Novel technologies to boost the shipyard industry

New technologies for automated manufacturing of fibre ships

ORGANIZED BY THE EU HORIZON 2020 PROJECTS:

FIBRE4YARDS SHIPYARD FOR THE FUTURE

RESURGAM

MARI4YARD MARI4ALLIANCE

30th and 31st May 2023, RTD Innovation Dock, Rotterdam

These projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreements n° 101006860 (FIBRE4YARDS), n° 101007005 (RESURGAM), and n° 101006798 (Mari4_YARD).

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- Adaptive Moulds & Composite Panel Assemblies – Tahira Ahmed, Curve Works
- ATP & 3D Printing – Joep Grapperhaus, 10XL
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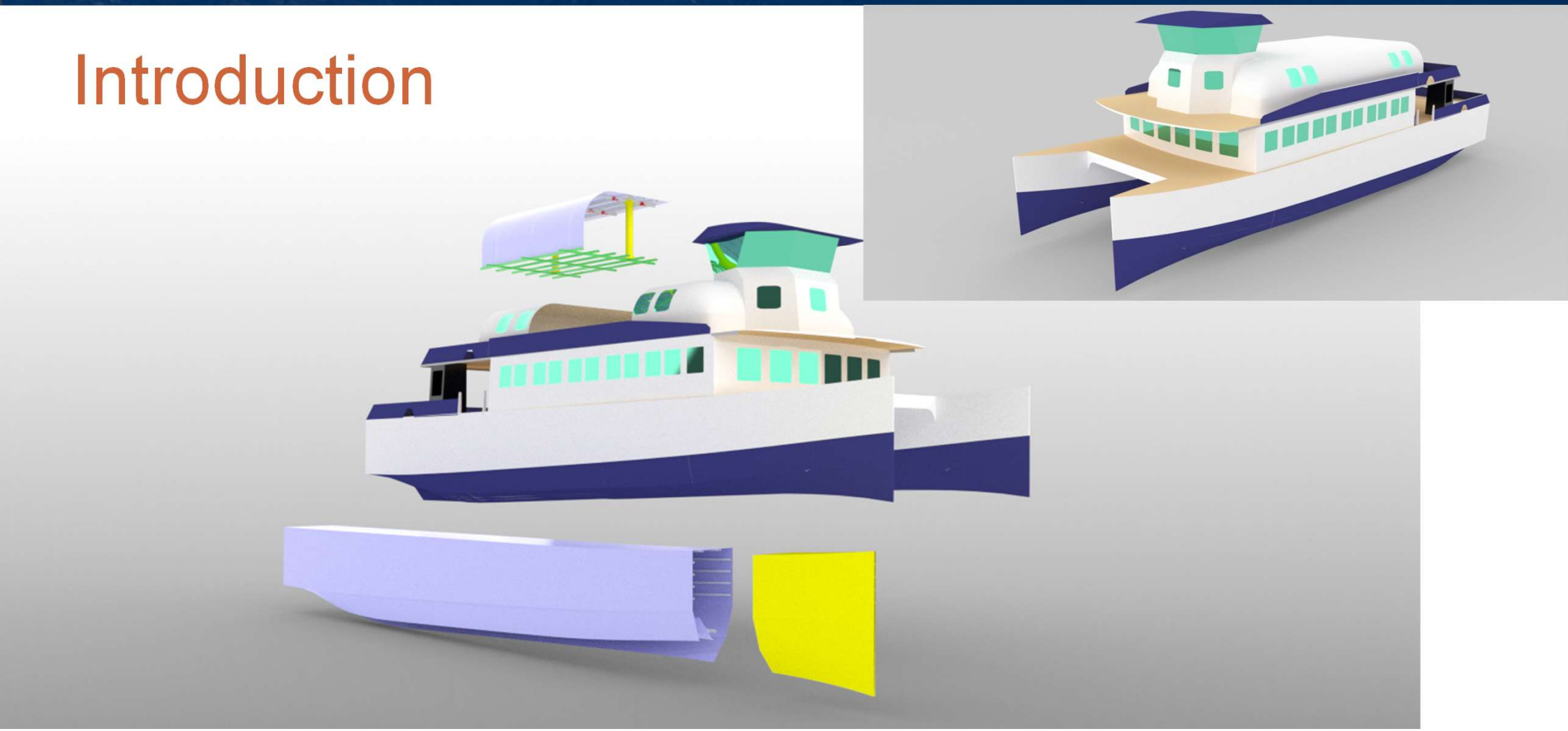
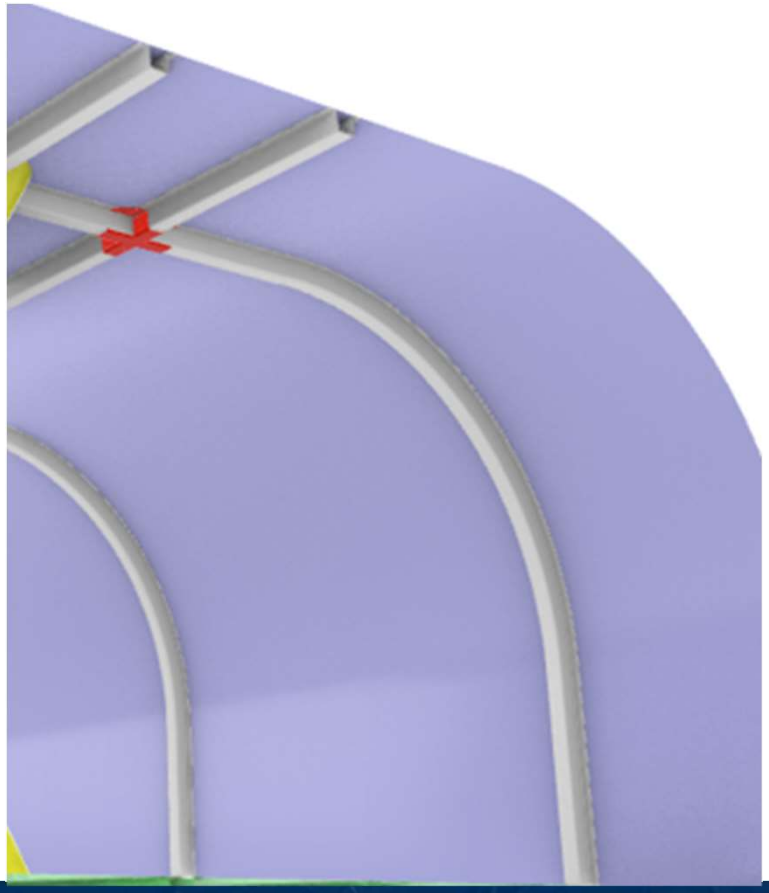
FIBREYARDS SHIPYARD FOR THE FUTURE

