SARC
MARITIME SOFTWARE AND SERVICES

Large Area
Hull Shape Modification

Bremen, March 2025

Funded by
the European Union

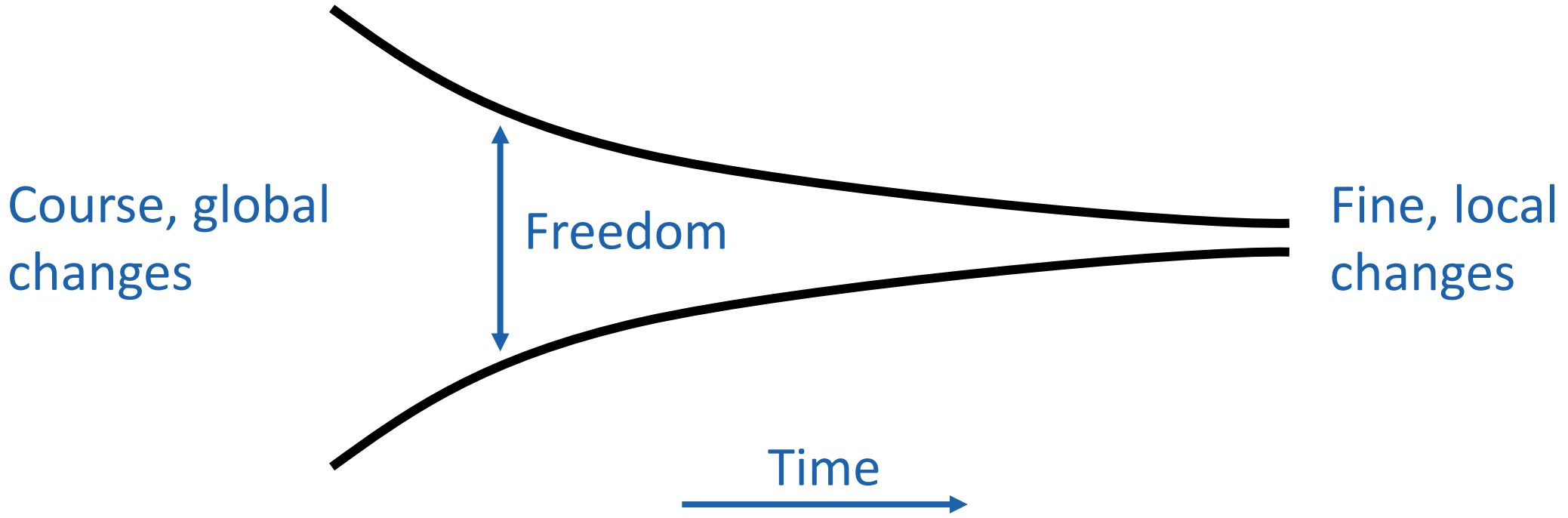
Fairway is special

Network of curves instead of patchwork of surfaces

1. No topological restrictions
   - Curves can intersect any number of other curves, leaving cells with any number of corners
2. No regularity requirements
   - Curves can run over arbitrary stretches of the hull in arbitrary directions
3. No indirection in surface manipulation
   - Points and curves are *on* the surface
4. Tools for evaluating and improving smoothness (Fairing)

