.900	1697.6 1447.6	
	LOC MIN	SEA-1, BSR_1P		SEA-1, BSR_1P		27.00	231	6.5 0.0	2.5 5.7	3.500	3.500	48.9	48.9	Yes
	BUC SLN	1697.6 350.9	0.0	18.4 1.8	0.0	726 1		4.5 0.0	0	0 7	0 231	1 4	0.02 1.00	Yes
Transverse Stiffener3	ACT	HPBulb 140 x 7		4395 890	63.38	500.0 6.5	235 136	1.5 2.5	139.5 0.0	7.0 0.0	0.00	0.950 0.900	2214.5 1964.5	
	LOC MIN	SEA-1, BSR_1P		SEA-1, BSR_1P		52.50	121	6.5 0.0	3.0 5.7	3.500	3.500	55.6	55.6	Yes
	BUC SLN	2214.5 403.0	0.0	31.6 3.0	0.0	748 1		4.5 0.0	0	0 6	0 231	-1 4	0.04 1.00	Yes
Transverse Stiffener4	ACT	HPBulb 140 x 7		4990 3300	72.61	500.0 6.0	235 136	0.5 0.5	140.3 0.0	7.0 0.0	0.00	0.950 0.900	2600.0 2350.0	
	LOC MIN	SEA-1, BSP_1P		SEA-1, BSP_1P		62.50	116	5.0 0.0	2.5 5.2	3.500	3.500	40.0	40.0	Yes
	BUC SLN	2600.0 430.3	0.0	30.0 3.2	0.0	836 1		3.5 0.0	0	0 4	0 232	7 3	0.05 1.00	Yes
Transverse Stiffener5	ACT	HPBulb 120 x 6		4990 5901	47.88	500.0 5.5	235 136	0.5 0.5	120.3 0.0	6.0 0.0	0.00	0.950 0.900	2600.2 2350.2	
	LOC MIN	SEA-1, BSP_1P		SEA-1, BSP_1P		25.50	188	4.5 0.0	1.5 5.2	3.500	3.500	16.4	16.4	Yes
	BUC SLN	2600.2 430.3	0.0	37.3 4.2	0.0	499 1		3.0 0.0	0	0 6	0 233	-3 2	0.07 1.00	Yes
Transverse Stiffener6	ACT	HPBulb 120 x 6		4875 7900	45.84	500.0 5.0	235 136	0.5 0.5	120.5 0.0	6.0 0.0	0.00	0.950 0.900	1410.9 1160.9	
	LOC MIN	SEA-1, HSM_1		SEA-1, HSM_1		1.50	3056	4.5 0.0	0.5 5.2	3.500	3.500	3.8	3.8	Yes
	BUC SLN	1410.9 310.9	0.0	0.0 0.0	0.0	456 1		3.0 0.0	0	0 8	0 231	-1 4	0.01 1.00	Yes
Inner bottom PS at #35														
Transverse Stiffener1	ACT	HPBulb 140 x 7		750 2000	69.43	500.0 5.5	235 136	0.5 0.5	140.5 0.0	7.0 0.0	0.00	1.150 0.950	1500.0 1250.0	
	LOC MIN	FD-1, Static		FD-1, Static		9.50	731	5.0 0.0	1.0 5.2	4.550	4.550	-26.7	-26.7	Yes
	BUC SLN	1500.0 324.3	0.0	9.9 1.0	0.0	761 1		3.5 0.0	0	0 5	0 230	0 5	0.01 1.00	Yes
Transverse Stiffener2	ACT	HPBulb 140 x 7		2341 2000	61.29	500.0 5.5	235 136	1.5 2.5	139.5 0.0	7.0 0.0	0.00	1.000 0.950	1682.0 1432.0	
	LOC MIN	TK-2, Static		TK-2, Static		31.00	198	6.5 0.0	2.5 5.2	3.500	3.500	-59.6	-59.6	Yes
	BUC SLN	1682.0 348.9	0.0	14.6 1.4	0.0	692 1		4.5 0.0	-1	0 5	0 230	2 5	0.01 1.00	Yes
Transverse Stiffener3	ACT	HPBulb 140 x 7		4086 2000	61.61	500.0 5.5	235 136	1.5 2.5	139.5 0.0	7.0 0.0	0.00	1.000 0.950	1808.0 1558.0	
	LOC MIN	TK-2, Static		TK-2, Static		35.50	174	6.5 0.0	2.5 5.2	3.500	3.500	-59.6	-59.6	Yes
	BUC SLN	1808.0 363.9	0.0	20.2 1.9	0.0	699 1		4.5 0.0	-1	0 6	0 230	2 5	0.02 1.00	Yes
Deck_4600_PS at #35														
Transverse Stiffener3	ACT	HPBulb 120 x 6		841 4600	46.79	500.0 5.5	235 136	0.5 0.5	120.3 0.0	6.0 0.0	0.00	0.950 0.900	1682.0 1432.0	
	LOC MIN	UDL-1, BSP 1P		UDL-1, BSP 1P		4.00	1170	5.0 0.0	0.5 5.2	3.500	3.500	7.3	7.3	Yes
	BUC SLN	1682.0 348.9	0.0	0.0 0.0	0.0	467 1		3.0 0.0	0	0 1	0 231	-1 4	0.00 1.00	Yes

