FIBRE4YARDS
SHIPYARD FOR THE FUTURE

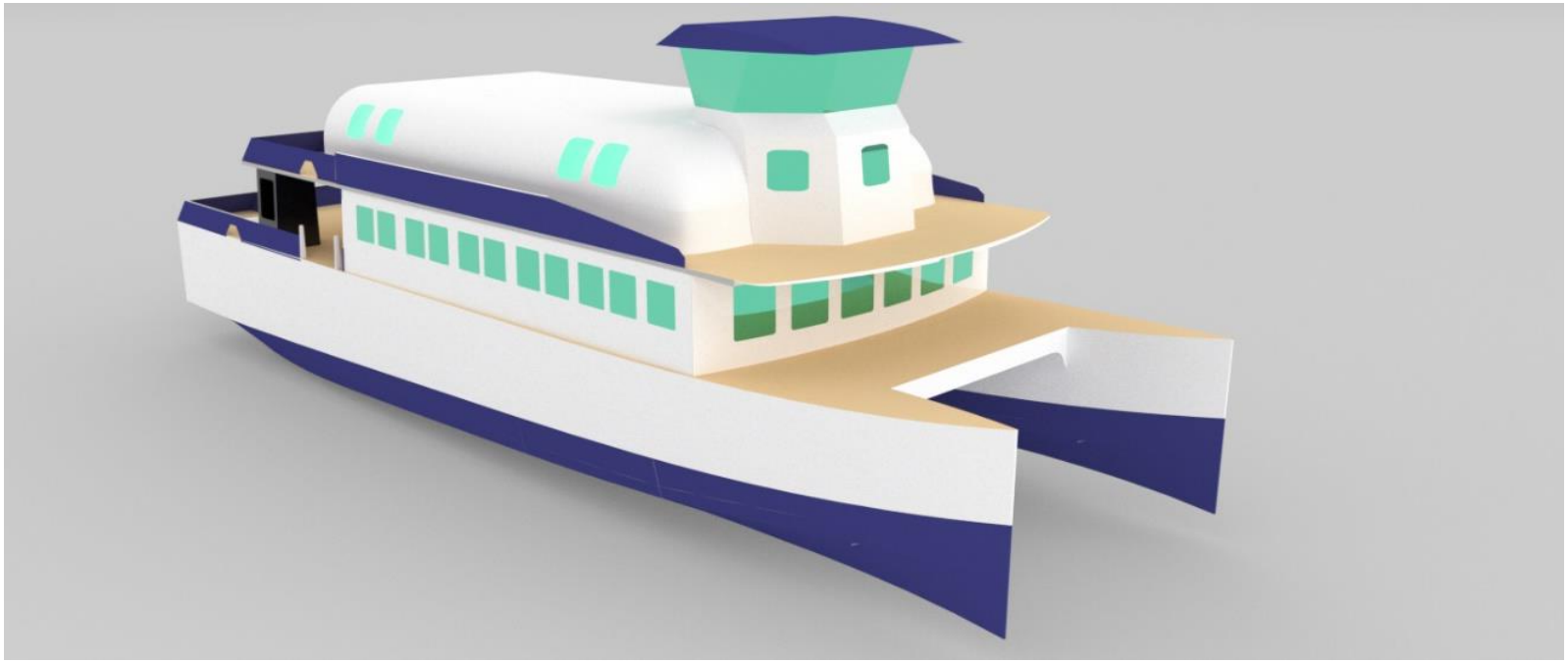
Advanced manufacturing technologies for composite ships

(I. Sáenz, J. Silva, F. Geuskens, J. Grapperhaus)

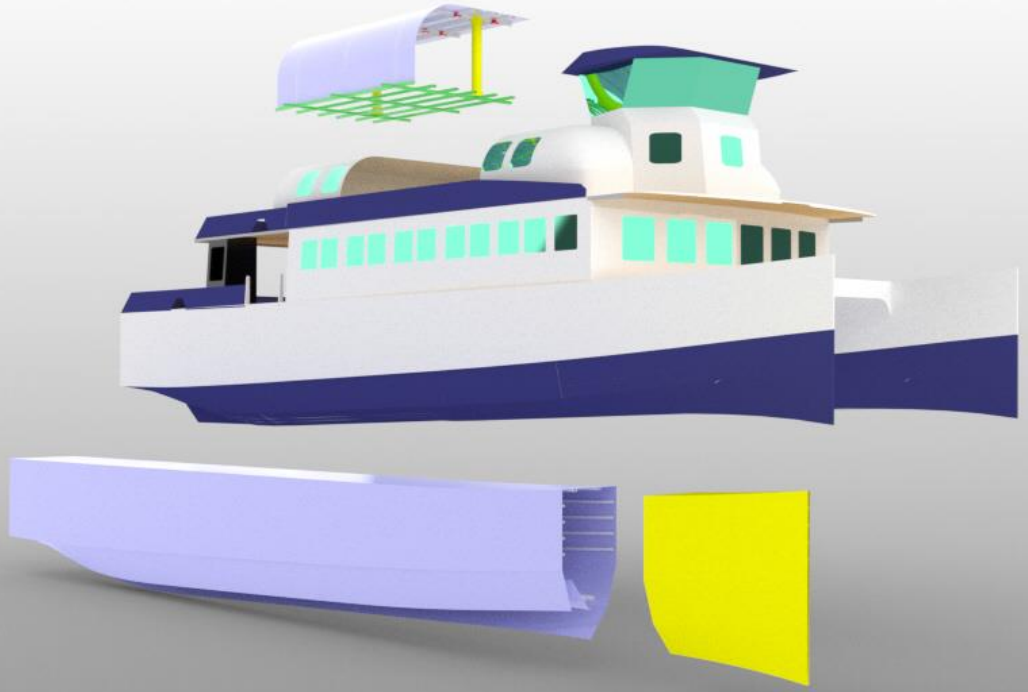
Final Dissemination Event
13 December 2023
Technocampus Océan, Nantes, France

This project has received funding from European Union's Horizon 2020 research and innovation programme under grant agreement n° 101006860

Introduction



Introduction

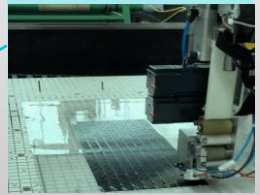


Introduction

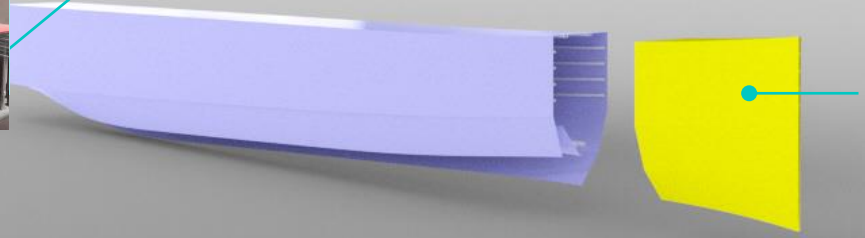
Hot-Stamping

Out-of-die UV cured pultrusion

ATP



Adaptive moulds



3D Printing

Out of die UV cured pultrusion

Iván Sáenz

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UV Pultrusion – Our solution for Shipbuilding