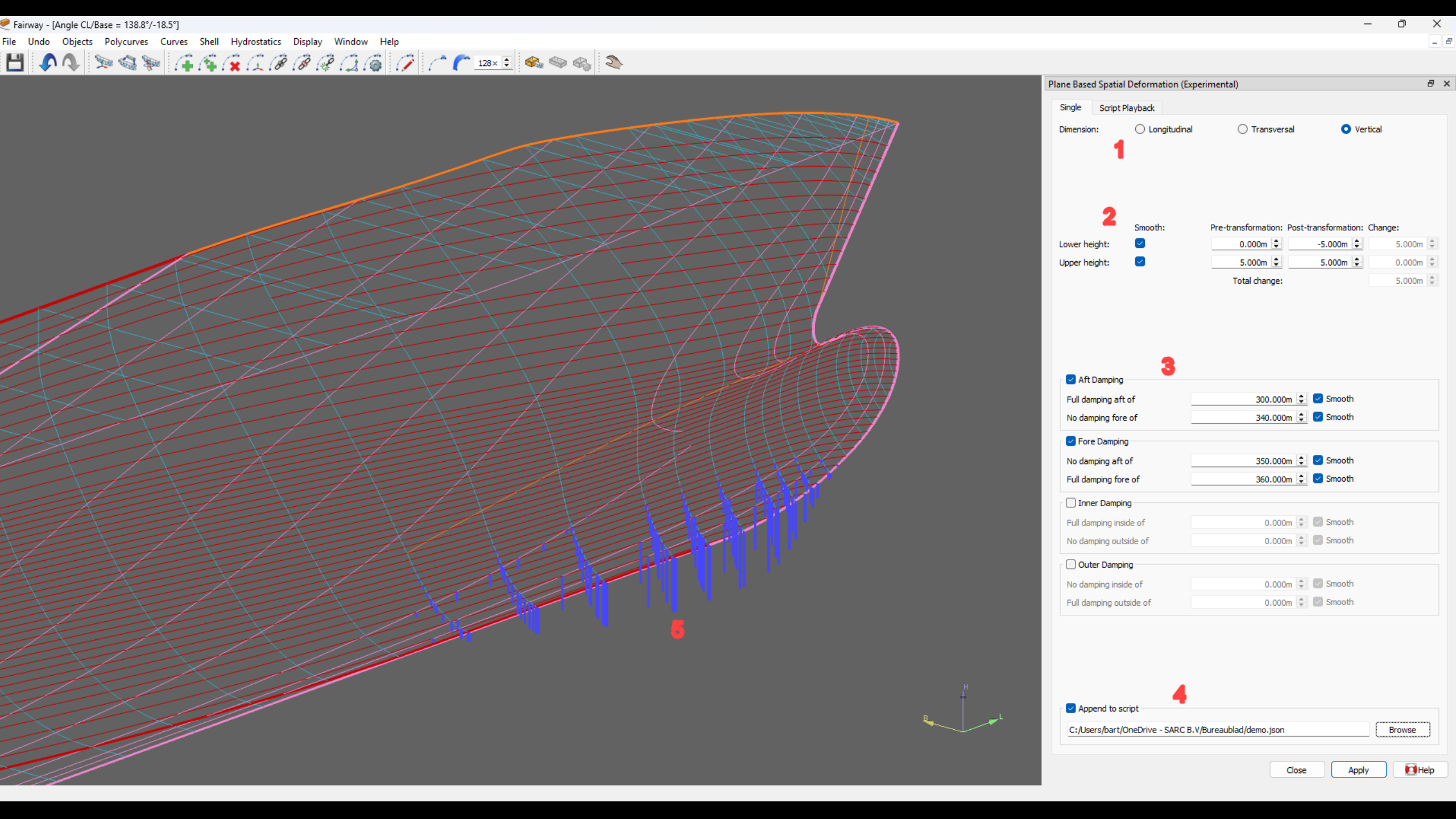
Progressive commitment

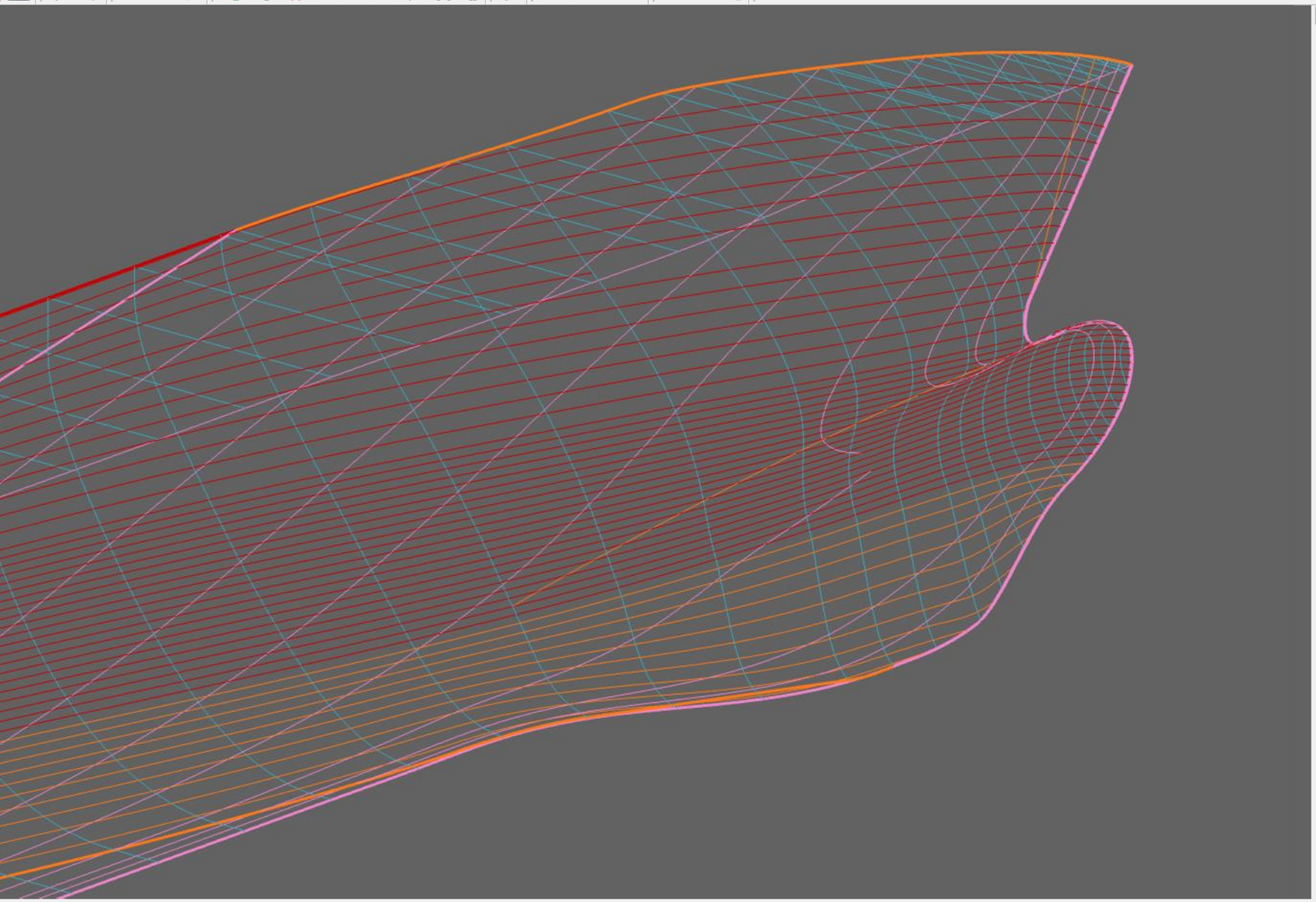
The further a design progresses, the more local changes get.



Spatial Deformation

- Deforming the fabric of space in which the model is defined
- Popular technique in entertainment industry
- Generally only applicable to discrete representations
  - Indirect modelling paradigms cannot maintain continuity across seams
  - CFD, optimizations need to be converted back into continuous representation by reverse engineering
- Thanks to direct surface manipulation: Applicable in Fairway!
- Developed and demonstrated in 2004
  - Point-based (a.k.a. radial basis functions)
  - Curve-based (in theory)
- New variant basis for SARC concept early design
  - Break free from progressive commitment


Fairway - [Angle CL/Base = 138.8°/-18.5°]
File
Undo
Objects
Polycurves
Curves
Shell
Hydrostatics
Display
Window
Help
128×
Plane Based Spatial Deformation (Experimental)
Single
Script Playback
Dimension:
Longitudinal
Transversal
Vertical
1
2
Smooth:
Pre-transformation:
Post-transformation:
Change:
Lower height:
0.000m
-5.000m
5.000m
Upper height:
5.000m
5.000m
0.000m
Total change:
5.000m
3
Aft Damping
Full damping aft of
300.000m
Smooth
No damping fore of
340.000m
Smooth
Fore Damping
No damping aft of
350.000m
Smooth
Full damping fore of
360.000m
Smooth
Inner Damping
Full damping inside of
0.000m
Smooth
No damping outside of
0.000m
Smooth
Outer Damping
No damping inside of
0.000m
Smooth
Full damping outside of
0.000m
Smooth
4
Append to script
C:/Users/bart/OneDrive - SARC B.V/Bureaublad/demo.json
Browse
Close
Apply
Help
5
H
B
L



Fairway - [Angle CL/Base = 138.8°/-18.5°]

File Undo Objects Polycurves Curves Shell Hydrostatics Display Window Help

Plane Based Spatial Deformation (Experimental)

Single | Script Playback

Dimension: ○ Longitudinal ○ Transversal ● Vertical

1

2

	Smooth:	Pre-transformation:	Post-transformation:	Change:
Lower height:	☑	0.000m	-5.000m	5.000m
Upper height:	☑	5.000m	5.000m	0.000m
			Total change:	5.000m

3

☑ Aft Damping
- Full damping aft of 300.000m ☑ Smooth
- No damping fore of 340.000m ☑ Smooth

☑ Fore Damping
- No damping aft of 350.000m ☑ Smooth
- Full damping fore of 360.000m ☑ Smooth

☐ Inner Damping
- Full damping inside of 0.000m Smooth
- No damping outside of 0.000m Smooth