Stiff. No	ACT	Type Dimension		y z [mm]	Z_{net} [cm³]	Spacing t_{pl_net} [mm]	R_{eH} τ_{eH} [N/mm²]	t_{cw} t_{cf} [mm]	h_{w_net} b_f [mm]	t_w t_f [mm]	*X*	C_s C_t	l_{bdg} l_{shr} [mm]	
	LOC MIN	Load ref. for Z		Load ref. for t_w		Z_{req} [cm³]	$Z_{Rel.\ req}$ [%]	$t_{w\ min}$ $t_{f\ min}$ [mm]	$t_{w\ shear}$ $t_{pl\ min\_net}$ [mm]	draught$_z$ [m]	draught$_{tw}$ [m]	p_z [kN/m²]	p_{tw} [kN/m²]	OK?
	BUC SLN	Span b_{eff} [mm]	Est. Z_{req} [cm³]	Est. $h_{w\ req}$ Est. $t_{f\ req}$ [mm]	$b_{f\ sl}$ [mm]	I_{buc} I_{req} [cm⁴]		$t_{w\ min\ sl}$ $t_{f\ min\ sl}$ [mm]	p_{lat} [kN/m²]	σ_x σ_y [N/mm²]	σ_a σ_b [N/mm²]	τ σ_w [N/mm²]	η_{actual} η_{allow}	OK?
Transverse Stiffener2	ACT	HPBulb 120 x 6		2469 4600	46.57	500.0 5.5	235 136	0.5 0.5	120.3 0.0	6.0 0.0	0.00	0.950 0.900	1573.0 1323.0	
	LOC MIN	UDL-1, BSP_1P		UDL-1, BSP_1P		3.50	1331	5.0 0.0	0.5 5.2	3.500	3.500	7.4	7.4	Yes
	BUC SLN	1573.0 334.6	0.0	0.0 0.0	0.0	462 1		3.0 0.0	0	0 1	0 231	4 4	0.01 1.00	Yes
Transverse Stiffener1	ACT	HPBulb 120 x 6		4123 4600	46.88	500.0 5.5	235 136	0.5 0.5	120.3 0.0	6.0 0.0	0.00	1.150 0.950	1735.0 1485.0	
	LOC MIN	FD-1, Static		FD-1, Static		5.00	938	5.0 0.0	0.5 5.2	4.550	4.550	-10.2	-10.2	Yes
	BUC SLN	1735.0 355.4	0.0	0.0 0.0	0.0	468 1		3.0 0.0	0	0 2	0 231	4 4	0.01 1.00	Yes
Deck_7200_PS at #35														
Transverse Stiffener1	ACT	HPBulb 120 x 6		625 7200	46.08	500.0 6.0	235 136	0.5 0.5	120.0 0.0	6.0 0.0	0.00	0.950 0.900	1250.0 1000.0	
	LOC MIN	UDL-1, BSP_1P		UDL-1, BSP_1P		2.00	2304	4.5 0.0	0.5 4.9	3.500	3.500	7.3	7.3	Yes
	BUC SLN	1250.0 283.9	0.0	0.0 0.0	0.0	454 1		3.0 0.0	0	0 5	0 231	1 4	0.01 1.00	Yes
Transverse Stiffener4	ACT	HPBulb 120 x 6		1775 7200	41.51	500.0 5.0	235 136	1.0 1.5	120.0 0.0	6.0 0.0	0.00	0.950 0.900	1050.0 800.0	
	LOC MIN	UDL-1, BSP_1P		UDL-1, BSP_1P		1.50	2767	5.0 0.0	1.0 4.9	3.500	3.500	7.3	7.3	Yes
	BUC SLN	1050.0 245.0	0.0	0.0 0.0	0.0	390 1		3.5 0.0	0	0 5	0 229	1 6	0.00 1.00	Yes
Transverse Stiffener2	ACT	HPBulb 120 x 6		2782 7200	45.05	500.0 6.0	235 136	0.5 0.5	120.0 0.0	6.0 0.0	0.00	0.950 0.900	963.0 713.0	
	LOC MIN	UDL-1, BSP_1P		UDL-1, BSP_1P		1.50	3004	4.5 0.0	0.5 4.9	3.500	3.500	7.4	7.4	Yes
	BUC SLN	963.0 226.1	0.0	0.0 0.0	0.0	427 1		3.0 0.0	0	0 5	0 230	1 5	0.00 1.00	Yes
Transverse Stiffener3	ACT	HPBulb 120 x 6		4113 7200	47.09	500.0 6.0	235 136	0.5 0.5	120.0 0.0	6.0 0.0	0.00	0.950 0.900	1699.5 1449.5	
	LOC MIN	UDL-1, BSP_1P		UDL-1, BSP_1P		4.00	1177	4.5 0.0	0.5 4.9	3.500	3.500	7.4	7.4	Yes
	BUC SLN	1699.5 351.1	0.0	16.3 1.8	0.0	476 1		3.0 0.0	0	0 6	0 232	1 3	0.02 1.00	Yes
Deck_8600_PS at #35														
Transverse Stiffener1	ACT	HPBulb 120 x 6		2937 8600	45.82	500.0 5.5	235 136	0.5 0.5	120.3 0.0	6.0 0.0	0.00	0.950 0.900	1273.0 1023.0	
	LOC MIN	UDL-1, BSP_1P		UDL-1, BSP_1P		2.50	1833	4.5 0.0	0.5 5.2	3.500	3.500	7.4	7.4	Yes
	BUC SLN	1273.0 287.9	0.0	0.0 0.0	0.0	445 1		3.0 0.0	0	0 8	0 230	0 5	0.01 1.00	Yes
Transverse Stiffener2	ACT	HPBulb 120 x 6		4180 8600	45.64	500.0 5.5	235 136	0.5 0.5	120.3 0.0	6.0 0.0	0.00	0.950 0.900	1214.5 964.5	
	LOC MIN	SEA-1, HSM_1		SEA-1, HSM_1		3.50	1304	4.5 0.0	0.5 5.2	3.500	3.500	13.2	13.2	Yes
	BUC SLN	1214.5 277.4	0.0	7.8 0.9	0.0	441 1		3.0 0.0	0	0 8	0 230	1 5	0.01 1.00	Yes
Long_Bhd_1500_f_CL_PS at #35														
Transverse Stiffener1	ACT	HPBulb 140 x 7		1500 1103	61.57	500.0 5.5	235 136	1.5 2.5	139.5 0.0	7.0 0.0	0.00	1.000 0.950	1793.8 1543.8	
	LOC MIN	TK-2, Static		TK-2, Static		48.50	127	6.5 0.0	3.5 5.6	3.500	3.500	-68.6	-68.6	Yes
	BUC SLN	1793.8 362.3	0.0	33.0 3.2	0.0	698 1		4.5 0.0	-9	0 8	0 230	0 5	0.02 1.00	Yes

