



RUSSIAN MARITIME REGISTER OF SHIPPING
KNOWLEDGE MATTERS

RS software for hull design support

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8 September 2021



Software for checking of hull structures

Software for prescriptive checking

Purpose: checking by comparing the scantlings and physical characteristic values of structural members accepted in project, with the ones required by Rules.

- calculations based on the formulae from the Rules are necessary for checking;
- relatively simple models (as a rule, 2D);
- mathematical formulae and functions.

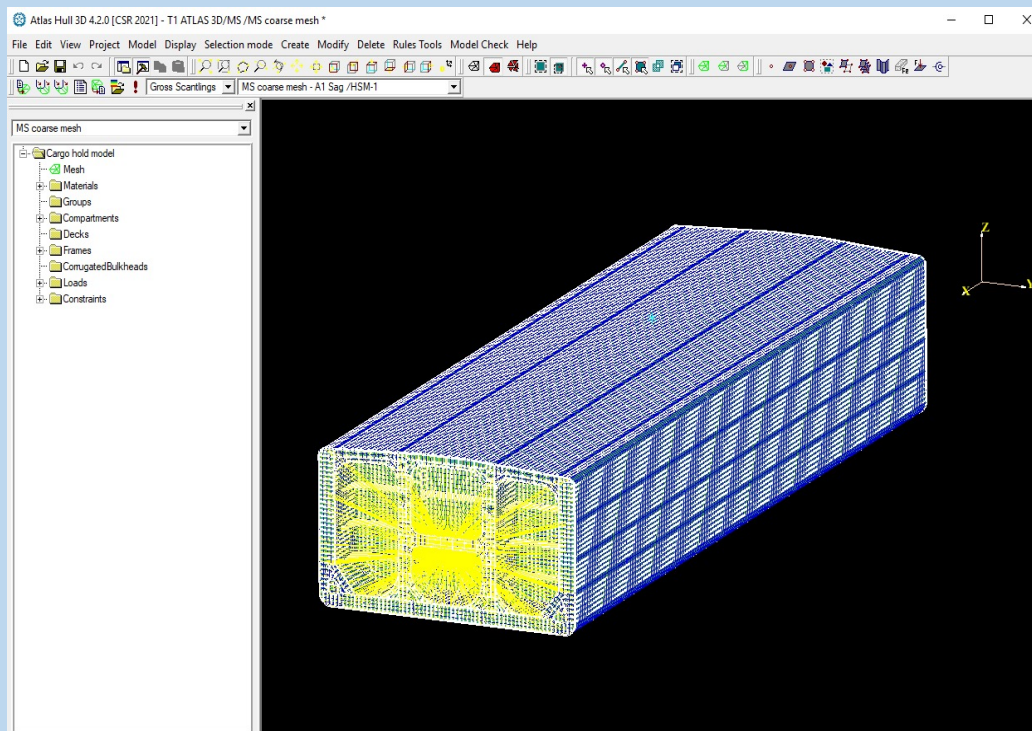
Software for direct calculations in accordance with rules or guidelines

Purpose: checking by analyzing the results of direct calculations of models prepared based on the accepted scantlings and on the requirements of the Rules for compliance with the criteria specified in the Rules.

- direct calculations are necessary for checking;
- complex models (as a rule, 3D);
- complex calculation approaches (finite element method, boundary element method, etc.).



RS software for checking based on direct calculation



Guiding Docs: IACS Common Structural Rules

Software being used presently: ATLAS 3D

FEM calculations pursuant to IACS Common Structural Rules and facilitating analysis of obtained results



RS software for prescriptive checking

The screenshot displays the RS software interface. The main window shows a cross-section of a ship's hull with various zones labeled: Region C, Zone_C_side, Region B, Zone_B_side, Ice load line, Ballast waterline, Region A₁, and Zone_A₁. A green box highlights the 'Ice strengthening frame' in the Zone_A₁ region. The Data Browser on the right shows the following table:

X [m]	Frame #	Z1 [m]	Z2 [m]	
73.20	94	1.98	11.50	X
86.40	108	5.60	11.50	X
+				

The compartment is identified as 'Dry tank 108'. The software title bar indicates 'Icebreaker_das_iter4 - ODYSSEY 0.4.1 [RS Rules 2020-01-01]'.