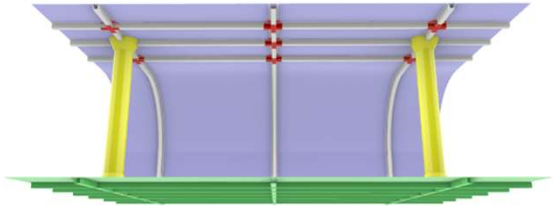
Introduction



FIBRE4YARDS SHIPYARD FOR THE FUTURE

Out-of-die UV Pultrusion

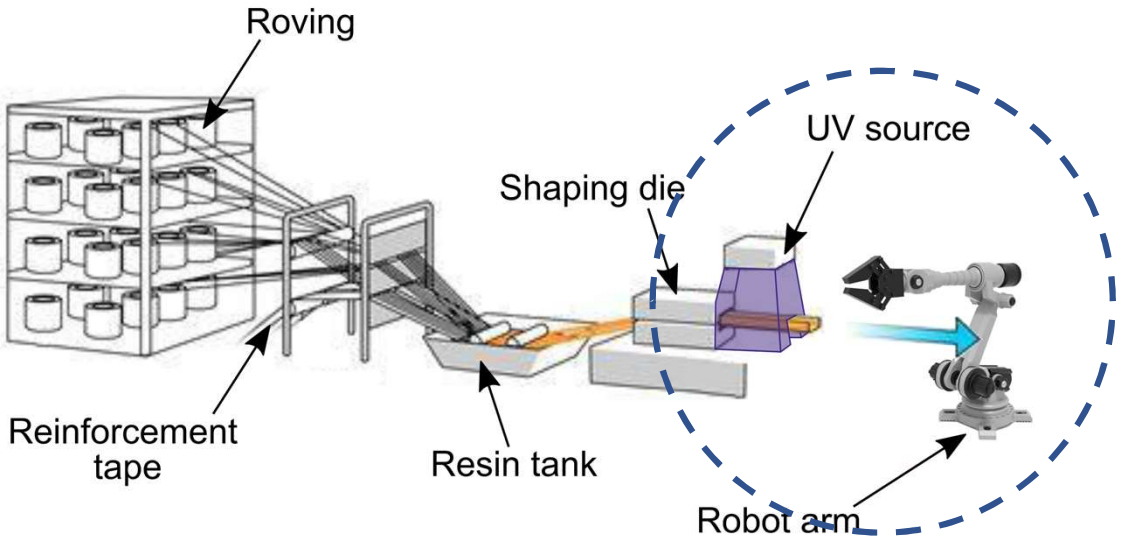


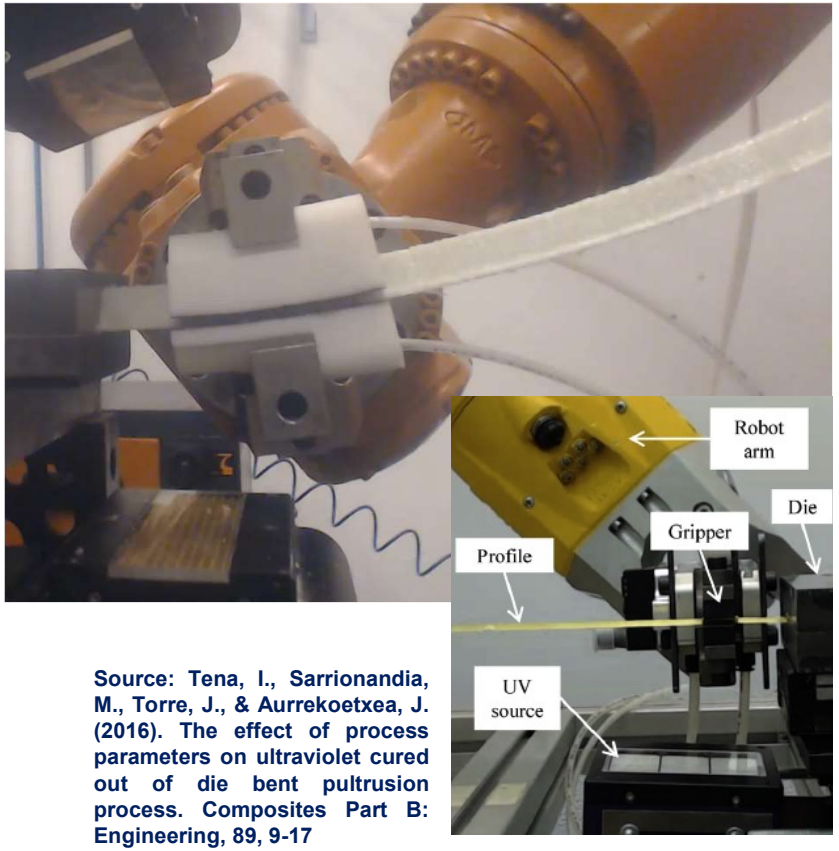


FIBRE4YARDS SHIPYARD FOR THE FUTURE

Out-of-die UV Pultrusion

Concept





Source: Tena, I., Sarrionandia, M., Torre, J., & Aurrekoetxea, J. (2016). The effect of process parameters on ultraviolet cured out of die bent pultrusion process. Composites Part B: Engineering, 89, 9-17

Advanced materials

Advanced manufacturing technologies

Automation technologies and intelligent robotics

FIBRE4YARDS SHIPYARD FOR THE FUTURE

Out-of-die UV Pultrusion

Our solution for shipbuilding

Current manufacturing methods

Source: Adapted from: Fabricando made in Spain – Barcos (https://www.youtube.com/watch?v=KwoXXkjvpo8)

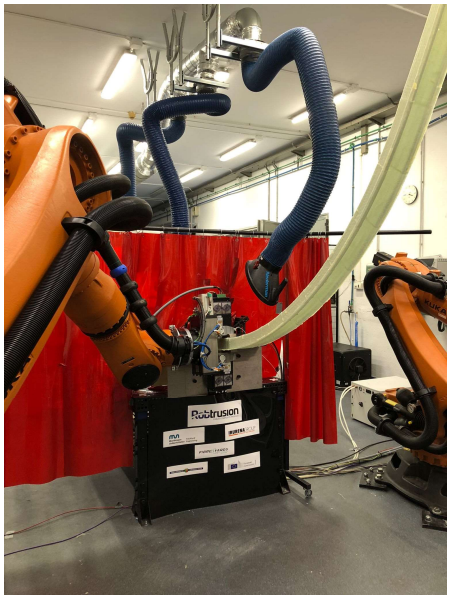
Semi-artisanal

Wastage of raw materials

Low quality control

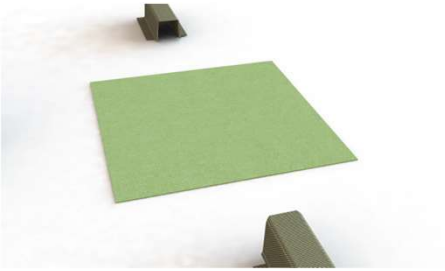
FRP Shipyard modernisation

Out-of-die UV Pultrusion



Automated production of stiffeners

Directly bonded to desired area

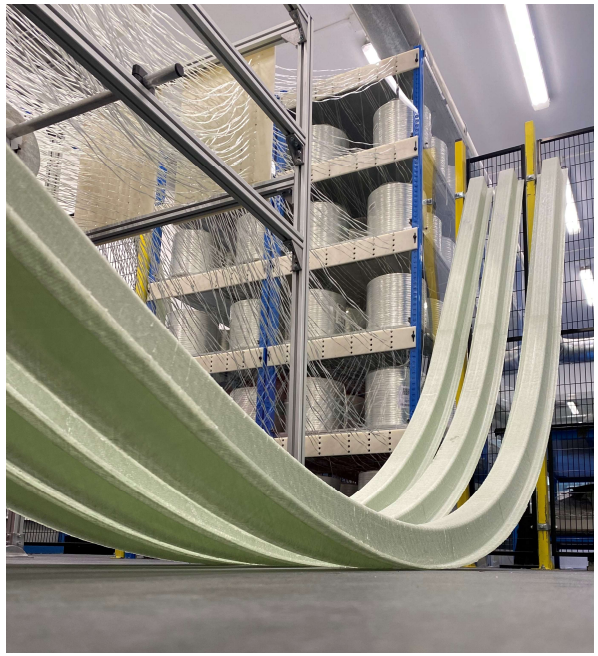


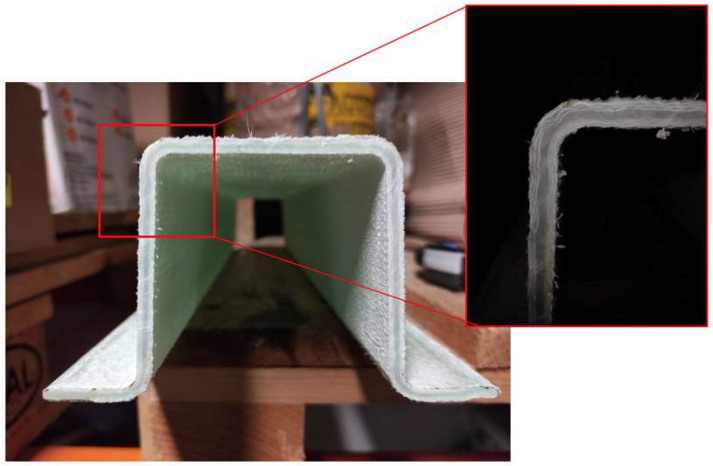
FIBREYARDS SHIPYARD FOR THE FUTURE

Out-of-die UV Pultrusion

Our solution for shipbuilding

Shipbuilding profile (developed in Fibre4Yards project)



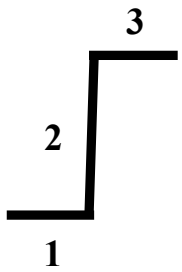


High-performance curved stiffener for the superstructure of a Catamaran

Physical properties

Fibre volume fraction: 58%
Void content: 1.6%

Geometrical accuracy (4.5 mm)
- Thickness 1: 4.57 ± 0.08 mm
- Thickness 2: 4.68 ± 0.05 mm
- Thickness 3: 4.57 ± 0.10 mm



Mechanical properties

Customizable

E_{11}: 31 GPa
E_{22}: 11 GPa
G_{12}: 6 GPa

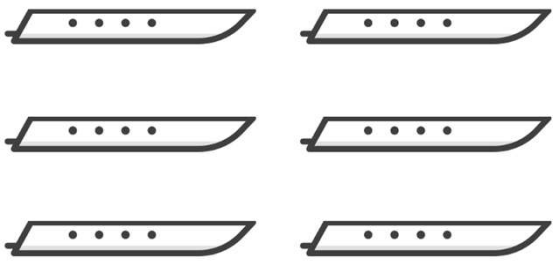
σ_{11}: 571 MPa
σ_{22} : 133 MPa
σ_{12} : 77 MPa

FIBRE4YARDS SHIPYARD FOR THE FUTURE

Out-of-die UV Pultrusion

Advantages for shipyards

Less cost and high manufacturing capacity



Stiffener directly bonded to the desired area

Increased quality control of vessels

Control of fibre volume and thickness of stiffeners

Automated and repetitive manufacturing process

Greener vessels

Reduction of raw materials

Polyurethane mould removal

Reduction of stiffener geometry

Increase in productivity

Certified product

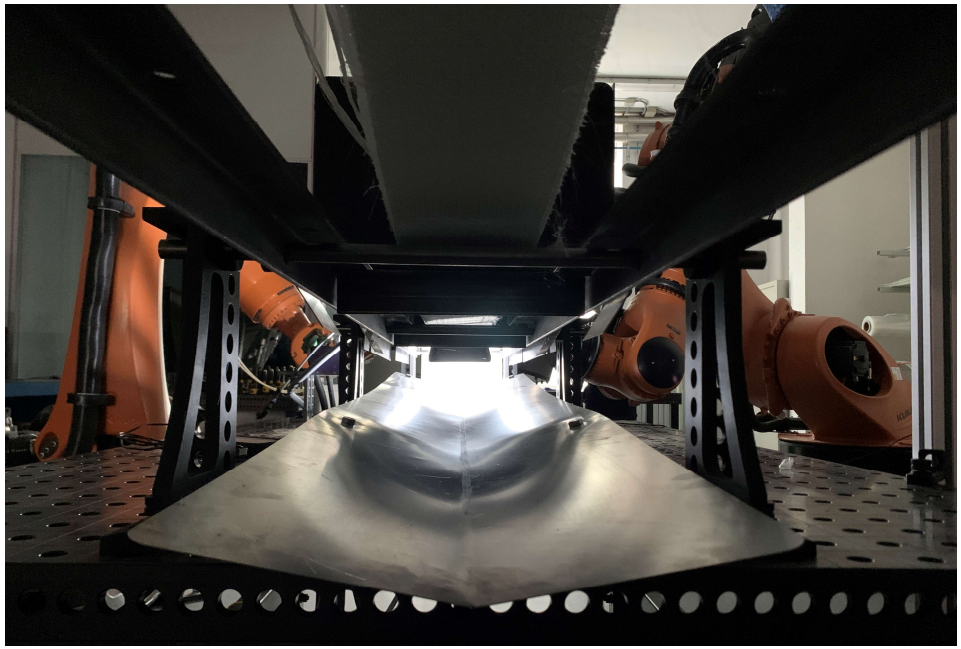
Reduction of the final weight of the vessel