Stiff. No	ACT	Type Dimension		y z [mm]	Z_{net} [cm³]	Spacing t_{pl_net} [mm]	R_{eH} τ_{eH} [N/mm²]	t_{cw} t_{cf} [mm]	h_{w_net} b_f [mm]	t_w t_f [mm]	X	C_s C_t	l_{bdg} l_{shr} [mm]	
	LOC MIN	Load ref. for Z		Load ref. for t_w		Z_{req} [cm³]	$Z_{Rel.\ req}$ [%]	$t_{w\ min}$ $t_{f\ min}$ [mm]	$t_{w\ shear}$ $t_{pl\ min\_net}$ [mm]	draught$_z$ [m]	draught$_{tw}$ [m]	p_z [kN/m²]	p_{tw} [kN/m²]	OK?
	BUC SLN	Span b_{eff} [mm]	Est. Z_{req} [cm³]	Est. $h_{w\ req}$ Est. $t_{f\ req}$ [mm]	$b_{f\ sl}$ [mm]	I_{buc} I_{req} [cm⁴]		$t_{w\ min\ sl}$ $t_{f\ min\ sl}$ [mm]	p_{lat} [kN/m²]	σ_x σ_y [N/mm²]	σ_a σ_b [N/mm²]	τ σ_w [N/mm²]	η_{actual} η_{allow}	OK?
Deck_9600_PS at #35														
Transverse Stiffener1	ACT	HPBulb 120 x 6		0 0	0.00	0.0 5.5	0 0	0.5 0.5	120.3 0.0	6.0 0.0	0.00	0.000 0.000	0.0 0.0	
	LOC MIN					0.00	0	4.5 0.0	0.0 4.9	0.000	0.000	0.0	0.0	N/A
	BUC SLN	1250.0 283.9	0.0	0.0 0.0	0.0	444 1		3.0 0.0	0	0 9	0 230	1 5	0.01 1.00	Yes
Long_Bhd_2500_f_CL_PS at #35														
Transverse Stiffener1	ACT	HPBulb 120 x 6		0 0	0.00	0.0 5.5	0 0	0.5 0.5	120.3 0.0	6.0 0.0	0.00	0.000 0.000	0.0 0.0	
	LOC MIN					0.00	0	4.5 0.0	0.0 4.9	0.000	0.000	0.0	0.0	N/A
	BUC SLN	2600.0 430.3	0.0	29.2 3.3	0.0	488 1		3.0 0.0	0	0 5	0 232	-1 3	0.04 1.00	Yes
Transverse Stiffener2	ACT	HPBulb 120 x 6		0 0	0.00	0.0 5.5	0 0	0.5 0.5	120.3 0.0	6.0 0.0	0.00	0.000 0.000	0.0 0.0	
	LOC MIN					0.00	0	4.5 0.0	0.0 4.9	0.000	0.000	0.0	0.0	N/A
	BUC SLN	1400.0 309.1	0.0	0.0 0.0	0.0	453 1		3.0 0.0	0	0 8	0 231	0 4	0.01 1.00	Yes
Long_Bhd_1250_f_CL_PS at #35														
Transverse Stiffener1	ACT	HPBulb 120 x 6		0 0	0.00	0.0 5.5	0 0	0.5 0.5	120.3 0.0	6.0 0.0	0.00	0.000 0.000	0.0 0.0	
	LOC MIN					0.00	0	4.5 0.0	0.0 4.9	0.000	0.000	0.0	0.0	N/A
	BUC SLN	2600.0 430.3	0.0	21.5 2.4	0.0	488 1		3.0 0.0	0	0 3	0 232	-4 3	0.04 1.00	Yes
Transverse Stiffener2	ACT	HPBulb 120 x 6		0 0	0.00	0.0 5.5	0 0	0.5 0.5	120.3 0.0	6.0 0.0	0.00	0.000 0.000	0.0 0.0	
	LOC MIN					0.00	0	4.5 0.0	0.0 4.9	0.000	0.000	0.0	0.0	N/A
	BUC SLN	2400.0 417.1	0.0	39.7 4.4	0.0	485 1		3.0 0.0	0	0 9	0 232	-2 3	0.07 1.00	Yes
Deck_9600_SB at #35														
Transverse Stiffener1	ACT	HPBulb 120 x 6		0 0	0.00	0.0 5.5	0 0	0.5 0.5	120.3 0.0	6.0 0.0	0.00	0.000 0.000	0.0 0.0	
	LOC MIN					0.00	0	4.5 0.0	0.0 4.9	0.000	0.000	0.0	0.0	N/A
	BUC SLN	1550.0 331.5	0.0	18.2 2.0	0.0	461 1		3.0 0.0	0	0 9	0 231	0 4	0.02 1.00	Yes
Inner bottom SB at #35														
Transverse Stiffener3	ACT	HPBulb 140 x 7		-4086 2000	61.61	500.0 5.5	235 136	1.5 2.5	139.5 0.0	7.0 0.0	0.00	1.000 0.950	1808.0 1558.0	
	LOC MIN	TK-2, Static		TK-2, Static		35.50	174	6.5 0.0	2.5 5.2	3.500	3.500	-59.6	-59.6	Yes
	BUC SLN	1808.0 363.9	0.0	20.2 1.9	0.0	699 1		4.5 0.0	-1	0 6	0 230	-2 5	0.02 1.00	Yes
Transverse Stiffener2	ACT	HPBulb 140 x 7		-2341 2000	61.29	500.0 5.5	235 136	1.5 2.5	139.5 0.0	7.0 0.0	0.00	1.000 0.950	1682.0 1432.0	
	LOC MIN	TK-2, Static		TK-2, Static		31.00	198	6.5 0.0	2.5 5.2	3.500	3.500	-59.6	-59.6	Yes
	BUC SLN	1682.0 348.9	0.0	14.6 1.4					-1	0 5	0 230	-1 5	0.01 1.00	Yes