Guiding Docs: RS Rules, IACS Common Structural Rules

Software being used presently: ATLAS 2D

Prescriptive checking pursuant to IACS Common Structural Rules

In development: ODYSSEY

Prescriptive checking pursuant to RS Rules and IACS Common Structural Rules



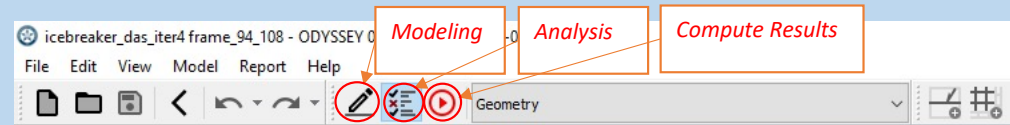
List of documents implemented into ODYSSEY software:

- RS Rules, Part II “Hull”;
 - Selection of materials;
 - Longitudinal strength;
 - Local strength of longitudinal and transverse members;
 - Buckling strength of longitudinal members;
 - Calculation of ice strengthening of RS ice class ships (Chapter 3.10);
 - Calculations for ships of special design (Section 3);
- IACS Common Structural Rules (tankers of 150 m in length or greater and bulk carriers of 90 m in length or greater)
- IACS Unified Requirement UR S6 (checking of materials);
- IACS Unified Requirement UR S11A (longitudinal strength standard for Container Ships);
- RS Rules, Part XVII “Distinguishing Marks and Descriptive Notations in the Class Notation Specifying Structural and Operational Particulars of Ships”;
 - Calculation of ice-strengthening for double acting ships (DAS);
- RS Rules, Part III “Equipment, Arrangements and Outfit”;
 - Checking of rudders;
- Guidelines on Fatigue Assessment of Ships (RS);
 - Calculations of details located at ends of primary longitudinal members in area of intersection with transverse deep members;
- Rules for the Classification and Construction of Ships Carrying Liquefied Gases in Bulk

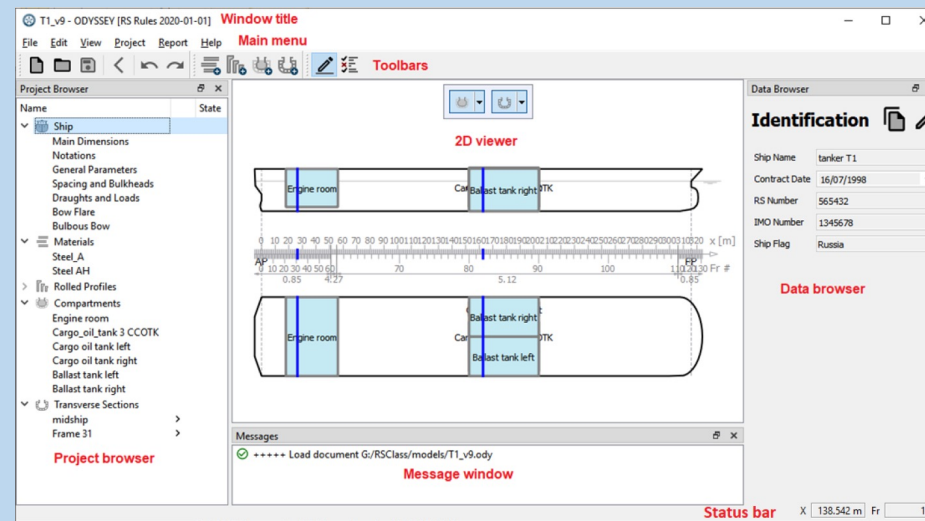


List of documents where the functionality is under development (ODYSSEY software):

- RS Rules, Part XVII “Distinguishing Marks and Descriptive Notations in the Class Notation Specifying Structural and Operational Particulars of Ships”;
 - Calculations of ice-strengthening for Baltic ice class and Polar class ships;
 - Calculations for assignment of a distinguishing mark NAABSA in class notation.
- IACS Unified Requirement UR S10 (rudder calculation);
- Guidelines on Stress-Strain State Assessment of Hull Structures by Finite Element Analysis;
 - Calculations of grillages modeled with beam finite elements (model preparation).



