RAMSSES - Realisation and Demonstration of Advanced Material Solutions for Sustainable and Efficient Ships

E-LASS SEMINAR

Cutting down the structural weight for planing and semi-planing workboats.

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MEC MARINE ENGINEERING

Baltic Workboats shipyard

RAMSSES

Introduction

- Our WP focuses on the deckhouses of workboats (length range 15-45 m)
- **OBJECTIVE: Reduction of the assembly time** for panels for the superstructure and deckhouses of aluminum crafts by implementing light weight structures

AIMS

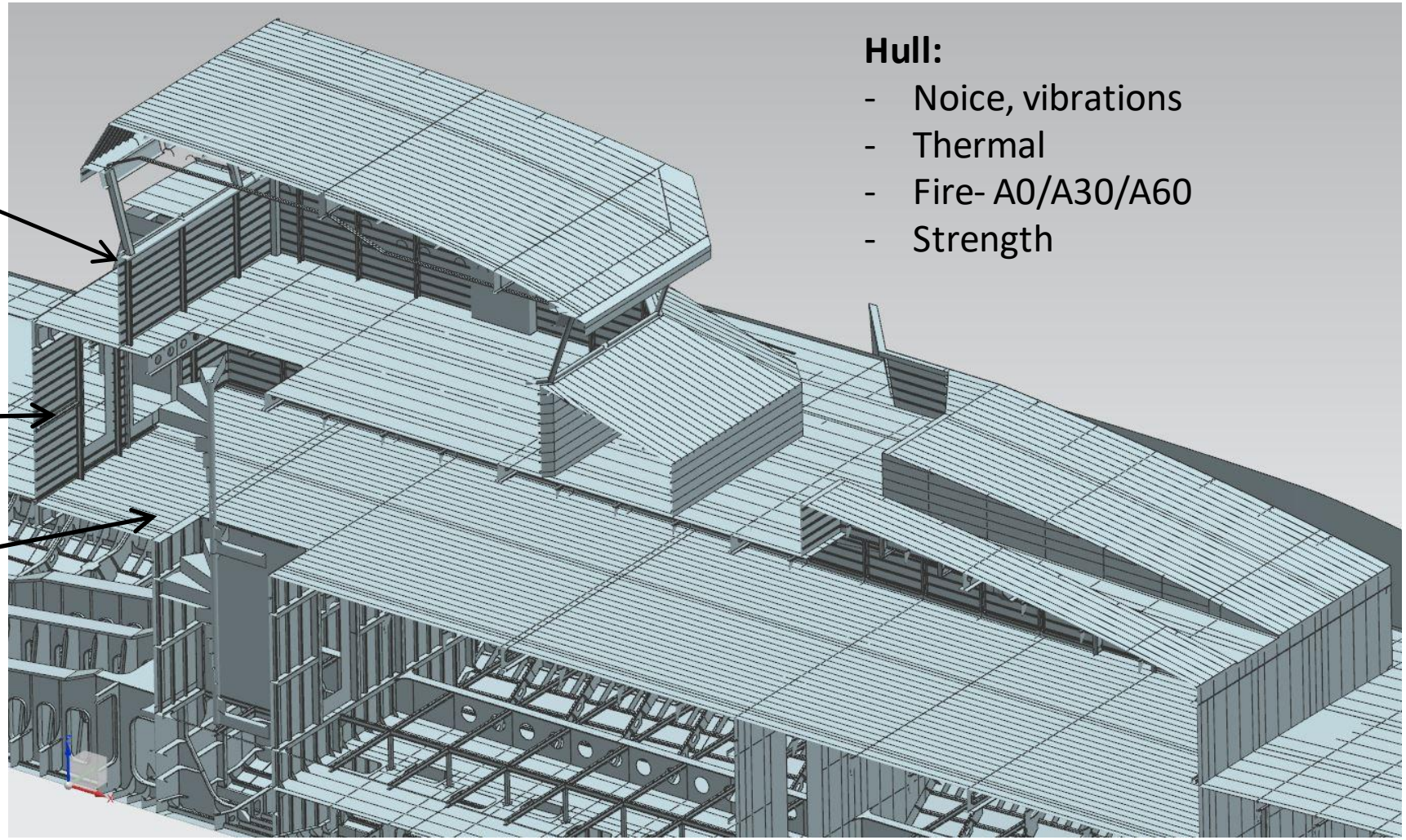
- Reduce the weight (and COG) of the deckhouse up to 20%
- Decrease the time for assembly and insulation
- Reduce the deckhouse deformations during assembly

REQUIREMENTS

Bridge:
- Noice, vibrations
- Thermal
- Fire- A0/NO
- Strength

Lower deckhouse:
- Noice, Vibrations
- Thermal
- Fire- A0/A30/A60
- Strength

Deck:
- Noice, Vibrations
- Thermal
- Fire- A0/A30/A60
- Strength



Hull:
- Noice, vibrations
- Thermal
- Fire- A0/A30/A60
- Strength

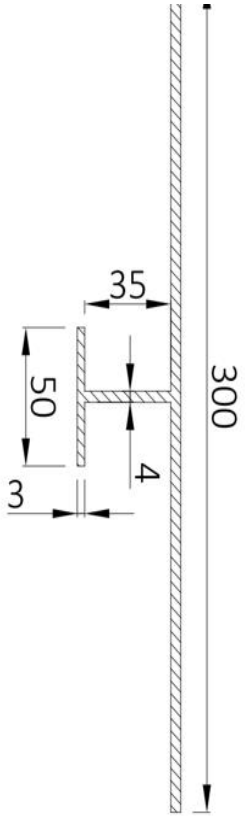
CURRENT SOLUTION

- Current solution is based on single skin extruded aluminum panels
- Insulation of the panels is time consuming
- Welding of the panels results in weld distortions