Stiff. No	ACT	Type / Dimension		y / z [mm]	Z_{net} [cm³]	Spacing t_{pl_net} [mm]	R_{eH} / τ_{eH} [N/mm²]	t_{cw} / t_{cf} [mm]	h_{w_net} / b_f [mm]	t_w / t_f [mm]	X	C_s / C_t	l_{bdg} / l_{shr} [mm]	
	LOC MIN	Load ref. for Z		Load ref. for t_w		Z_{req} [cm³]	$Z_{Rel.\ req}$ [%]	$t_{w\ min}$ / $t_{f\ min}$ [mm]	$t_{w\ shear}$ / $t_{pl\ min\_net}$ [mm]	draught$_z$ [m]	draught$_{tw}$ [m]	p_z [kN/m²]	p_{tw} [kN/m²]	OK?
	BUC SLN	Span b_{eff} [mm]	Est. Z_{req} [cm³]	Est. $h_{w\ req}$ / Est. $t_{f\ req}$ [mm]	$b_{f\ sl}$ [mm]	I_{buc} / I_{req} [cm⁴]		$t_{w\ min\ sl}$ / $t_{f\ min\ sl}$ [mm]	p_{lat} [kN/m²]	σ_x / σ_y [N/mm²]	σ_a / σ_b [N/mm²]	τ / σ_w [N/mm²]	η_{actual} / η_{allow}	OK?
Transverse Stiffener1	ACT	HPBulb 140 x 7		-750 / 2000	69.43	500.0 / 5.5	235 / 136	0.5 / 0.5	140.5 / 0.0	7.0 / 0.0	0.00	1.150 / 0.950	1500.0 / 1250.0	
	LOC MIN	FD-1, Static		FD-1, Static		9.50	731	5.0 / 0.0	1.0 / 5.2	4.550	4.550	-26.7	-26.7	Yes
	BUC SLN	1500.0 / 324.3	0.0	9.9 / 1.0	0.0	761 / 1		3.5 / 0.0	0	0 / 5	0 / 230	0 / 5	0.01 / 1.00	Yes
Deck_4600_SB at #35														
Transverse Stiffener3	ACT	HPBulb 120 x 6		-4040 / 4600	48.29	500.0 / 7.0	235 / 136	0.5 / 0.5	120.3 / 0.0	6.0 / 0.0	0.00	0.950 / 0.900	1900.0 / 1650.0	
	LOC MIN	SEA-1, BSP_1S		SEA-1, BSP_1S		17.50	276	5.0 / 0.0	1.0 / 5.2	3.500	3.500	25.3	25.3	Yes
	BUC SLN	1900.0 / 373.9	0.0	0.0 / 0.0	0.0	505 / 1		3.0 / 0.0	0	0 / 2	0 / 232	-5 / 3	0.02 / 1.00	Yes
Transverse Stiffener2	ACT	HPBulb 120 x 6		-2398 / 4600	47.40	500.0 / 7.0	235 / 136	0.5 / 0.5	120.3 / 0.0	6.0 / 0.0	0.00	0.950 / 0.900	1385.0 / 1135.0	
	LOC MIN	SEA-1, HSM_1		SEA-1, HSM_1		8.00	593	4.5 / 0.0	1.0 / 5.2	3.500	3.500	21.7	21.7	Yes
	BUC SLN	1385.0 / 306.7	0.0	0.0 / 0.0	0.0	486 / 1		3.0 / 0.0	0	0 / 1	0 / 231	-5 / 4	0.01 / 1.00	Yes
Transverse Stiffener1	ACT	HPBulb 120 x 6		-853 / 4600	47.10	500.0 / 6.0	235 / 136	0.5 / 0.5	120.0 / 0.0	6.0 / 0.0	0.00	0.950 / 0.900	1705.0 / 1455.0	
	LOC MIN	UDL-1, BSP_1S		UDL-1, BSP_1S		4.00	1178	5.0 / 0.0	0.5 / 5.2	3.500	3.500	7.3	7.3	Yes
	BUC SLN	1705.0 / 351.8	0.0	0.0 / 0.0	0.0	477 / 1		3.0 / 0.0	0	0 / 1	0 / 232	-1 / 3	0.00 / 1.00	Yes
Deck_7200_SB at #35														
Transverse Stiffener2	ACT	Flatbar 150 x 10		-1400 / 7200	43.96	500.0 / 5.5	235 / 136	1.5 / 0.0	149.8 / 0.0	10.0 / 0.0	0.00	0.950 / 0.900	300.0 / 50.0	
	LOC MIN	UDL-1, BSP_1S		UDL-1, BSP_1S		0.00	0	5.5 / 0.0	1.5 / 4.9	3.500	3.500	7.3	7.3	Yes
	BUC SLN	0.0 / 0.0	0.0	0.0 / 0.0	0.0	0 / 0		8.5 / 0.0	0	0 / 0	0 / 0	0 / 0	0.00 / 0.00	Yes
Transverse Stiffener1	ACT	HPBulb 120 x 6		-625 / 7200	45.75	500.0 / 5.5	235 / 136	0.5 / 0.5	120.3 / 0.0	6.0 / 0.0	0.00	0.950 / 0.900	1250.0 / 1000.0	
	LOC MIN	UDL-1, BSP_1S		UDL-1, BSP_1S		2.00	2288	4.5 / 0.0	0.5 / 4.9	3.500	3.500	7.3	7.3	Yes
	BUC SLN	1250.0 / 283.9	0.0	5.6 / 0.6	0.0	444 / 1		3.0 / 0.0	0	0 / 5	0 / 230	0 / 5	0.01 / 1.00	Yes
Long_Bhd_1500_f_CL_SB at #35														
Transverse Stiffener1	ACT	HPBulb 120 x 6		-1500 / 1103	42.27	500.0 / 5.5	235 / 136	1.0 / 2.5	119.5 / 0.0	6.0 / 0.0	0.00	1.000 / 0.950	1793.8 / 1543.8	
	LOC MIN	TK-2, Static		TK-2, Static		48.50 *	87	6.0 / 0.0	3.5 / 5.6	3.500	3.500	-68.6	-68.6	No!
	BUC SLN	1793.8 / 362.3	0.0	32.7 / 3.3	0.0	428 / 1		3.5 / 0.0	-9	0 / 8	0 / 231	0 / 4	0.03 / 1.00	Yes
Long_Bhd_1250_f_CL_SB at #35														
Transverse Stiffener1	ACT	HPBulb 120 x 6		0 / 0	0.00	0.0 / 5.5	0 / 0	0.5 / 0.5	120.3 / 0.0	6.0 / 0.0	0.00	0.000 / 0.000	0.0 / 0.0	
	LOC MIN					0.00	0	4.5 / 0.0	0.0 / 4.9	0.000	0.000	0.0	0.0	N/A
	BUC SLN	2600.0 / 430.3	0.0	21.5 / 2.4	0.0	488 / 1		3.0 / 0.0	0	0 / 3	0 / 232	-6 / 3	0.05 / 1.00	Yes
Long_Bhd_1550_f_CL_SB at #35														