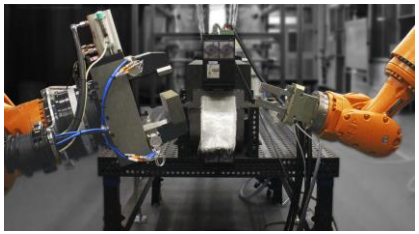
Current manufacturing methods for stiffeners

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

Semi-artisanal

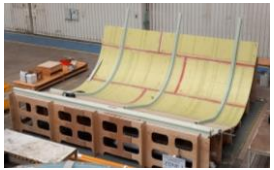
Wastage of raw materials

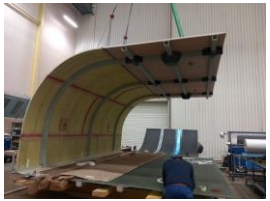
FRP Shipyard modernisation



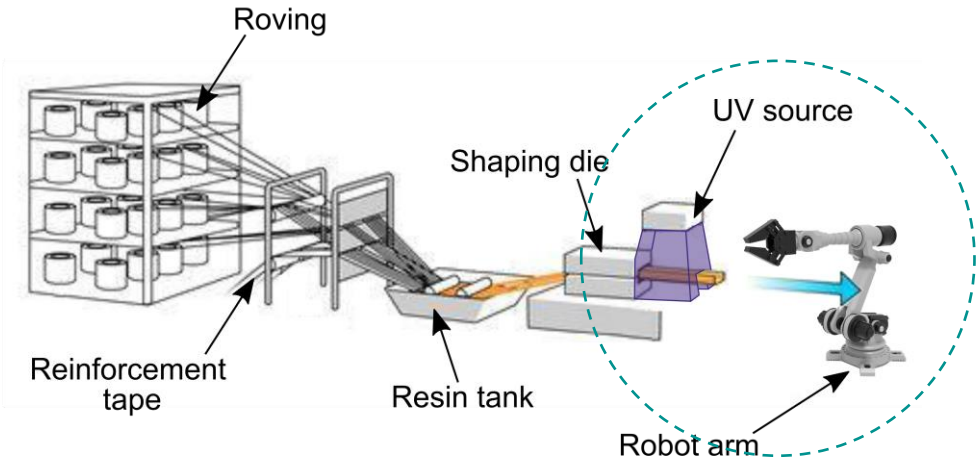
Automated production of stiffeners

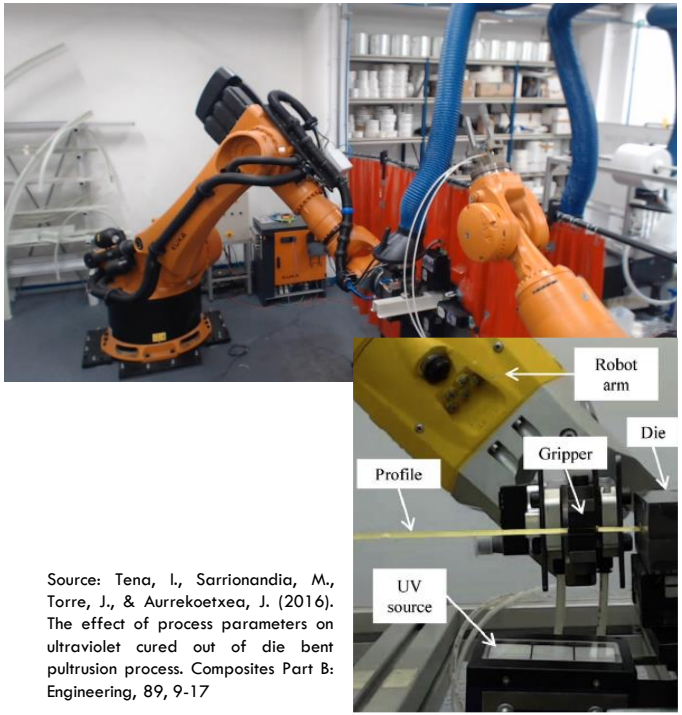
Directly bonded to desired area





UV Pultrusion – Our Technology





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

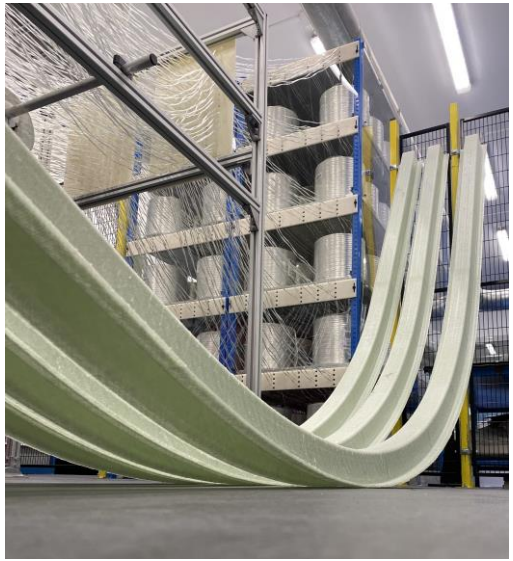
Advanced materials

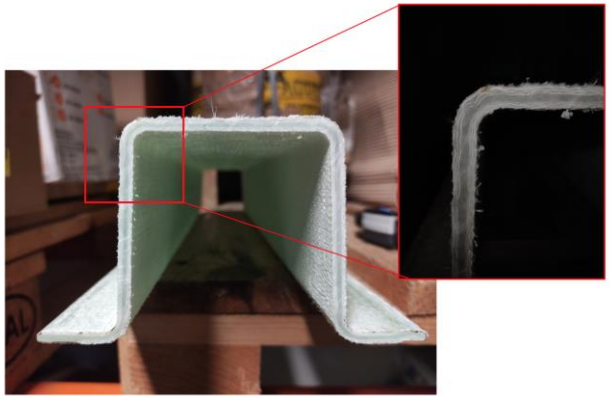
Advanced manufacturing technologies

Automation technologies and intelligent robotics

UV Pultrusion – Our stiffeners

Shipbuilding profile (developed in Fibre4Yards project)