FIBREYARDS SHIPYARD FOR THE FUTURE

Out-of-die UV Pultrusion

Startup Robtrusion

Robtrusion
CURVED COMPOSITE PROFILES

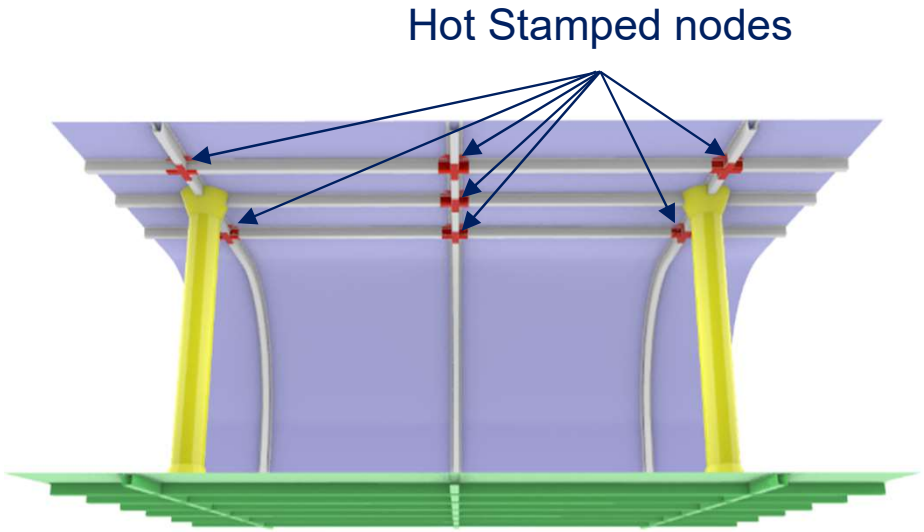


Not only a Project!

FIBREYARDS SHIPYARD FOR THE FUTURE

Hot stamping of TP-FRP

Concept

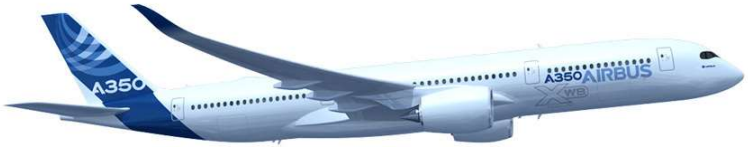


FIBRE4YARDS SHIPYARD FOR THE FUTURE

Hot stamping of TP-FRP

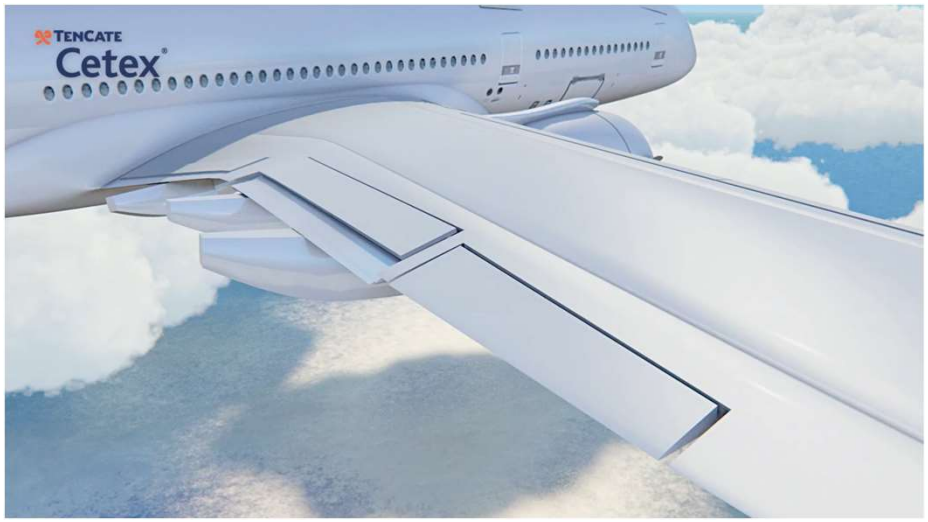
Technology transfer

Technology transfer



Source: https://www.greenoptimistic.com

Source: https://insights.globalspec.com



Source: https://www.toraytac.com

FIBRE4YARDS SHIPYARD FOR THE FUTURE

Hot stamping of TP-FRP

Technology outline

Automated Tape Laying

Source: https://basalt.today

Blank Consolidation

Source: https://frenchoil.com

Hot Stamping

Source: https://www.rucks.de

Tailored layup

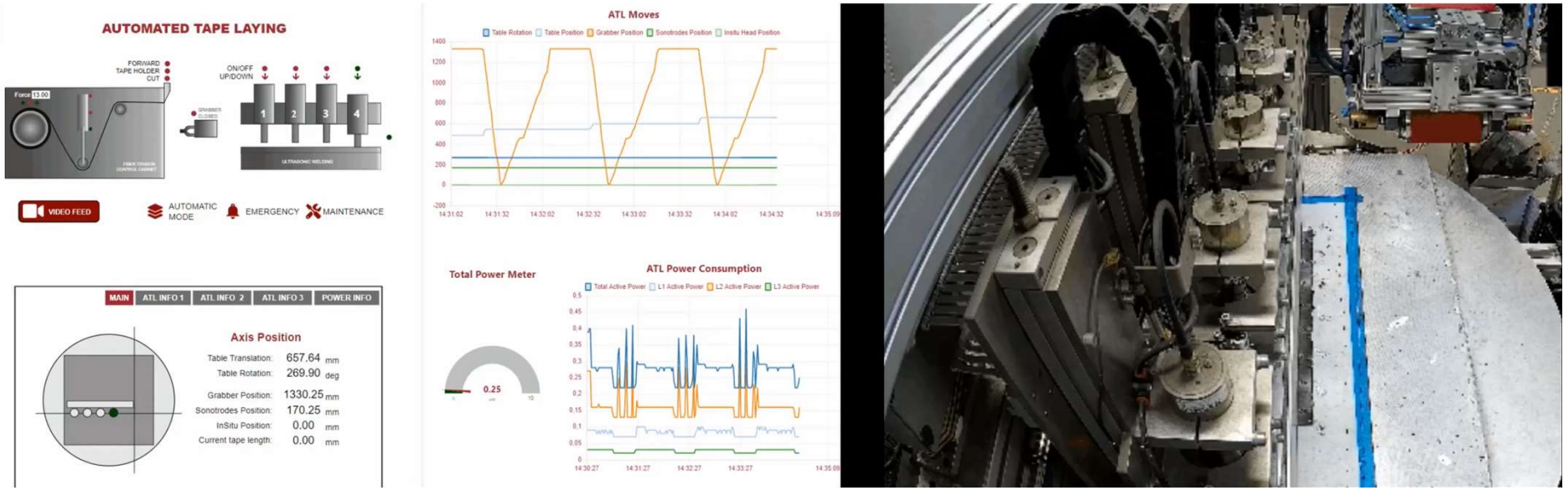
Consolidated preform

Final part

FIBRE4YARDS SHIPYARD FOR THE FUTURE

Hot stamping of TP-FRP

Automation and digitalization

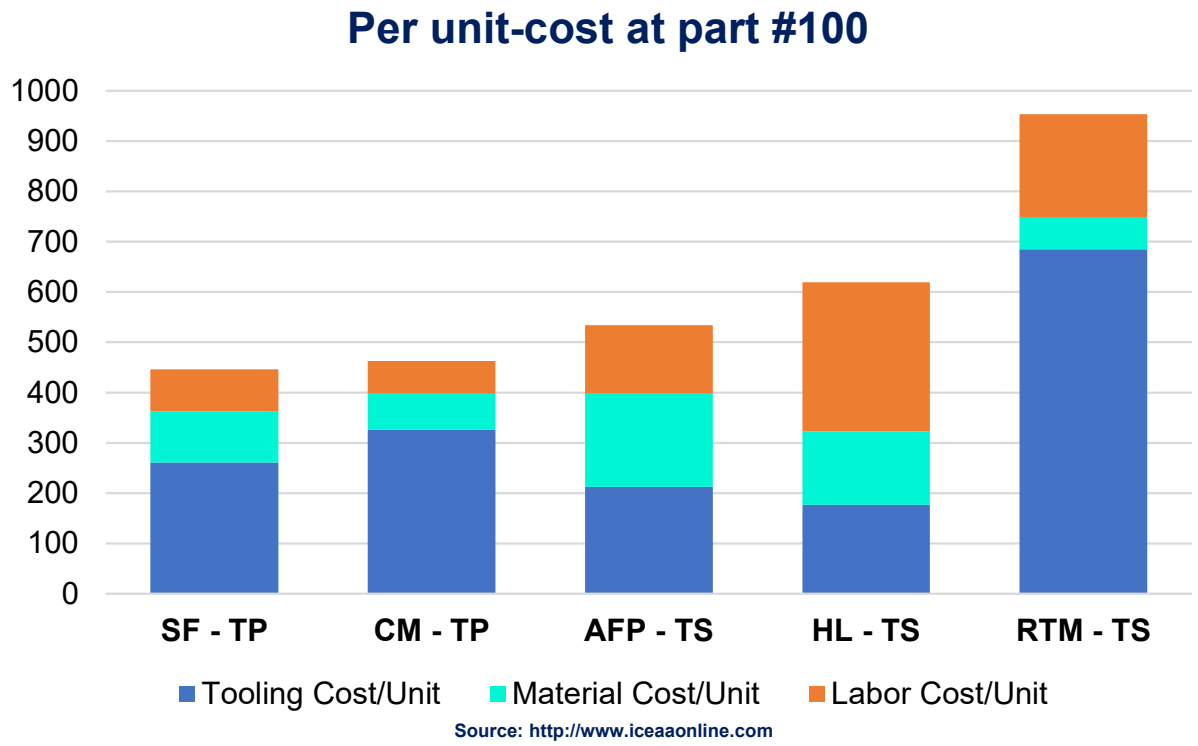


Fully automatic and digitized F4Y Hot Stamping cell

FIBRE4YARDS SHIPYARD FOR THE FUTURE

Hot stamping of TP-FRP

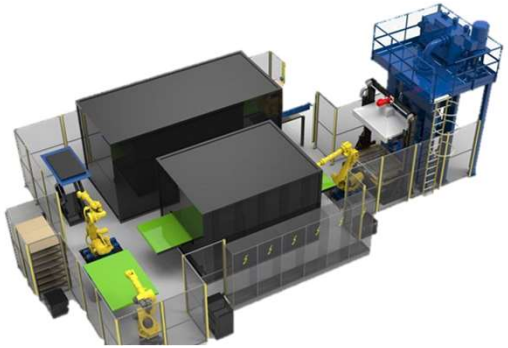
Implementation benefits



Source: http://www.iceaaonline.com

SF – Stamp Forming
CM – Compression Moulding
AFP – Automated Fibre Placement
HL – Hand Layup
RTM – Resin Transfer Moulding