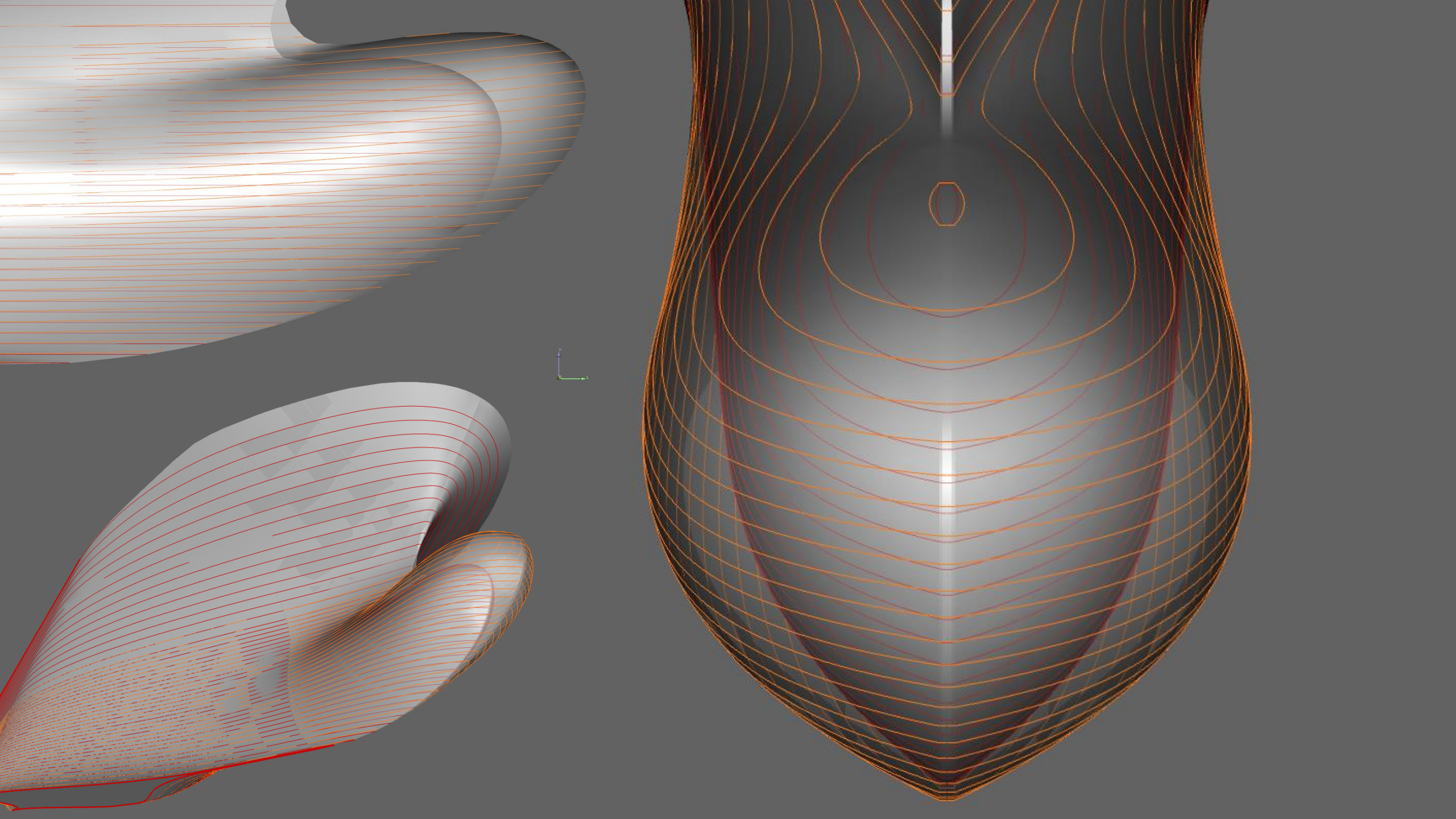
☐ Outer Damping
- No damping inside of 0.000m Smooth
- Full damping outside of 0.000m Smooth

