

Dynalift C-43 – Increased Displacement

Introduction

This document should be read together with “CCG 3613 054 - DC01_PA1 - Dynalift C-43 Hull Scantling”.

The vessel was originally designed for a mass (displacement) of 10 tonnes. It has later been found that a more realistic displacement is 12 tonnes. Consequently, relevant and the most critical load cases are updated and the structure is reanalysed for the updated displacement.

Old displacement	$\Delta = 10$	[tonnes]
New displacement	$\Delta = 12$	[tonnes]

Relevant Load Cases

Where the current utilisation (at 10 tonnes) is deemed low, the load case is not re-analysed.

Since calculations are linear and the centre of gravity is assumed unaffected, the FE model is updated by proportionally adjusting the applied acceleration and node forces.

Discarded Load Cases

Bottom Slamming (ref. Ch. 2.2.2.1)

The bottom slamming pressure increase is 5.6%. The utilisation of the current structure is less than 0.28 (= 0.3/1.056), hence the new displacement will not push the utilisation above the allowed 0.3. No updated analysis is carried out.

Pitch Slamming on Bottom (ref. Ch. 2.2.2.2)

The pitch slamming gives the highest utilisation of the slamming types, however does not change with displacement, therefore no updated analysis is carried out.

Wetdeck slamming (ref. Ch. 2.2.2.3)

The slamming on wetdeck is increased by 5.6%, however the current utilisation is low, hence no updated analysis is carried out.

Sea Pressure (ref. Ch. 2.2.4.1)

The sea pressure does not have a linear relationship with displacement and is therefore not straightforward to analyse. The new block coefficient is 0.62, compared to 0.51 for the previous value. This gives an overall lower sea pressure (maximum value is decreased by 13%). It is considered that the increased draught (which is not accounted for here) does not give an increase significantly above 13%, and therefore the sea pressure needs not be re-analysed.

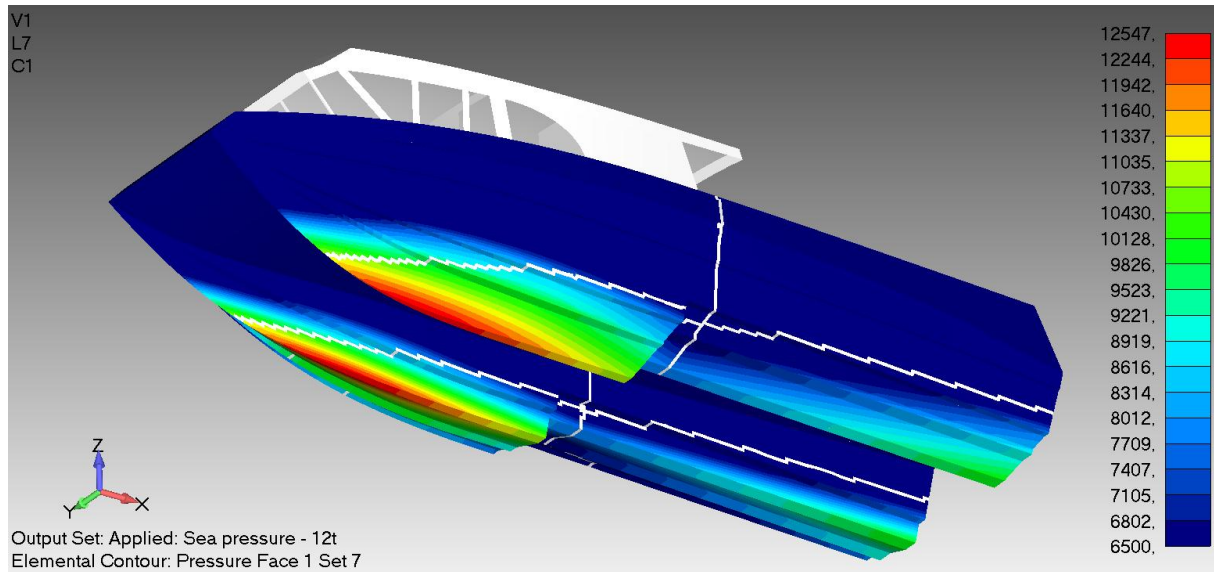


Figure 1. Updated sea pressure.

Updated Load Cases

Global Loads (ref. Ch. 2.3)

The global loads are directly dependant on the displacement and acceleration. The applied acceleration and supporting node forces are multiplied by 1.2 to account for the increased displacement. For a detailed analysis, the buoyant areas supported by sea need to be re-evaluated due to the changed draught, however in this case only the acceleration is updated. Since the supported area is not updated, the results are likely conservative.

Results for 12 tonnes

Although not insignificant, the reaction forces are still considered small and the structure is not considerably stressed at these locations. The same nodes are therefore used as for the original analysis and the loads are hence scaled up proportionally (1.2 times original).

Crest Landing

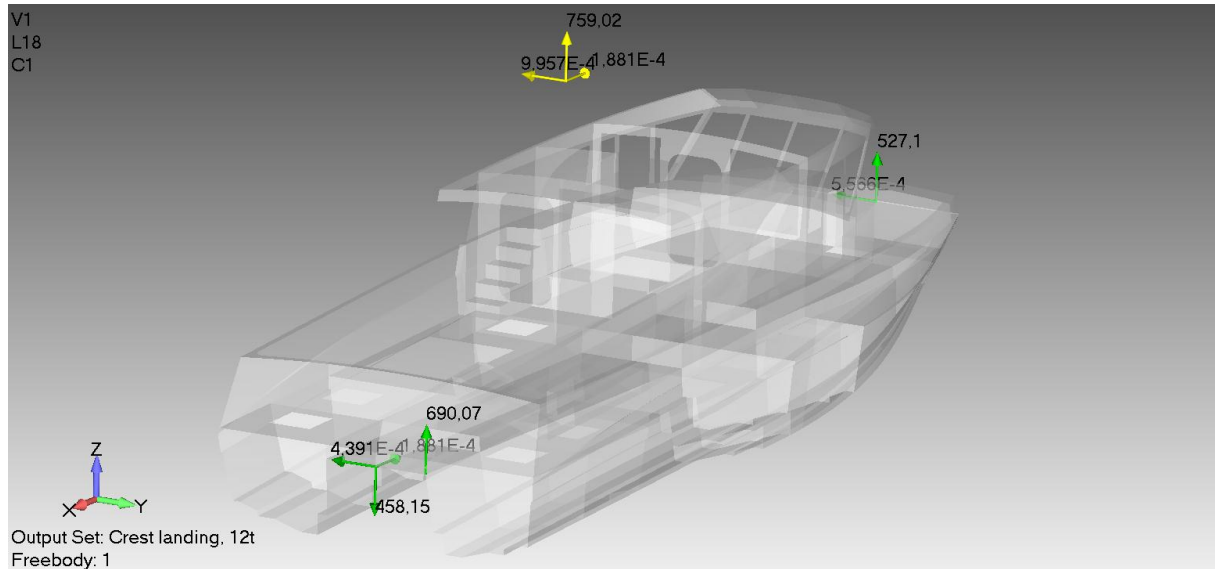


Figure 2. Crest landing, reaction forces.

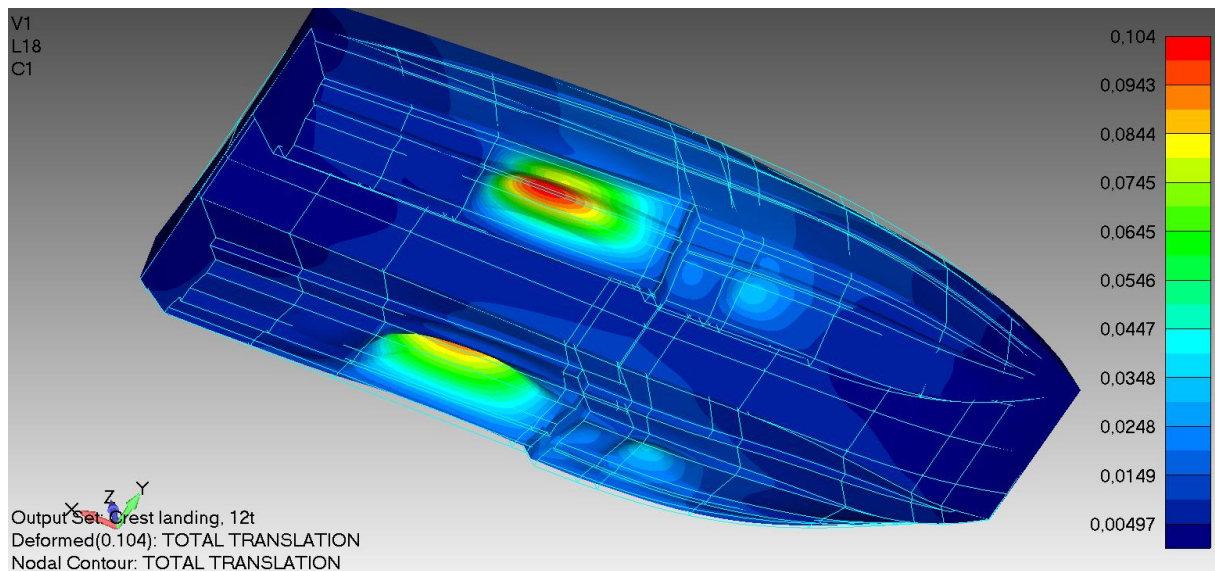


Figure 3. Deformed shape.