TP – Thermoplastic
TS – Thermoset



Hot Stamping cell

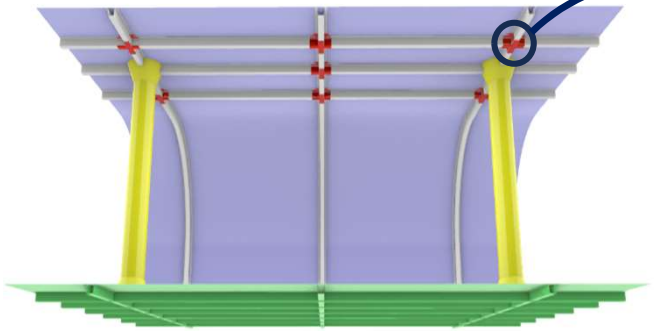
Source: https://pinetteemidecau.eu

FIBREYARDS SHIPYARD FOR THE FUTURE

Hot stamping of TP-FRP

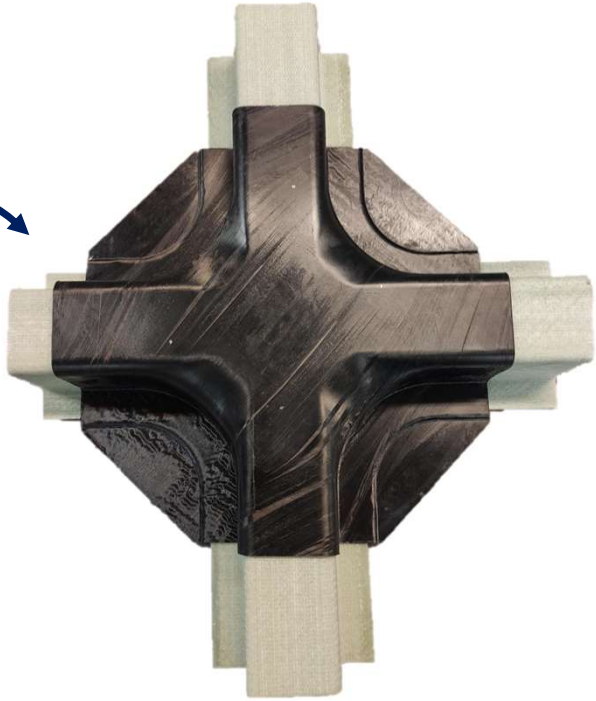
Integration

Concept



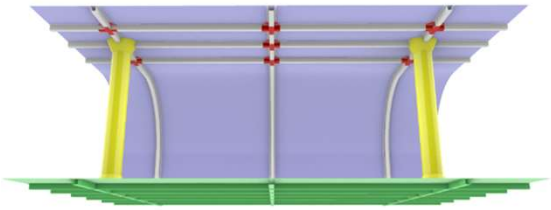
Demonstrator

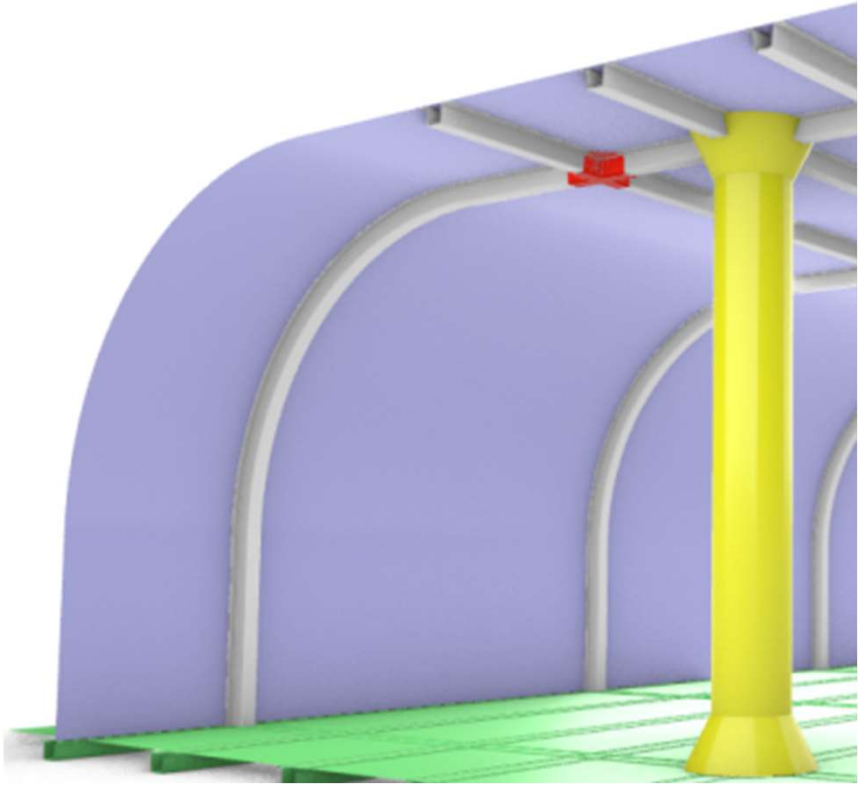
Assembly



FIBRE4YARDS SHIPYARD FOR THE FUTURE

Panel assemblies and adaptive mould technology

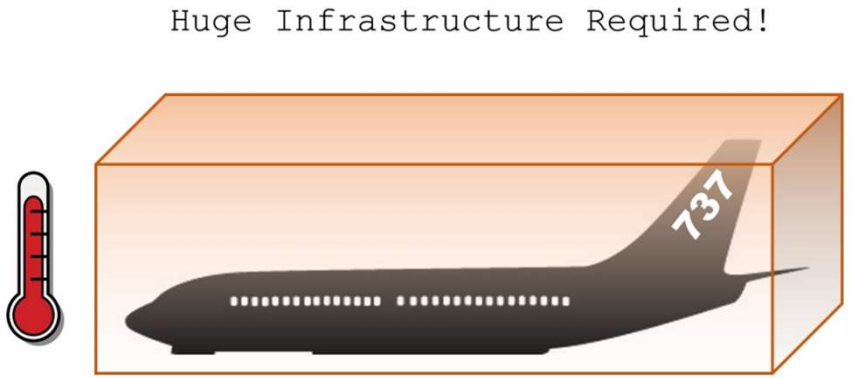




FIBRE4YARDS SHIPYARD FOR THE FUTURE

Panel assemblies and adaptive mould technology

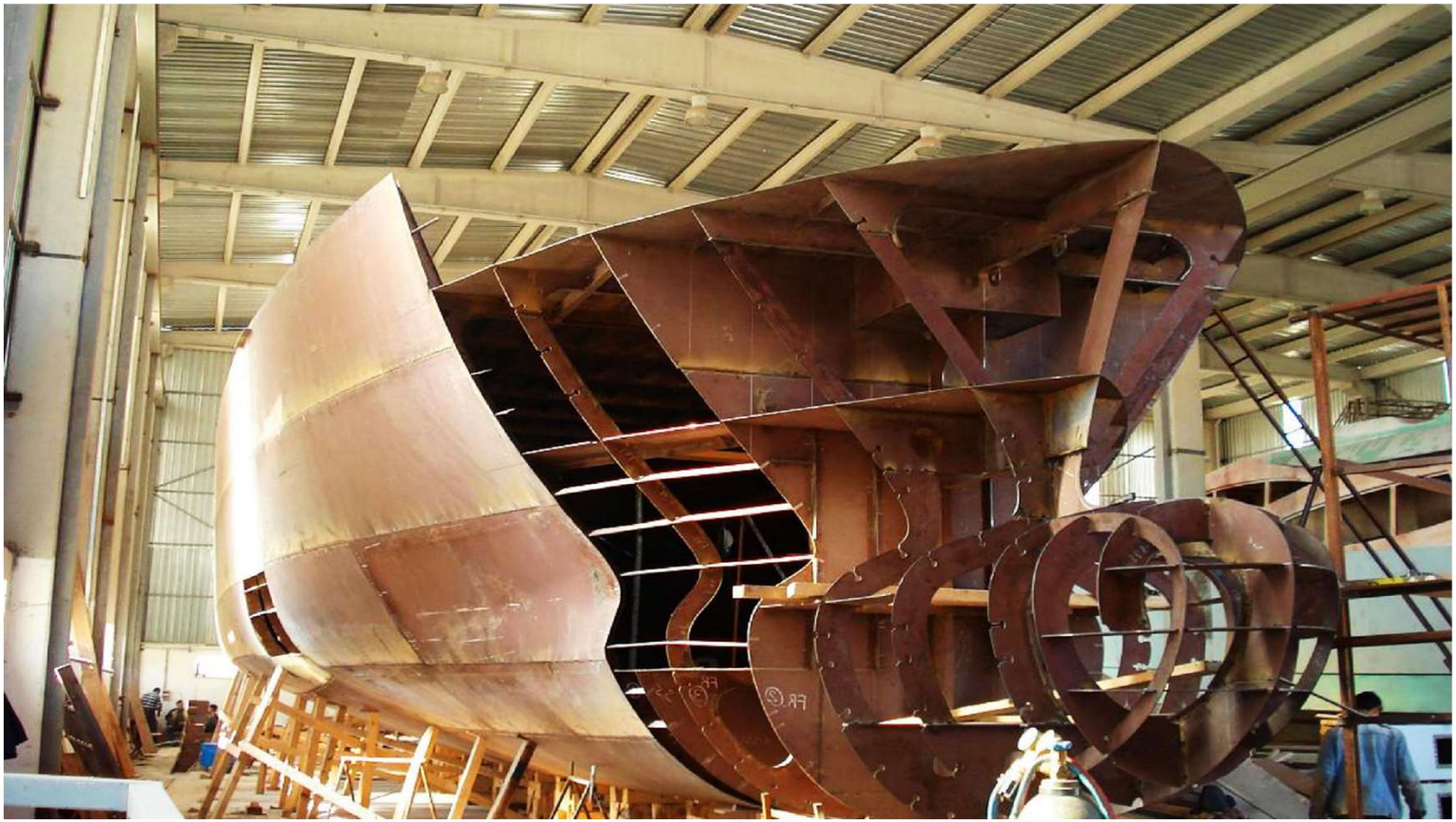
Current large composite production



