FIBRESHIP

INTEGRAL COMPOSITE SHIP

This project has received funding from European Union´s Horizon 2020 research and innovation programme under grant agreement Nº 723360

2nd WORKSHOP

BREAKOUT SESSION 3

PRODUCTION/DEMONSTRATOR

La Ciotat, 25th June 2019

INDEX – BREAKOUT SESSION 3

PRODUCTION

Project objectives

PROJECT OBJECTIVES

- GENERAL OBJECTIVE
  - GENERATE EFFICIENT PRODUCTION METHODOLOGIES
- Specific objectives
  - ✓ Develop and qualify production techniques to build large components.
  - ✓ Develop and qualify modular assembly techniques of large vessels parts.
  - ✓ Study and qualify the techniques to manage large composite parts.
  - ⏳ Analysis of the best facilities to build large composite vessel parts and small-medium shipyard adaptation.
  - ○ Development of the new classification societies guidance notes for the large vessel composite construction

- **Task 5.1 – Optimum building strategy & techniques**
  - Subtasks:
    - ✓ 5.1.1. Materials and production techniques applicable to build large scale components.
    - ✓ 5.1.2. Modular assemblies and equipment/piping integration.
    - ✓ 5.1.3. Optimum building strategies & techniques versus vessel zone/type and functionalities.

- **Task 5.2 – Shipyards adaptation to develop this new activity**
  - Subtasks:
    - ✓ 5.2.1. Assessment of the existing facilities for small/medium vessel.
    - ✓ 5.2.2. Analysis of the needs to develop this new activity for large length vessels
    - ✓ 5.2.3. Problems and solutions
    - ✓ 5.2.4. Analysis of existing shipyard facilities transformation and economic viability.

- **Task 5.3 – Development of classification societies' guidance notes for the adoption of new building techniques**
  - Subtasks:
    - ✓ 5.3.1. Assessment of the rules and guidelines in use.
    - ✓ 5.3.2. New guidance notes for large length vessels

MATERIALS & PRODUCTION METHODS

Materials

- What is composite
- Fibers, types and orientation
  - Fibreglass will be the predominant reinforcement.
- Resins, types
  - Thermoset resins is the most relevant class of resins and the most familiar to the shipyards.
- Prepregs, pre-impregnated fibers
- Monolithic
- Sandwich

- Many combinations

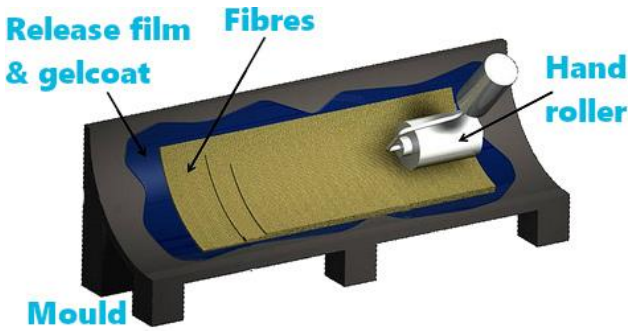
Materials and production techniques applicable to build large scale components

- **Vacuum-assisted Resin Transfer Moulding** (VaRTM) has been identified as the manufacturing method which is most feasible and best suited to build large-scale sections.
- Also, manual procedures, i.e. hand lamination and layup, will be indispensable to make e.g. joinings during assembly.