Stiff. No	ACT	Type Dimension		y z [mm]	Z_{net} [cm³]	Spacing t_{pl_net} [mm]	R_{eH} T_{eH} [N/mm²]	t_{cw} t_{cf} [mm]	h_{w_net} b_f [mm]	t_w t_f [mm]	X	C_s C_t	l_{bdg} l_{shr} [mm]	
	LOC MIN	Load ref. for Z		Load ref. for t_w		Z_{req} [cm³]	$Z_{Rel.\ req}$ [%]	$t_{w\ min}$ $t_{f\ min}$ [mm]	$t_{w\ shear}$ $t_{pl\ min\_net}$ [mm]	$draught_z$ [m]	$draught_{tw}$ [m]	p_z [kN/m²]	p_{tw} [kN/m²]	OK?
	BUC SLN	Span b_{eff} [mm]	Est. Z_{req} [cm³]	Est. $h_{w\ req}$ Est. $t_{f\ req}$ [mm]	$b_{f\ sl}$ [mm]	l_{buc} l_{req} [cm⁴]		$t_{w\ min\ sl}$ $t_{f\ min\ sl}$ [mm]	p_{lat} [kN/m²]	σ_x σ_y [N/mm²]	σ_a σ_b [N/mm²]	τ σ_w [N/mm²]	η_{actual} η_{allow}	OK?
Transverse Stiffener1	ACT	HPBulb 120 x 6		0 0	0.00	0.0 5.5	0 0	0.5 0.5	120.3 0.0	6.0 0.0	0.00	0.000 0.000	0.0 0.0	
	LOC MIN					0.00	0	4.5 0.0	0.0 4.9	0.000	0.000	0.0	0.0	N/A
	BUC SLN	2400.0 417.1	0.0	43.2 4.8	0.0	485 1		3.0 0.0	0	0 9	0 232	-1 3	0.09 1.00	Yes
Deck_8600_SB at #35														
Transverse Stiffener2	ACT	HPBulb 120 x 6		-3938 8600	43.12	500.0 5.0	235 136	1.0 1.5	120.0 0.0	6.0 0.0	0.00	0.950 0.900	1698.5 1448.5	
	LOC MIN	SEA-1, HSM_1		SEA-1, HSM_1		7.50	575	5.0 0.0	1.5 5.2	3.500	3.500	-13.2	-13.2	Yes
	BUC SLN	1698.5 351.0	0.0	35.7 3.8	0.0	428 1		3.5 0.0	-13	0 8	0 231	1 4	0.02 1.00	Yes
Transverse Stiffener1	ACT	HPBulb 120 x 6		-2320 8600	42.83	500.0 5.0	235 136	1.0 1.5	120.0 0.0	6.0 0.0	0.00	0.950 0.900	1539.0 1289.0	
	LOC MIN	UDL-1, BSP_1S		UDL-1, BSP_1S		3.50	1224	5.0 0.0	1.0 5.2	3.500	3.500	7.3	7.3	Yes
	BUC SLN	1539.0 329.9	0.0	15.5 1.6	0.0	421 1		3.5 0.0	0	0 8	0 230	2 5	0.02 1.00	Yes
Outer Shell SB at #35														
Transverse Stiffener1	ACT	HPBulb 140 x 7		-750 105	73.14	500.0 8.5	235 136	0.5 0.5	140.5 0.0	7.0 0.0	0.00	0.950 0.900	1514.1 1264.1	
	LOC MIN	SEA-1, FSM_2		SEA-1, FSM_2		18.50	395	5.0 0.0	1.0 6.8	3.500	3.500	41.6	41.6	Yes
	BUC SLN	1514.1 326.4	0.0	13.4 1.4	0.0	872 3		3.5 0.0	0	0 8	0 231	0 4	0.01 1.00	Yes
Transverse Stiffener2	ACT	HPBulb 140 x 7		-2342 312	62.39	500.0 6.5	235 136	1.5 2.5	139.5 0.0	7.0 0.0	0.00	0.950 0.900	1697.6 1447.6	
	LOC MIN	SEA-1, BSR_1S		SEA-1, BSR_1S		27.00	231	6.5 0.0	2.5 5.7	3.500	3.500	48.9	48.9	Yes
	BUC SLN	1697.6 350.9	0.0	18.4 1.8	0.0	726 1		4.5 0.0	0	0 7	0 231	0 4	0.02 1.00	Yes
Transverse Stiffener3	ACT	HPBulb 140 x 7		-4395 890	63.38	500.0 6.5	235 136	1.5 2.5	139.5 0.0	7.0 0.0	0.00	0.950 0.900	2214.5 1964.5	
	LOC MIN	SEA-1, BSR_1S		SEA-1, BSR_1S		52.50	121	6.5 0.0	3.0 5.7	3.500	3.500	55.6	55.6	Yes
	BUC SLN	2214.5 403.0	0.0	31.6 3.0	0.0	748 1		4.5 0.0	0	0 6	0 231	-1 4	0.04 1.00	Yes
Transverse Stiffener4	ACT	HPBulb 140 x 7		-4990 3300	72.61	500.0 6.0	235 136	0.5 0.5	140.3 0.0	7.0 0.0	0.00	0.950 0.900	2600.0 2350.0	
	LOC MIN	SEA-1, BSP_1S		SEA-1, BSP_1S		62.50	116	5.0 0.0	2.5 5.2	3.500	3.500	40.0	40.0	Yes
	BUC SLN	2600.0 430.3	0.0	36.7 3.9	0.0	836 1		3.5 0.0	0	0 6	0 232	4 3	0.05 1.00	Yes

Abbreviations for stiffener results

Stiff. No	Stiffener name
ACT	Actual stiffener properties
Type	Profile type
Dimension	Profile dimension
y	Y coordinate [mm]
z	Z coordinate [mm]

Spacing	Spacing between stiffeners [mm]
t_{pl_net}	Actual plating net thickness [mm]
Z_{net}	Net section modulus [cm^3]
R_{eH}	Minimum yield strength [N/mm^2]
τ_{eH}	R_{eH} /(3)$^{0.5}$ [N/mm^2]
t_{cf}	Corrosion addition flange [mm]
t_{cw}	Corrosion addition web [mm]
h_w	Net web height [mm]
b_f	Flange breadth [mm]
t_w	Gross web thickness [mm]
t_f	Gross flange thickness [mm]
X	Coefficient
C_s	Permissible bending stress coefficient
C_t	Permissible shear stress coefficient
l_{bdg}	Effective bending span [mm]
l_{shr}	Effective shear span [mm]

LOC/MIN	Requirements due to local loads and minimum requirements
Load ref. for Z	Load ref for section modulus requirement (Design Load Set, Load Case)
Load ref. for t_w	Load ref for web thickness requirement (Design Load Set, Load Case)
Z_{req}	Minimum net section modulus [cm^3]
$Z_{Rel.\ req}$	Z Actual / requirement [%]
$t_{w\ min}$	Min gross web thickness (minimum requirement) [mm]
$t_{f\ min}$	Min gross flange thickness (minimum requirement) [mm]
$t_{w\ shear}$	Min gross web thickness (yielding) [mm]
$t_{pl\ min\ net}$	Net required thickness of the attached plating [mm]
$draught_Z$	Draught for Z_{net}
$draught_{tw}$	Draught for $t_{w\ shear}$
p_Z / F_{sc}	Design pressure for Z_{net} [kN/m^2] or Steel coil load, if decisive, i.e. BC-9 or BC-10 [kN]
p_{tw}	Design pressure for $t_{w\ shear}$ [kN/m^2]
OK?	Whether requirement(s) are fulfilled

BUC/SLN	Buckling and slenderness requirements
Span	Span [mm]
b_{eff}	Effective breadth of attached plating [mm]
Z_{req} [1)]	Minimum estimated local net section modulus (computed only if $\eta_{actual} > \eta_{allow}$) [mm]
$h_{w\ req}$ [1)]	Minimum estimated local net web height for flatbars (computed only if $\eta_{actual} > \eta_{allow}$) [mm]
$t_{f\ req}$ [1)]	Minimum estimated local net flange thickness for actual h_w (computed only if $\eta_{actual} > \eta_{allow}$) [mm]
$b_{f\ sl}$	Minimum required gross flange thickness (slenderness) [mm]
I_{buc}	Actual net moment of inertia including plate flange with effective width according to Ch8, Sec5, 2.3.5. [cm^4] I_{req} Required net moment of inertia including plate flange with effective width according to Ch8, Sec5, 2.3.5. [cm^4]
I_{slend}	Actual net moment of inertia including plate flange with effective width = 0.8*s [cm^4]
$I_{min\ sl}$	Minimum required net moment of inertia including plate flange with effective width = 0.8*s (slenderness) [cm^4]
$t_{w\ min\ sl}$	Min gross web thickness (slenderness) [mm]