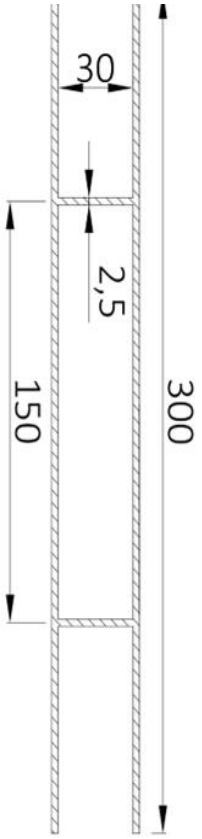
PANEL SOLUTIONS STUDIED

CURRENT SOLUTION

SINGLE SKIN AL PANEL

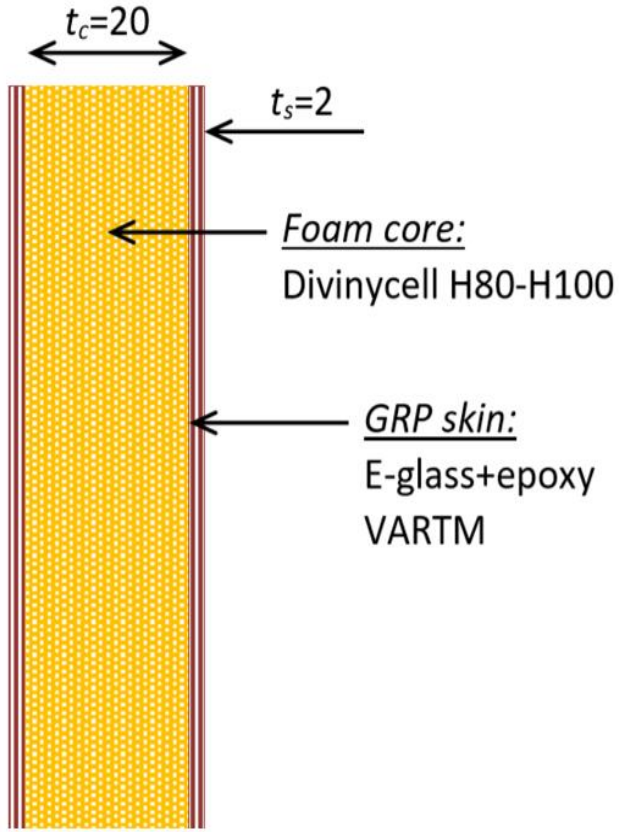


AL SANDWICH PANEL



NEW SOLUTIONS

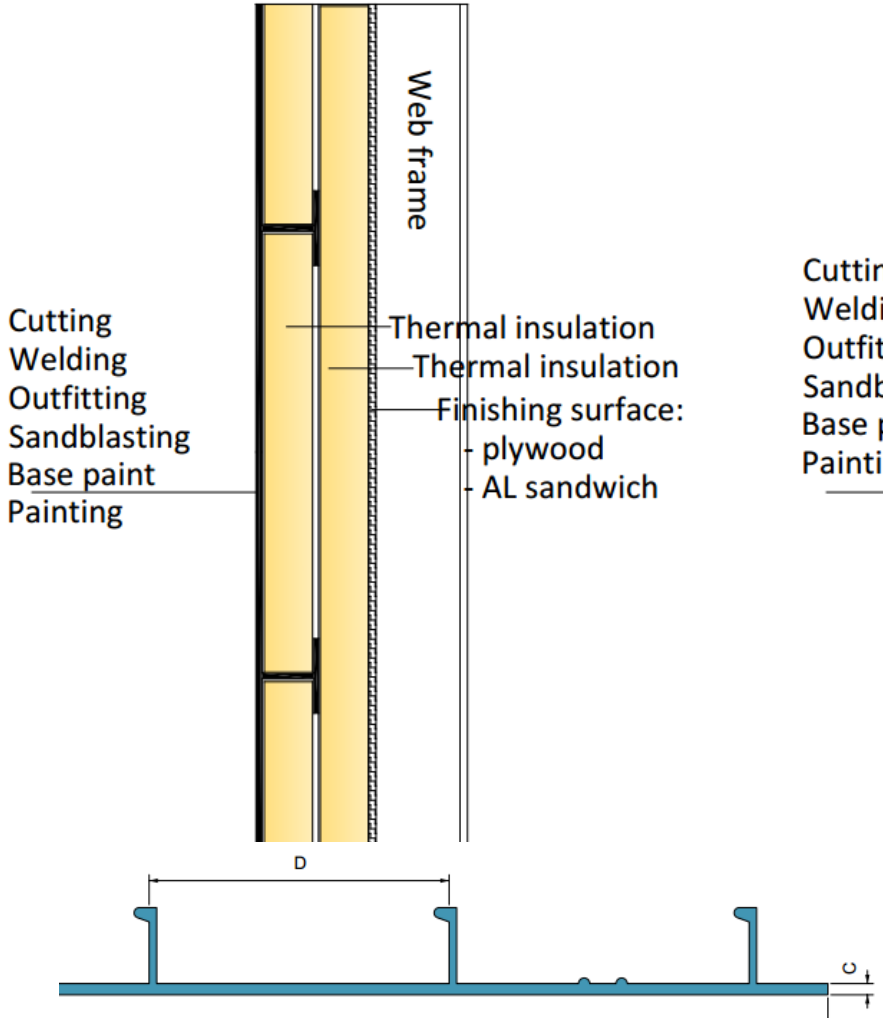
CONV. COMPOSITE PANEL

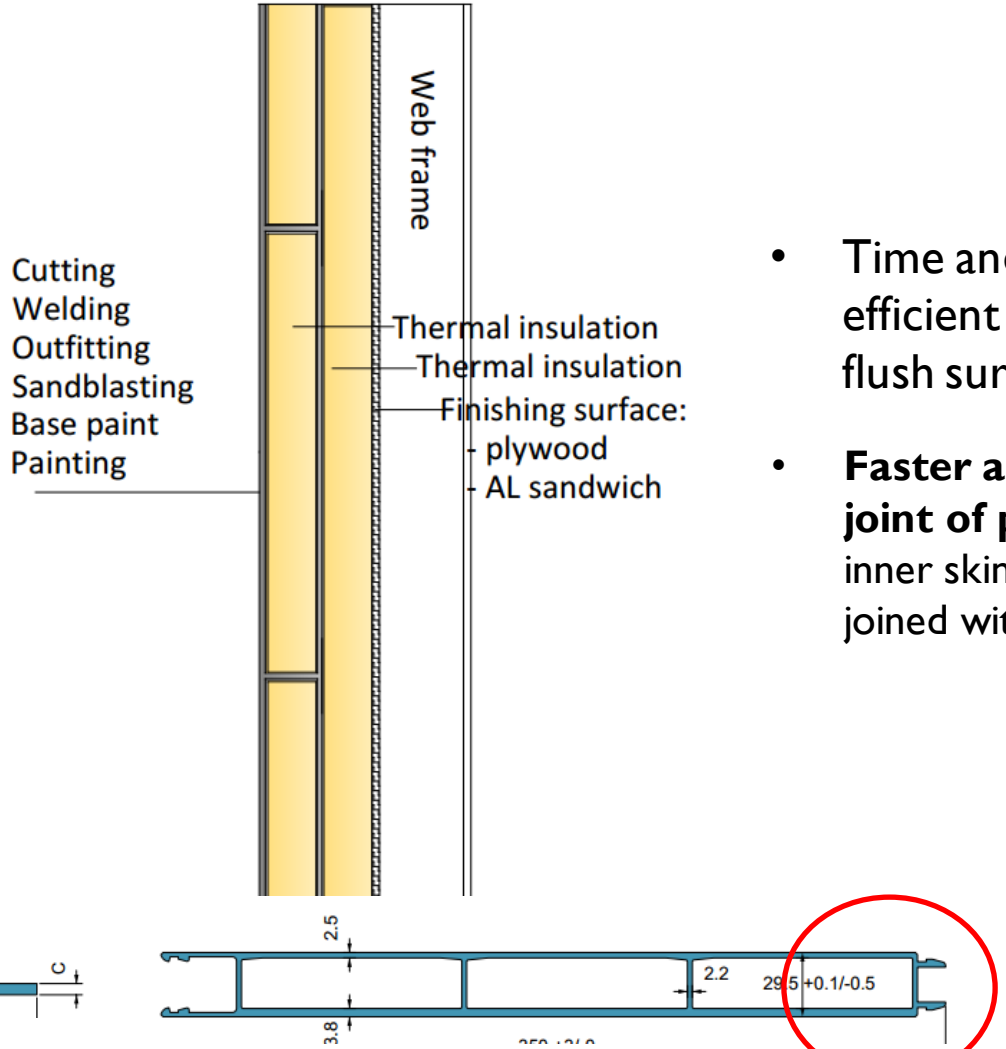


FIRE RESISTANT COMPOSITE PANEL

SOLUTION BASED ON ALUMINIUM SANDWICH PANELS

CONCEPT SOLUTION BASED ON AL SANDWICH PANELS

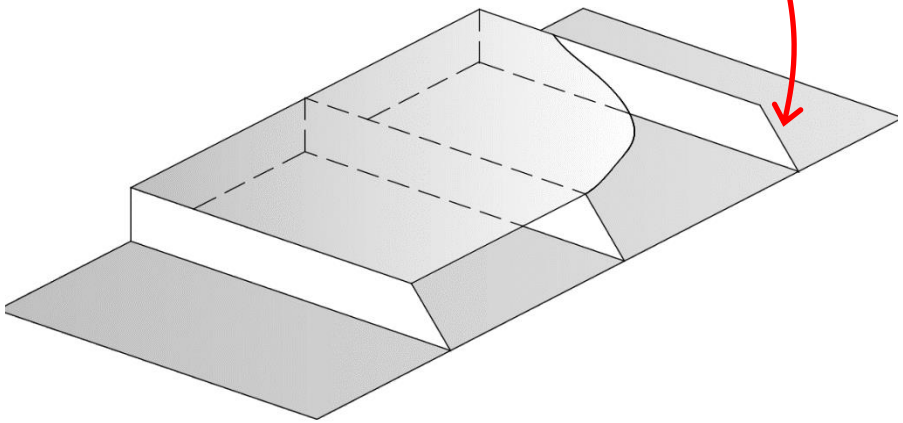