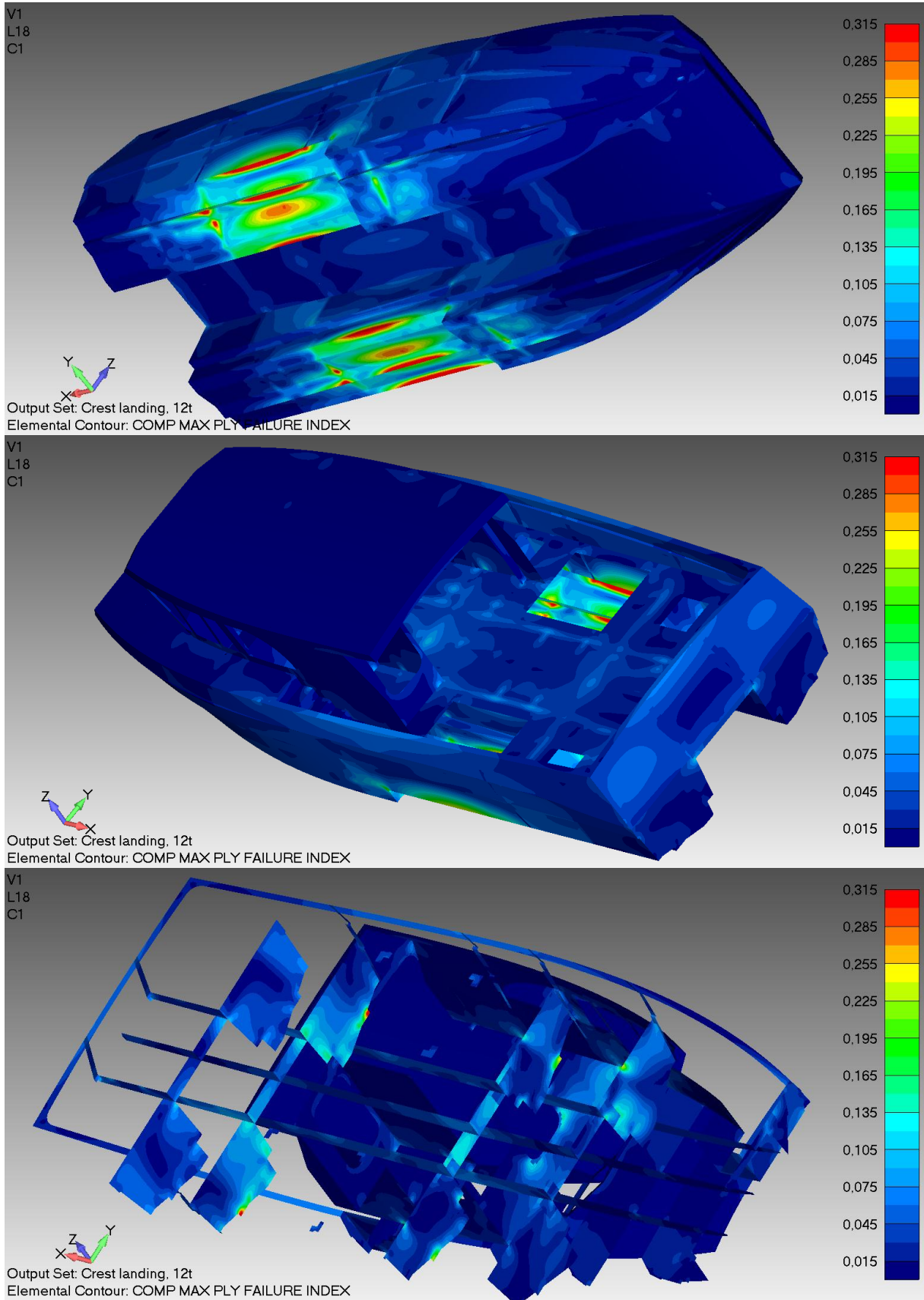


Figure 4. Max fibre failure index.

Hollow Landing

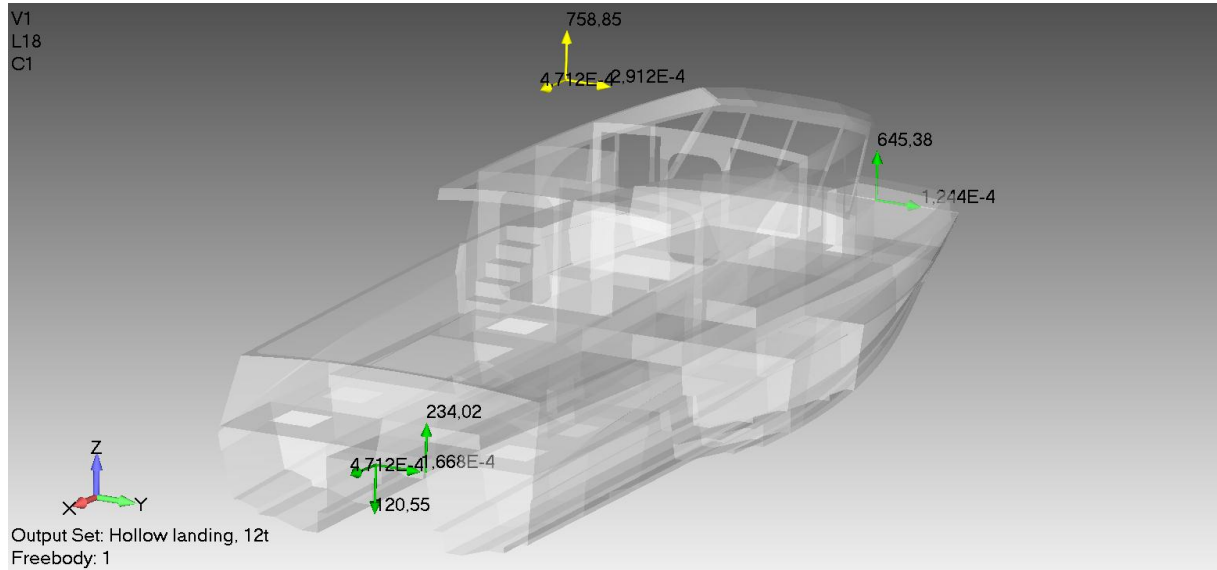


Figure 5. Hollow landing, reaction forces.

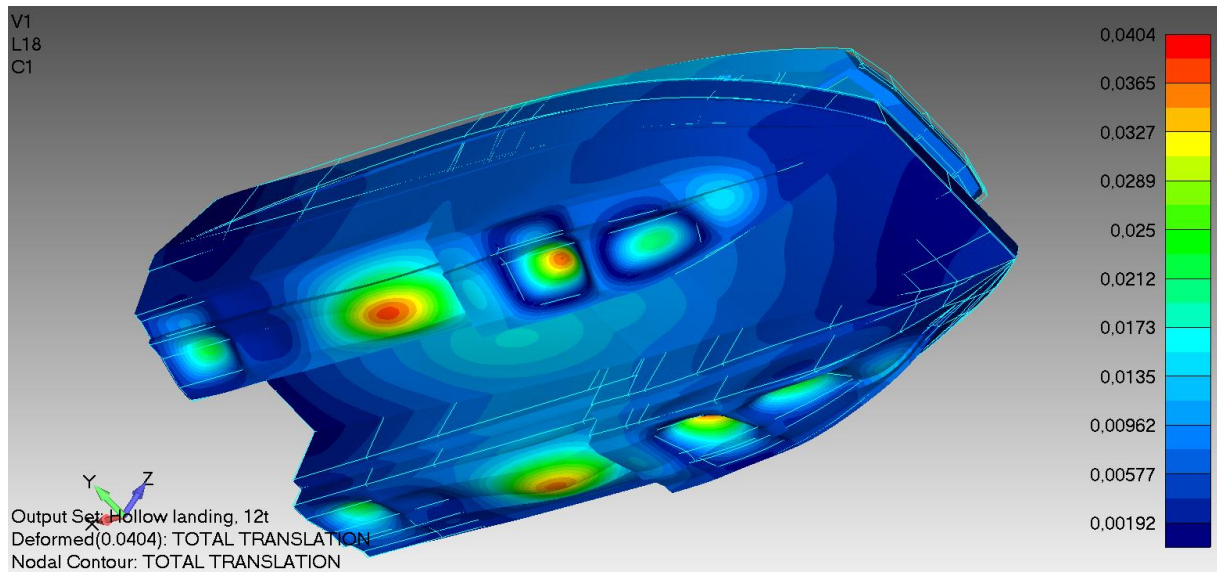


Figure 6. Deformed shape.

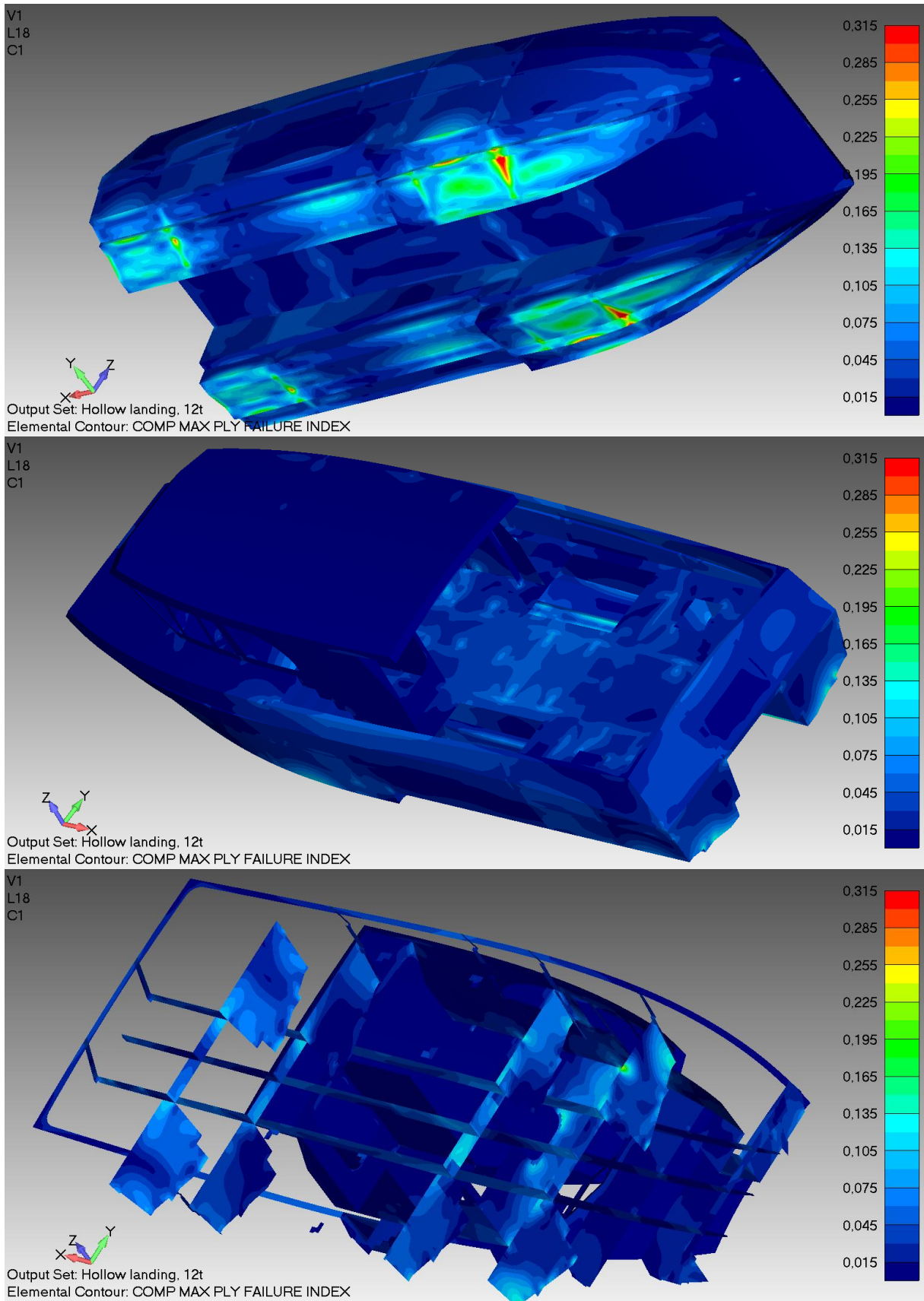


Figure 7. Max fibre failure index.