High-performance 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

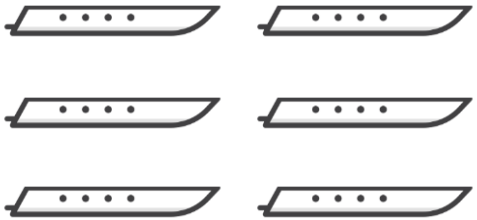
Mechanical properties

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

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

UV Pultrusion – Advantages for shipyards

Less cost and high manufacturing capacity



Stiffener directly bonded to the desired area

Elimination of curing times

Increase in productivity

Increased quality control of vessels

Control of fibre volume and thickness of stiffeners

Automated and repetitive manufacturing process

Certified product

Greener vessels

Reduction of raw materials and suppression of polyurethane moulds

Reduction of stiffener geometry

Reduction of the final weight of the vessel

UV Pultrusion – Not only a I+D project

Robtrusion
CURVED COMPOSITE PROFILES

Best innovative Startup in Basque Country 2022 (Spain)

Thank you !

IRURENAGROUP ADVANCED TECH COATINGS

Mondragon Unibertsitatea Goi Eskola Politeknikoa

EUSKO JAURLARITZA GOBIERNO VASCO

European Commission

Gipuzkoako Foru Aldundia
Diputación Foral de Gipuzkoa

ORAIN GIPUZKOA

WEEVIL

Grant agreement n° 653926

GRUPO spri TALDEA

BIC GIPUZKOA UP! EUSKADI

FIBRE4YARDS

AEMAC ASOCIACIÓN ESPAÑOLA DE MATERIALES COMPUESTOS

Grant agreement n° 101006860

Hot-Stamping

João Silva

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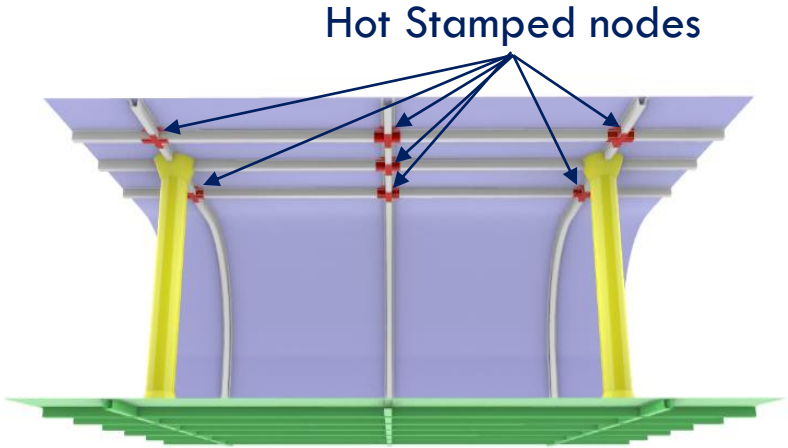
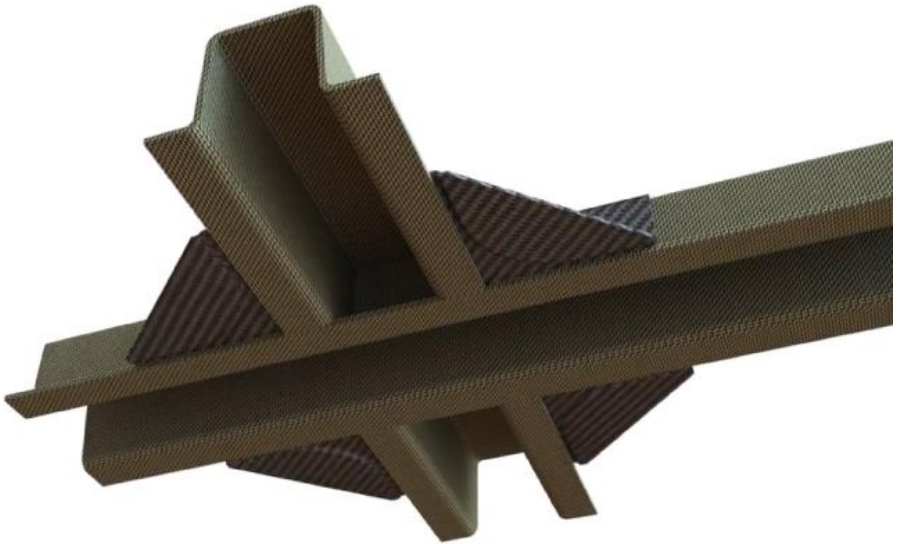
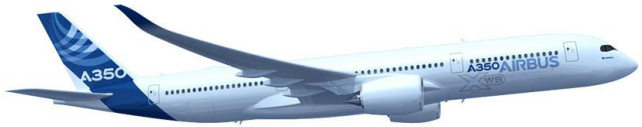
Hot-stamping of thermoplastic-based composite
Concept





Hot-stamping of thermoplastic-based composite
Technology Transfer

Technology transfer



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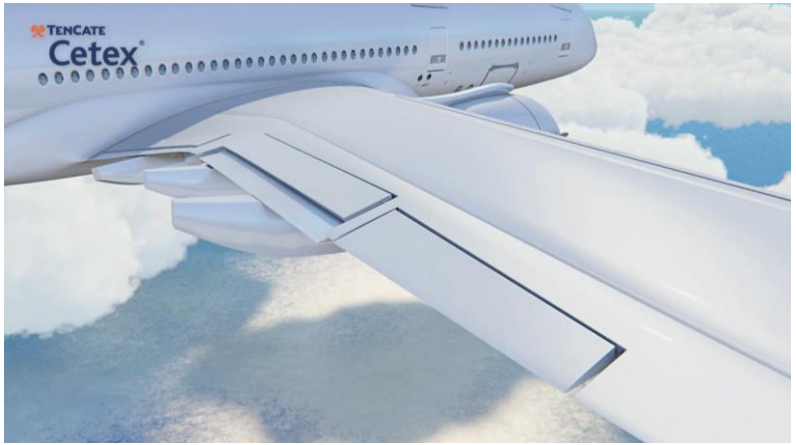

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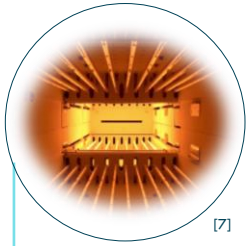
Hot-stamping of thermoplastic-based composite
From CAD to component


[5]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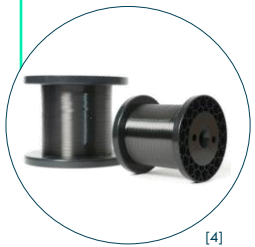
[9]