- Time and space saving from more efficient installation of insulation as flush surface is to be insulated
- **Faster assembly: mechanical „Clip“-joint of panels:** a solution, where only inner skin is welded and the outer skin is joined with a clip joint

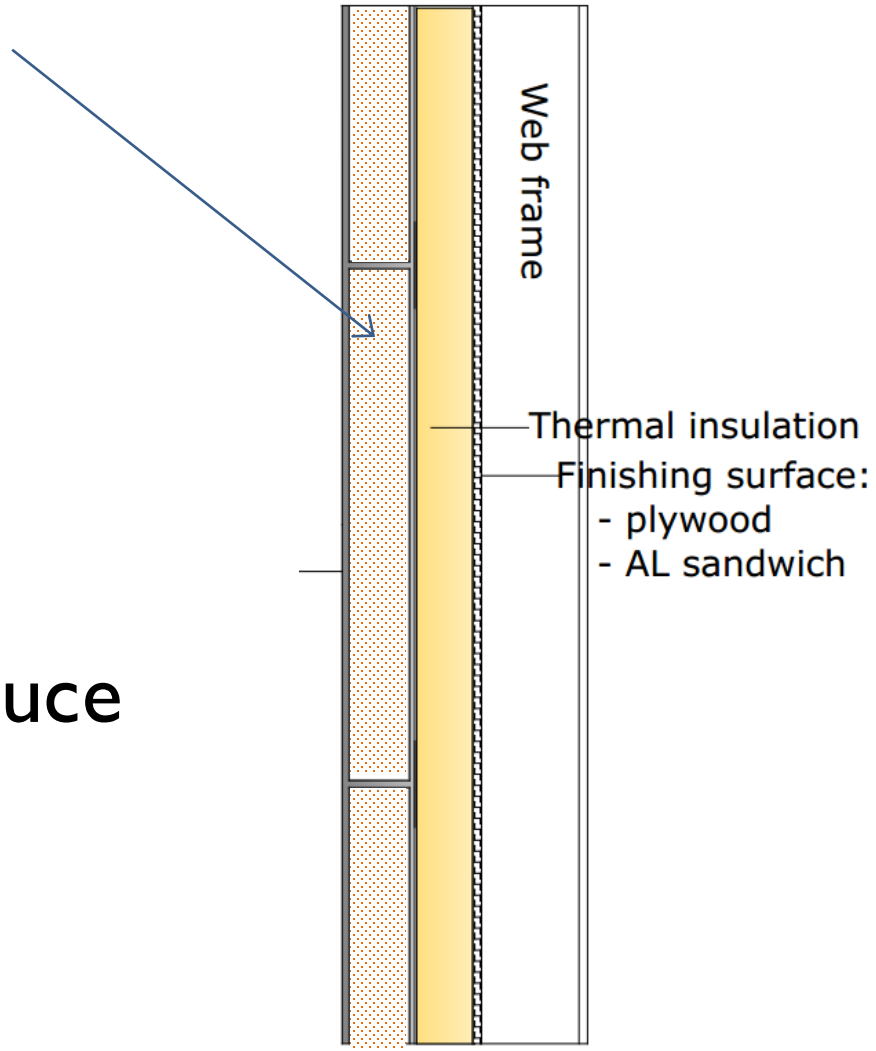
AL SANDWICH: PRACTICAL ISSUES

- Cutting of the panels, preparation of corner connections etc.
  - *New procedure for the yard*
- Cutting under oblique angle might be an issue
- Friction stir welding capacity is required for full benefit