Switch panel of operating modes



Key elements of ODYSSEY software interface



- > Ship
- > Ice Class
- > Materials
- > Rolled Profiles
- > Compartments
- > Stem
- > Stern-post
- > Transverse Sections
- > Bulkhead Arrangements
- > Grillages
- > Ice Strengthenings

- Ship
 - Main Dimensions
 - Notations
 - General Parameters
 - Spacing and Bulkheads
 - Loads
 - Bow Flare

Data Browser

Identification

Ship Name

Contract Date 01.01.1990

RS Number

IMO Number

Ship Flag

Data Browser

Main Dimensions

Length (L)

Scantling Length

Load Line Length (L_{LL})

Breadth (B)

Depth (D)

Draughts

Scantling Draught (d_s)

Design Draught (d)

Ballast Draught 0.6 d

Form Factor Parameters

Block Coefficient (C_b)

Displacement (Δ)

Designed Waterplane Coefficient (C_w)

Has Bulbous Bow No

Specified Speed (v_s)

Data Browser

Notations

Service Notations Oil tanker (ESP)

Container No

Navigation Notation Unrestricted

Berth-connected ship No

Helicopter None

NAABSA None

Ice Class

RS Ice Class None

DAS Class None

Polar Class None

Baltic Class None

Data Browser

General Parameters

Planned service life 25 years 25 years

Check of Materials

Minimum surrounding air temperature (T_a)

Check according to RS Rules



- > Ship
- > Ice Class
- > Materials
- > Rolled Profiles
- > Compartments
- > Stem
- > Stern-post
- > Transverse Sections
- > Bulkhead Arrangements
- > Grillages
- > Ice Strengthenings

Data Browser

Spacing and Bulkheads

Numbering from fore to aft:

X of frame #0:

First Frame #:

	To frame #	Spacing [m]
1	60	0.85
2	61	4.27
3	110	5.12
4	131	0.85

Watertight bulkheads

X of afterpeak bulkhead: Fr #

X of collision bulkhead: Fr #

	Name	X from AE [m]	Frame #
1	engine room	51.00	60
2	4 cargo hold	101.35	70
3	3 cargo hold	152.55	80
4	2 cargo hold	203.75	90
5	1 cargo hold	254.95	100

X of stern counter: Fr #

Engine room position:

Number of bulkheads required by Pt V:

Data Browser

Loads

Still Water Loads

X from AE [m]	Frame #	M _{max, still} [kN·m]	M _{min, still} [kN·m]	N _{max, still} [kN]	N _{min, still} [kN]
1 63.00	63*2510 mm	3776000	-3079000	42936	-42936
2 94.50	69*1730 mm	5663000	-4619000	42936	-42936
3 126.00	75*950 mm	7551000	-6159000	35000	-35000
4 189.00	87*810 mm	7551000	-6159000	35000	-35000
5 204.75	90*1000 mm	7551000	-6159000	42500	-42500
6 220.50	93*1380 mm	6472000	-5279000	50000	-50000
7 267.75	102*2560 mm	3236000	-2639000	50000	-50000

Regular Change of Sign of Bending Moment on Still Water

Weight and Accelerations

Full load (design draught) condition

X_c:

Z_c:

Transverse Metacentre (h):

Roll period factor (c):

Ballast (minimal draught) condition

X_c:

Z_c:

Transverse Metacentre (h):

Roll period factor (c):



Specifying of Materials
(Materials tab)

- > Ship
- > Ice Class
- > Materials
- > Rolled Profiles
- > Compartments
- > Stem
- > Stern-post
- > Transverse Sections
- > Bulkhead Arrangements
- > Grillages
- > Ice Strengthenings