PROCESS

AUTOMATED LAYUP | **CONSOLIDATION** | **HEATING** | **HOT STAMPING**

COMPOSITE TAPE | **TAILORED LAYUP** | **PREFORM** | **MELTED PREFORM** | **FINAL PART**

PRODUCT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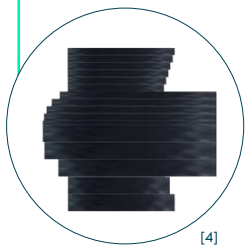
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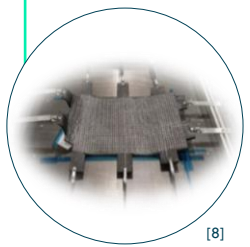
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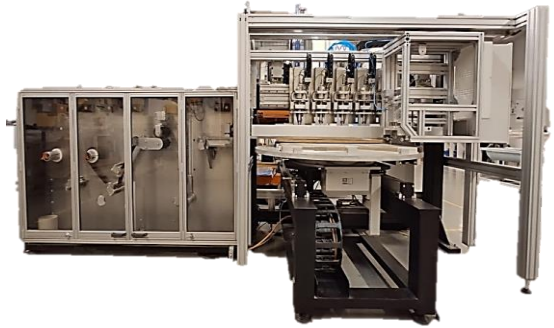
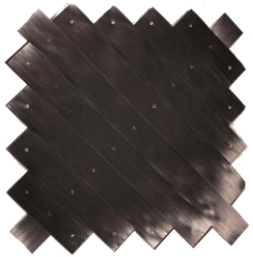
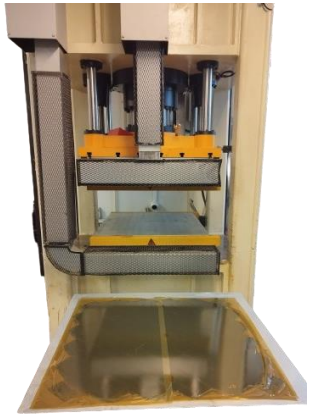
Hot-stamping of thermoplastic-based composite
Technology Outline

Automated Tape Laying



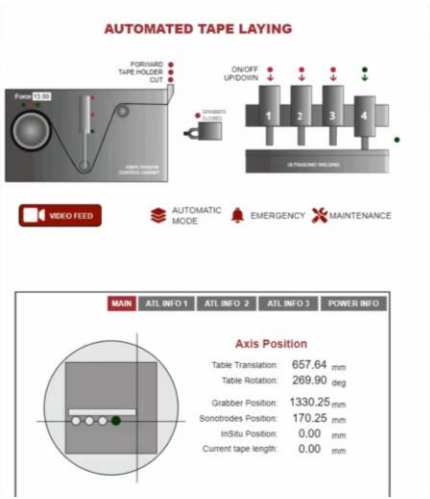


Blank Consolidation



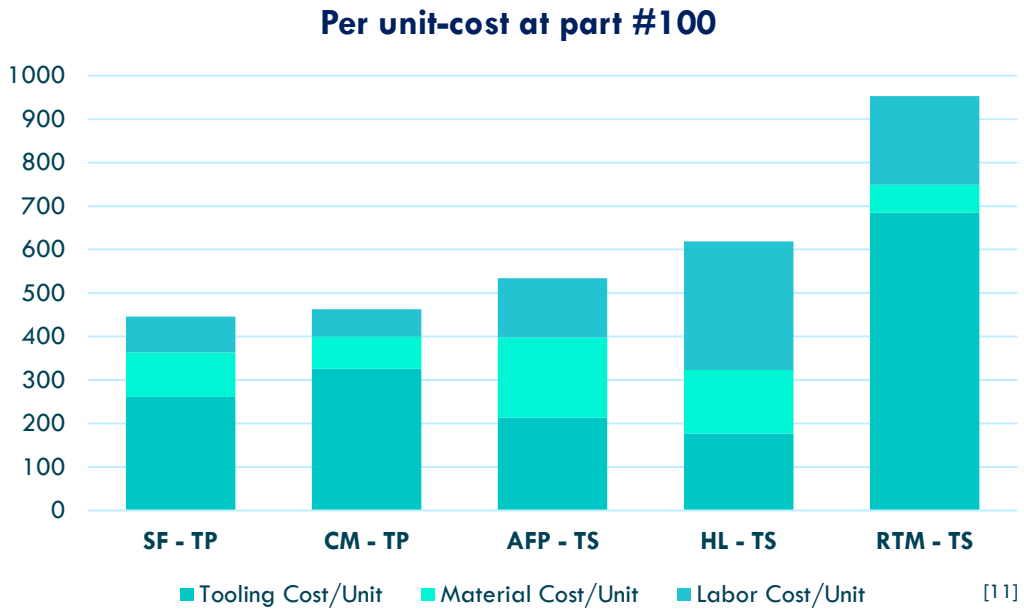
Hot Stamping

Hot-stamping of thermoplastic-based composite
Automation and digitalization



Hot Stamping cell

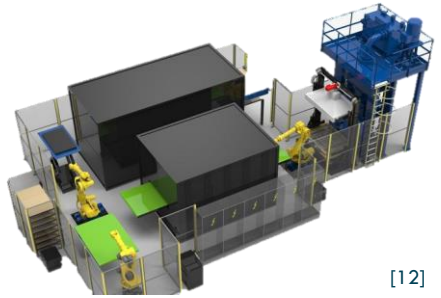
Hot-stamping of thermoplastic-based composite
Implementation benefits



[11]

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

TP – Thermoplastic
TS – Thermoset



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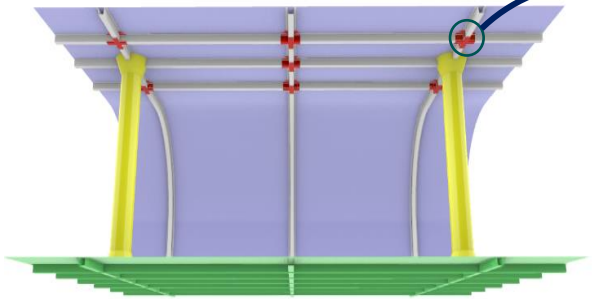
Hot Stamping cell