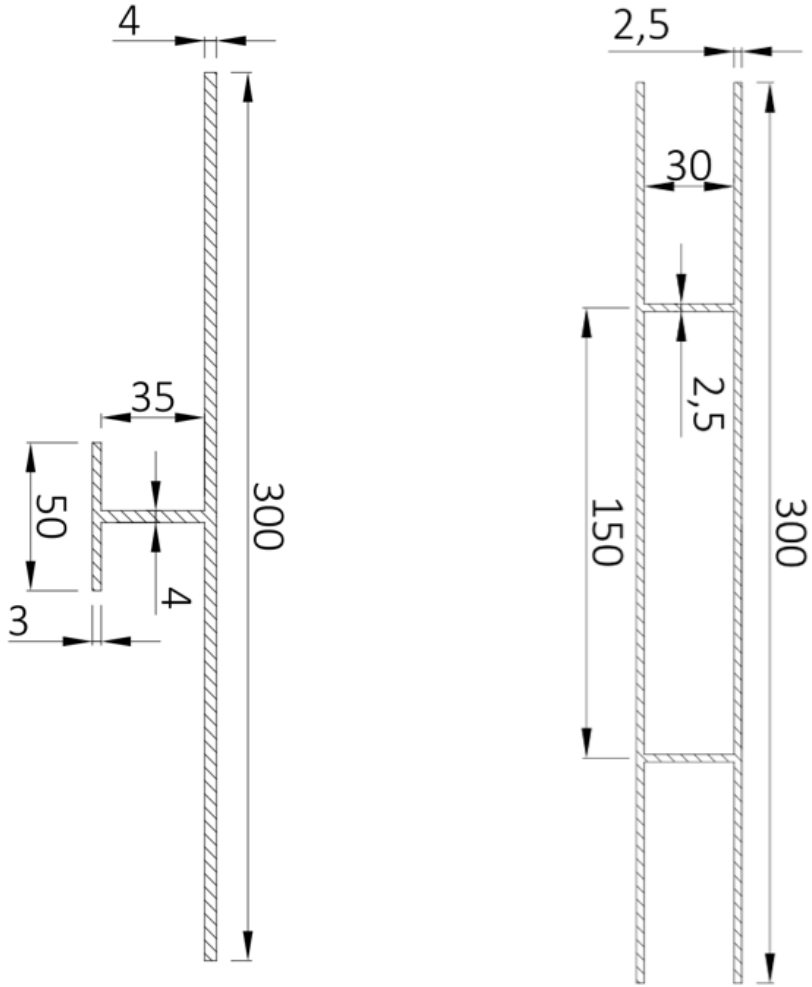
AL SANDWICH: CRITICAL POINTS

- Insulation of enclosed compartments
  - *Assuring airtightness*
  - *Condensed water/corrosion*
  - *Noise and vibration damping*
- Core should be filled with (preferably) non-combustible insulation
  - *Welding and cutting of the filled panels*
- Filling is problematic and would introduce availability issues

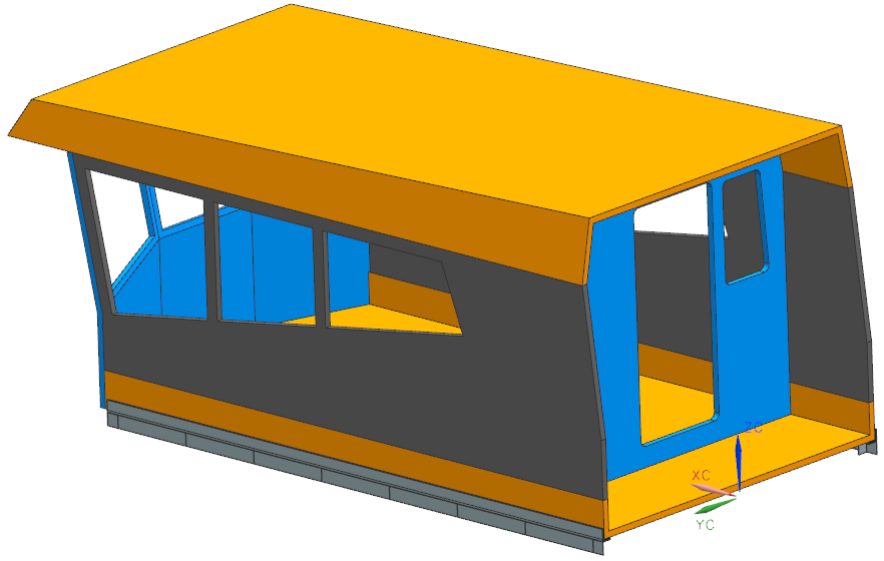


AL SANDWICH: MAIN CONLUSIONS

- In that ship length range the deckhouse is typically made of 4 mm extruded AL panels
  - To be weight competitive, this requires very small thicknesses for the double skins (max 2 mm)
  - Local strength might become an issue (core filling could support the thin plates)
- Weight saving is hard to achieve with this plating thickness

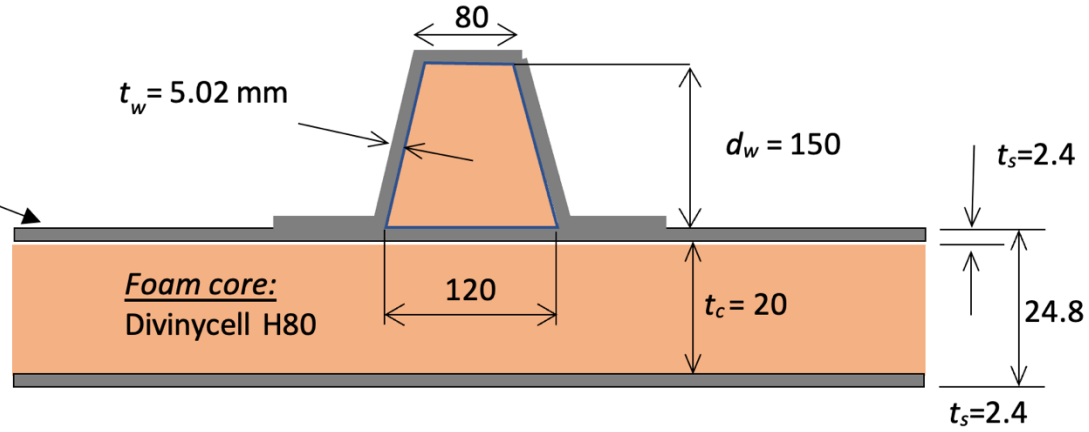


SOLUTION BASED ON CONVENTIONAL SANDWICH PANELS

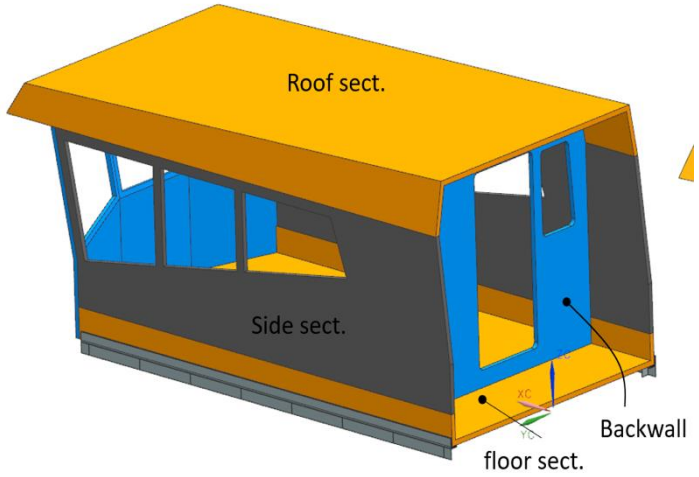


GRP skin:

Glass + polyester woven rowing (WR) layers+ one layer of chopped strand mat (CSM) on either side of the panel core.