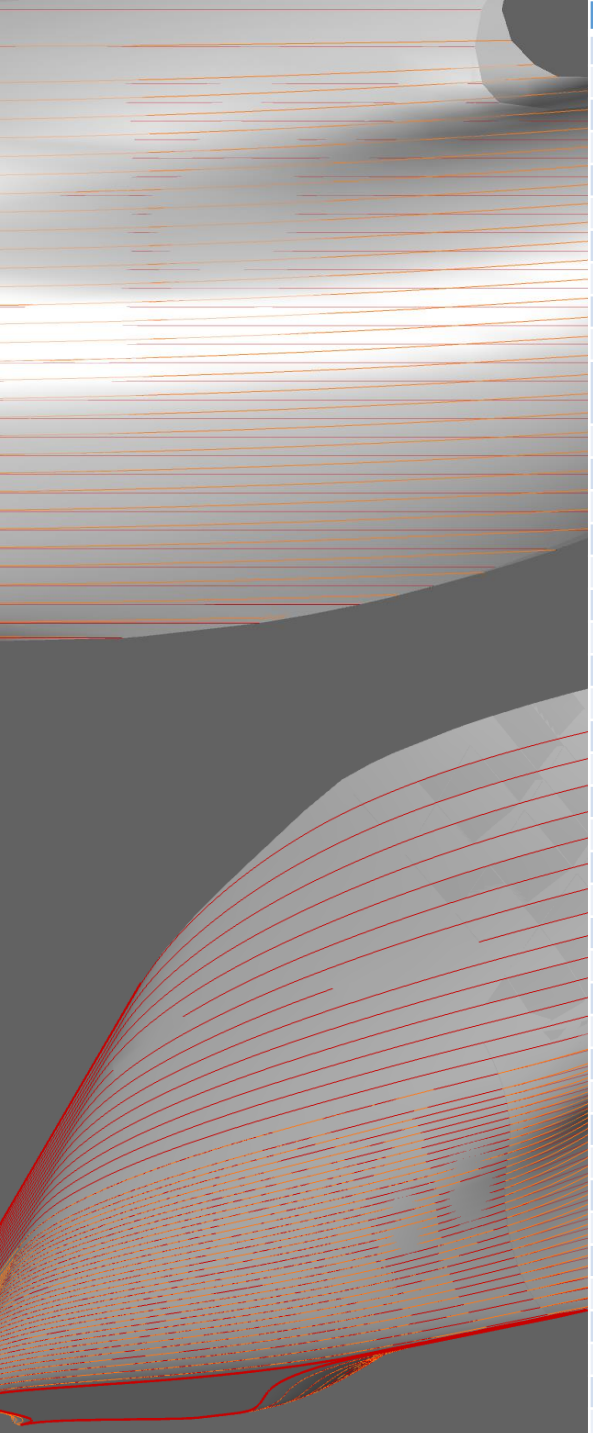
4

☑ Append to script

C:/Users/bart/OneDrive - SARC B.V/Bureaublad/demo.json Browse

Close Apply Help





The script	Comments
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"transformations": [	
{	Start of script for a single transformation
"damping": [	Damping of transformation
{	
"dimension": 0,	Damping applies to original Length coordinate (of transformation in another direction).
"full damping": {	
"smooth": true,	changes towards threshold will diminish to 0 (so that curves may remain continuous).
"threshold": 337.25	Treshold: start/end of the range for damping
},	
"no damping": {	No damping is required for threshold at 370 m, as the extreme position of the bulbous bow is less.
"smooth": true,	changes towards threshold will diminish to 0 (so that curves may remain continuous)
"threshold": 370	End of damping area.
}	
},	
{	