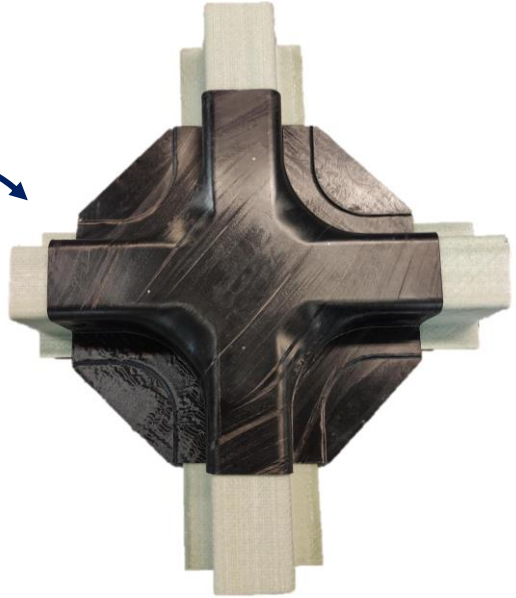
Hot-stamping of thermoplastic-based composite
Integration

Concept



Demonstrator

Assembly



Adaptive mould

François Geuskens

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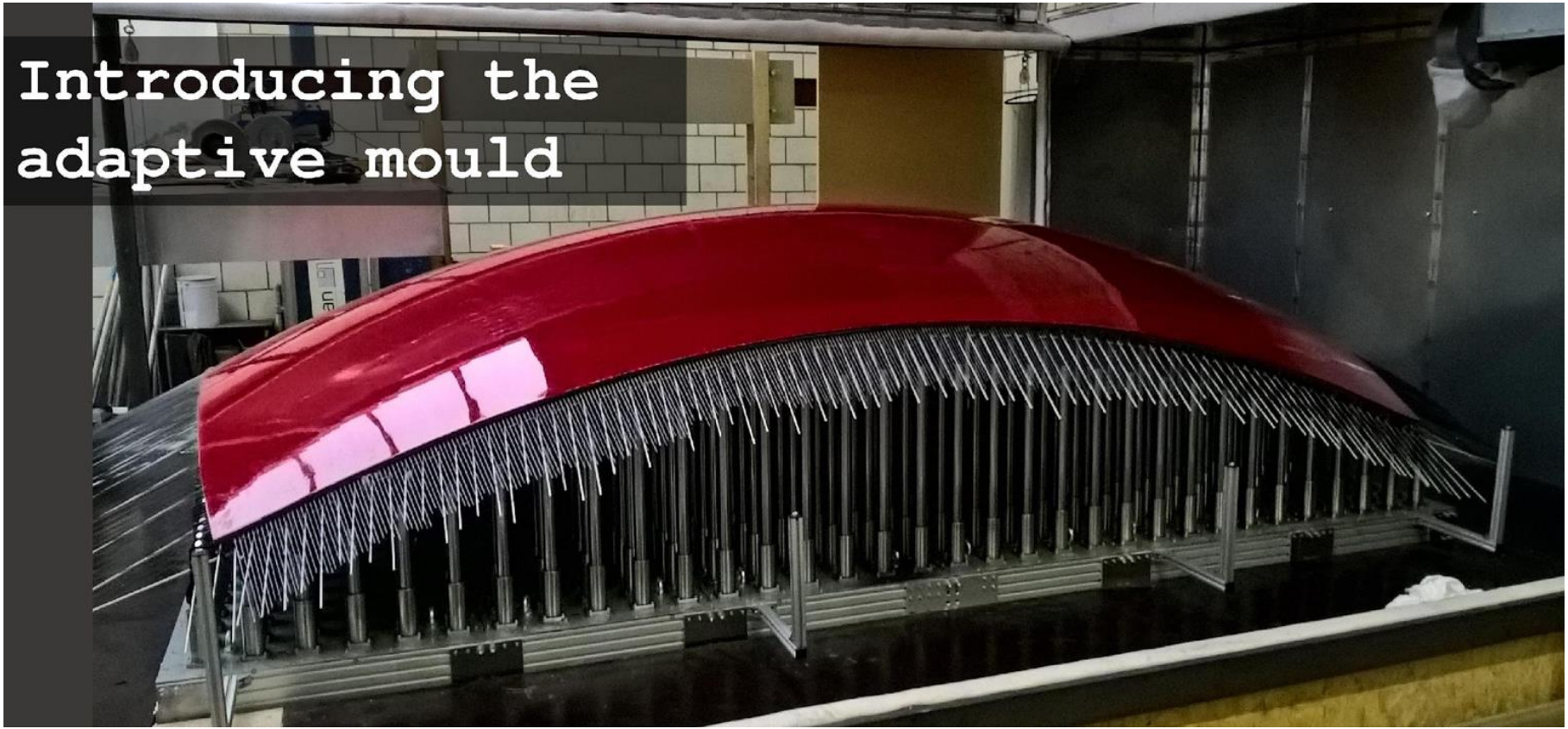
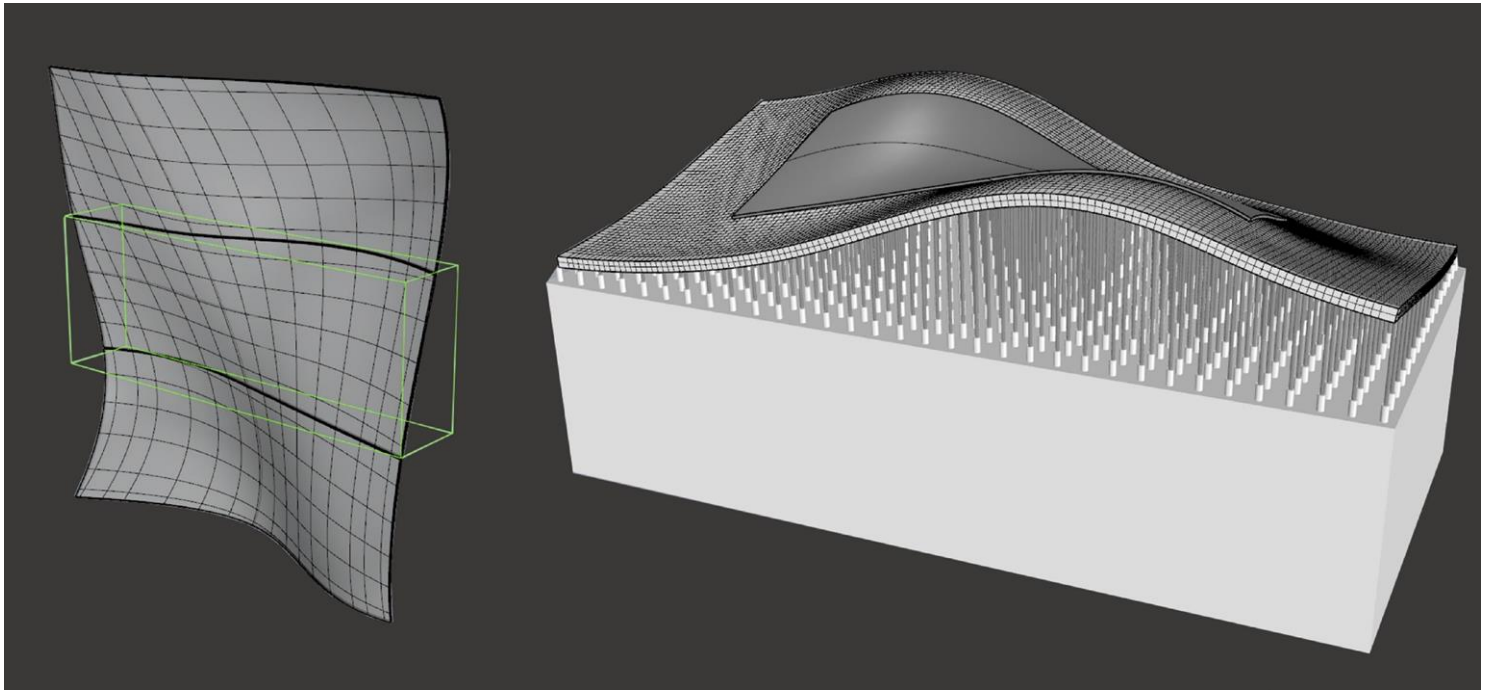
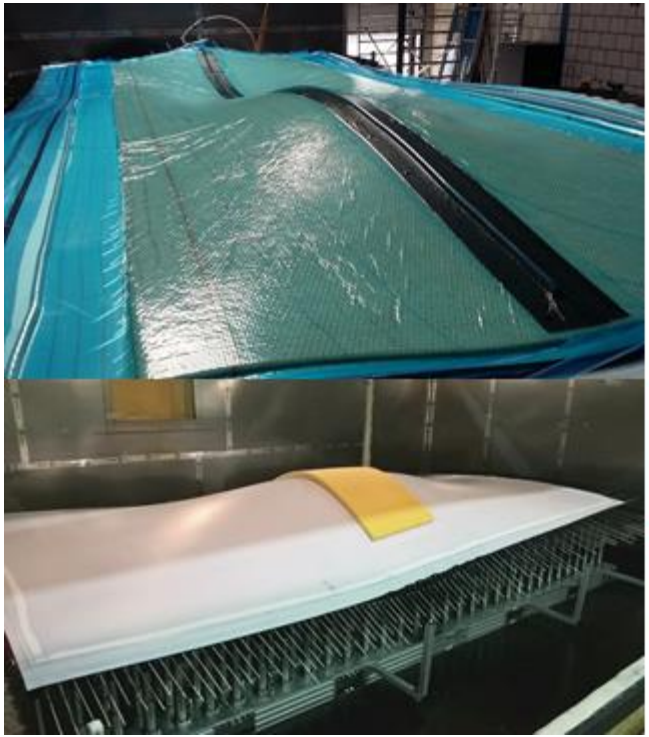
Introducing the adaptive mould