MODULAR COMPOSITE DECKHOUSE USING CONV. SANDWICH PANELS



Section	Design load, kN/m2	Fire class	Panel thickness, mm	Weight reduction, %
Roof sect.	28	A0	50	25
Side sect.	28	A0	50	20
Front sect.	28	A0	50	20
Backwall sect.	28	A0	50	20
Floor sect.	28	A60	50	20

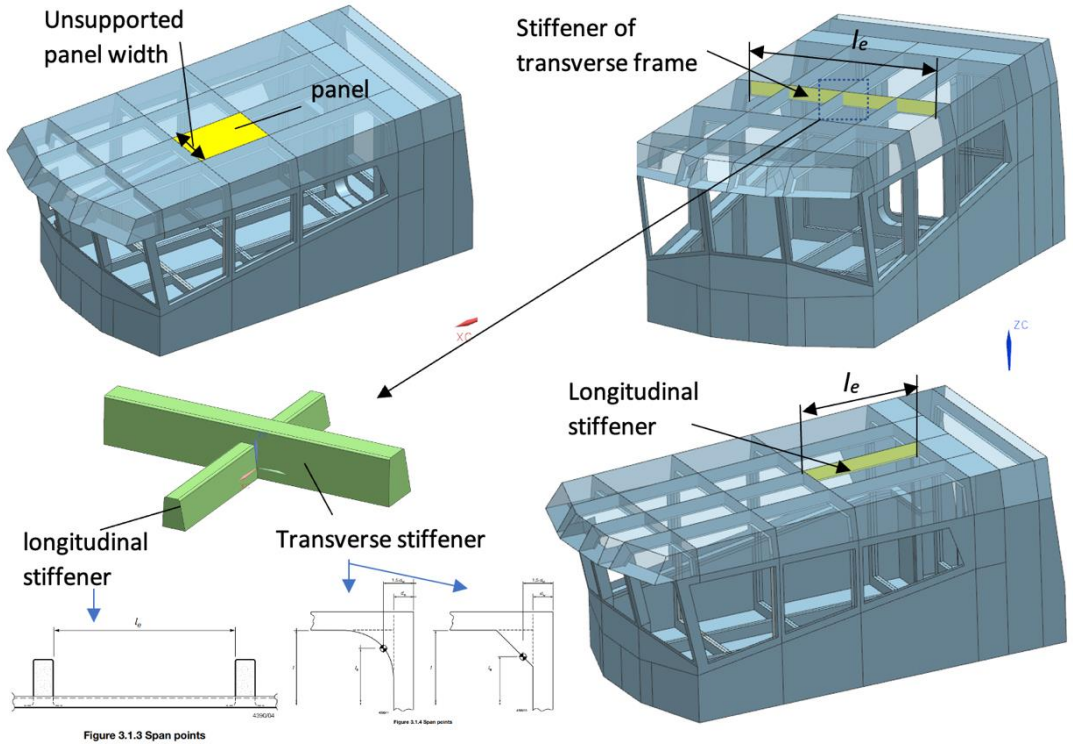
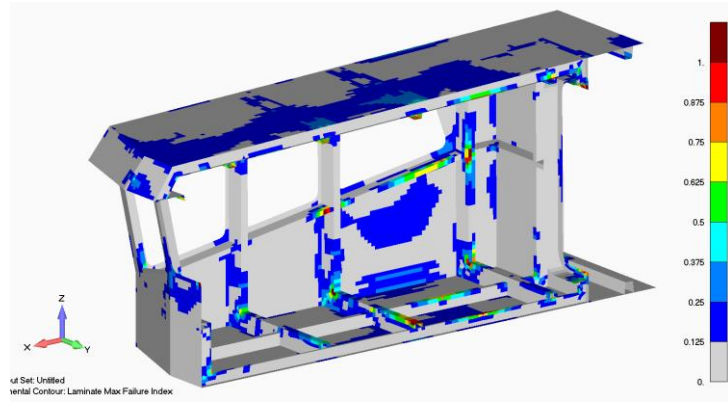
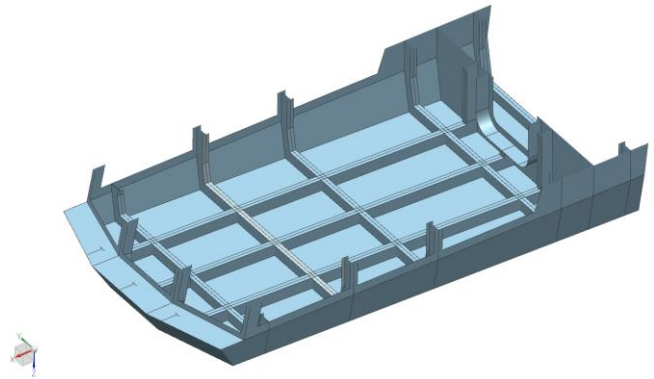