Still Water - Hogging/Sagging

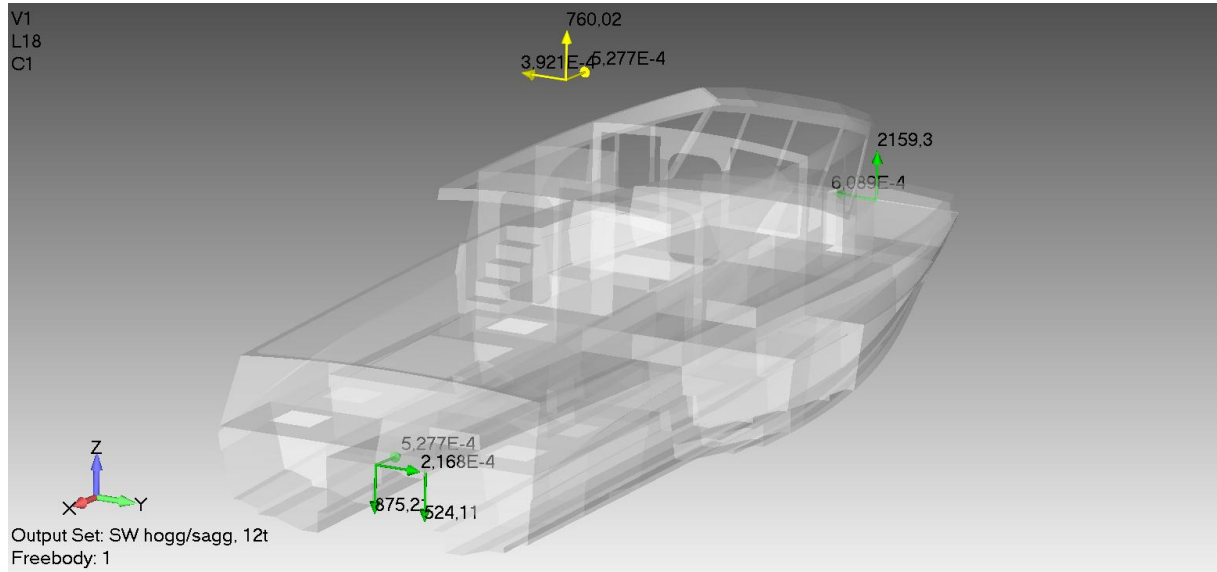


Figure 8. Hogging/sagging, reaction forces.

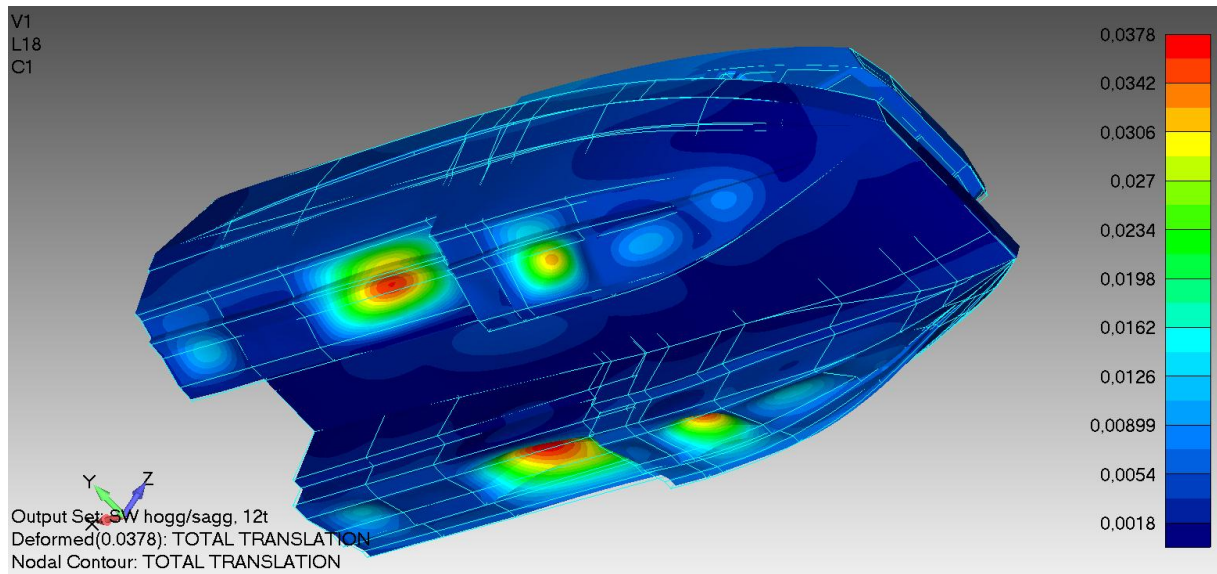


Figure 9. Deformed shape.

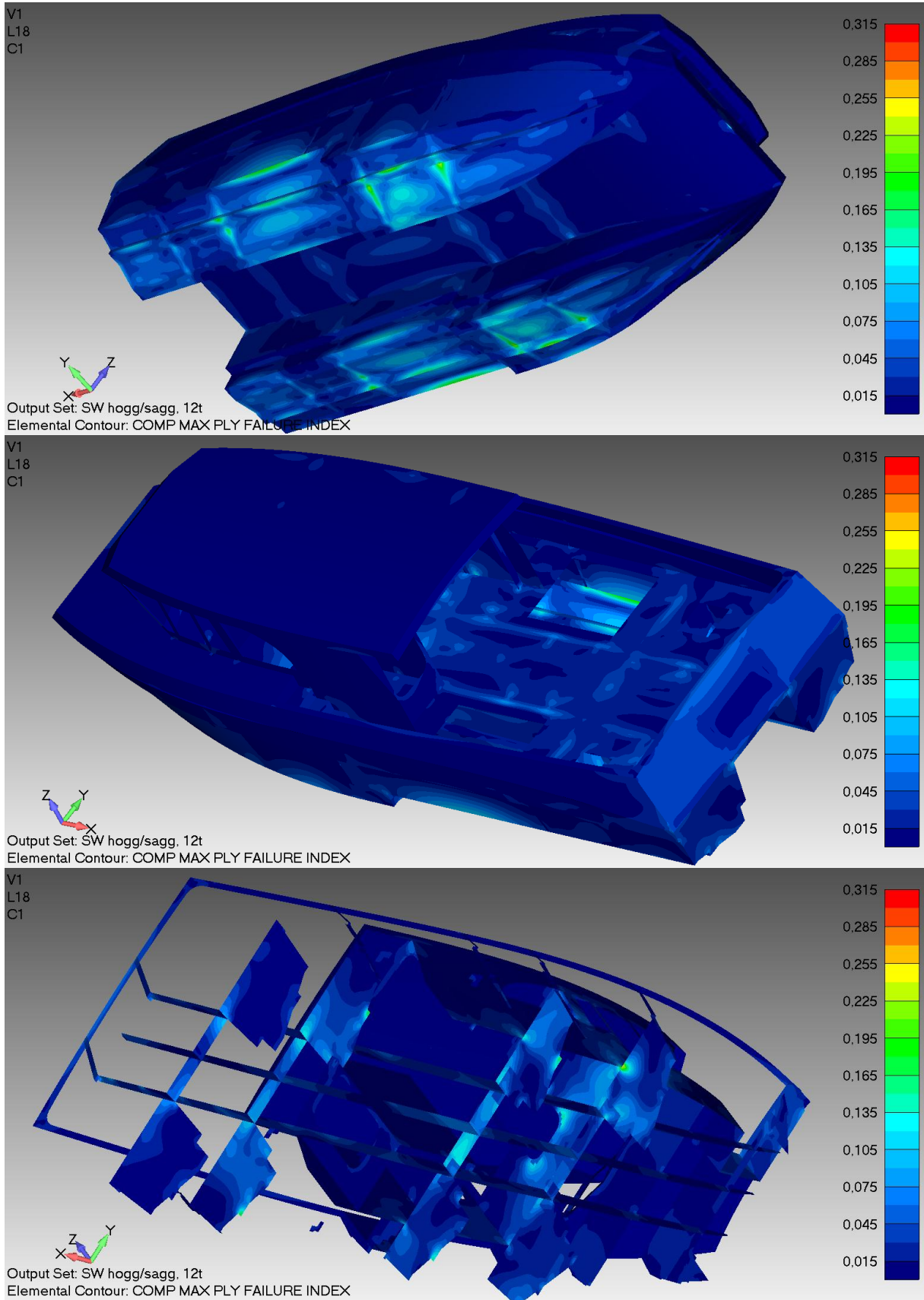


Figure 10. Max fibre failure index.