"dimension": 2,	Damping applies to original height coordinate (of transformation in another direction).
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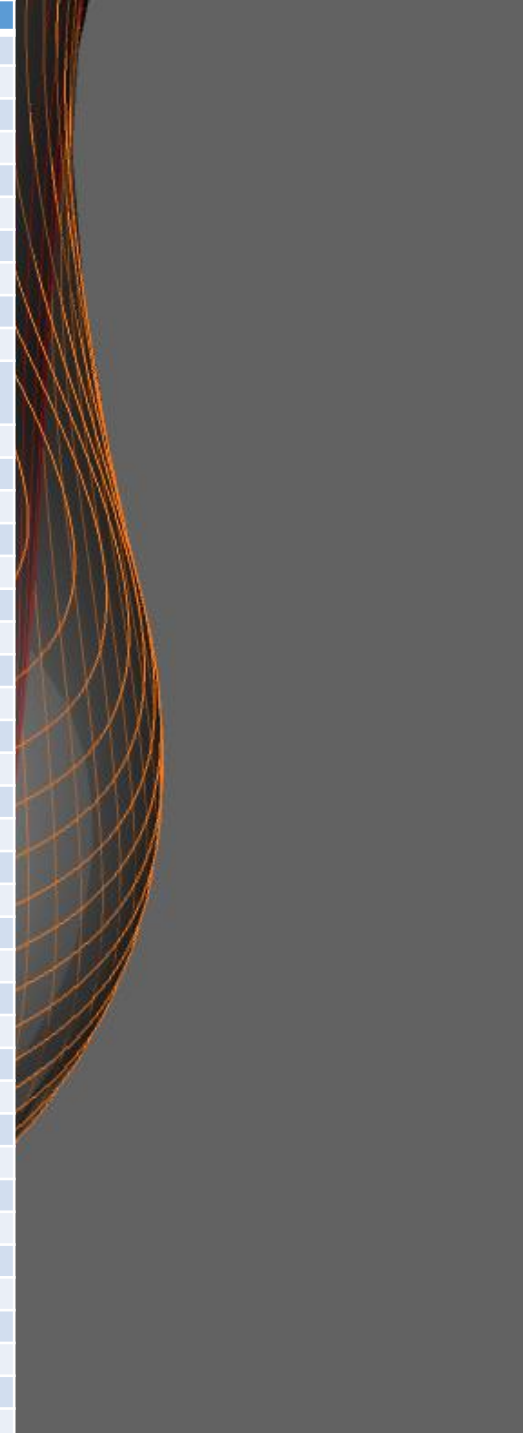
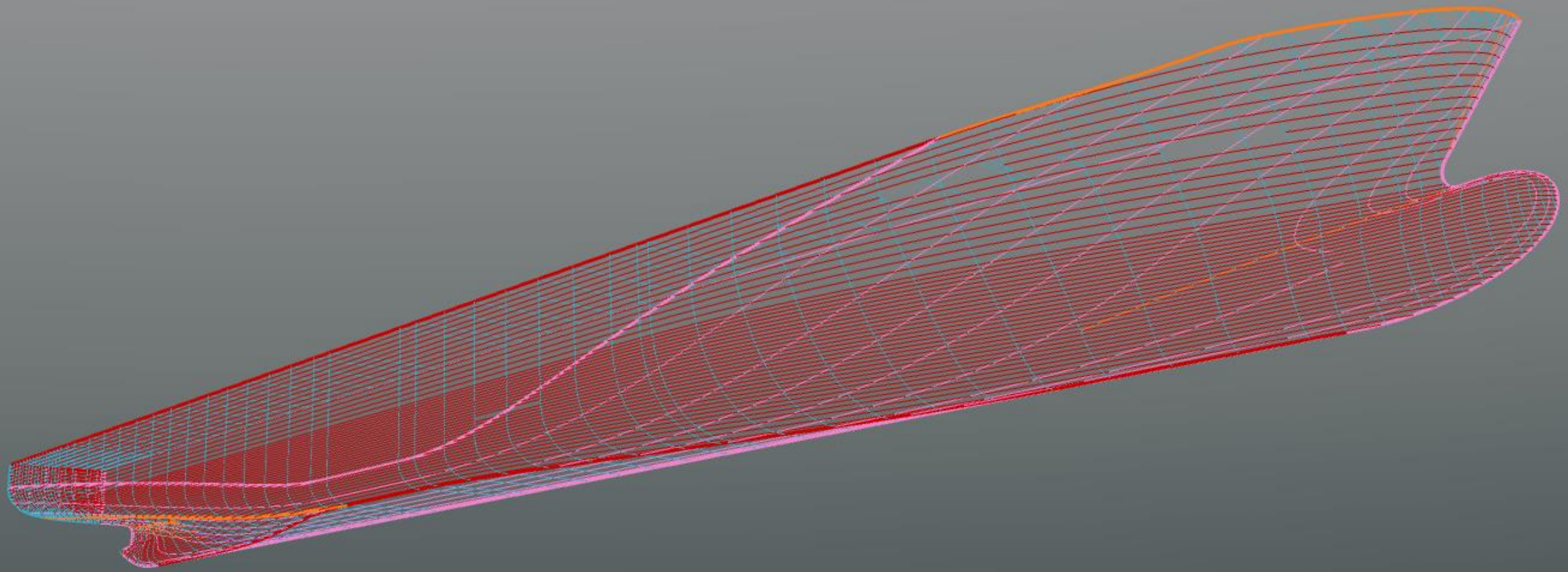
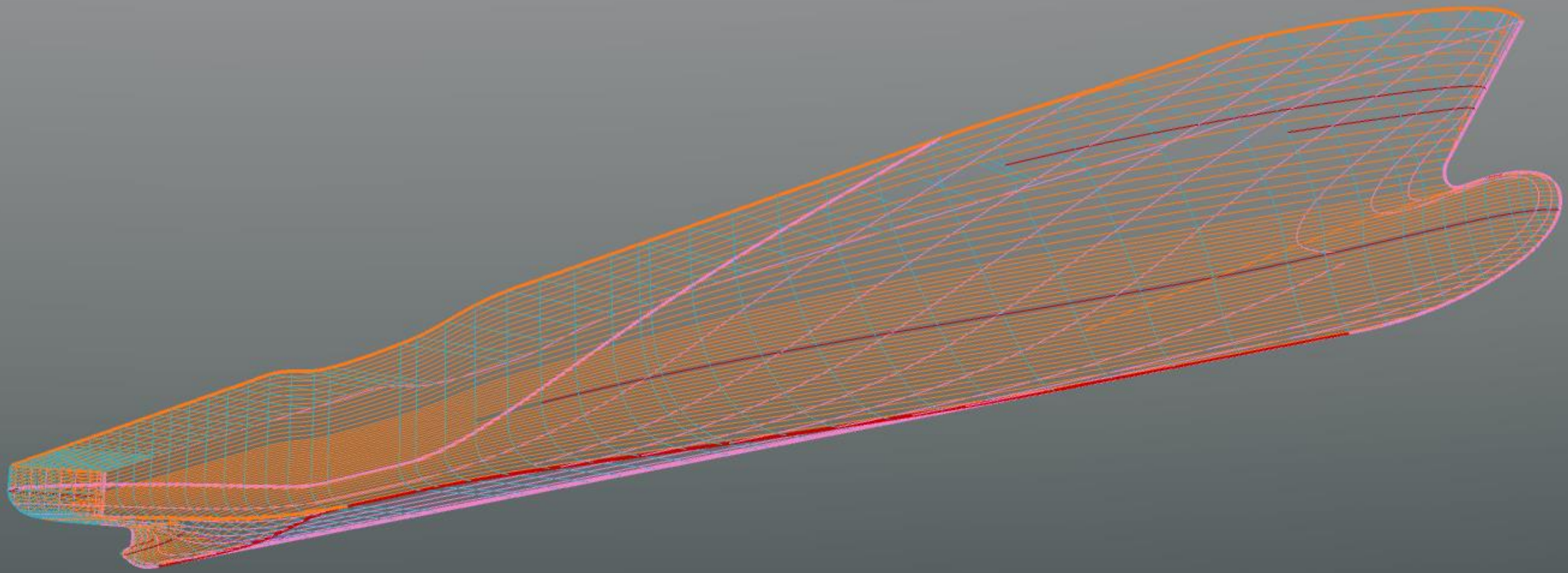
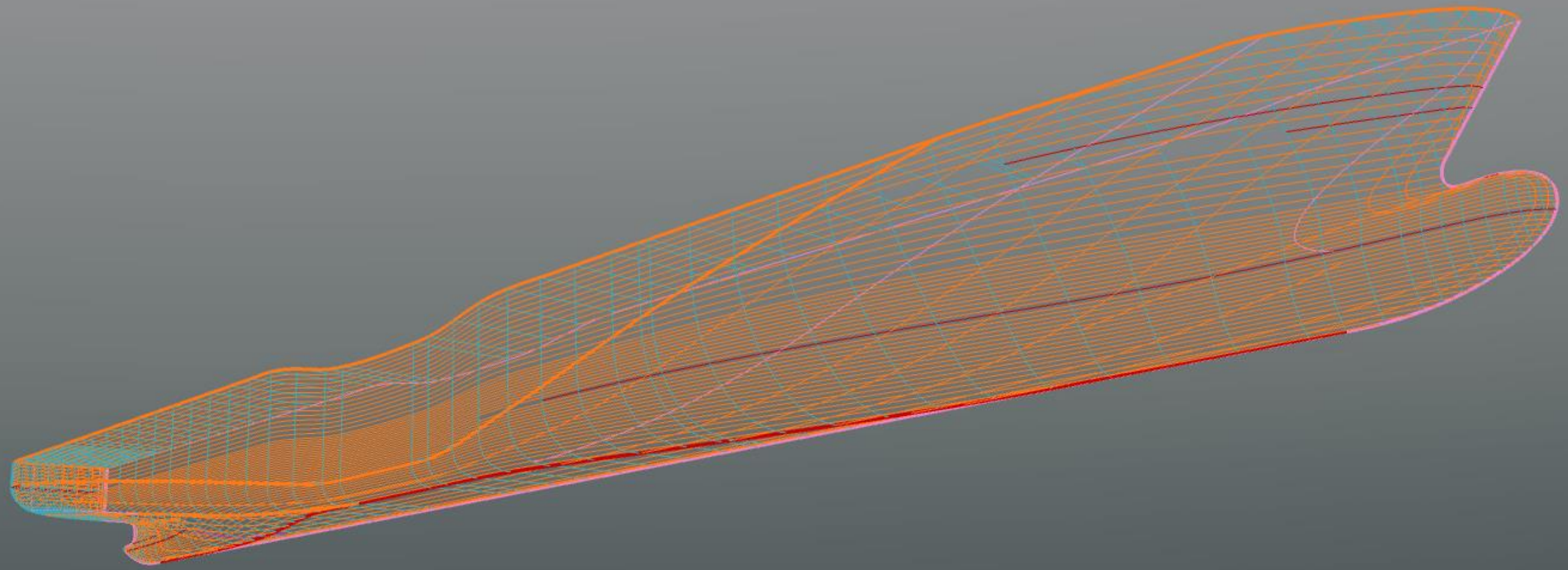
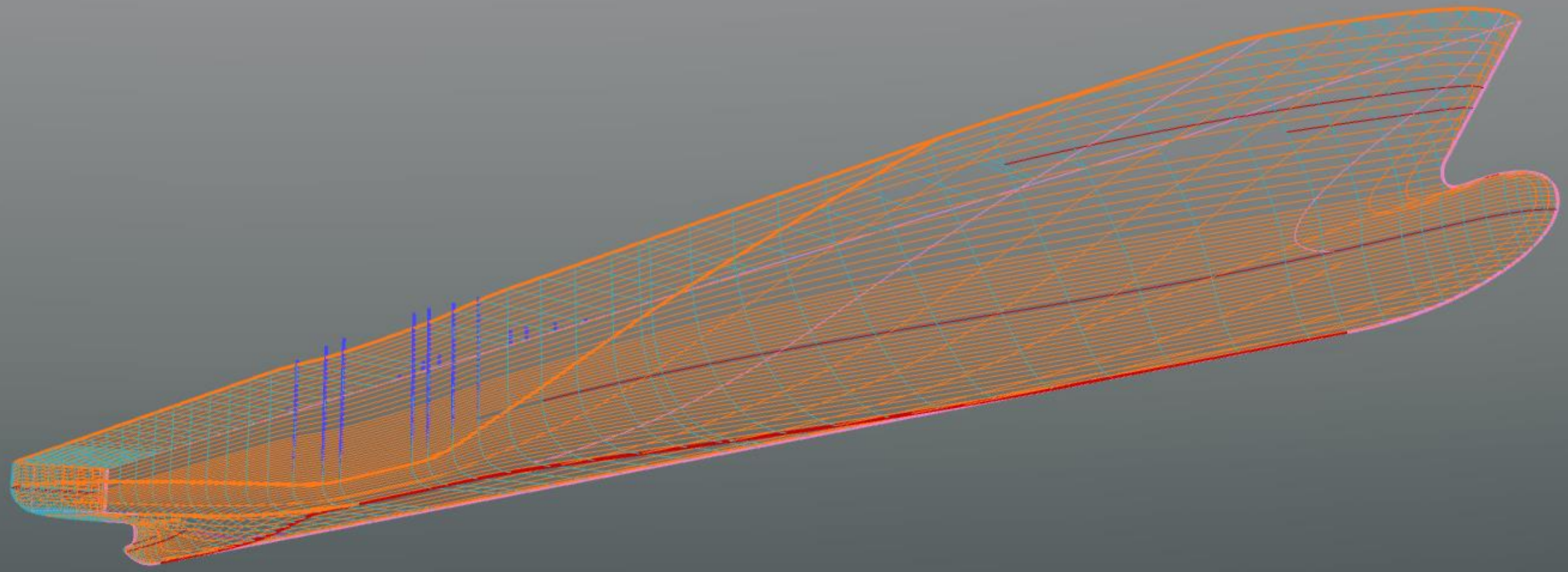
"smooth": true,	
"threshold": 19	
},	
"no damping": {	
"smooth": true,	
"threshold": 14	
}	
}	
],	
"dimension": 1,	Transformation in vertical direction
"lower threshold": {	Start point (height)
"post transformation": 0,	Height after transformation
"pre transformation": 0,	Height before transformation
"smooth": false	No damping of transformation towards start point
},	
"upper threshold": {	End point
"post transformation": 7,	After (increasing Z coordinates with 2 m)
"pre transformation": 5,	Before
"smooth": true	Damping of transformation towards upper threshold
},	
"version": 0	
}	
]	
}	