$t_{f\ min\ sl}$	Min gross flange thickness (slenderness) [mm]
p_{lat}	Lateral pressure [kN/m^2]
σ_x	Nominal plate stress in X-dir [N/mm^2]
σ_y	Nominal plate stress in Y-dir [N/mm^2]
σ_a	Compressive axial effective stress [N/mm^2]
σ_b	Bending stress [N/mm^2]
τ	Nominal plate shear stress [N/mm^2]
σ_w	Warping stress [N/mm^2]
η_{actual}	Eta actual
η_{allow}	Eta allowable
OK?	Whether requirement(s) are fulfilled

FAT	Fatigue results (longitudinals only)
ConnType	Connection type number
Double skin?	“Yes” for double skin construction, otherwise “No”
Web dist	Web distance [mm]
$L_{bdg}1$ / $L_{bdg}2$	Bending span HotSpot 1 / 2 [mm]
X1 / X2	Distance to Hot Spot 1 / 2 [mm]
K_a1 / K_a2	K_a factor HotSpot 1 / 2
K_b1 / K_b2	K_b factor HotSpot 1 / 2
D1 / D2	Relative damage HotSpot 1 / 2
T1 / T2	Fatigue life HotSpot 1 / 2 [years]
Damage	Total relative damage
Fat.Life	Calculated fatigue life [years]
HotSpot	Critical hotspot
OK?	Whether fatigue life is greater than design life time
Note: 1)	Local scantling estimate without optimisation of the whole cross section

7.6. All main frames

ID. ACT	Type Dimension		y z [mm]	Z_{net} [cm^3]	A_{eff} A_{shear} [cm^2]	R_{eH} τ_{eH} [N/mm^2]	t_{cw} t_{cf} [mm]	h_{w_net} t_w [mm]	b_f t_f [mm]	t_{pl_net} [mm]	C_s C_t	l_{bdg} l_{shr} [mm]	
LOC MIN	**Load ref.**		Z_{req} [cm^3]	$Z_{Rel.\ req}$ **[%]**	$A_{sh\ min}$ [cm^2]	$A_{sh\ Rel.\ req}$ [%]	$t_{w\ min}$ $t_{f\ min}$ [mm]	$t_{w\ shear}$ $t_{pl\ min\_net}$ [mm]	**draught$_z$** [m]	**draught$_{tw}$** [m]	p_z [kN/m^2]	p_{tw} [kN/m^2]	**OK?**
BUC SLN	**Span b_{eff}** [mm]	Z_{req} [cm^3]	$h_{w\ req}$ $t_{f\ req}$ [mm]	$b_{f\ sl}$ [mm]	I_{buc} I_{req} [cm^4]		$t_{w\ min\ sl}$ $t_{f\ min\ sl}$ [mm]	p_{lat} [kN/m^2]	σ_x σ_y [N/mm^2]	σ_a σ_b [N/mm^2]	τ σ_w [N/mm^2]	η_{actual} η_{allow}	**OK?**

Frame #35 (17500 mm from A.P.)

Abbreviations for Main Frame results

ID	Main Frame Id name
ACT	Actual properties
Type	Profile type
Dimension	Profile dimension
y	Y coordinate [mm]
z	Z coordinate [mm]

Z_{net}	Net section modulus [cm^3]
A_{eff}	Net sectional area including effective attached plate [cm^2]
A_{shear}	Net sectional shear area [cm^2]
R_{eH}	Minimum yield strength [N/mm^2]
τ_{eH}	R_{eH} /(3)$^{0.5}$ [N/mm^2]
t_{cw}	Corrosion addition web [mm]
t_{cf}	Corrosion addition flange [mm]
h_w	Net web height [mm]
t_w	Gross web thickness [mm]
b_f	Gross flange breadth [mm]
t_f	Gross flange thickness [mm]
t_{pl_net}	Actual plating net thickness [mm]
C_s	Permissible bending stress coefficient
C_t	Permissible shear stress coefficient
l_{bdg}	Effective bending span [mm]
l_{shr}	Effective shear span [mm]

LOC/MIN	Requirements due to local loads and minimum requirements
Load ref.	Load ref for section modulus requirement (Design Load Set, Load Case)
Z_{req}	Minimum net section modulus [cm^3]
$Z_{Rel.\ req}$	Z_{net} / Z_{req} [%]
$A_{sh\ min}$	Minimum net section shear area [cm^2]
$A_{sh\ Rel.\ req}$	A_{shear} / $A_{sh\ min}$ [%]
$t_{w\ min}$	Min gross web thickness (minimum requirement) [mm]
$t_{f\ min}$	Min gross flange thickness (minimum requirement) [mm]
$t_{w\ shear}$	Min gross web thickness (yielding) [mm]
$draught_Z$	Draught for Z_{req}
$draught_{tw}$	Draught for $t_{w\ shear}$
p_Z	Design pressure for Z_{req} [kN/m^2]
p_{tw}	Design pressure for $t_{w\ shear}$ [kN/m^2]
OK?	Whether requirement(s) are fulfilled

BUC/SLN	Buckling and slenderness requirements
Span	Span [mm]
b_{eff}	Effective breadth of attached plating [mm]
Z_{req} [1)]	Minimum estimated local net section modulus (computed only if $\eta_{actual} > \eta_{allow}$) [mm]
$h_{w\ req}$ [1)]	Minimum estimated local net web height for flatbars (computed only if $\eta_{actual} > \eta_{allow}$) [mm]
$t_{f\ req}$ [1)]	Minimum estimated local net flange thickness for actual h_w (computed only if $\eta_{actual} > \eta_{allow}$) [mm]
$b_{f\ sl}$	Minimum required gross flange thickness (slenderness) [mm]
I_{buc}	Actual net moment of inertia including plate flange with effective width according to Ch8, Sec5, 2.3.5. [cm^4] I_{req} Required net moment of inertia including plate flange with effective width according to Ch8, Sec5, 2.3.5. [cm^4]
I_{slend}	Actual net moment of inertia including plate flange with effective width = 0.8*s [cm^4]
$I_{min\ sl}$	Minimum required net moment of inertia including plate flange with effective width = 0.8*s (slenderness) [cm^4]
$t_{w\ min\ sl}$	Min gross web thickness (slenderness) [mm]

$t_{f\ min\ sl}$	Min gross flange thickness (slenderness) [mm]
p_{lat}	Lateral pressure [kN/m^2]
σ_x	Nominal plate stress in X-dir [N/mm^2]
σ_y	Nominal plate stress in Y-dir [N/mm^2]
σ_a	Compressive axial effective stress [N/mm^2]
σ_b	Bending stress [N/mm^2]
τ	Nominal plate shear stress [N/mm^2]
σ_w	Warping stress [N/mm^2]
η_{actual}	Eta actual
η_{allow}	Eta allowable
OK?	Whether requirement(s) are fulfilled
Note: 1)	Local scantling estimate without optimisation of the whole cross section

7.7. All main frame brackets

ID. ACT	y z [mm]	R_{eH} [N/mm^2]		$t_{c\ UB}$ $t_{c\ LB}$ [mm]	$h_{w\ UB}$ $h_{w\ LB}$ [mm]	$t_{w\ UB}$ $t_{w\ LB}$ [mm]	$b_{f\ UB}$ $b_{f\ LB}$ [mm]	$t_{f\ UB}$ $t_{f\ LB}$ [mm]	Z_{UB} Z_{LB} [cm^3]	
LOC									$Z_{min\ UB}$ $Z_{min\ LB}$ [cm^3]	OK?