Outwards Split Moment

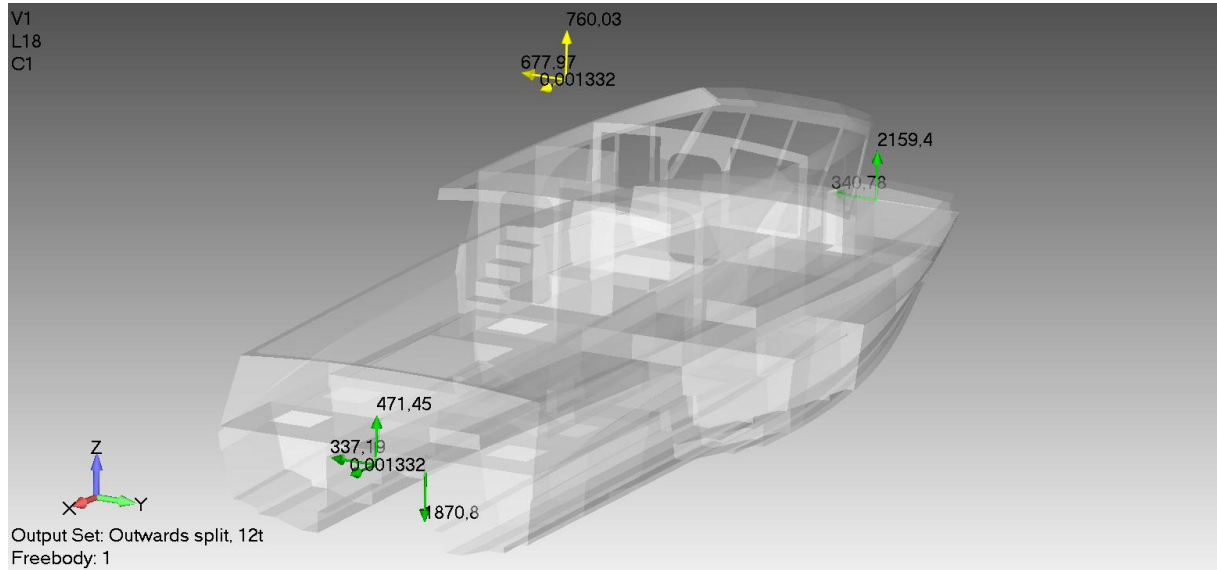


Figure 11. Outwards split, reaction forces.

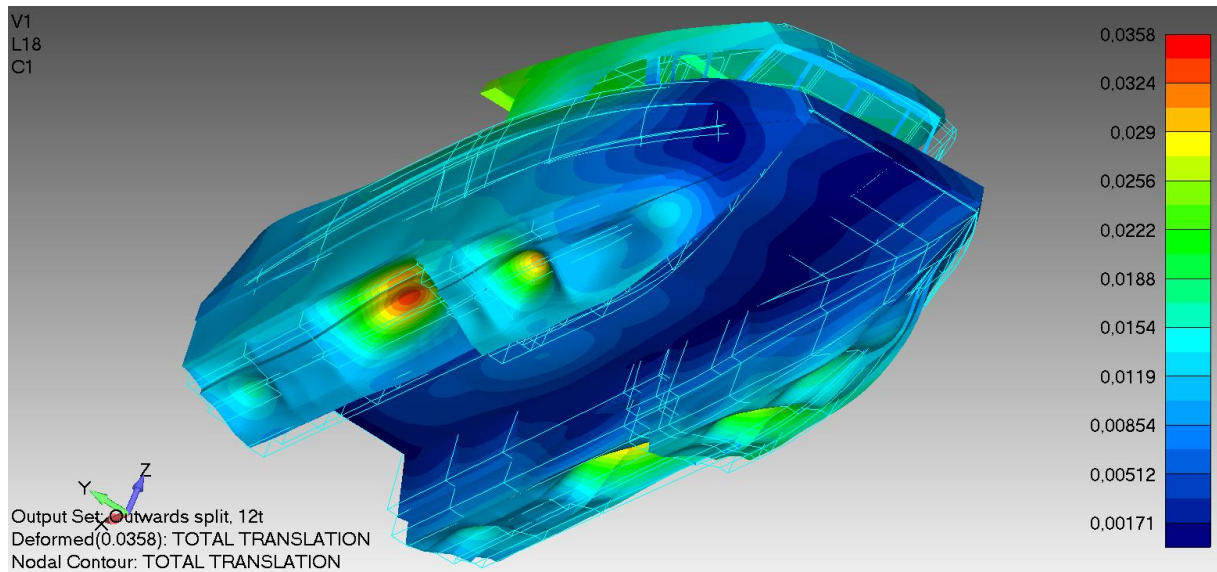


Figure 12. Deformed shape.

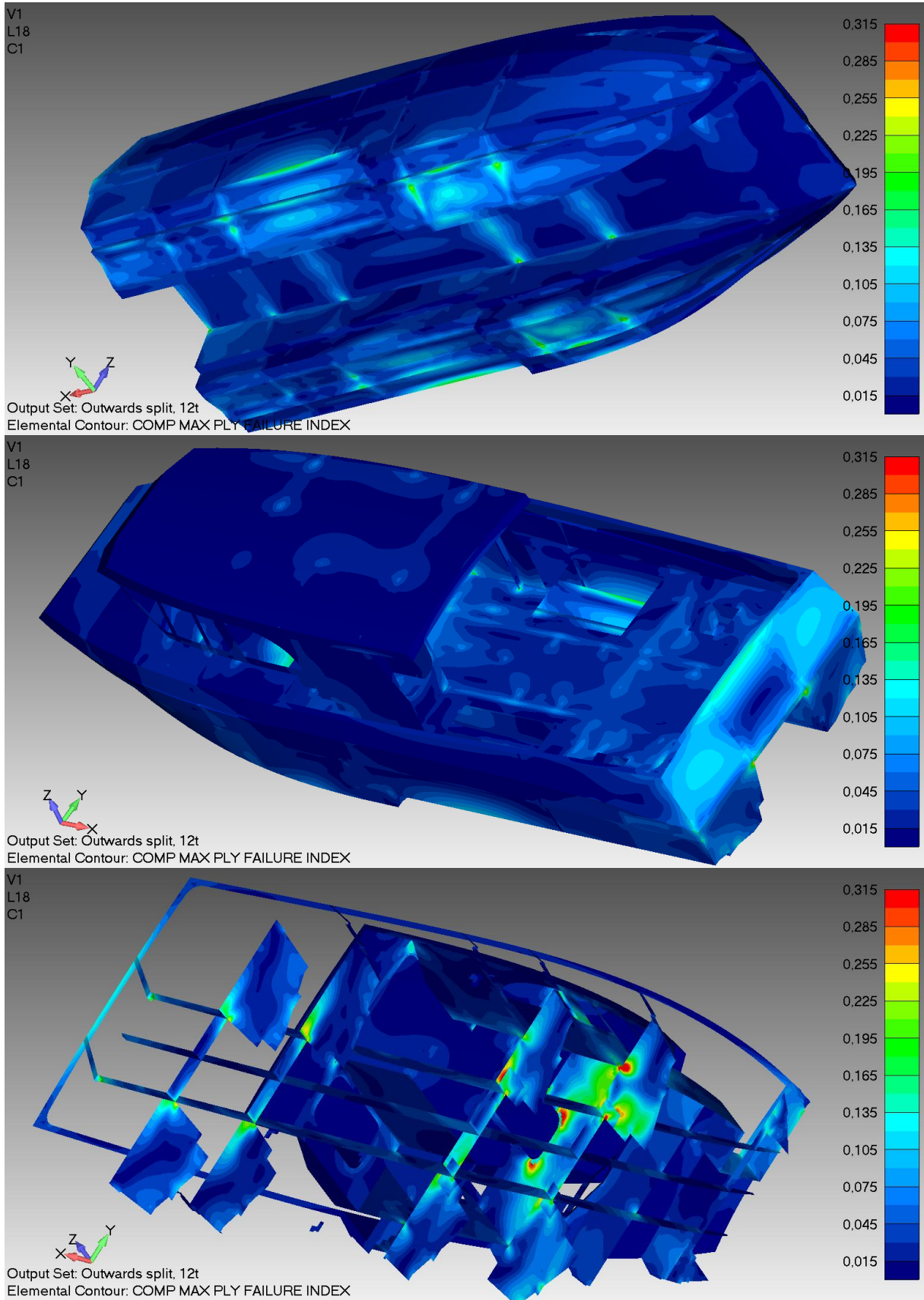


Figure 13. Max fibre failure index.

Inwards Split Moment

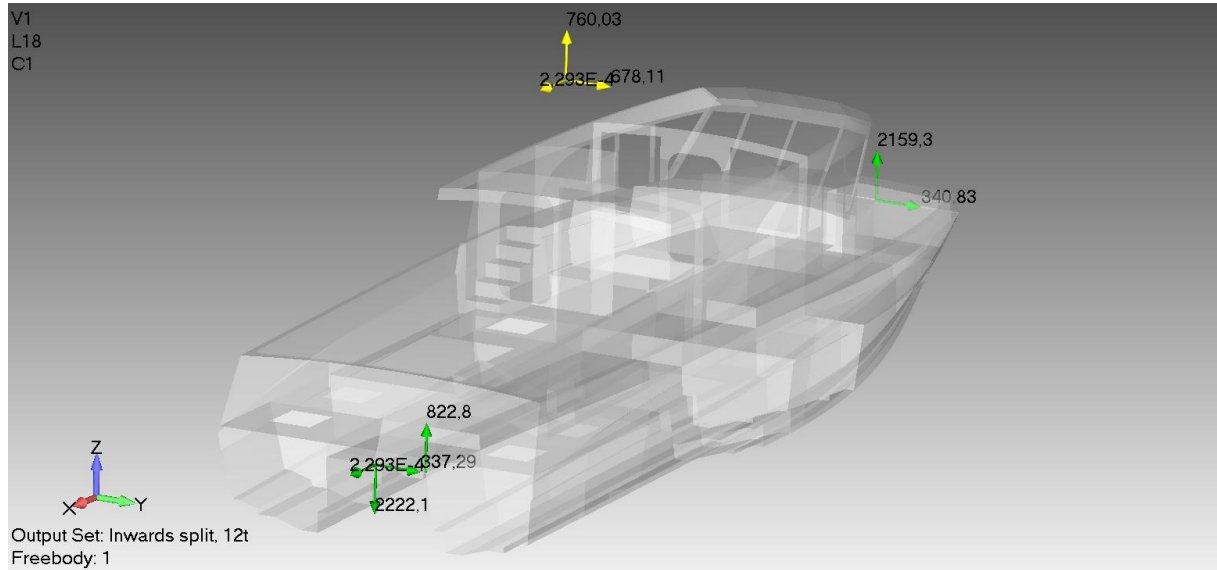


Figure 14. Inwards split, reaction forces.