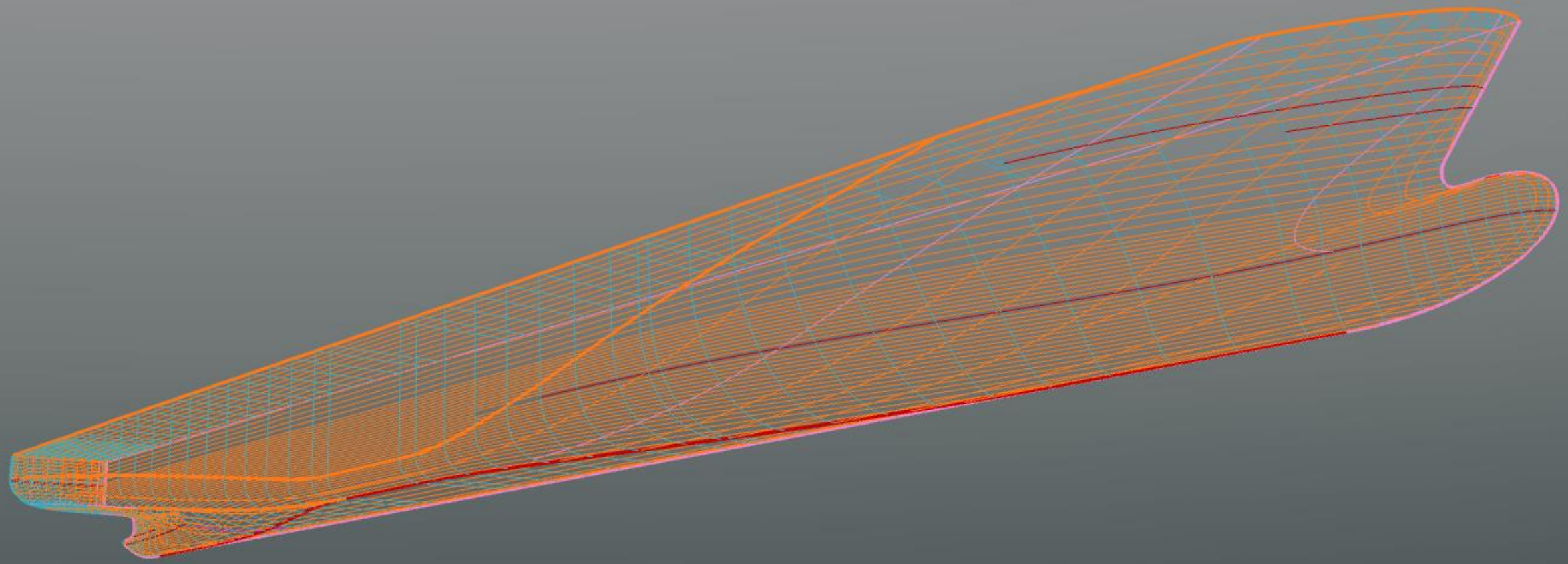


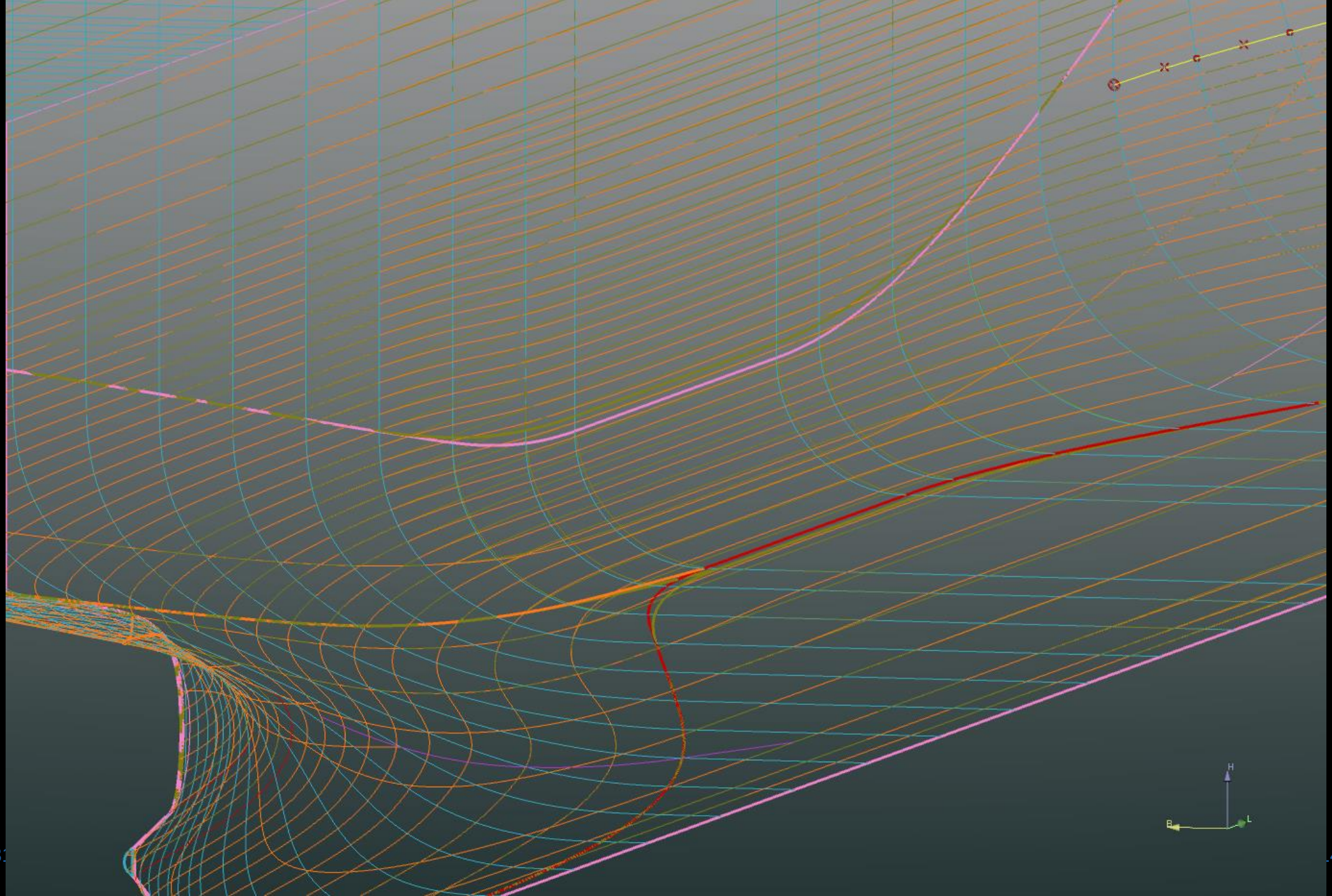




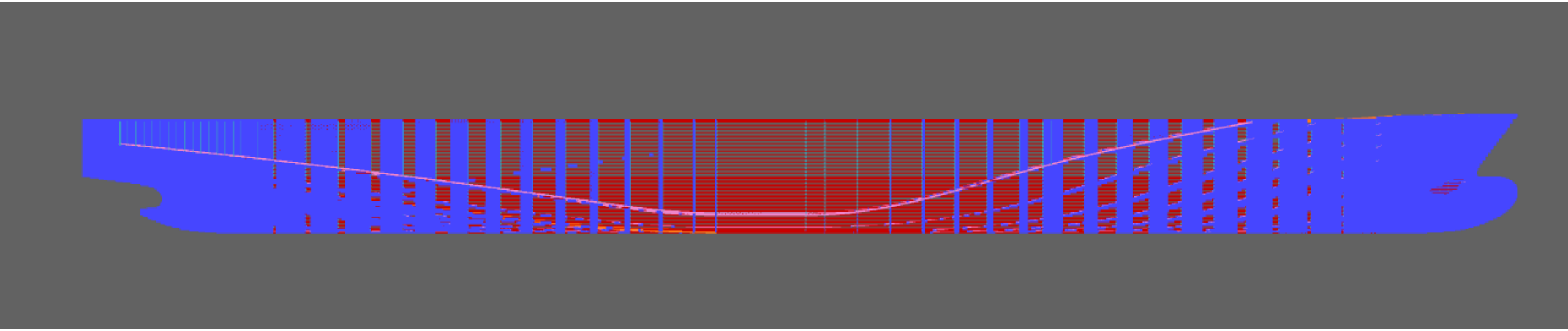




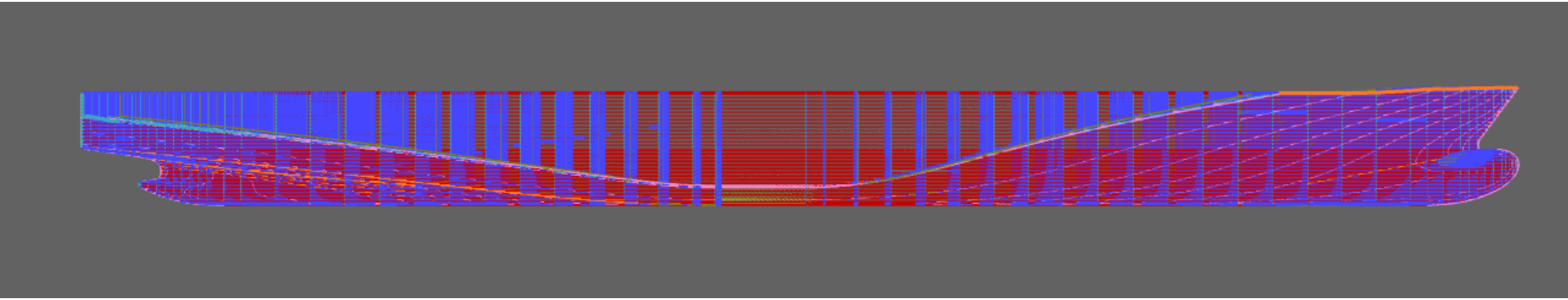