Frame #35 (17500 mm from A.P.)

Abbreviations for Main Frame Brackets

Notation: UB = Upper Bracket, LB: Lower Bracket

ID	Main Frame Id name
ACT	Actual properties
y	y co-ordinate [mm]
z	z co-ordinate [mm]
R_{eH}	Minimum yield strength [N/mm^2]
τ_{eH}	R_{eH} /(3)$^{0.5}$ [N/mm^2]
t_c	Corrosion addition [mm]
h_w	Web depth [mm]
t_w	Actual net thickness [mm]
b_f	Gross flange breadth [mm]
t_f	Gross flange thickness [mm]
Z	Actual net section modulus [cm^3]
LOC	Requirements due to local loads
Z_{min}	Minimum net section modulus [cm^3]
OK?	Whether requirement(s) are fulfilled

8. COMPARTMENT DATA

8.1. General compartment data

Name	Type	Area	Tank / Hold	Length [m]	Top of air pipe [m]	Volume [m³]	CoG from A.P. [m]	CoG from C.L. [m]	CoG from B.L. [m]	Heated cargo/fuel oil tank	Ballast water exchange by flow-throw
Bilge Water	BilgeTank	MachinerySpace	1	5.000	7.960	29.1	13.000	0.000	1.028	False	False
Shaft Void Space	VoidSpace	CargoArea	4	1.500	2.260	1.7	2.250	0.000	0.483	False	False
DO PS	FuelOilTank	MachinerySpace	5	5.500	7.960	19.8	14.570	3.360	1.000	True	False
DO SB	FuelOilTank	MachinerySpace	6	5.500	7.960	19.8	14.570	-3.360	1.000	True	False
SO	LubricationOilTank	MachinerySpace	7	1.000	7.960	0.7	12.500	0.500	1.000	False	False
Dirty Oil	LubricationOilTank	MachinerySpace	8	1.000	7.960	0.7	12.500	-0.500	1.000	False	False
Hydraulic Oil	LubricationOilTank	MachinerySpace	9	1.000	7.960	0.6	12.500	1.500	1.000	False	False
Sludge	BilgeTank	MachinerySpace	10	1.000	7.960	0.6	12.500	-1.500	1.000	False	False
Machinery Space	MachinerySpace	MachinerySpace	0	10.000	2.760	50.0	8.000	0.000	1.375	False	False
Wet Lab	Accommodation	MachinerySpace	0	5.000	7.960	36.4	13.500	1.400	5.900	False	False
Black Water	BilgeTank	MachinerySpace	0	1.500	7.960	9.9	18.265	3.265	1.000	False	False
Gray Water	BilgeTank	MachinerySpace	0	1.500	7.960	9.9	18.265	-3.265	1.000	False	False
Transceiver room	MachinerySpace	MachinerySpace	0	13.000	2.760	74.0	22.000	0.000	1.051	False	False
Accommodation 24-38	Accommodation	MachinerySpace	0	7.000	5.360	181.6	15.500	0.000	3.300	False	False
Garderobe	Accommodation	MachinerySpace	0	4.500	7.960	31.5	18.250	3.644	5.899	False	False
Torrlab	Accommodation	MachinerySpace	0	4.000	7.960	26.0	17.500	0.000	5.900	False	False
HVAC	Accommodation	MachinerySpace	0	5.500	9.360	19.8	18.750	3.588	7.892	False	False
IKT-ROM	Accommodation	MachinerySpace	0	2.500	10.360	16.8	18.250	-0.150	8.400	False	False
FW fr44to56 PS	FreshWaterTank	MachinerySpace	0	6.500	7.960	24.0	26.975	1.400	1.250	False	False
FW fr44to56 SB	FreshWaterTank	MachinerySpace	0	6.500	7.960	24.0	26.975	-1.400	1.250	False	False
Accomodation fr38to61	Accommodation	MachinerySpace	0	11.500	5.360	203.2	24.750	0.000	3.319	False	False
Mess	Accommodation	MachinerySpace	0	7.500	7.960	97.3	24.750	-1.247	5.917	False	False
antirolling tank	BallastWaterTank	MachinerySpace	0	2.000	9.360	23.8	22.500	7.900	22.500	False	False
Galley	Accommodation	MachinerySpace	0	4.000	7.960	25.9	26.500	2.497	5.933	False	False
Fresh Water SB	FreshWaterTank	CargoArea	0	1.500	5.360	10.8	2.250	-3.250	3.300	False	False

Name	Type	Area	Tank / Hold	Length [m]	Top of air pipe [m]	Volume [m^3]	CoG from A.P. [m]	CoG from C.L. [m]	CoG from B.L. [m]	Heated cargo/fuel oil tank	Ballast water exchange by flow-throw
Fresh Water PS	FreshWaterTank	CargoArea	0	1.500	5.360	10.8	2.250	3.250	3.300	False	False
Lasterom	CargoHold	CargoArea	0	2.500	5.360	27.3	2.750	0.000	3.250	False	False

8.2. Other compartment data

Name	Filling height from B.L. for sloshing [m]	Sloshing length [m]	Sloshing breadth [m]	Over-pressure due to liquid flow Pdrop [kN/m^2]	Testing load height Zst [m]
Bilge Water	1.400	0.000	0.000	0.0	0.000
Shaft Void Space	1.400	0.000	0.000	25.0	0.000
DO PS	1.211	0.000	0.000	25.0	0.000
DO SB	1.211	0.000	0.000	25.0	0.000
SO	0.257	0.000	0.000	25.0	0.000
Dirty Oil	0.257	0.000	0.000	25.0	0.000
Hydraulic Oil	0.283	0.000	0.000	25.0	0.000
Sludge	0.283	0.000	0.000	25.0	0.000
Machinery Space	0.875	0.000	0.000	25.0	0.000
Wet Lab	1.820	0.000	0.000	25.0	0.000
Black Water	1.212	0.000	0.000	25.0	0.000
Gray Water	1.212	0.000	0.000	25.0	0.000
Transceiver room	1.400	0.000	0.000	25.0	0.000
Accommodation 24-38	1.820	0.000	0.000	25.0	0.000
Garderobe	1.820	0.000	0.000	25.0	0.000
Torrlab	1.820	0.000	0.000	25.0	0.000
HVAC	0.980	0.000	0.000	25.0	0.000
IKT-ROM	1.680	0.000	0.000	25.0	0.000
FW fr44to56 PS	0.970	0.000	0.000	25.0	0.000
FW fr44to56 SB	0.970	0.000	0.000	25.0	0.000
Accomodation fr38to61	1.820	0.000	0.000	25.0	0.000
Mess	1.820	0.000	0.000	25.0	0.000
antirolling tank	0.980	0.000	0.000	25.0	0.000
Galley	1.820	0.000	0.000	25.0	0.000
Fresh Water SB	1.838	0.000	0.000	25.0	0.000
Fresh Water PS	1.838	0.000	0.000	25.0	0.000
Lasterom	2.170	0.000	0.000	25.0	0.000