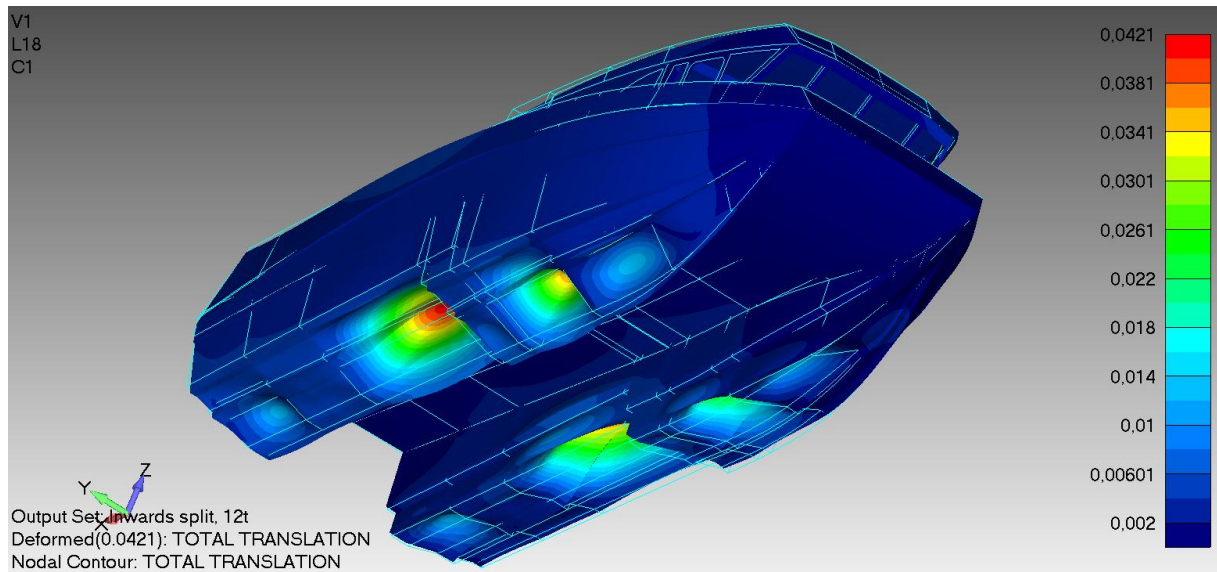


Figure 15. Deformed shape.

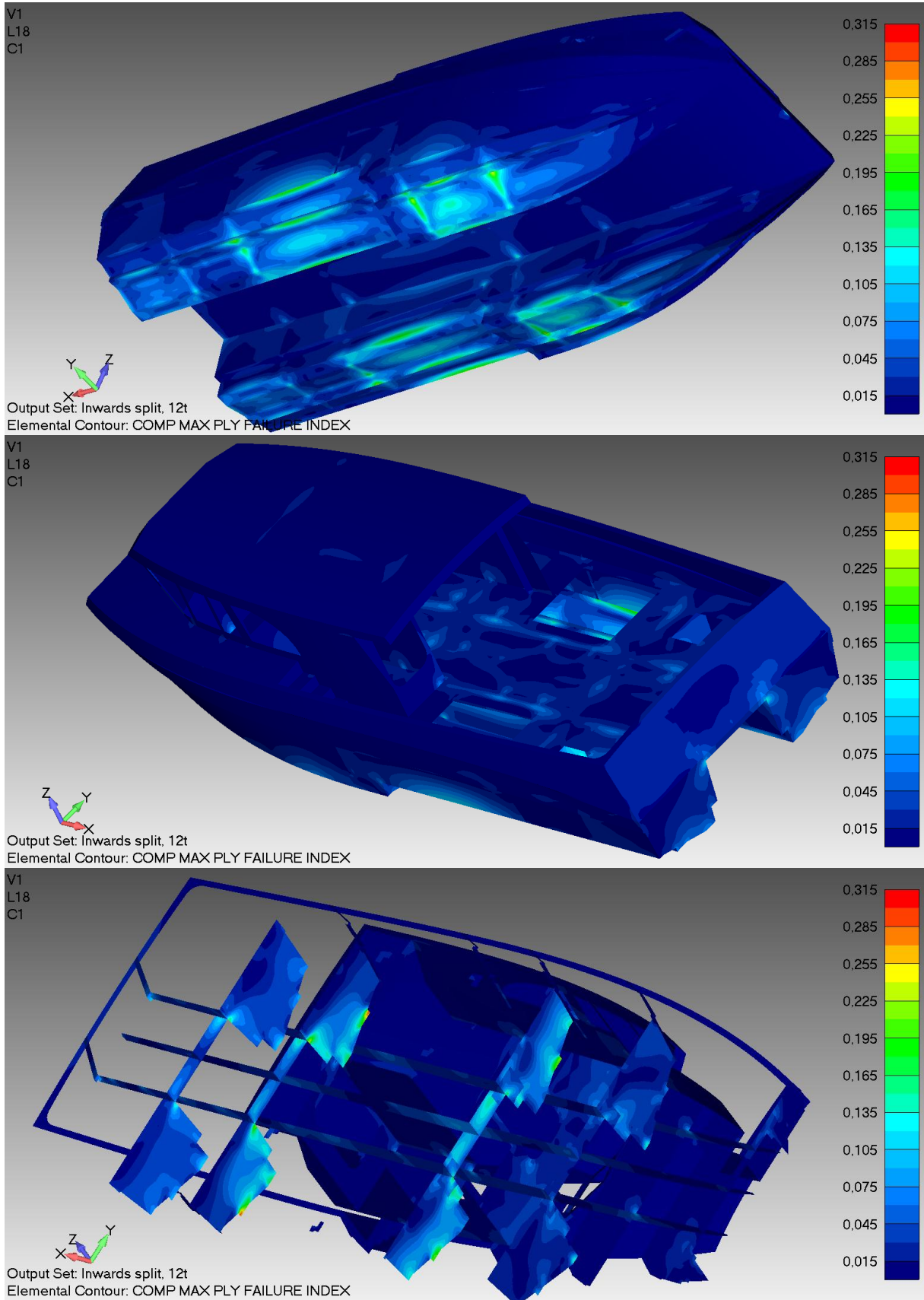


Figure 16. Max fibre failure index.

Pitch Connecting Moment

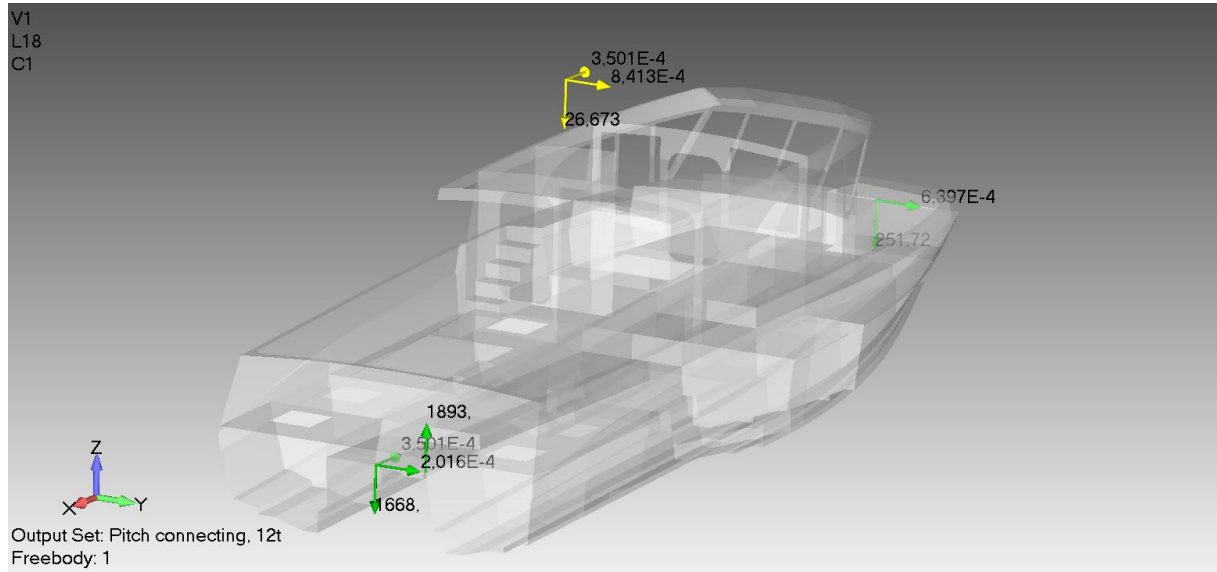


Figure 17. Pitch connection, reaction forces.

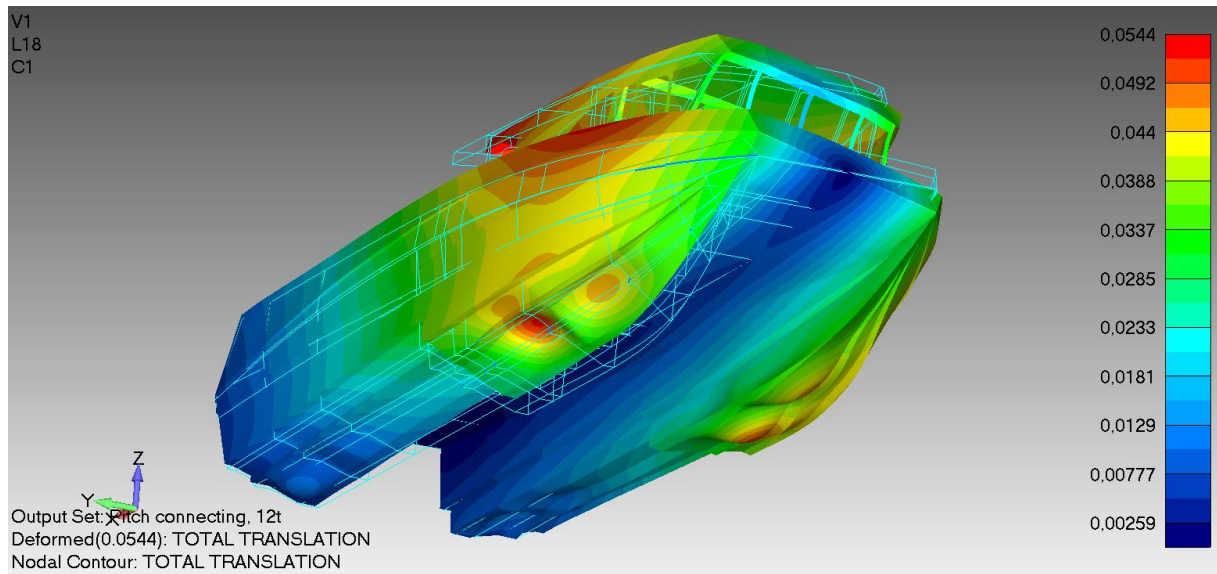


Figure 18. Deformed shape.