Figure 3.1.3 Span points

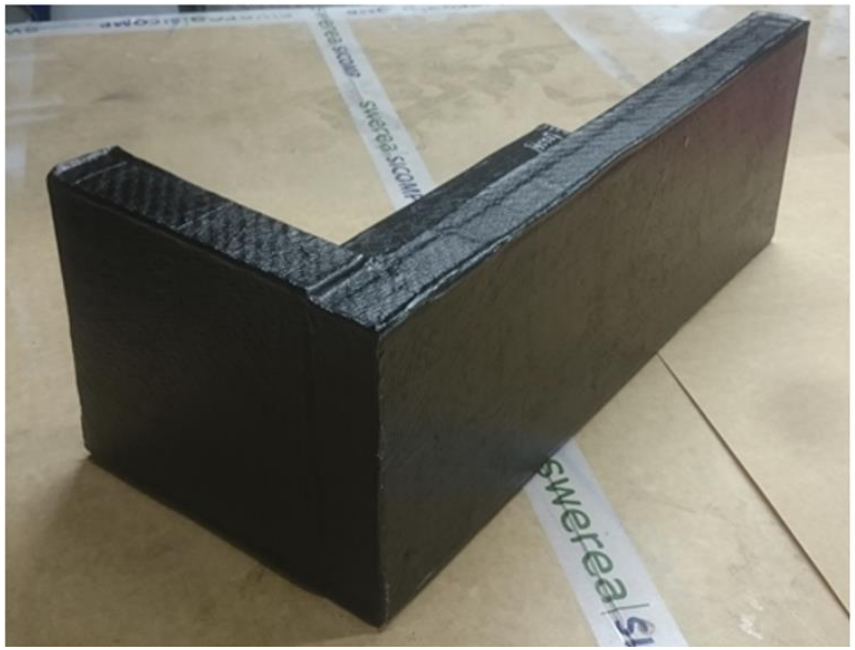


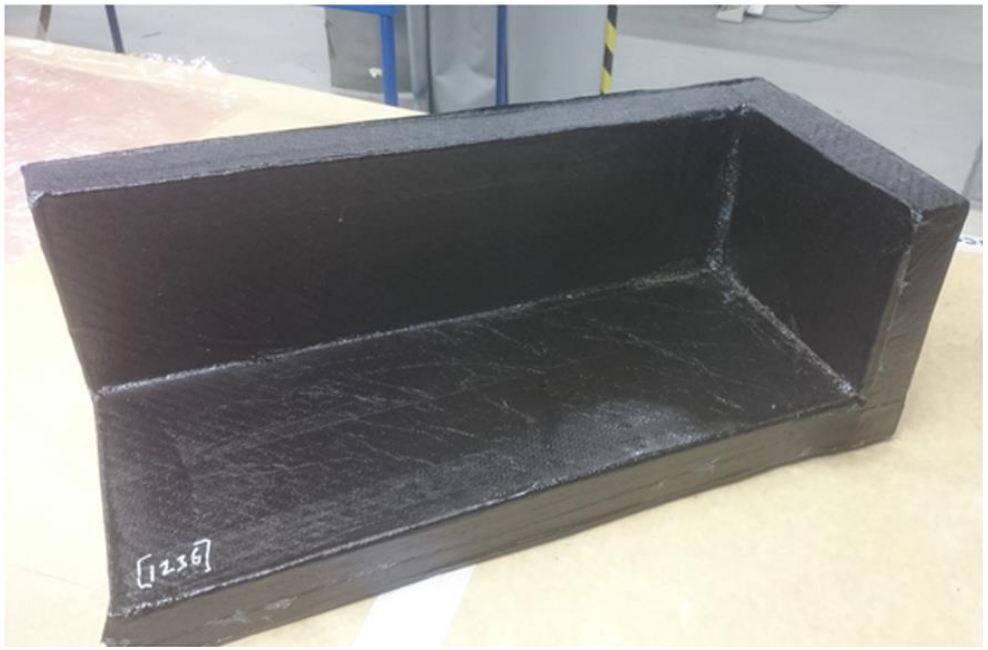


CON. SANDWICH: MAIN CONLUSIONS

- Offers weight saving and flush final surface
- New production technology for the AL shipyard vs outsourcing
- Separate production hall and logistics
- Changes to the design procedures

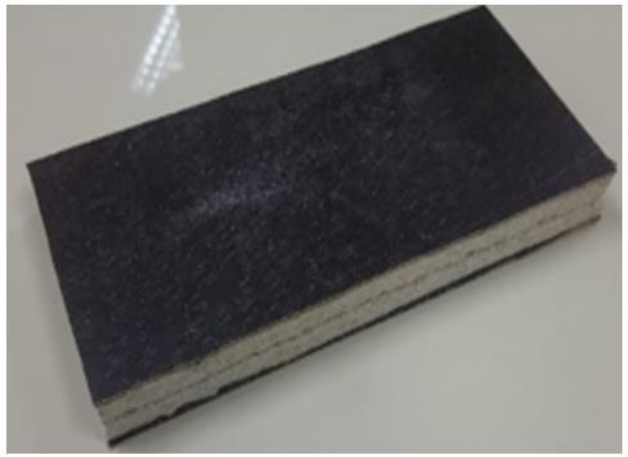
SOLUTION BASED ON FIRE RESISTANT SANDWICH PANELS

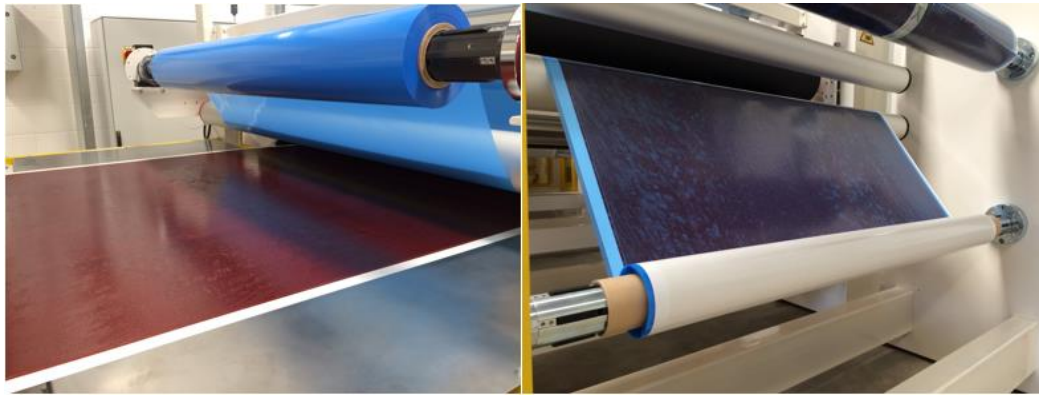




Courtesy to PodComp

FIRE RESISTANT SANDWICH PANEL





- PFA/Glass prepreg facing: from 1.5 to 3 mm thick
- Core thickness available: 10, 20 and 40mm
- Area weight range: from 8.6 to 23 kg/m^2

FIRE RESISTANT SANDWICH PANEL: DEVELOPERS

PODCOMP: WP leader, product design & demo producer, evaluation

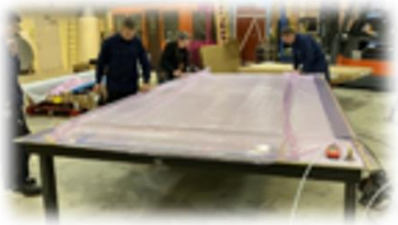
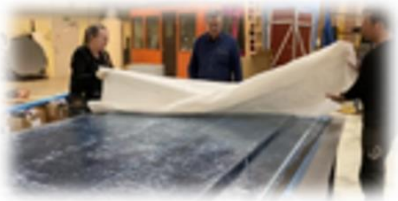
RISE SICOMP: pre-trials, material selection and tuning of production process, acoustic design and testing

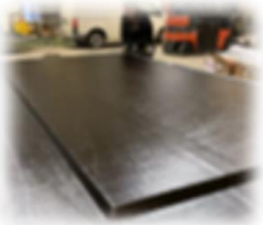
BALance: concept development, business scenario

Coventive Composites / Composites Evolution: developing and producing PFA prepregs