- Materials
 - Steel_A
 - Steel AH
 - Steel DH

Data Browser

Edit Material Steel_A

Name: Steel_A

Material type: Hull Structural Steel

Steel grade: A

R_{eH} : 235 MPa

η : 1.00

Data Browser

Edit Material Steel_A

Name: Steel_A

Material type: Hull Structural Steel

Steel grade: A

R_{eH}

η

- A
- B
- D
- E
- AH A32
- AH A36
- AH A40
- AH A420
- AH A460
- AH A500
- AH A550
- AH A620
- AH A690
- AH A890
- AH A960
- DH D32
- DH D36
- DH D40
- DH D420
- DH D460
- DH D500
- DH D550
- DH D620
- DH D690
- DH D890
- DH D960
- EH E32
- EH E36
- EH E40
- EH E420
- EH E460
- EH E47
- EH E500
- EH E550
- EH E620
- EH E690
- EH E890
- EH E960
- FH F32
- FH F36



Specifying of Rolled Profiles
(Rolled Profiles tab)

- > Ship
- > Ice Class
- > Materials
- > Rolled Profiles
- > Compartments
- > Stem
- > Stern-post
- > Transverse Sections
- > Bulkhead Arrangements
- > Grillages
- > Ice Strengthenings

Data Browser

Rolled Profiles

	Name	Type
1	P GOST 100×6	P GOST 100×6
2	P GB 260×12	P GB 260×12

Data Browser

Edit Profile P DIN 100×7

Name: P DIN 100×7

Profile: Bulb

Scantling

Standard: DIN (EN)

Profile: P DIN 100×7

Web Height (h_w): 100.0 mm

Web Thickness (t_w): 7.0 mm

Flange Breadth (b_f): 15.5 mm

r_1 : 4.5 mm

r_2 : 4.5 mm

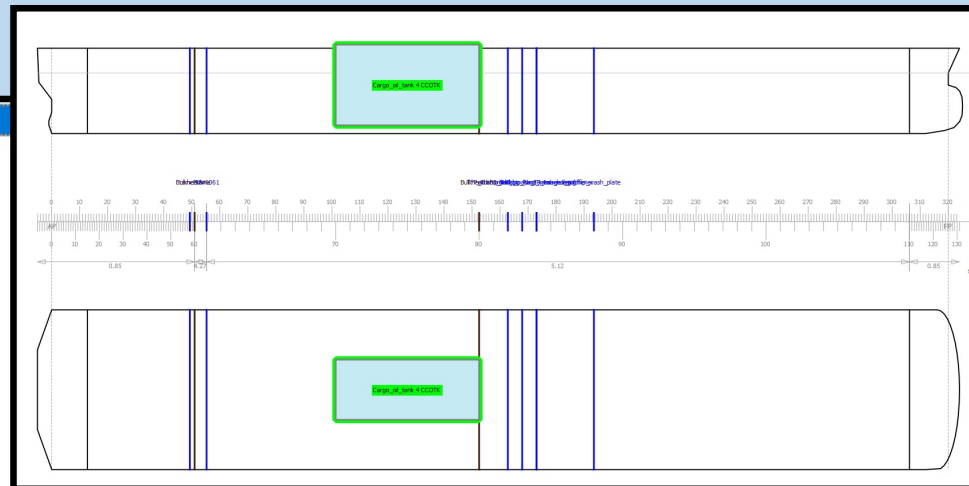
r_3 : 0.0 mm

Flange Angle (α): 30 °



Specifying of Compartments (Compartments tab)

- Compartments
- Engine room
- Cargo_oil_tank 3 CCOTK
- Cargo oil tank 3
- pump room
- HFTK(P)
- service
- superstructure
- water
- Cargo_oil_tank 5 CCOTK
- Cargo_oil_tank 4 CCOTK
- Cargo oil tank 5
- Cargo oil tank 4
- Ballast tank 3
- Ballast tank 4
- Ballast tank 5



Data Browser

Compartment Cargo_<

General Data

Symmetric: Yes (one compartment)