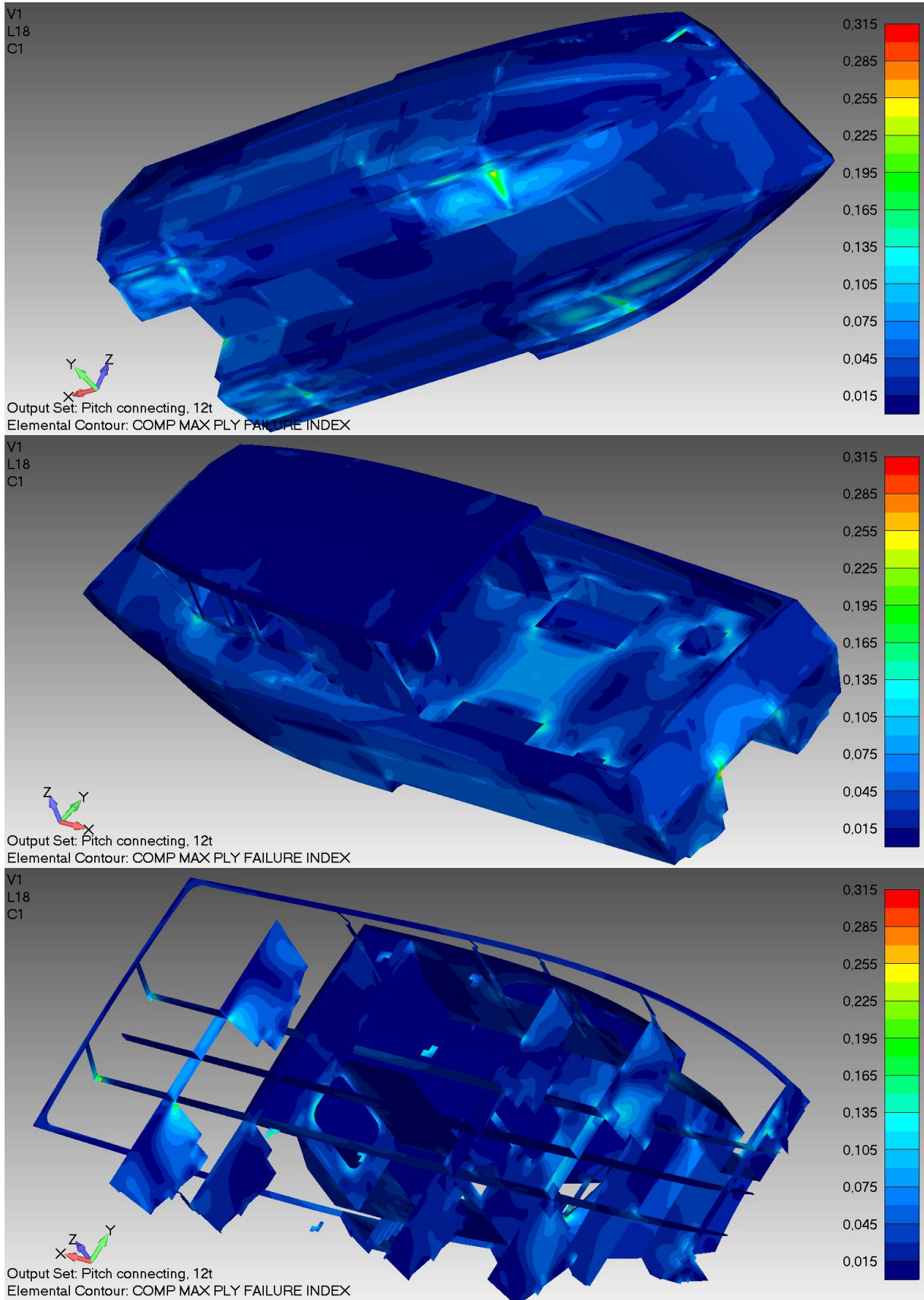


Figure 19. Max fibre failure index.

Torsional Moment

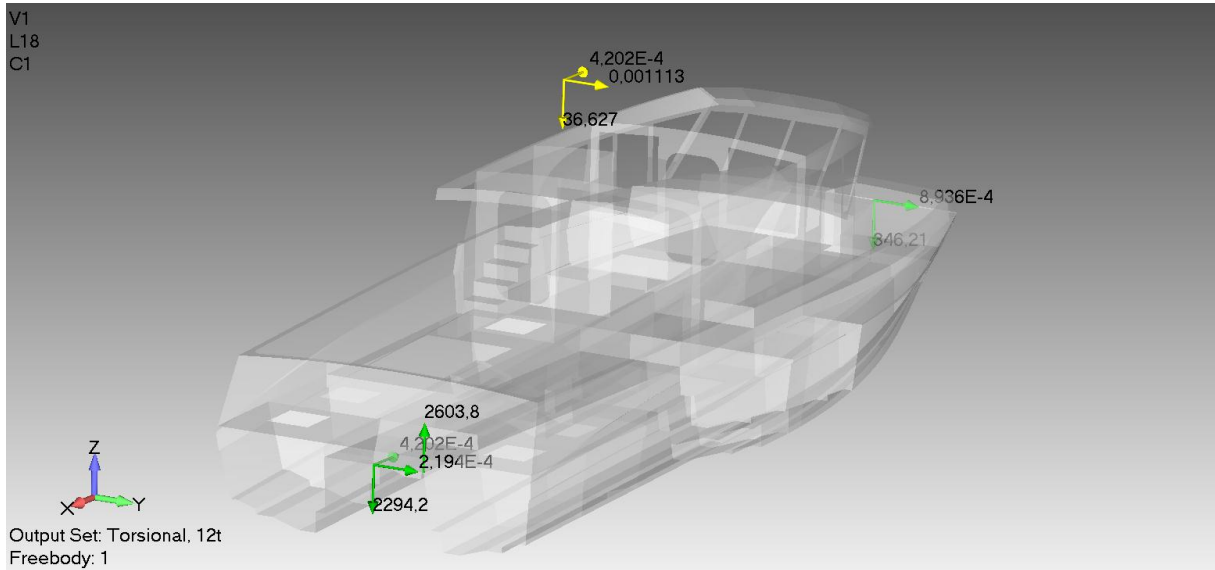


Figure 20. Torsion, reaction forces.

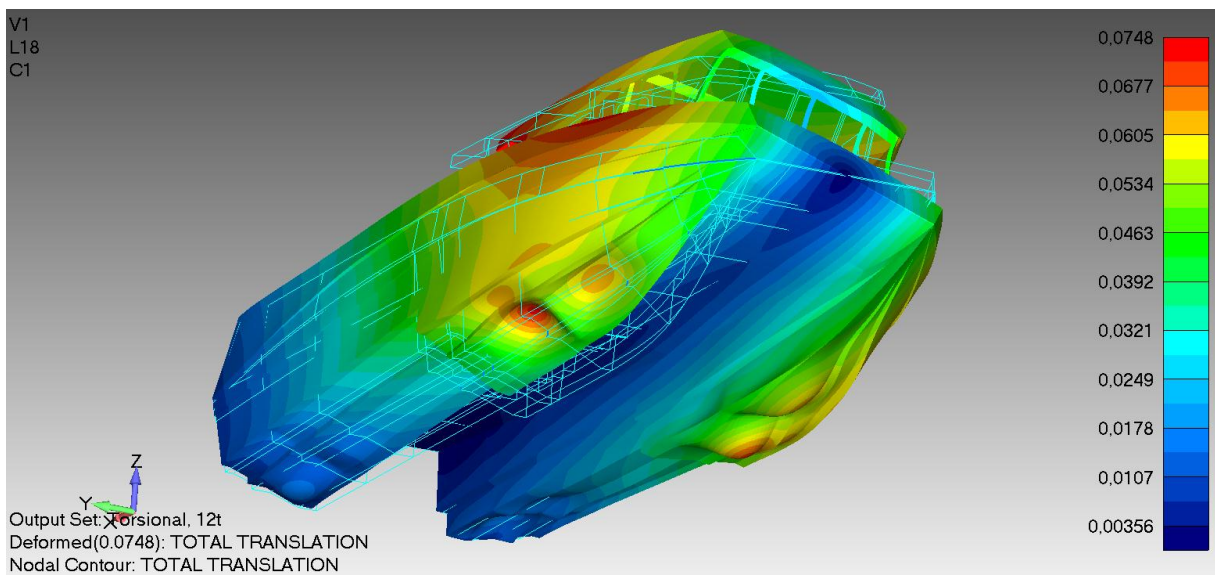


Figure 21. Deformed shape.