Automation
Direct from 3D CAD environment



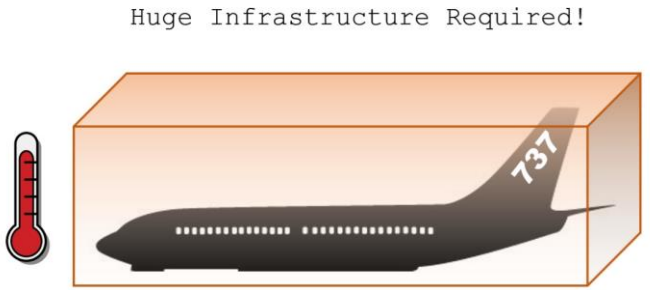
Many composite processes possible



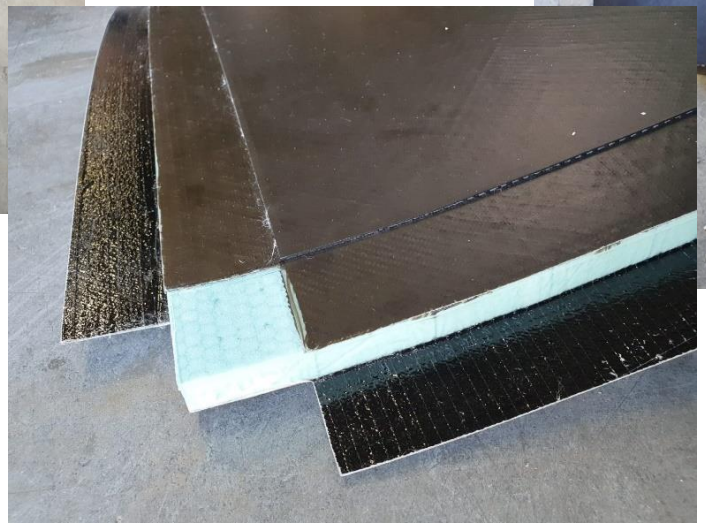
Vacuum infusion
& Prepregging

Thermoforming

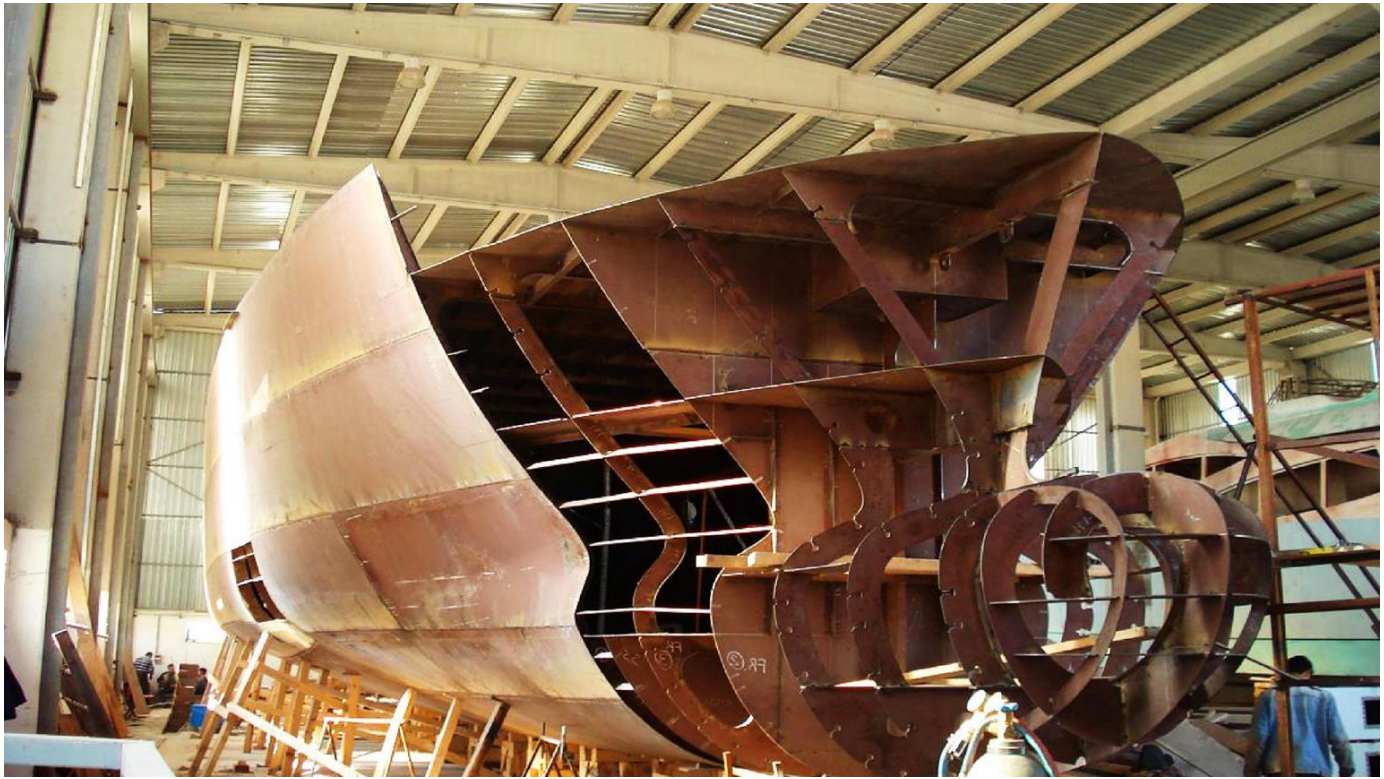
Current large composite production



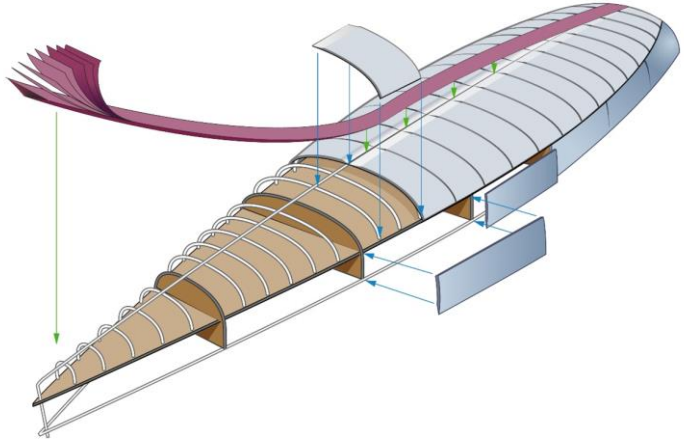
Joint detail

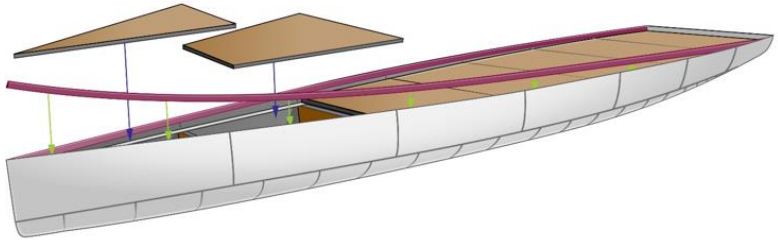


Let’s look at metal shipbuilding