Type: Cargo tank

Heating: No

Insulation: No

Inert gas: No

Minimal temperature (T_{min}): 10.00 °C default

Size and Position

X_{min} : 101.35 m Fr# 70

X_{max} : 152.55 m Fr# 80

Y_{min} : -10.92 m

Y_{max} : 10.92 m

Z_{min} : 3.00 m

Z_{max} : 32.30 m

Height of air pipe (Δz): 2.50 m

Length: 51.20 m auto

Breadth: 21.84 m auto

Loadings

May be empty in full load condition: No

Ballast

Liquid

Liquid density (ρ_L): 0.900 t/m³

Setting pressure of safety valve (p_s): 25.000 kPa

Partial filling is allowed: Yes



Specifying and checking of Stern-post and Rudder (Stern-post tab)

Data Browser

Edit Stern-post

Material: A

Steering gear

Steering gear type: Case 1

l_1 : 0.610 m

Quadrant radius (r_1): 0.580 m

Mean inertia moment (I_1): 65600 cm⁴

Sternframe

Sternframe type: Welded

Length (l_2): 0.900 m

Thickness (s): 24.0 mm

Propeller

Number of propellers (n): 1

Thrust (T): 1093 kN

Diameter (D_0): 4.342 m

Average wake factor (W): 0.296 auto

Maximum astern speed (v_{10}): 8.0 kn 0.5 v ₀ > ₀

Fixed steering nozzle

Data Browser

Edit Rudder

Rudder type: III

Rudder blade

Rudder behind propeller: Yes

Rudder area (A): 14.60 m²

Rudder area in non-reversed position (A_0): 13.23 m²

Mean height (h_0): 4.830 m

Rudder blade area forward of CL (A_1): 5.94 m²

Mean moment of inertia (I_1): 145000 cm⁴

Dimensions

l_1 : 2.010 m

l_2 : 5.360 m

l_3 : 3.516 m

e : 0.468 m

Solepiece

	Distance (x) [m]	Vertical section	Horizontal section	
1	3.52	38295.00	57165.00	×
+				