CETENA: acoustic design and testing



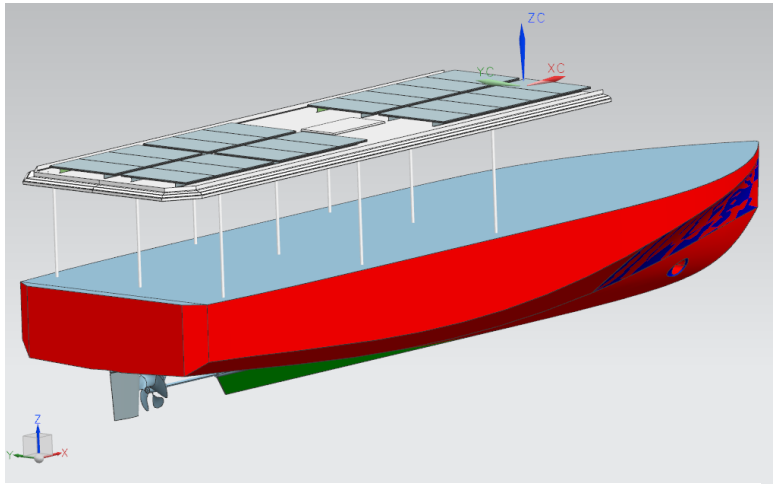



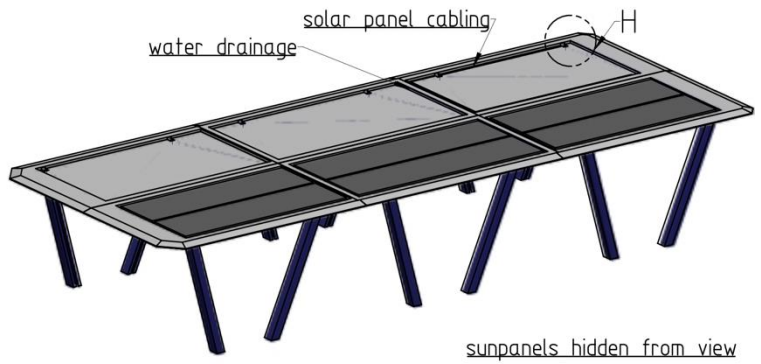


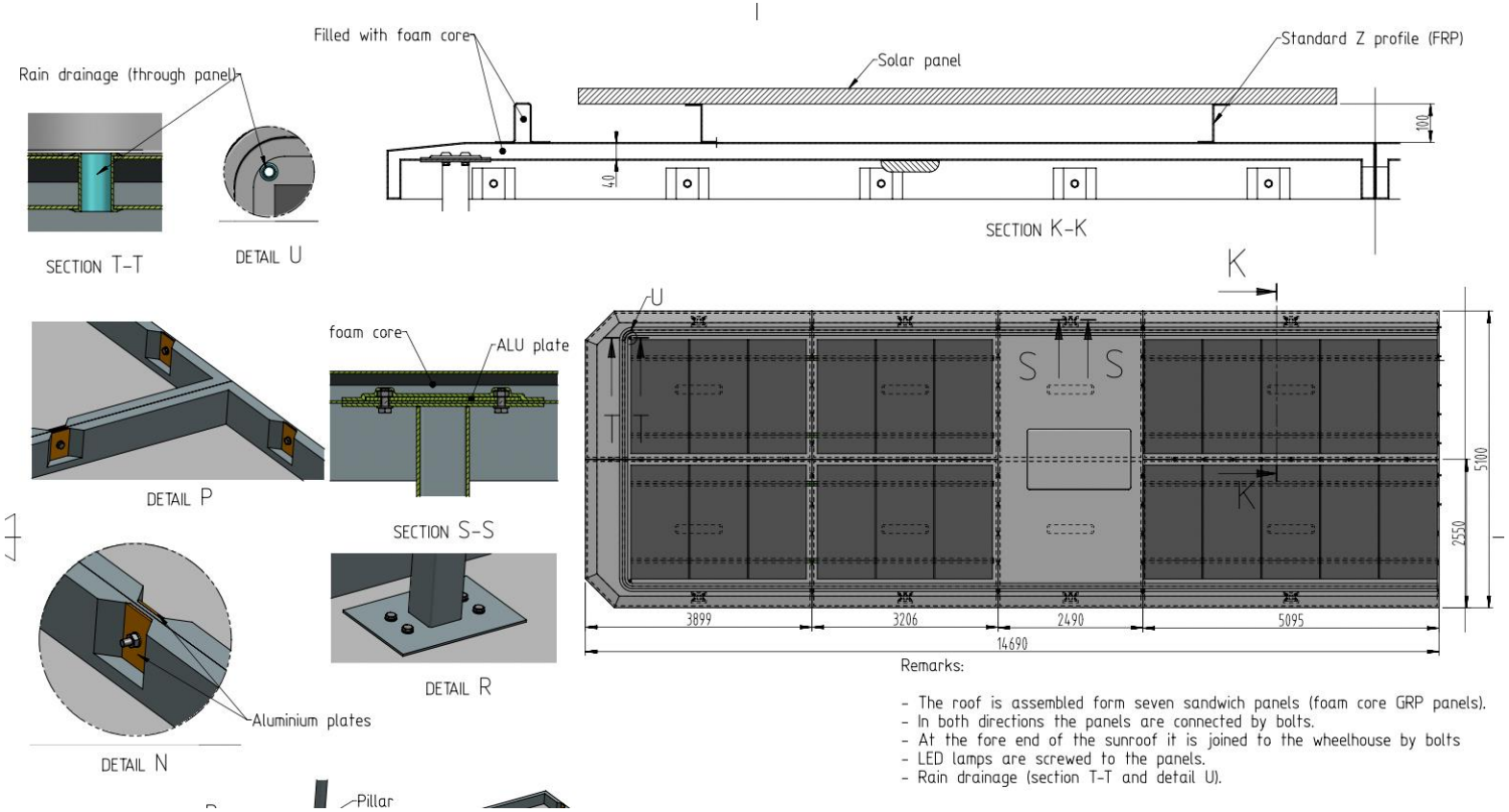
DEMONSTRATOR: A SUN ROOF

- To test the concept, a sun roof of a small passenger vessel was considered.
- Initial aim was to produce the whole sun roof for the actual vessel.

SUN ROOF DESIGN USING FIRE RESISTANT PANELS

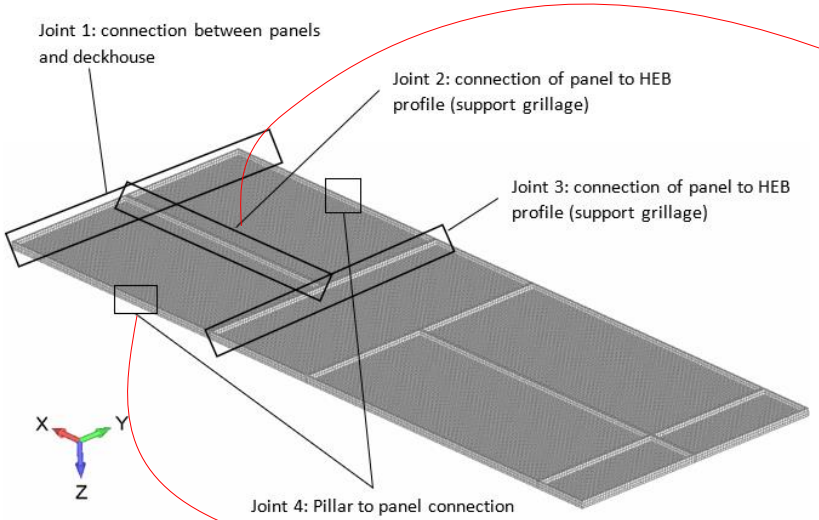






SUN ROOF DESIGN USING FIRE RESISTANT PANELS

Initial idea using all composite flanges did not work as it resulted in too high shear stresses



Note: The design of Joints 1-3 is similar

Figure 57. Joints in roof design.