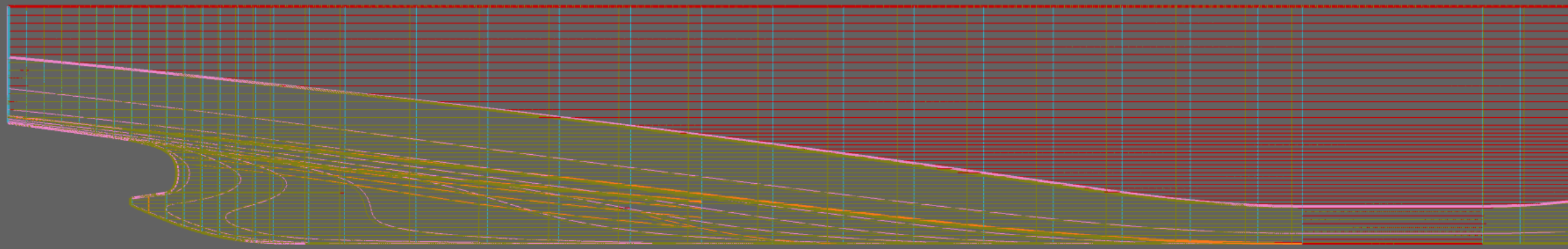

H
B
L

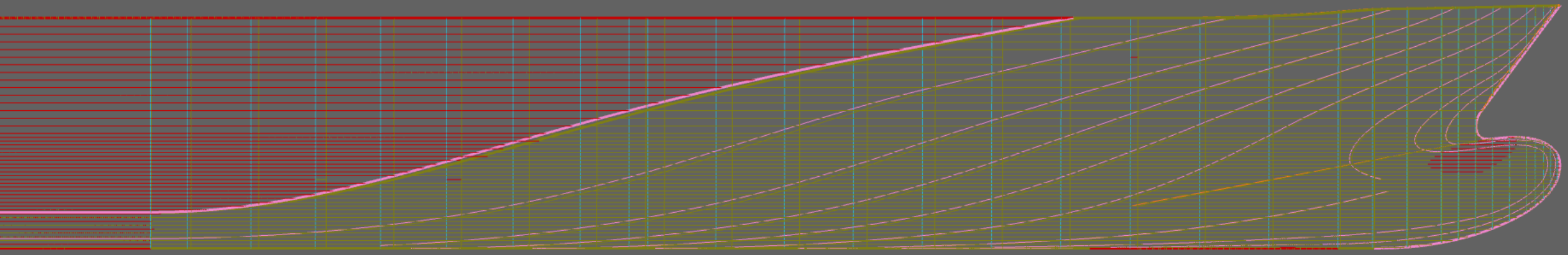
Reduce Cb (displacement)

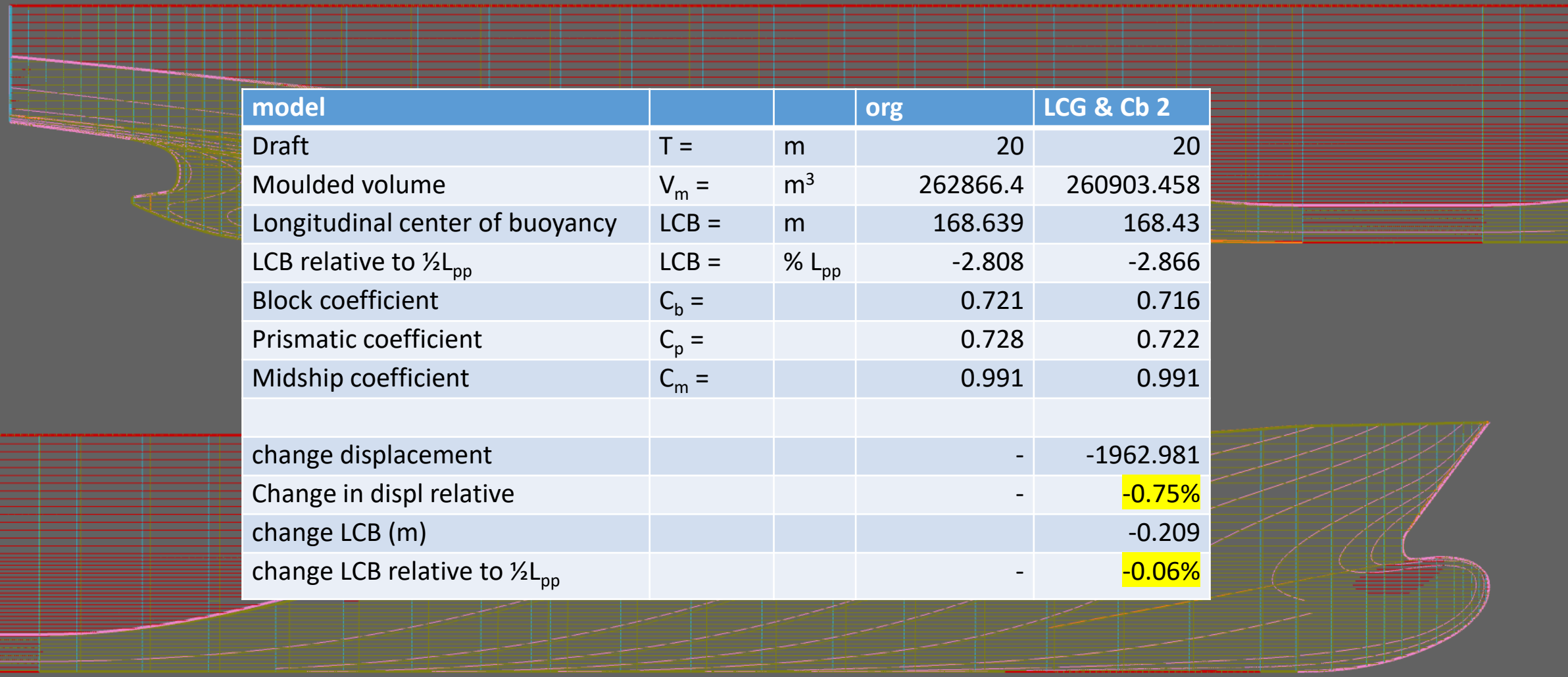


Reduce Cb (displacement)