FIBRE4YARDS SHIPYARD FOR THE FUTURE

Panel assemblies and adaptive mould technology

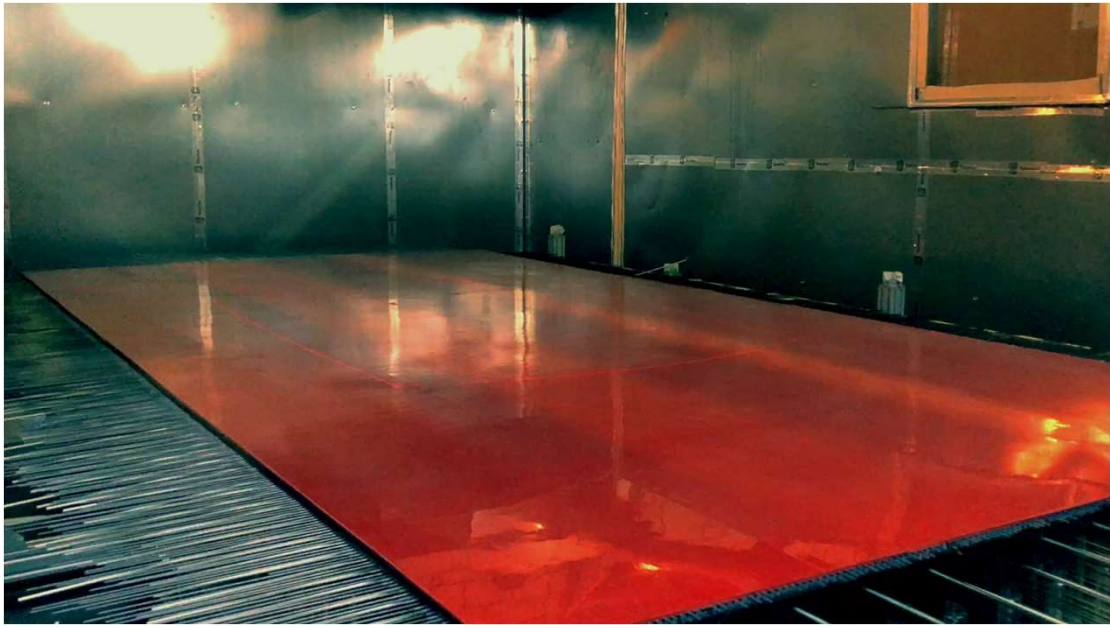
Metal ship building



FIBREYARDS SHIPYARD FOR THE FUTURE

Panel assemblies and adaptive mould technology

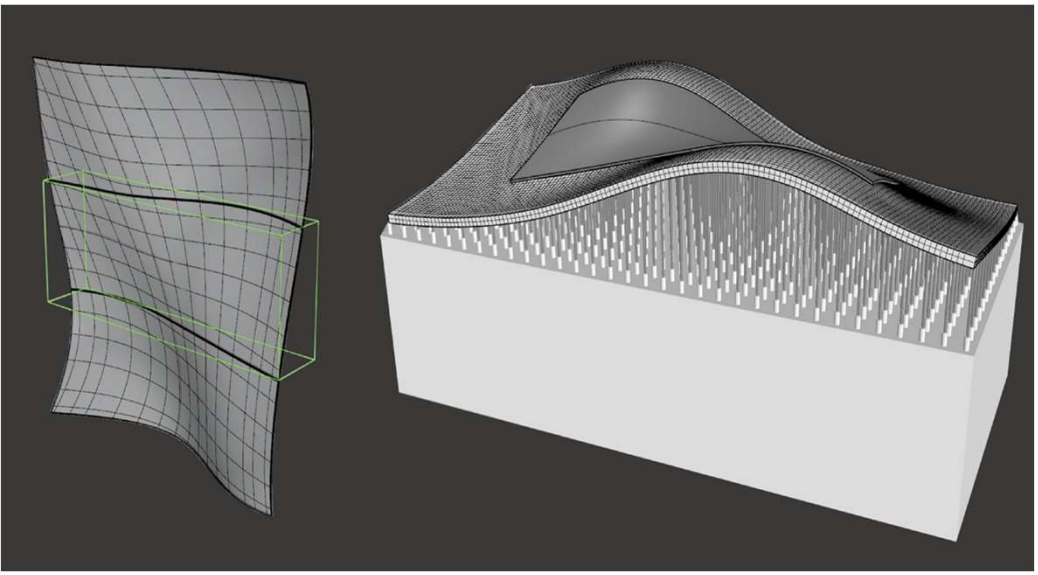
Introducing the adaptive mould

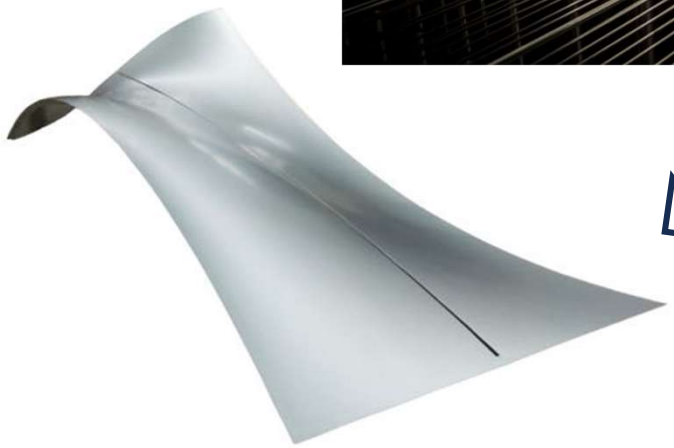


FIBRE4YARDS SHIPYARD FOR THE FUTURE

Panel assemblies and adaptive mould technology

Automation direct from 3D CAD environment



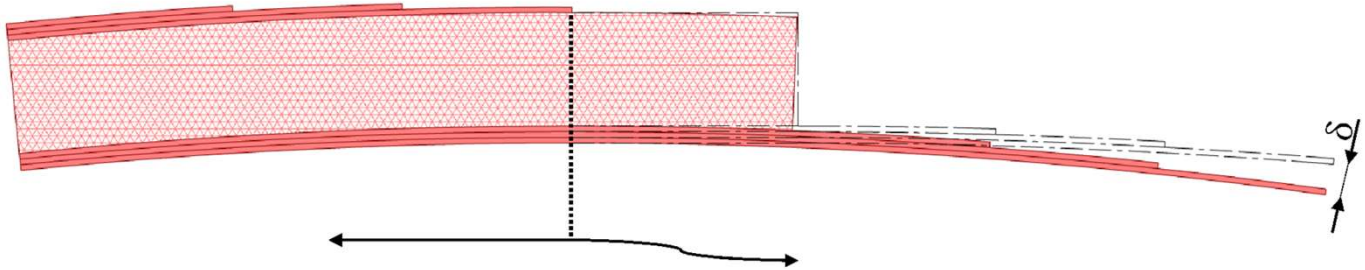


FIBRE4YARDS SHIPYARD FOR THE FUTURE

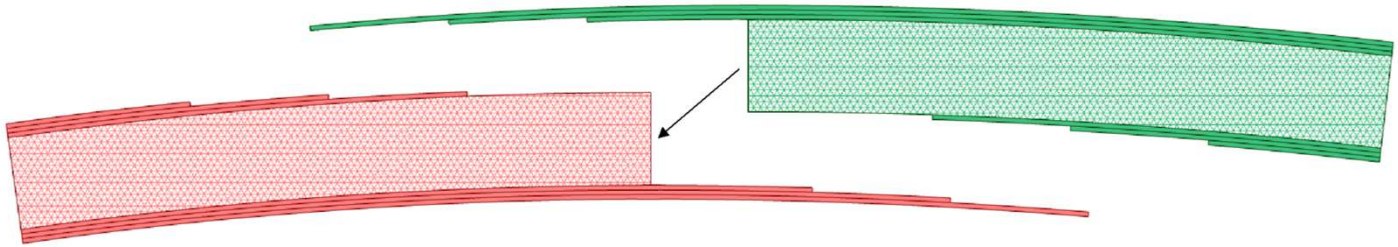
Panel assemblies and adaptive mould technology