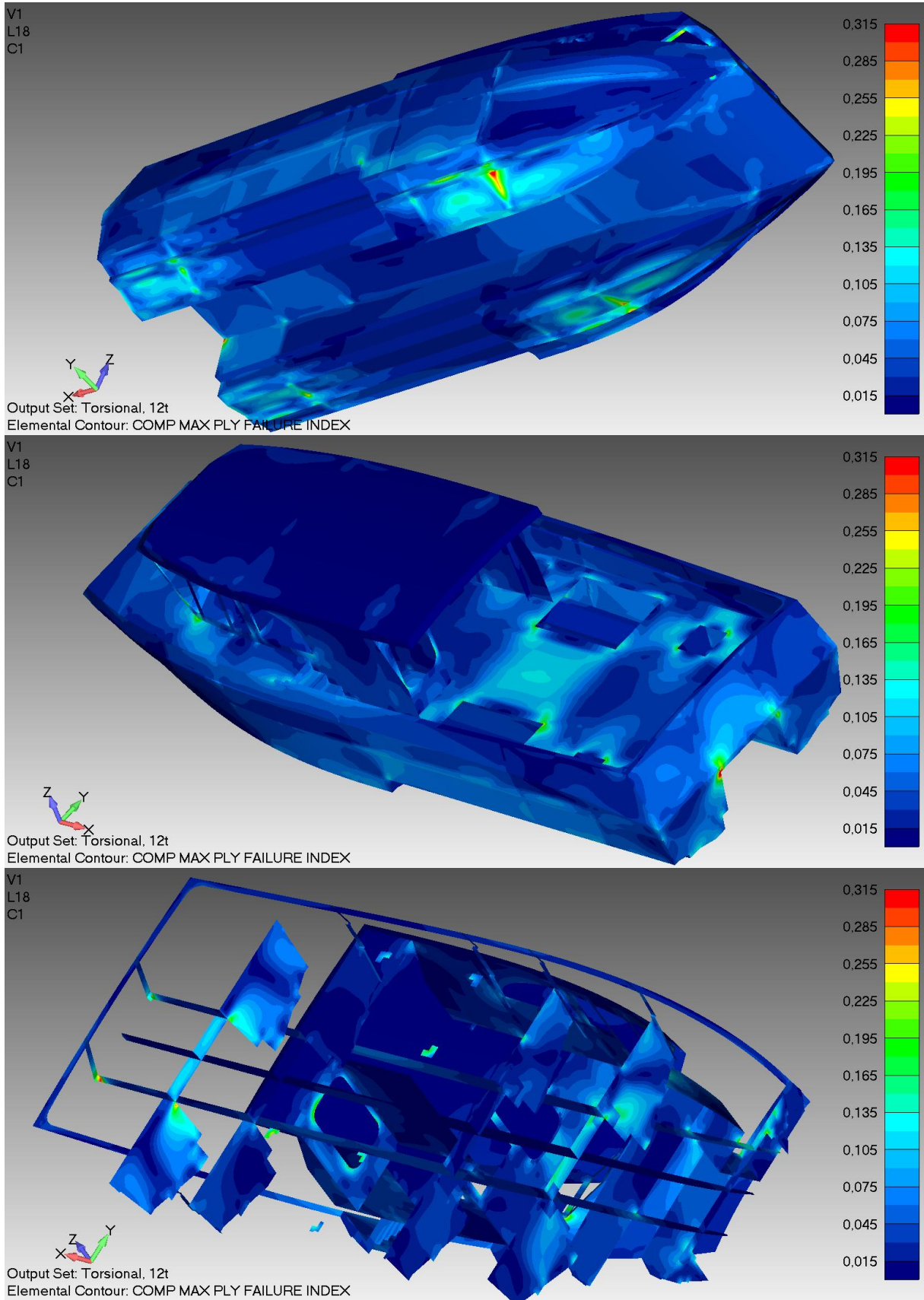


Figure 22. Max fibre failure index.

Fibre Failure Index - Combined All Load Cases

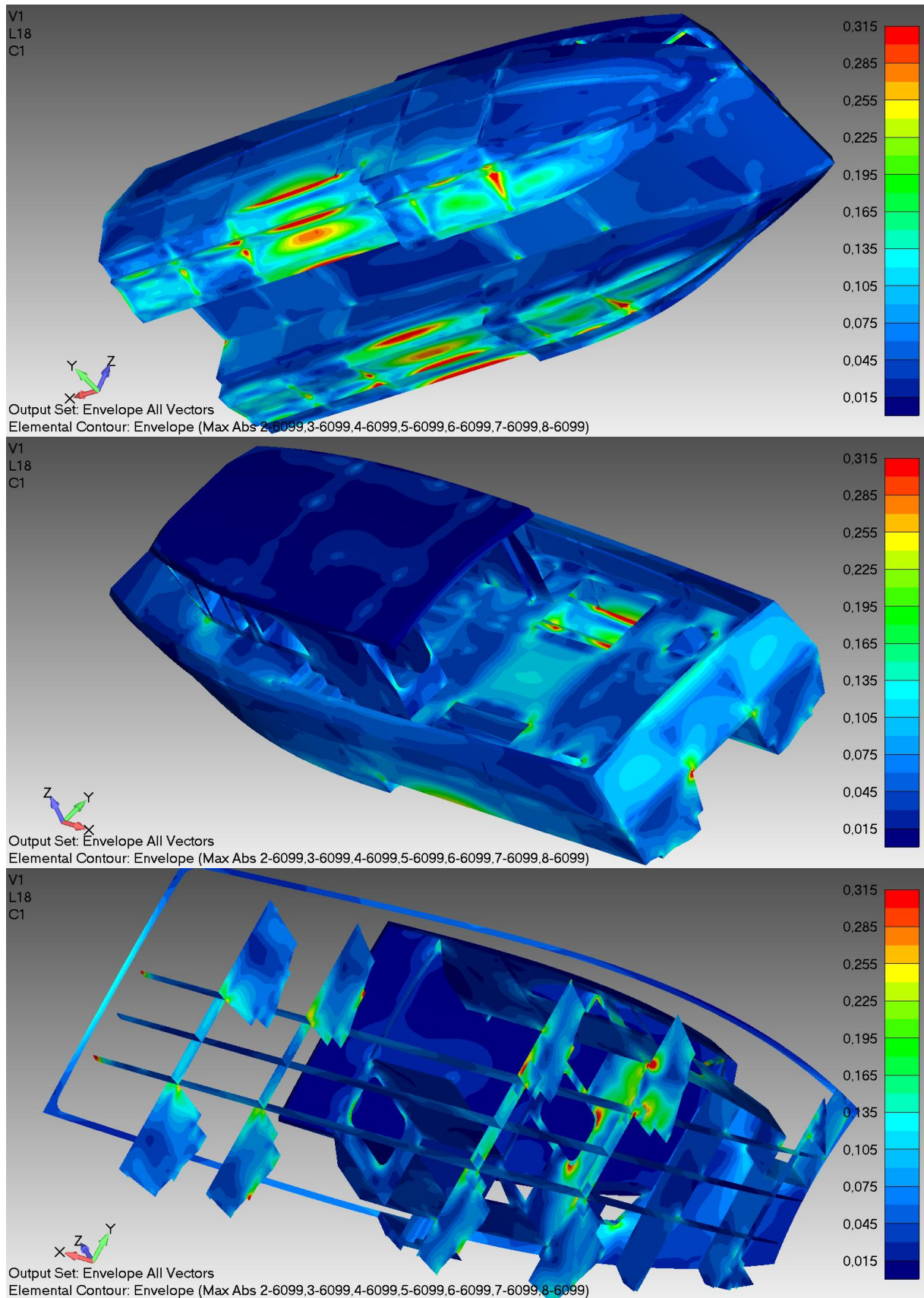


Figure 23. Max fibre failure index for all global load cases.

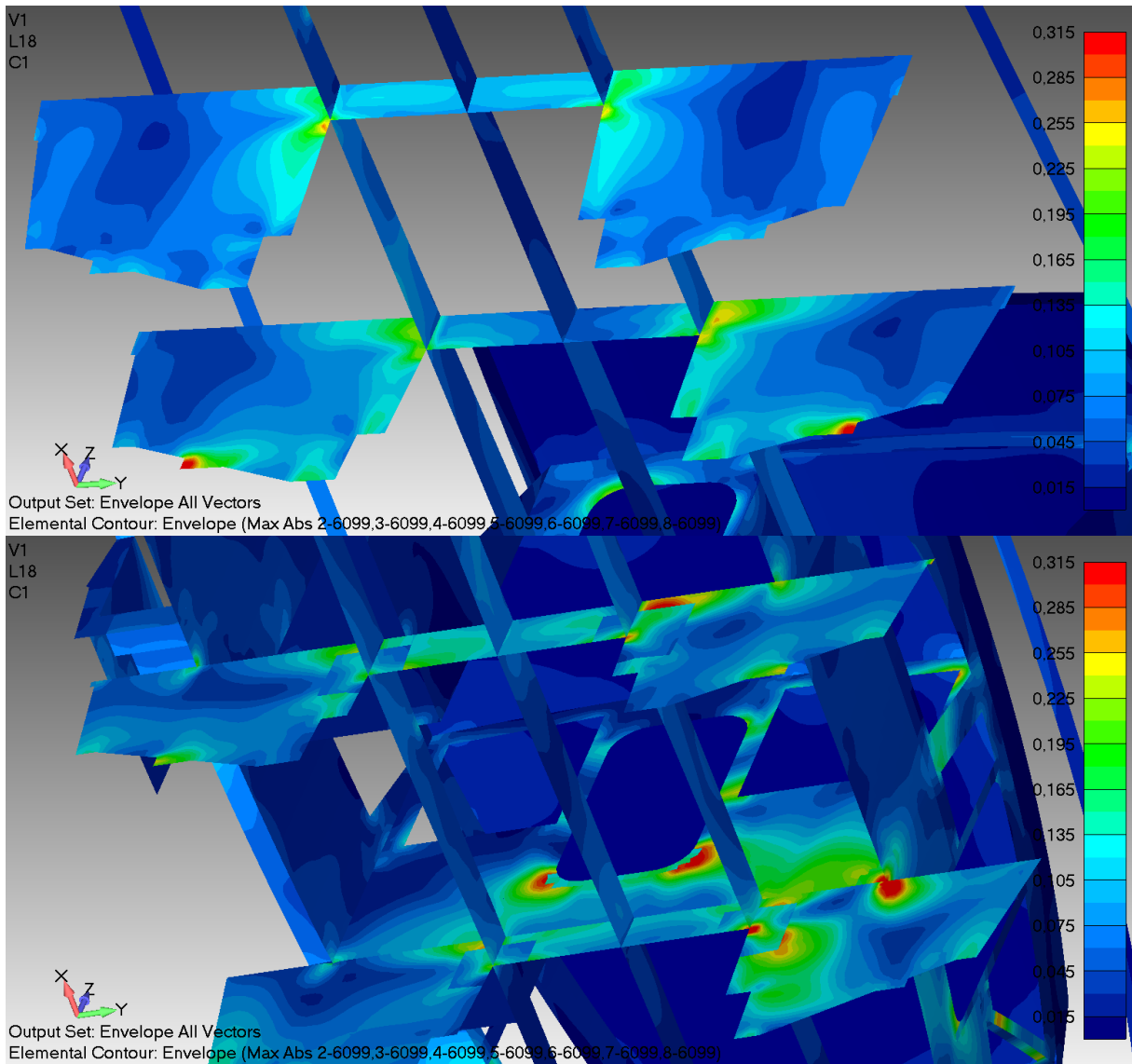


Figure 24. Detail of internal highest loaded areas.