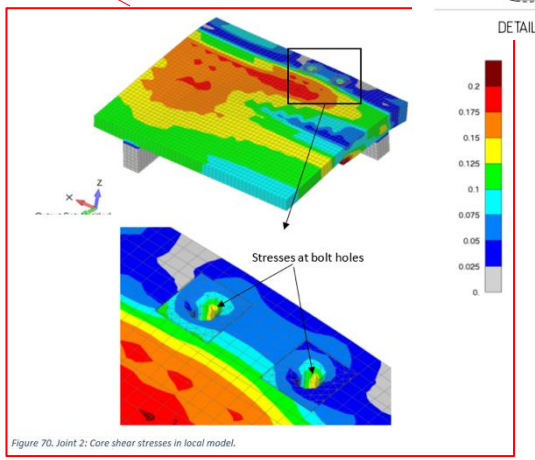
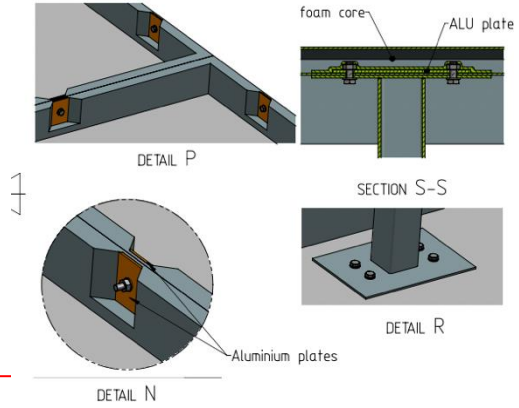


Figure 70. Joint 2: Core shear stresses in local model.



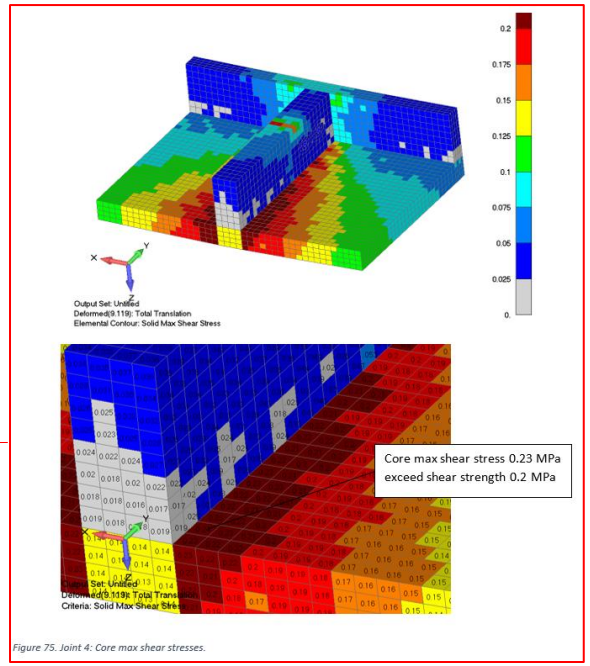
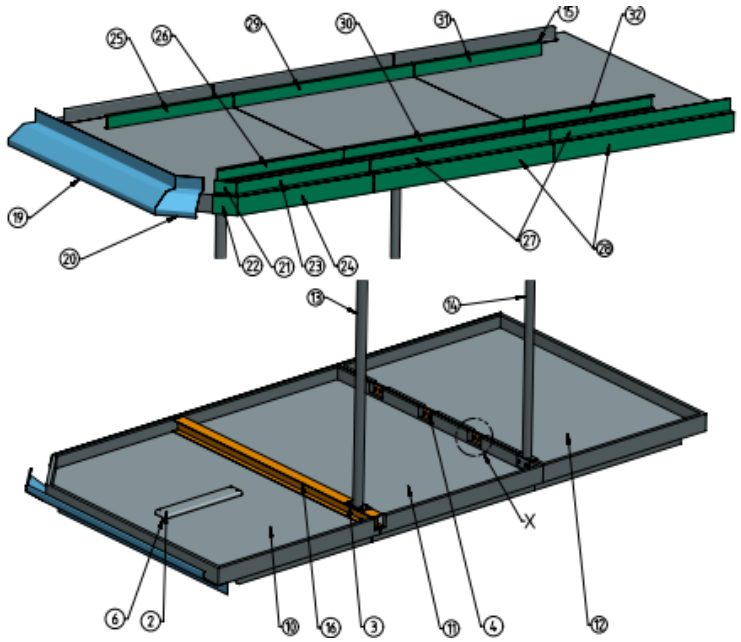
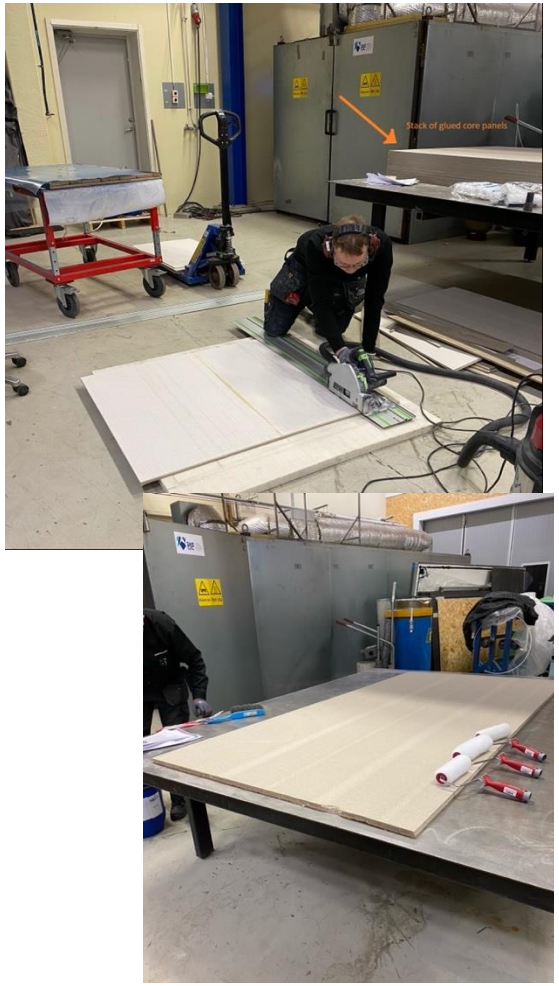


Figure 75. Joint 4: Core max shear stresses.

This rose the concerns of using the novel material in the actual vessel and the idea was having so novel solution in actual vessel was dropped

DEMONSTRATOR DESIGN AND PRODUCTION





CONCLUSIONS

- Double skin AL panels are not reasonable for midsize ships where already small thicknesses are used for single skin panels
- Conventional composite sandwich panels offer lighter alternative
- Novel fire-resistant panels should be developed towards more suitable mechanical properties

VARIABLE	SINGLE SKIN AL PANEL	DOUBLE SKIN AL PANEL	CONV. SANDWICH PANEL	FIRE.RES. SANDWICH PANEL	Unit
Neutral axis, *NA*	0.8	1.75	1.2		cm
Moment of inertia, I_k	24.22	0.9	29.78		cm^4
Sectional modulus, Z_{upper}	31.43		24.82		cm^3
Sectional modulus, Z_{lower}	7.06		24.82		cm^3
Bending stiffness, k_{mm}	1,2E+02		115		N/mm
Mass per sqm	**13,4**	**14.9**	**9.6**	**19.4**	**kg/m^2**
Mass per sqm w. fire insulation	**17.0**	**18.5**	**13.4**	**19.4**	**kg/m^2**

REASONABLE AT t >6 mm

Weight ↓ shear strength ↑

*Includes fire resistant insulation.

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THANK YOU!

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