Joint detail

Compliant Integration

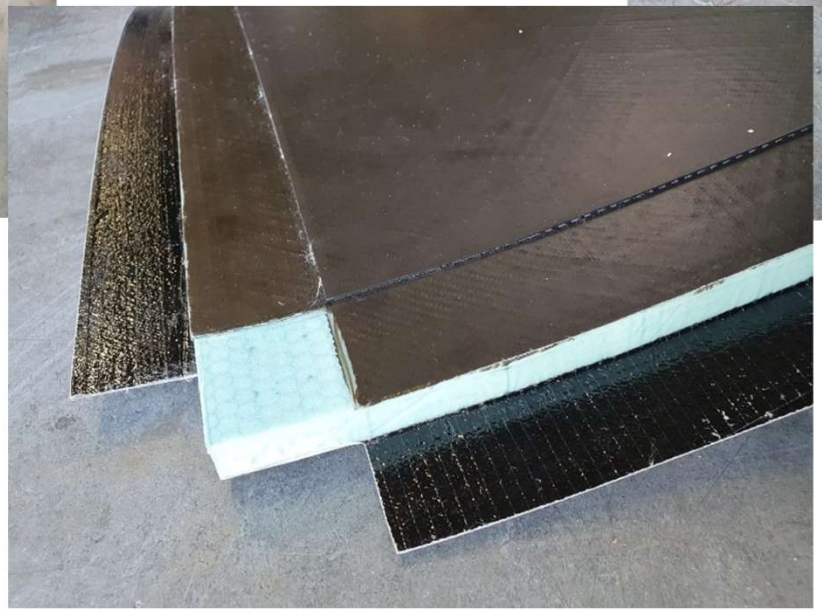


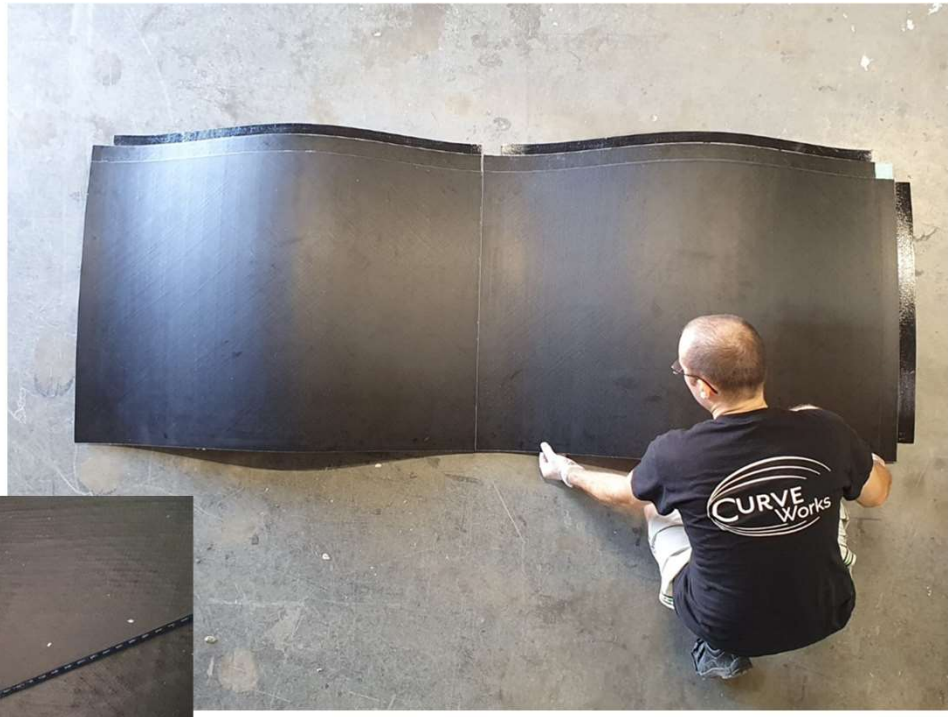
Straightforward Assembly



FIBRE4YARDS SHIPYARD FOR THE FUTURE

Joint detail





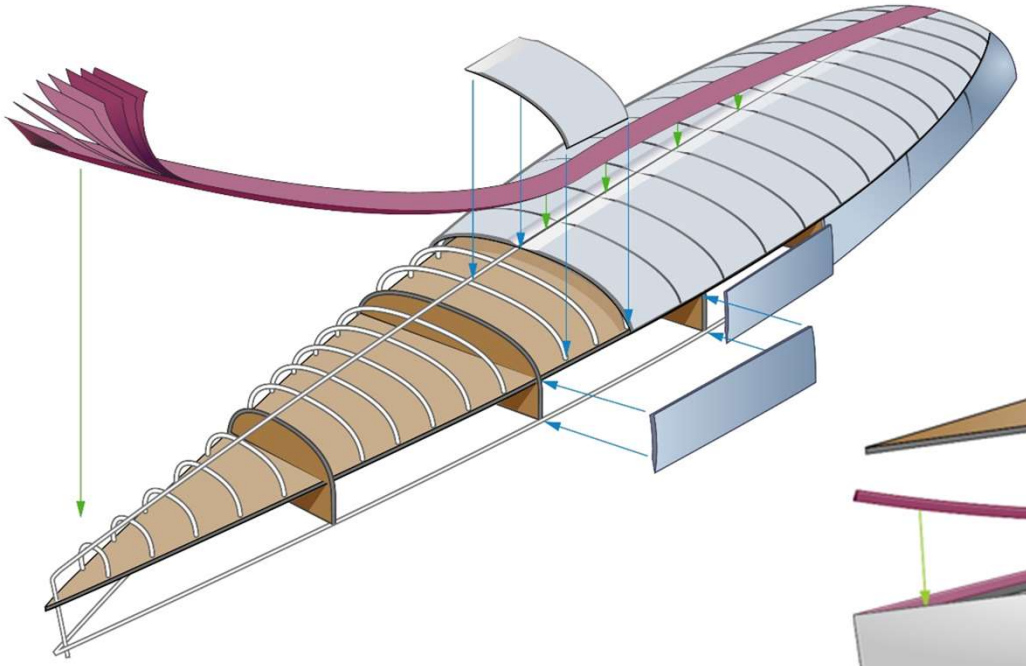
FIBRE YARDS SHIPYARD FOR THE FUTURE

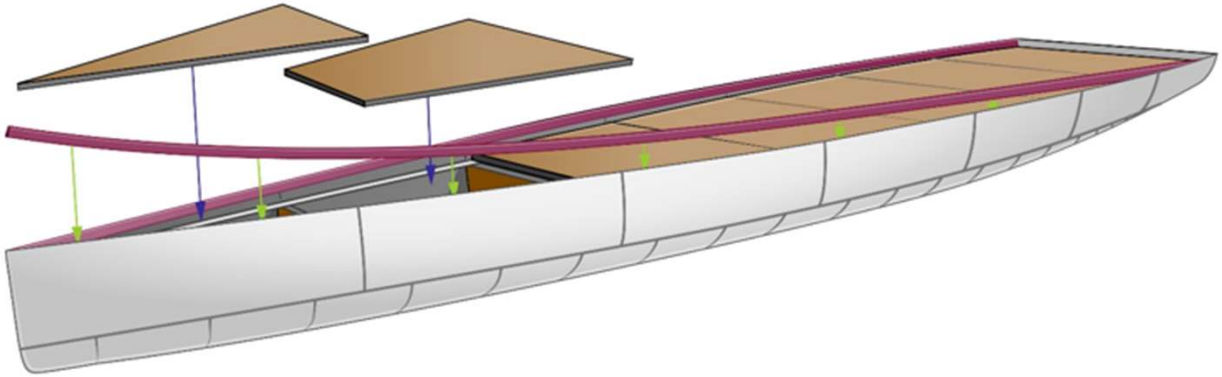
Panel assemblies and adaptive mould technology