Data Browser

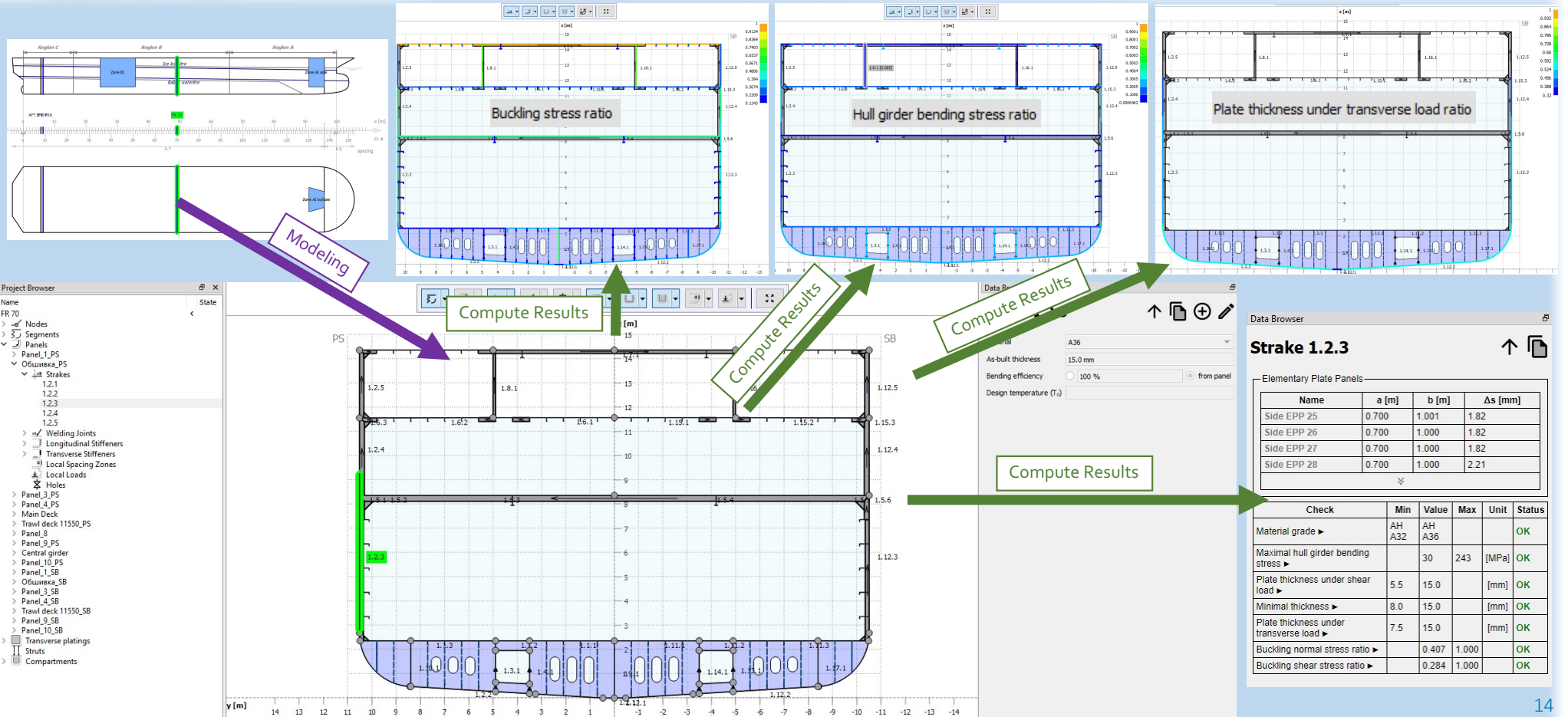
Stern-post

Check	Min	Value	Max	Unit	Status
Welded sternframe, length (l_2) ▶	0.429	0.900		[m]	OK
Welded sternframe, thickness (s) ▼	23.0	24.0		[mm]	OK
$s_{req} = \text{round}_{0.5}[s_{min}] = 23.0 \text{ mm} \blacktriangledown$ $s_{min} = 1.6s_0 = 23.0 \text{ mm} \blacktriangledown$ $s_0 = 0.1L + 4.4 = 14.4 \text{ mm} \blacktriangleright$					
Solepiece vertical section modulus ratio ▶	1.00	2.00			OK
Solepiece horizontal section modulus ratio ▶	1.00	5.96			OK

Checks are OK



Checking of cross sections illustrated with a midship section of a fishing vessel



Data Browser

Strake 1.2.3

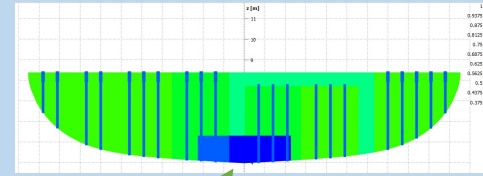
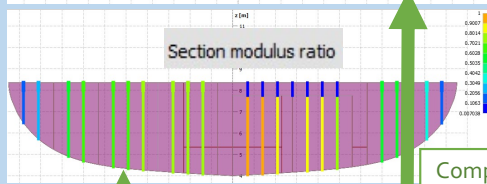
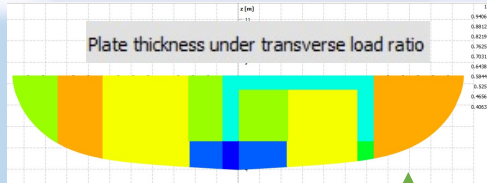
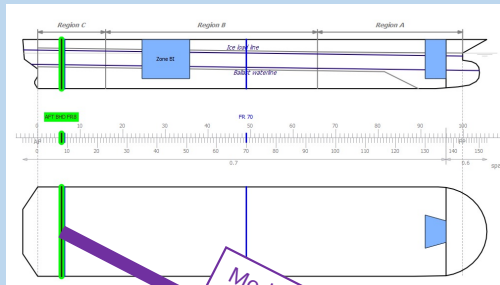
Elementary Plate Panels

Name	a [m]	b [m]	Δs [mm]
Side EPP 25	0.700	1.001	1.82
Side EPP 26	0.700	1.000	1.82
Side EPP 27	0.700	1.000	1.82
Side EPP 28	0.700	1.000	2.21

Check	Min	Value	Max	Unit	Status
Material grade ▶	AH A32	AH A36			OK
Maximal hull girder bending stress ▶		30	243	[MPa]	OK
Plate thickness under shear load ▶	5.5	15.0		[mm]	OK
Minimal thickness ▶	8.0	15.0		[mm]	OK
Plate thickness under transverse load ▶	7.5	15.0		[mm]	OK
Buckling normal stress ratio ▶		0.407	1.000		OK
Buckling shear stress ratio ▶		0.284	1.000		OK