8.3. Geometry

Name	Min X [#]	Max X [#]	Min Y [mm]	Max Y [mm]	Min Z [mm]	Max Z [mm]	Highest points Aft Port Stbd/ Fwd Port Stbd (If user specified)
Bilge Water	#26	#26	-1000	1000	0	2000	/
Shaft Void Space	#3	#3	500	-500	-500	1500	/
DO PS	#26	#38	2000	5000	268	2000	/
DO SB	#26	#38	-5000	-2000	268	2000	/
SO	#26	#26	0	1000	268	2000	/
Dirty Oil	#26	#26	-1000	0	268	2000	/
Hydraulic Oil	#26	#26	1000	2000	268	2000	/
Sludge	#26	#26	-2000	-1000	268	2000	/
Machinery Space	#3	#26	-5000	5000	750	4600	/
Wet Lab	#26	#26	0	5000	4600	7200	/
Black Water	#38	#38	2000	5000	250	2000	/
Gray Water	#38	#38	-5000	-2000	250	2000	/
Transceiver room	#26	#61	-2000	2000	0	2000	/
Accommodation 24-38	#26	#38	-5000	5000	2000	4600	/
Garderobe	#26	#38	2300	5000	4600	7200	/
Torrlab	#26	#38	-1250	1250	4600	7200	/
HVAC	#26	#38	1250	5000	7200	8600	/
IKT-ROM	#38	#38	-1550	1250	7200	9600	/
FW fr44to56 PS	#38	#61	500	4200	430	2000	/
FW fr44to56 SB	#38	#61	-4200	-500	430	2000	/
Accomodation fr38to61	#38	#61	-5000	5000	2000	4600	/
Mess	#38	#61	-5000	5000	4600	7200	/
antirolling tank	#38	#38	-5000	5000	7200	8600	/
Galley	#38	#61	1250	4000	4600	7200	/
Fresh Water SB	#3	#3	-5000	-3000	1975	4600	/
Fresh Water PS	#3	#3	3000	5000	1975	4600	/
Lasterom	#3	#3	-3000	3000	1500	4600	/

9. LOADING CONDITIONS

9.1. Prescriptive loading conditions

Name	Condition	Density	Draught [m]	Kr [m]	GM [m]	FSRU mode	User, a_l [m/s²]	User, a_t [m/s²]	User, a_v [m/s²]
Full load	Full	Undefined	3.500	3.900	0.700	N/A	N/A	N/A	N/A
Ballast	Ballast	Undefined	3.500	3.900	0.700	N/A	N/A	N/A	N/A

Full load — Prescriptive

Ballast — Prescriptive

Compartment Loads

Compartment	Load type	Density [t/m³]	Filling height from B.L. [m]	Bulk cargo mass [t]	Angle of repose [deg]	Pressure valve setting [kN/m²]
Bilge Water	Liquid	1.025	2.000	0.0	0	0.00
DO PS	FuelOil	1.025	2.000	0.0	0	0.00
DO SB	FuelOil	1.025	2.000	0.0	0	0.00
SO	LubeOil	1.025	2.000	0.0	0	0.00
Dirty Oil	LubeOil	1.025	2.000	0.0	0	0.00
Hydraulic Oil	LubeOil	1.025	2.000	0.0	0	0.00
Sludge	Liquid	1.025	2.000	0.0	0	0.00
Black Water	Liquid	1.025	2.000	0.0	0	0.00
Gray Water	Liquid	1.025	2.000	0.0	0	0.00
FW fr44to56 PS	FreshWater	1.025	2.000	0.0	0	0.00
FW fr44to56 SB	FreshWater	1.025	2.000	0.0	0	0.00
antirolling tank	WB	1.025	8.600	0.0	0	0.00
Fresh Water SB	FreshWater	1.025	4.600	0.0	0	0.00
Fresh Water PS	FreshWater	1.025	4.600	0.0	0	0.00

9.2. Flooding conditions

Name	Condition	Density	Draught [m]	Kr [m]	GM [m]
Full load - flooding	Full	Undefined	4.550	3.900	0.700
Full load - flooding angel 15	Full	Undefined	4.550	0.000	0.000

Full load - flooding — Flooding

Compartment Content

Compartment	Load type	Density [t/m³]	Filling height from B.L. [m]	Bulk cargo mass [t]	Angle of repose [deg]

Shaft Void Space	Flooded	1.025	1.500	0.0	0
Machinery Space	Flooded	1.025	4.600	0.0	0
Wet Lab	Flooded	1.025	7.200	0.0	0
Transceiver room	Flooded	1.025	2.000	0.0	0
Accommodation 24-38	Flooded	1.025	4.600	0.0	0
Garderobe	Flooded	1.025	7.200	0.0	0
Torrlab	Flooded	1.025	7.200	0.0	0
HVAC	Flooded	1.025	8.600	0.0	0
IKT-ROM	Flooded	1.025	9.600	0.0	0
Accomodation fr38to61	Flooded	1.025	4.600	0.0	0
Mess	Flooded	1.025	7.200	0.0	0
Galley	Flooded	1.025	7.200	0.0	0
Lasterom	Flooded	1.025	4.600	0.0	0

Full load - flooding angel 15

Flooding

Compartment Content

Compartment	Load type	Density [t/m^3]	Filling height from B.L. [m]	Bulk cargo mass [t]	Angle of repose [deg]
Shaft Void Space	Flooded	1.025	1.500	0.0	0
Machinery Space	Flooded	1.025	4.600	0.0	0
Wet Lab	Flooded	1.025	7.200	0.0	0
Transceiver room	Flooded	1.025	2.000	0.0	0
Accommodation 24-38	Flooded	1.025	4.600	0.0	0
Garderobe	Flooded	1.025	7.200	0.0	0
Torrlab	Flooded	1.025	7.200	0.0	0
HVAC	Flooded	1.025	8.600	0.0	0
IKT-ROM	Flooded	1.025	9.600	0.0	0
Accomodation fr38to61	Flooded	1.025	4.600	0.0	0
Mess	Flooded	1.025	7.200	0.0	0
Galley	Flooded	1.025	7.200	0.0	0
Lasterom	Flooded	1.025	4.600	0.0	0

9.3. Fatigue conditions

Name	Condition	Density	Draught [m]	Kr [m]	GM [m]