Demonstrator assembly

Panel assemblies and adaptive mould technology

Composite panel assemblies are possible





FIBRE4YARDS SHIPYARD FOR THE FUTURE

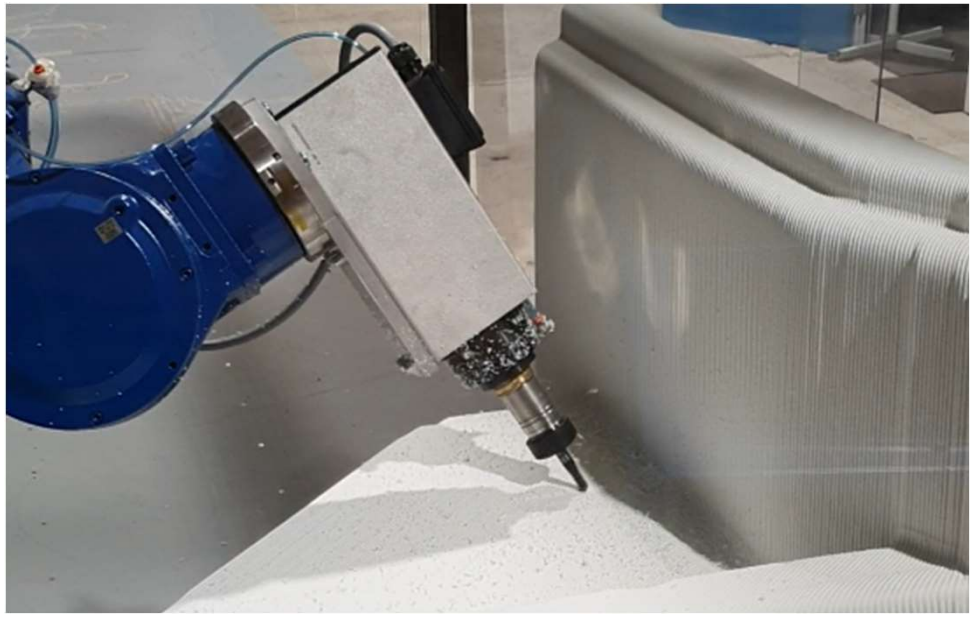
3D Printing

FIBRE4YARDS SHIPYARD FOR THE FUTURE

3D Printing

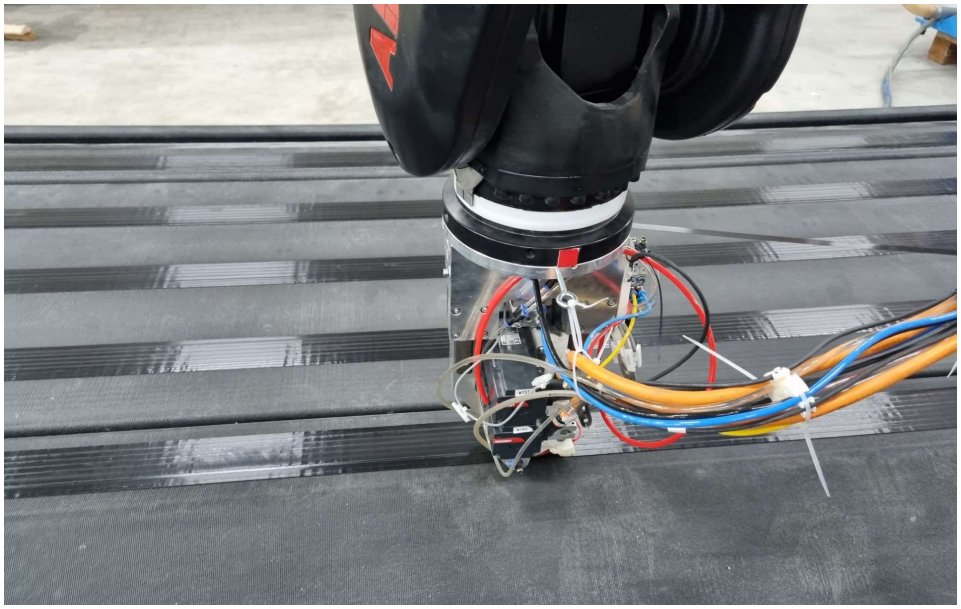
FIBREYARDS SHIPYARD FOR THE FUTURE

CNC

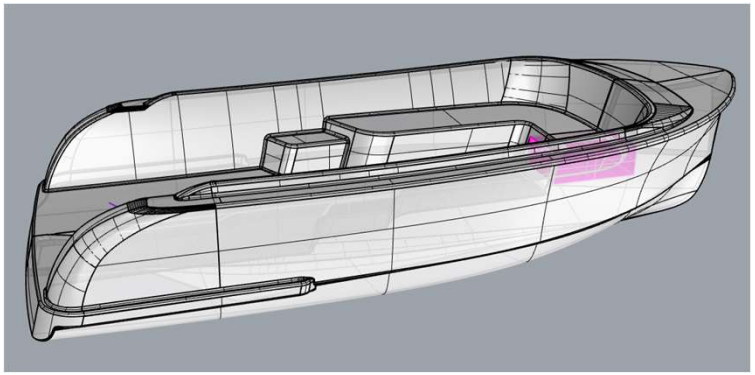


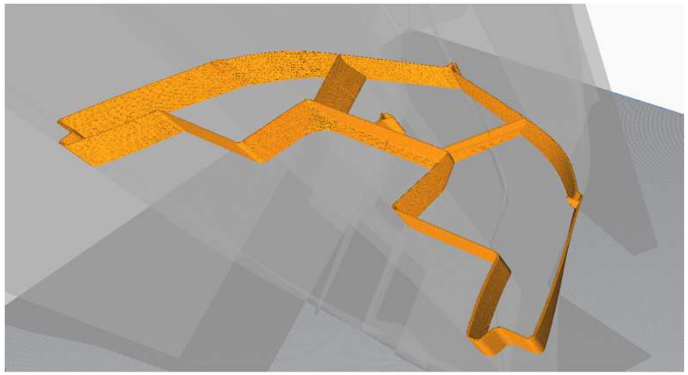
FIBREYARDS SHIPYARD FOR THE FUTURE

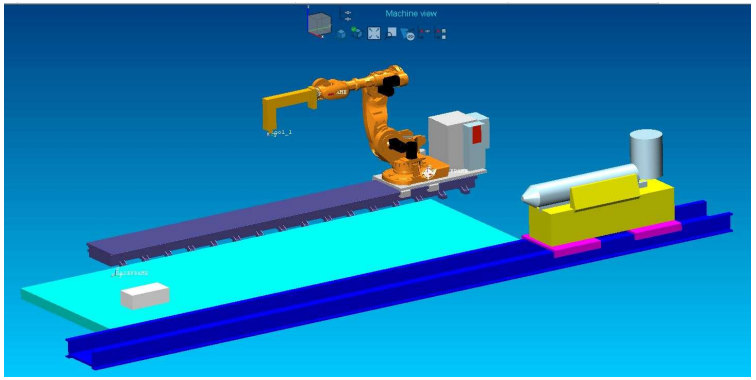
ATP

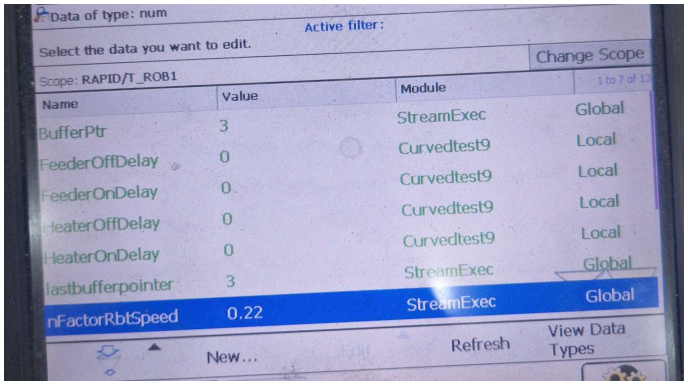


ATP - Workflow





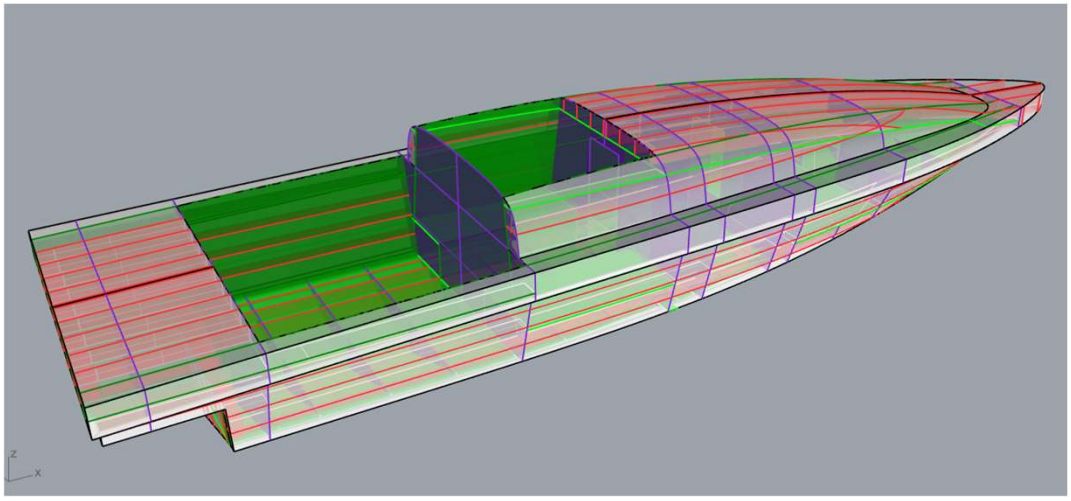


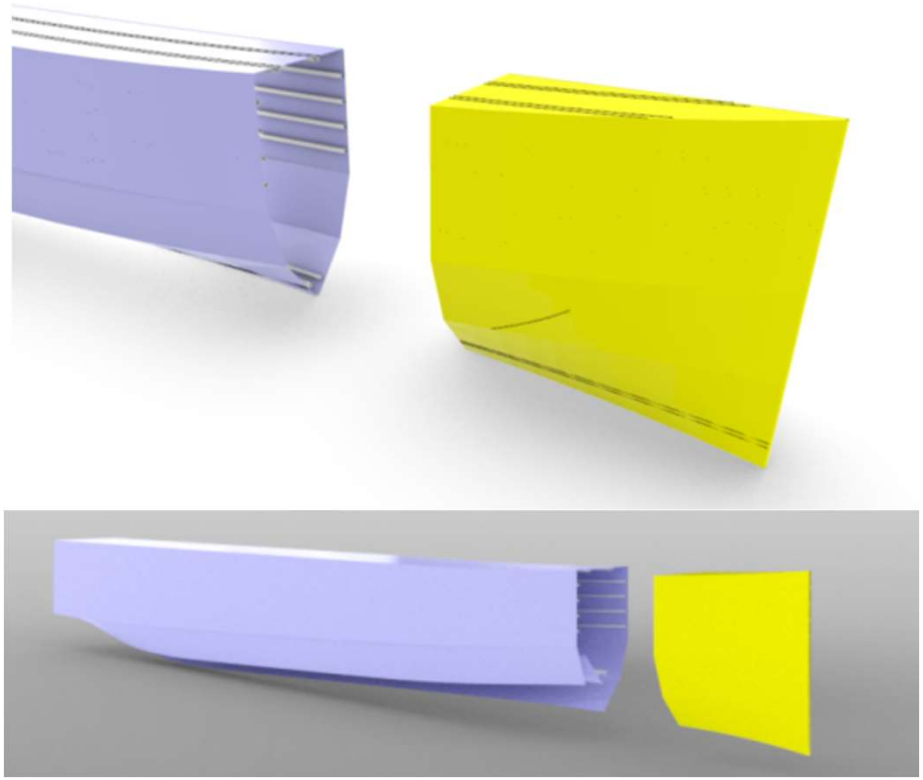


FIBREYARDS SHIPYARD FOR THE FUTURE

ATP & 3D Printing

F4Y





FIBRE4YARDS SHIPYARD FOR THE FUTURE

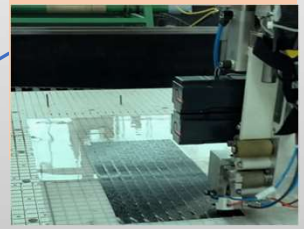
Summary

Summary

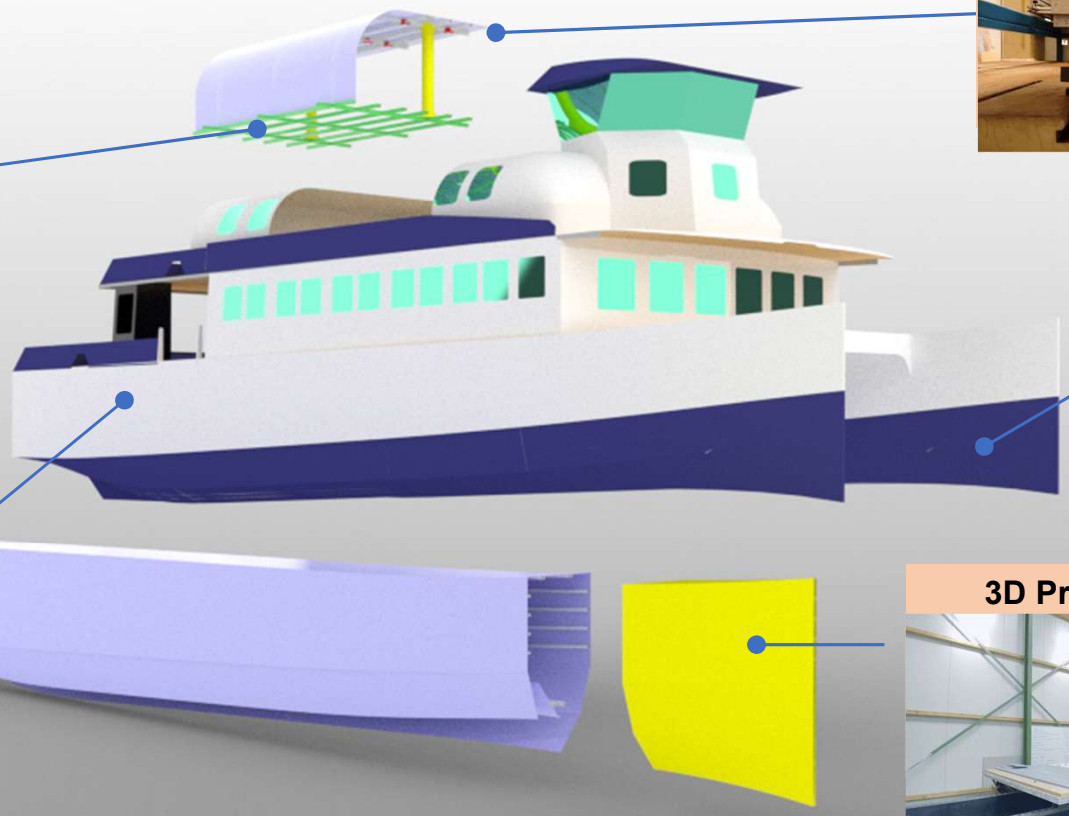
Hot-Stamping

Out-of-die UV cured pultrusion

ATP