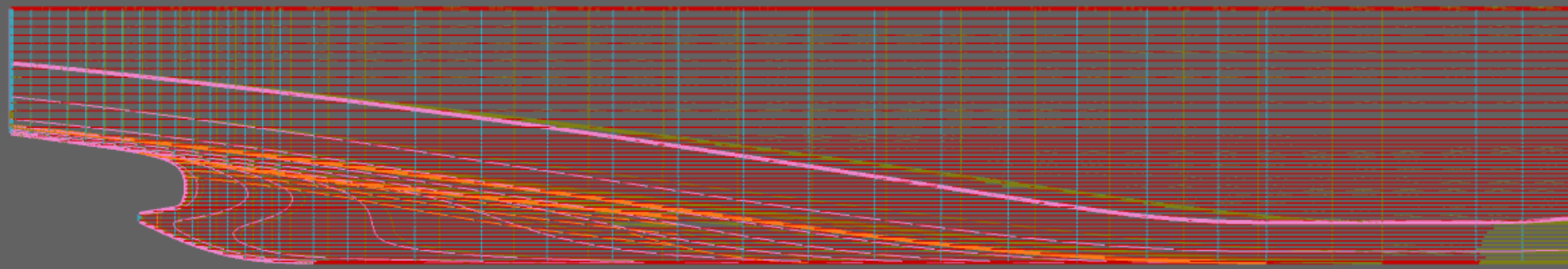


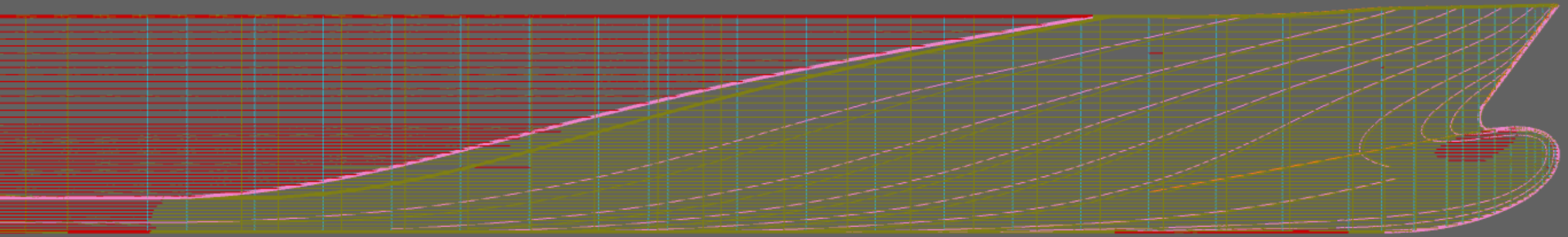


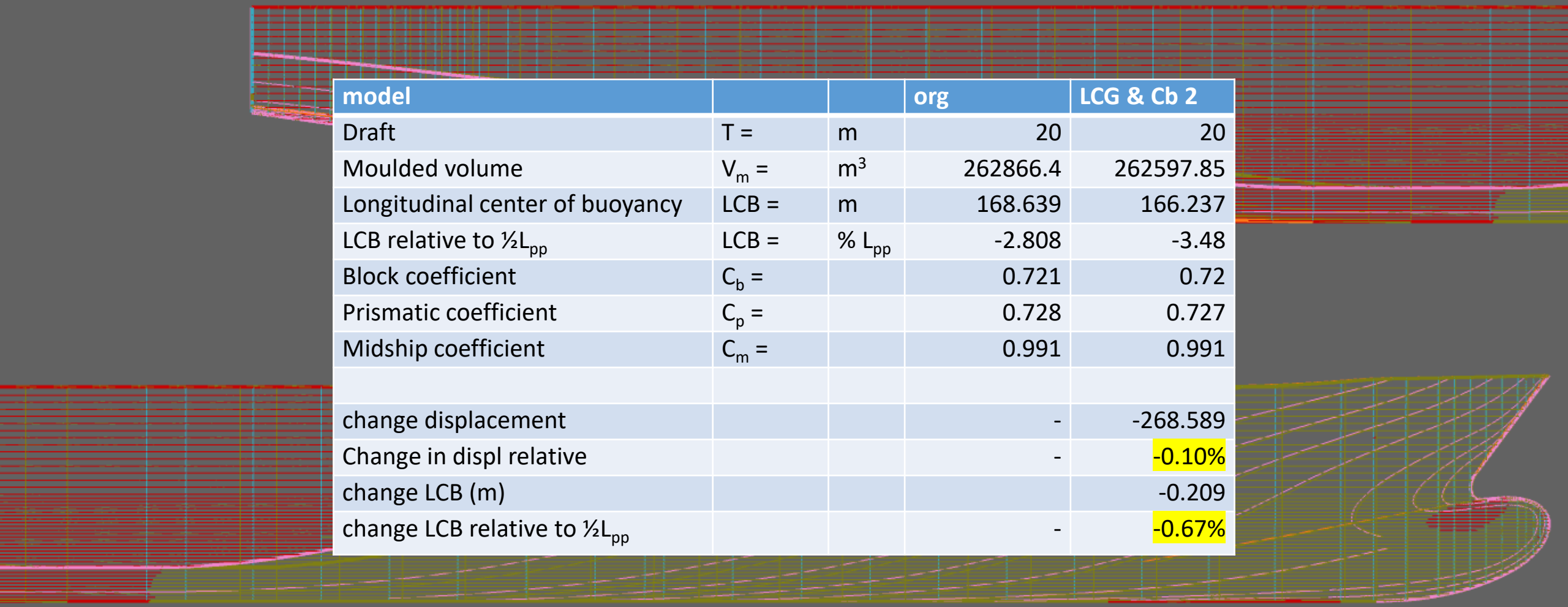




model			org	LCG & Cb 2
Draft	T =	m	20	20
Moulded volume	V_m =	m^3	262866.4	260903.458
Longitudinal center of buoyancy	LCB =	m	168.639	168.43
LCB relative to ½L_{pp}	LCB =	% L_{pp}	-2.808	-2.866
Block coefficient	C_b =		0.721	0.716
Prismatic coefficient	C_p =		0.728	0.722
Midship coefficient	C_m =		0.991	0.991
change displacement			-	-1962.981
Change in displ relative			-	-0.75%
change LCB (m)				-0.209
change LCB relative to ½L_{pp}			-	-0.06%







model			org	LCG & Cb 2
Draft	T =	m	20	20
Moulded volume	V_m =	m^3	262866.4	262597.85
Longitudinal center of buoyancy	LCB =	m	168.639	166.237
LCB relative to ½L_{pp}	LCB =	% L_{pp}	-2.808	-3.48
Block coefficient	C_b =		0.721	0.72
Prismatic coefficient	C_p =		0.728	0.727
Midship coefficient	C_m =		0.991	0.991
change displacement			-	-268.589
Change in displ relative			-	-0.10%
change LCB (m)				-0.209
change LCB relative to ½L_{pp}			-	-0.67%

Key Points

- Break free from progressive commitment
- Simple concept
- Composable
- Replayable
- Variable and expandable

- Can express legacy transformations (Linear scaling, Lackenby)

Vision

- Ensure sufficient surface points
- Reinterpolate planar curves, build frames
- Dimensionless
- Higher level interfaces, sliders
  - Change bilge radius to *r*
  - Increase the beam to *b* but preserve the bilge radius
  - Raise the propeller shaft by *n*
  - Lift the bulb by %
  - Change LCB to *l*
  - Make more room for the gearbox
  - etc., etc.
- Lower level scriptable (also by capable customers)
- Automated feedback loop with CFD optimization
- Mother shapes (do we even need more than one?)