Composite Panel assemblies are possible





3D Print & ATP

Joep Grapperhaus

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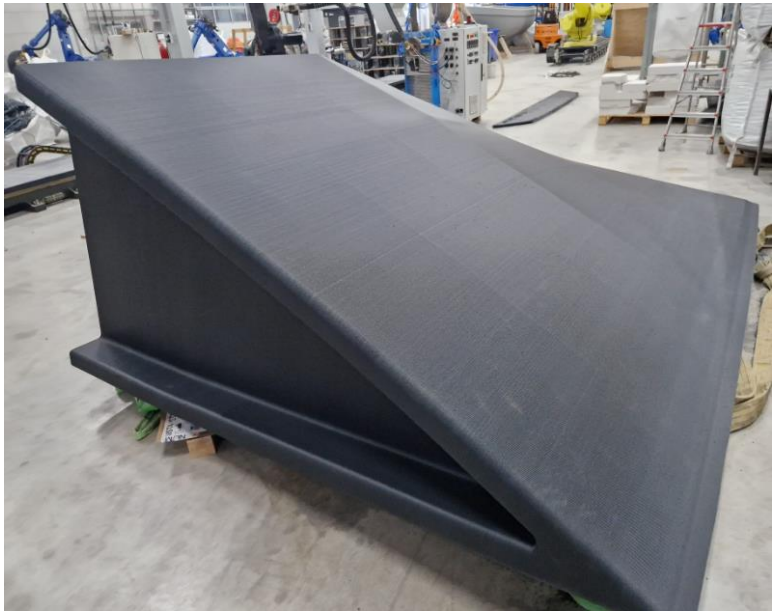
3D Printing

3D Printing

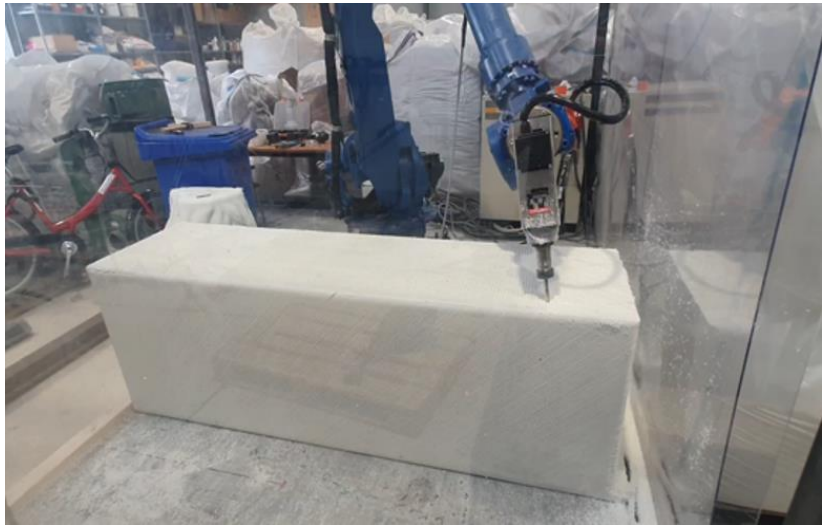
Additive Manufacturing – Shipbuilding

Additive Manufacturing – Shipbuilding

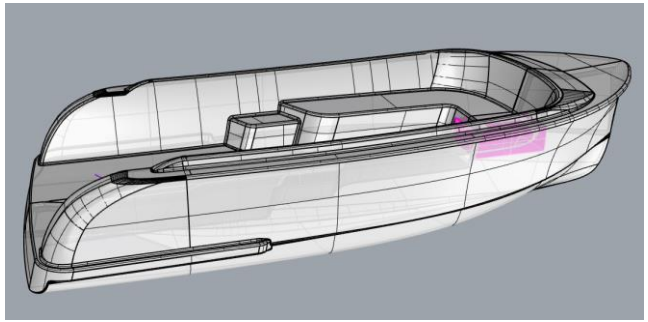
Additive Manufacturing – Fibre4Yards Axe Bow