Updated structure

Bulkheads #3 and #4 are updated according to the Figure 26.

It is recommended to taper the ends of the UD plies below the door, see “alternative 2” in the original scantling document (last figure). These should preferably run full thickness 150 mm past the doorway before tapered off. The UD tape to be minimum 100 mm wide and fibre direction across the door (global Y-axis).

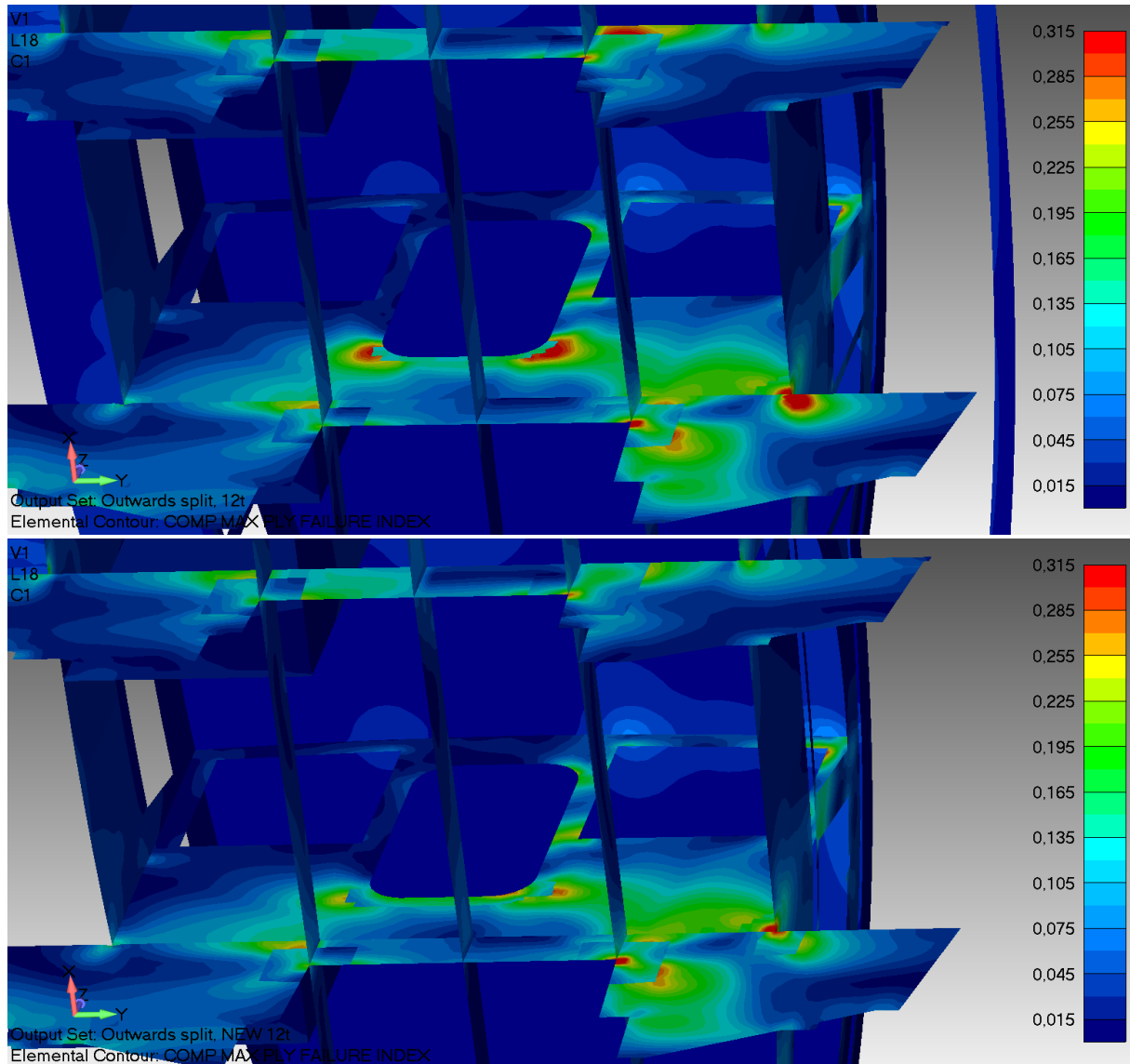


Figure 25. Fibre failure index for old structure (upper view) vs. updated reinforced patches (lower view). Both at 12 tonnes displacement.

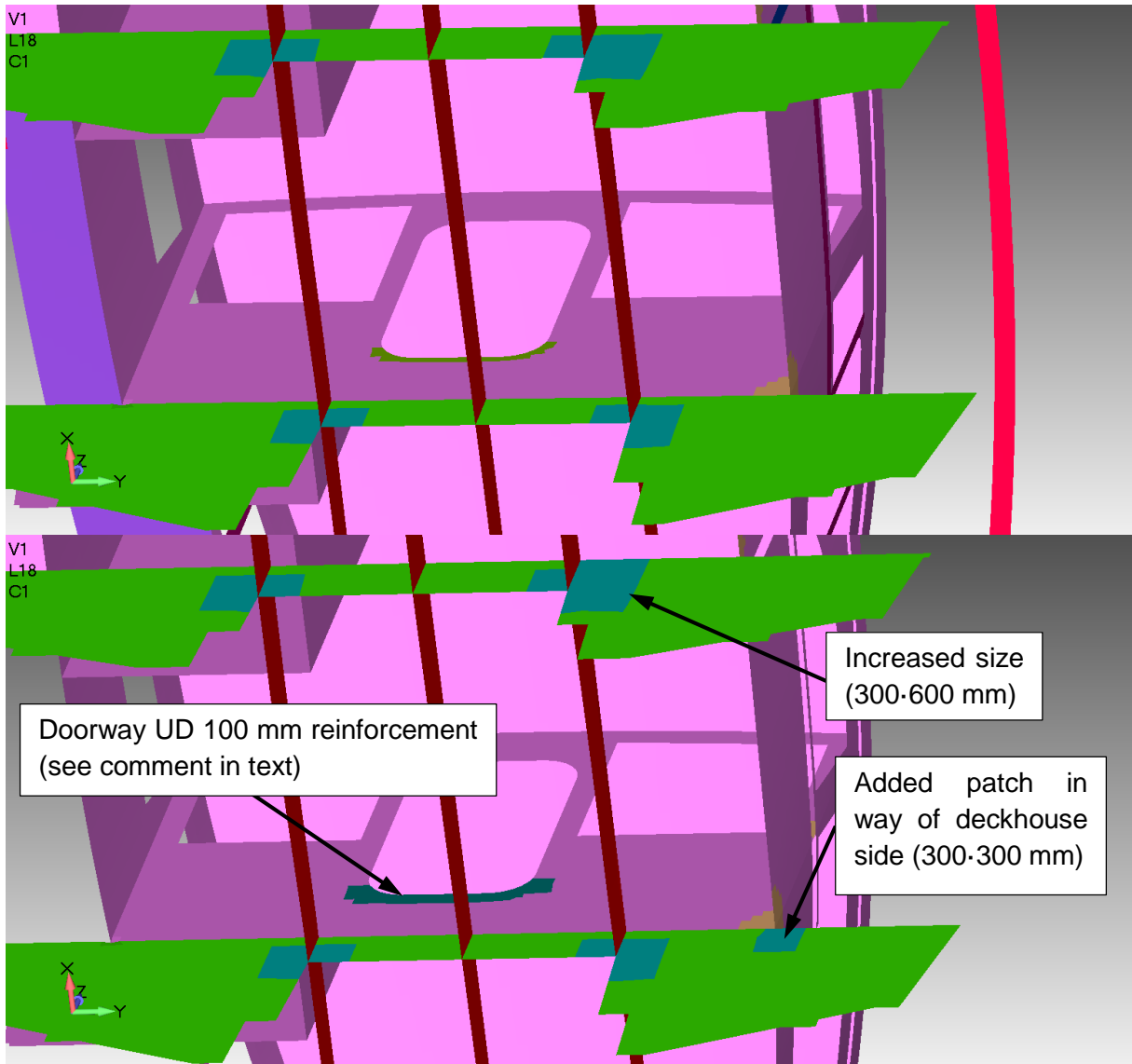


Figure 26. Updated bulkhead laminate reinforcement. Upper view shows old layup.

Colour code	Component	Layup sequence	Estimated thickness [mm]
	Doorway UD reinforcement	[CSM300 / UD2400, 100mm / DBLT800 / CSM300 / H60, 20 mm / CSM300 / DBLT800 / UD2400, 100mm / CSM300]	24.0

Table 1. UD reinforcement layup below doorway.

Summary of Results

The bottom structure is mostly affected by the crest landing load. The supporting area is located aft of the step and with a high span the bottom plating is now on the limit. However the engine girders would effectively lower the utilisation and therefore the structure should have reserve capacity with respect to this. In addition the load supporting area is likely larger, which is not accounted for in this update.

The spray rails are highly stressed, as already indicated in the 10t calculation, however still considered non-critical since they are filled and reinforced compared to the FE model. The same reasoning is made where the bulkheads attach to the hull, these locations are in reality less aggressive with over-laminated radii.

The internal structure is highest stressed from the outwards split moment, where the bulkheads directly below the deckhouse are above allowable at some locations, see detailed view in Figure 24.

Conclusion and Update Recommendations

No further reinforcement of the bottom is needed, with the engine girder installed it is considered that the structure is sound.

The bulkheads below the deckhouse (3:rd and 4:th from transom) need to be reinforced in addition to what is shown in the original 10 tonne scantling document, see Figure 26.