Checking of transverse bulkheads illustrated with an after peak bulkhead of a fishing vessel



Compute Results

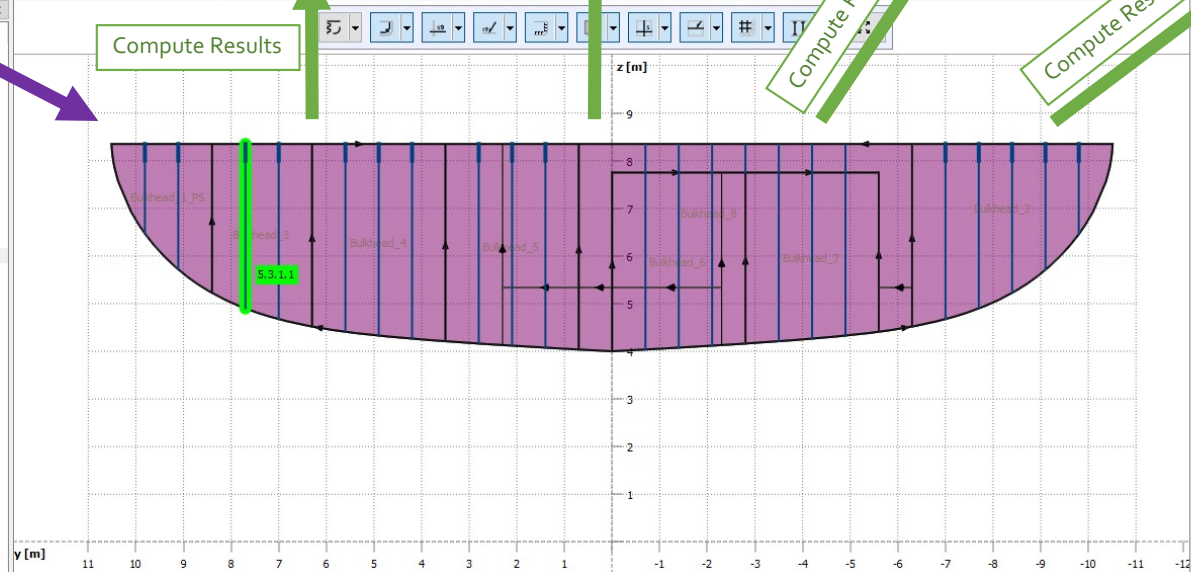
Compute Results

Compute Results

Compute Results

Project Browser

- Name
- AFT BHD FR8
- Nodes
- Segments
- Panels
- Bulkheads
 - Bulkhead_1_PS
 - Bulkhead_2
 - Bulkhead_3
 - Welding Joints
 - Bulkhead Plates
 - 5.3.1
 - Bulkhead Stiffeners
 - 5.3.1
 - 5.3.1.1
 - 5.3.1.2
 - Bulkhead_4
 - Bulkhead_5
 - Bulkhead_6
 - Bulkhead_7
 - Bulkhead_8



Data Browser

Bh Stiffener 5.3.1.1

Notifications

The combination of connection types does not match RS Rules Pt II Table 2.7.4.2: Stiffener 5.3.1.1

Properties

Parameter	Value	Unit
Role	Stiffener	
l	3.273	[m]
a	0.700	[m]
B _y	0.546	[m]
s _{plate}	9.0	[mm]
Δs	1.30	[mm]

Check	Min	Value	Max	Unit	Status
Material grade	A	A			OK
Web minimal thickness	6.5	14.0		[mm]	OK
Section modulus	229.45	433.379		[cm ³]	OK