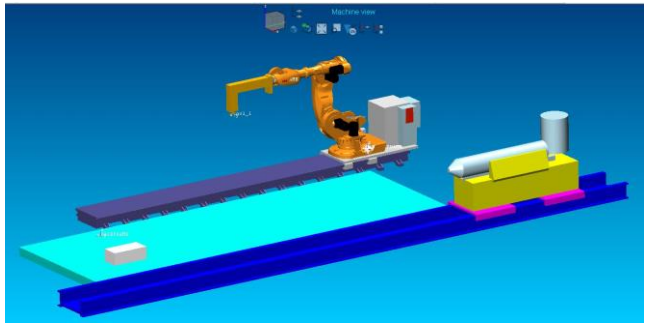


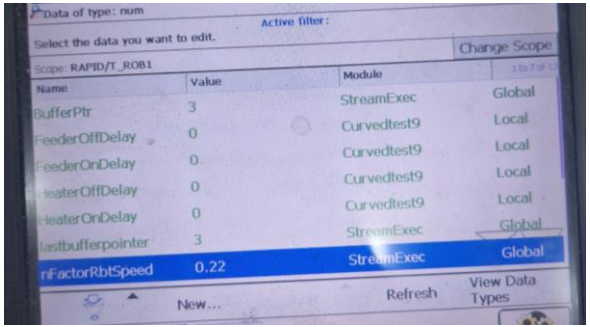
CNC



ATP
Workflow

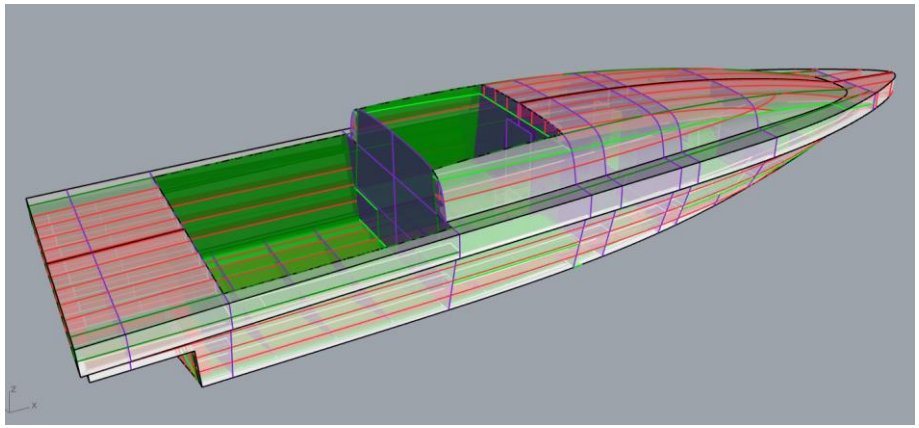


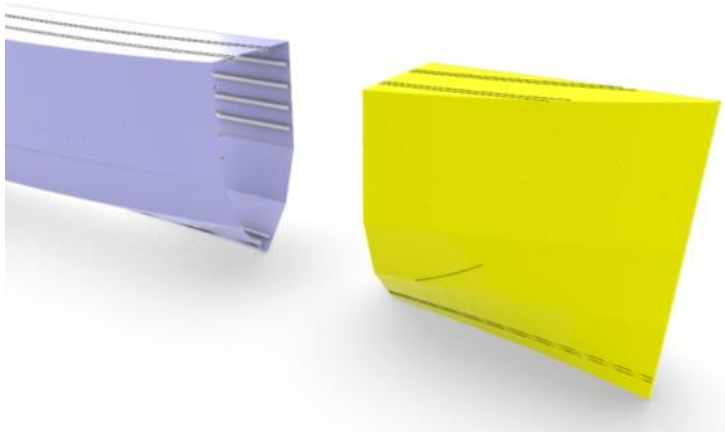


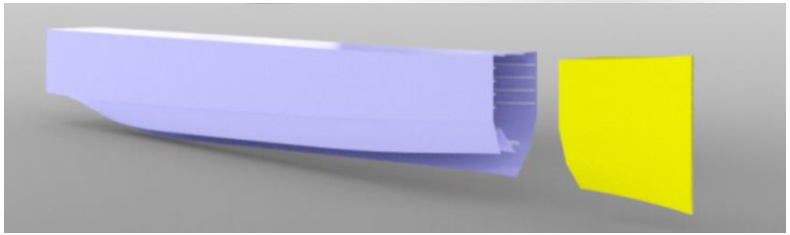


ATP

ATP & 3D Printing
Workflow







Modular Assembly

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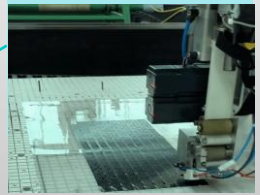
Modular Assembly
Integration

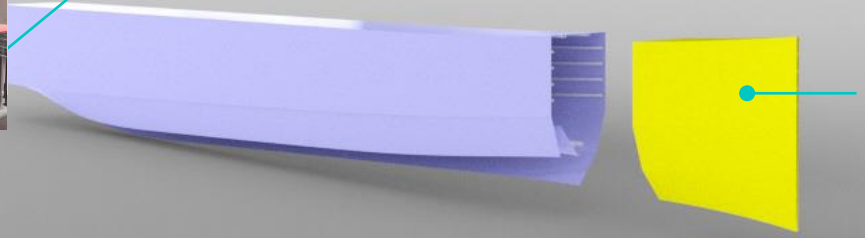
Hot-Stamping

Out-of-die UV cured pultrusion

ATP



Adaptive moulds



3D Printing

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SHIPYARD FOR THE FUTURE

Thank you !

https://www.fibre4yards.eu/

https://www.linkedin.com/company/fibre4yards/

This project has received funding from European Union's Horizon 2020 research and innovation programme under grant agreement n° 101006860.

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