Adaptive moulds



3D Printing

FIBRE4YARDS SHIPYARD FOR THE FUTURE

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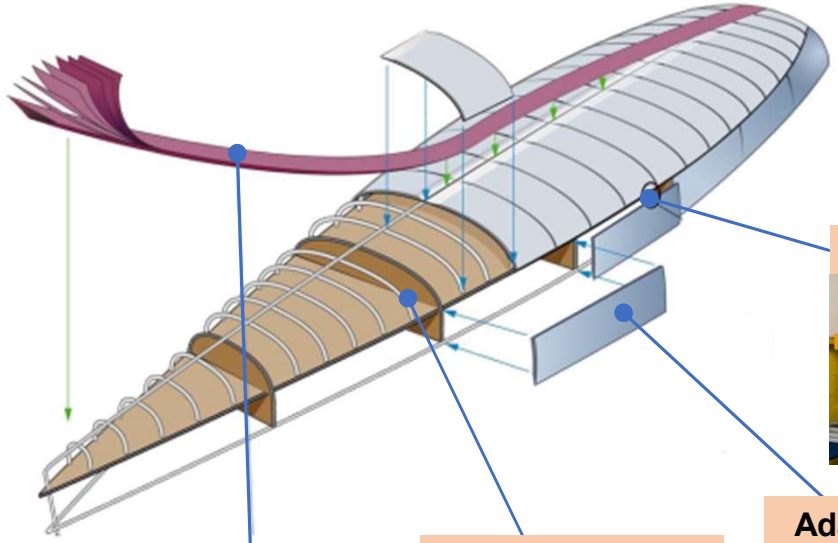
Summary

Medium-to-large vessels



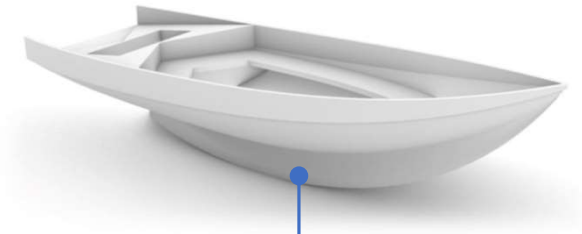
Hot-Stamping

ATP

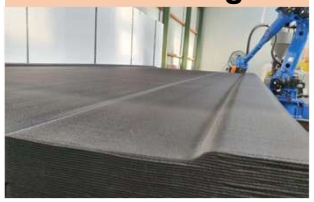
Out-of-die UV cured pultrusion

Adaptive molds

Small vessels



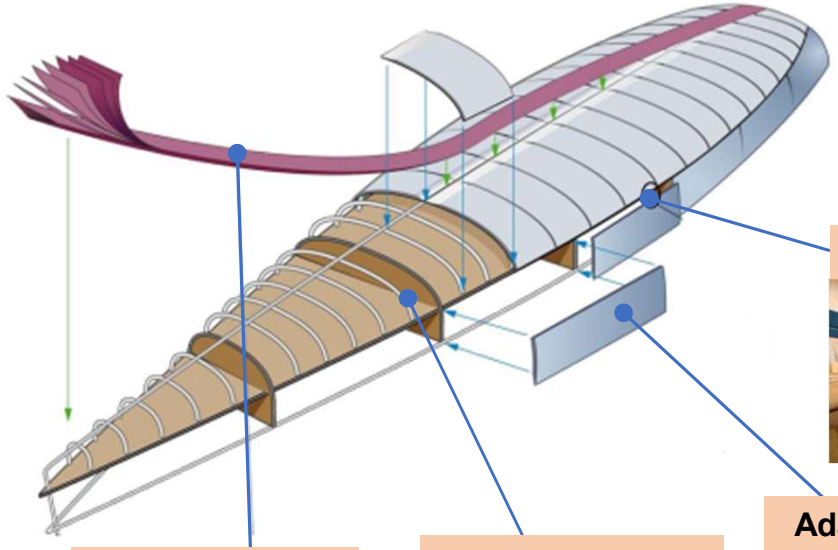
3D Printing



FIBRE4YARDS SHIPYARD FOR THE FUTURE

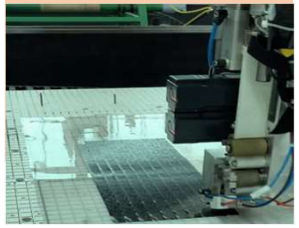
Summary

Medium-to-large vessels



Hot-Stamping

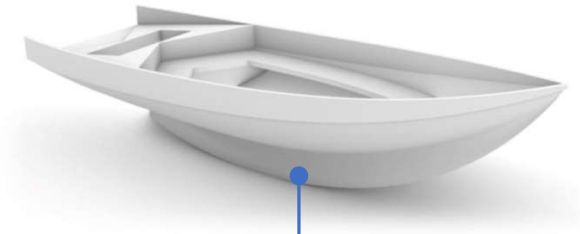
ATP



Out-of-die UV cured pultrusion

Adaptive molds

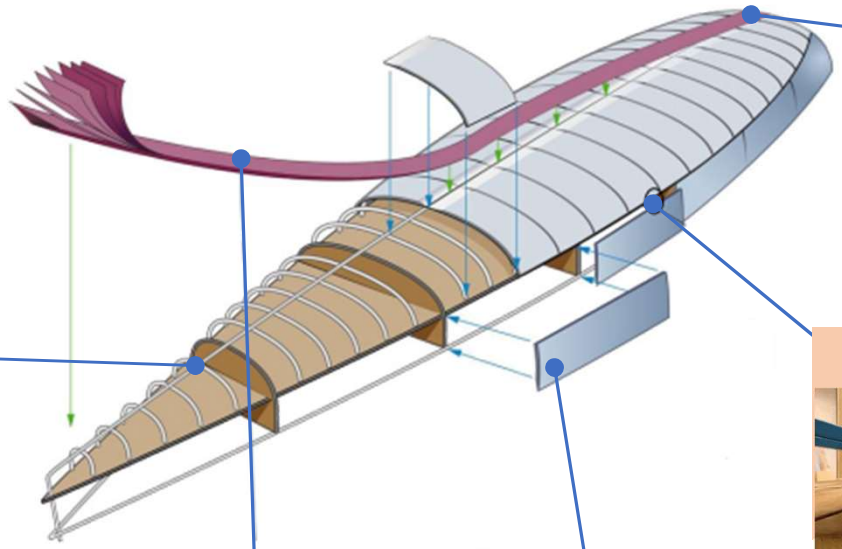
Small vessels



3D Printing

FIBRE4YARDS SHIPYARD FOR THE FUTURE

Summary

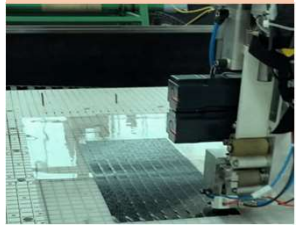


3D Printing

Out-of-die UV cured pultrusion

Hot-Stamping

ATP



Adaptive molds

FIBRE4YARDS SHIPYARD FOR THE FUTURE