Data Browser

Bh Stiffener 5.3.1.1

Common

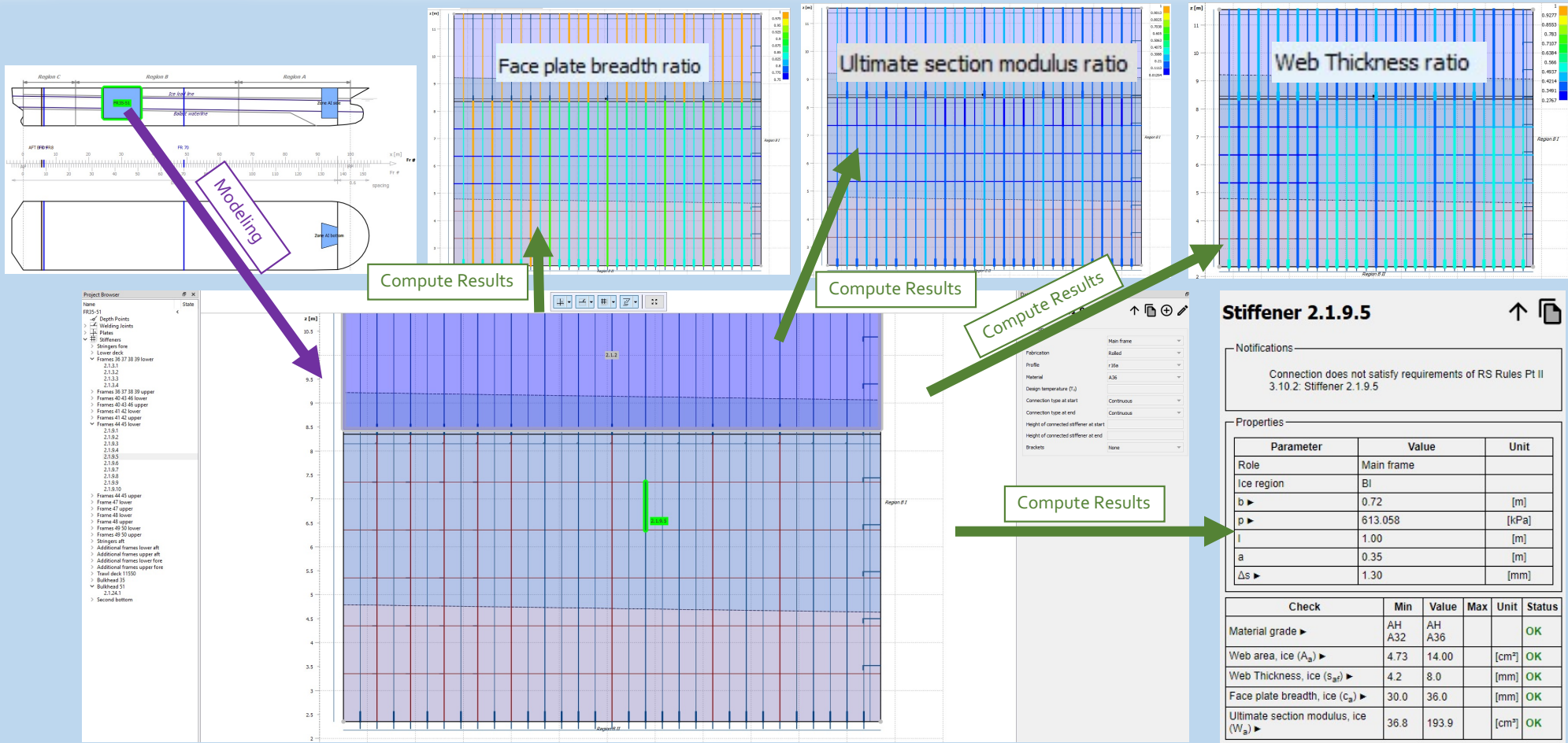
- Role: Stiffener
- Fabrication: Rolled
- Profile: r24a
- Material: A
- Design temperature (T_d):
- Connection type at start: Continuous
- Connection type at end: Continuous
- Brackets: Only at end

End bracket

- Size along stiffener (c₁): 350 mm
- Size across stiffener (c₂): 700 mm
- Thickness: 12.0 mm
- Radius: Straight
- Free edge stiffening: None



Checking of ice strengthening of grillages illustrated with grillages in region BI for a fishing vessel





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THANK YOU FOR YOUR ATTENTION!