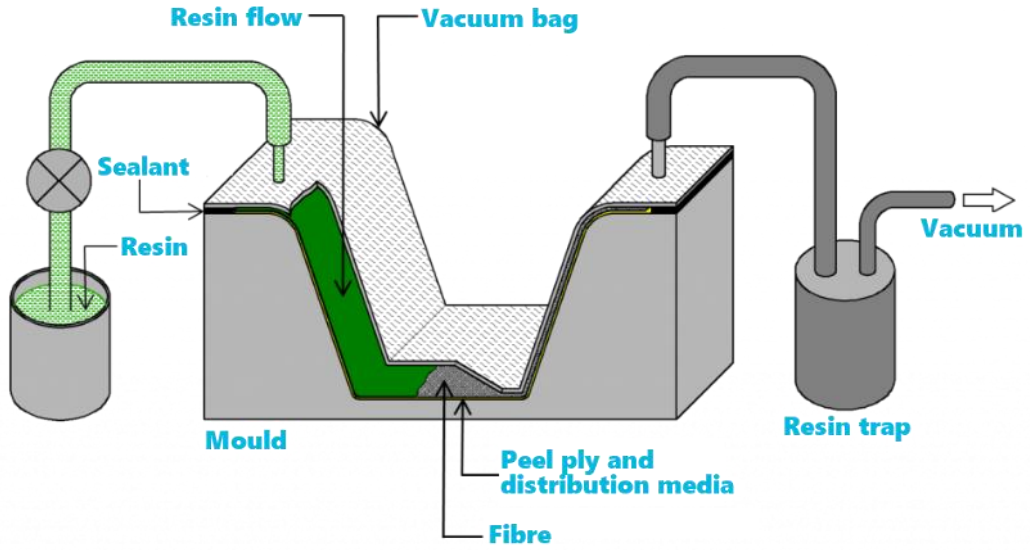
Production techniques applicable to build large scale components

- Most common production process is VRTM, known as “infusion”, used for large parts
- Hand-layup is mostly used for connections
- Other alternative production methods for serial production of smaller parts

Hand lay up



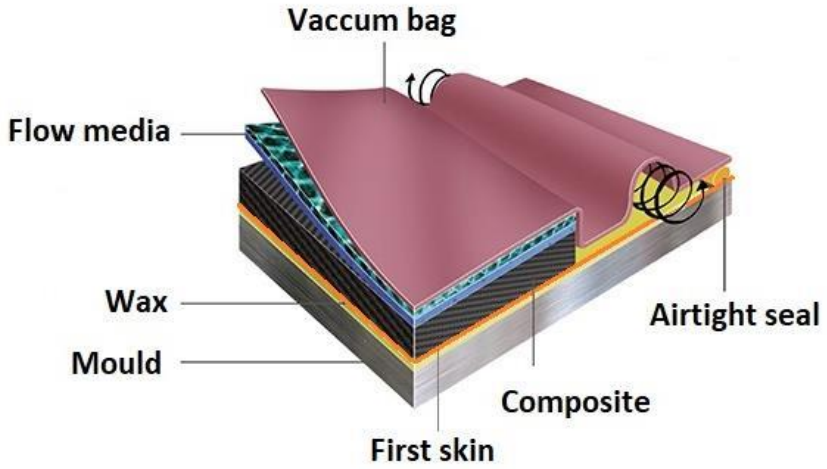
Vacuum-assisted Resin Transfer Moulding



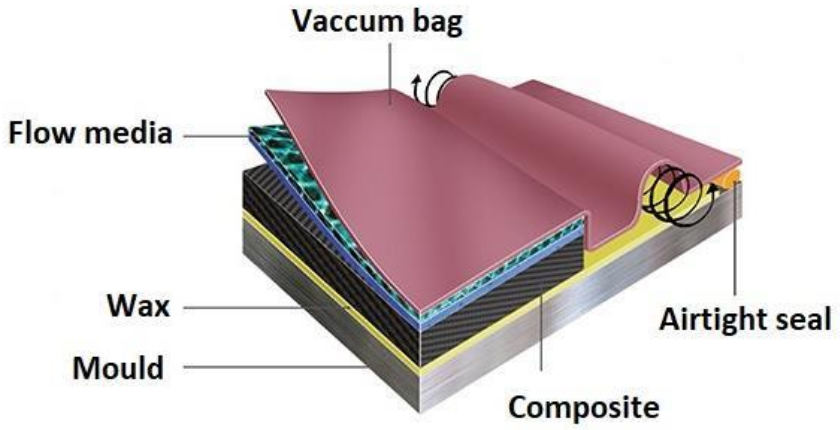
Infusion layup, in details

- Best way to produce large composite parts
- Both monolithic and sandwich
- Better ratio between fabric and resin, compared to hand layup
- Reduce risk of human failures

Lay up for infusion with polyester / vinylester



Layup for infusion with epoxy



Materials and production techniques applicable to build large scale components

- Example of VaRTM infusion process of 35m Carbon catamaran hull

Automated processes

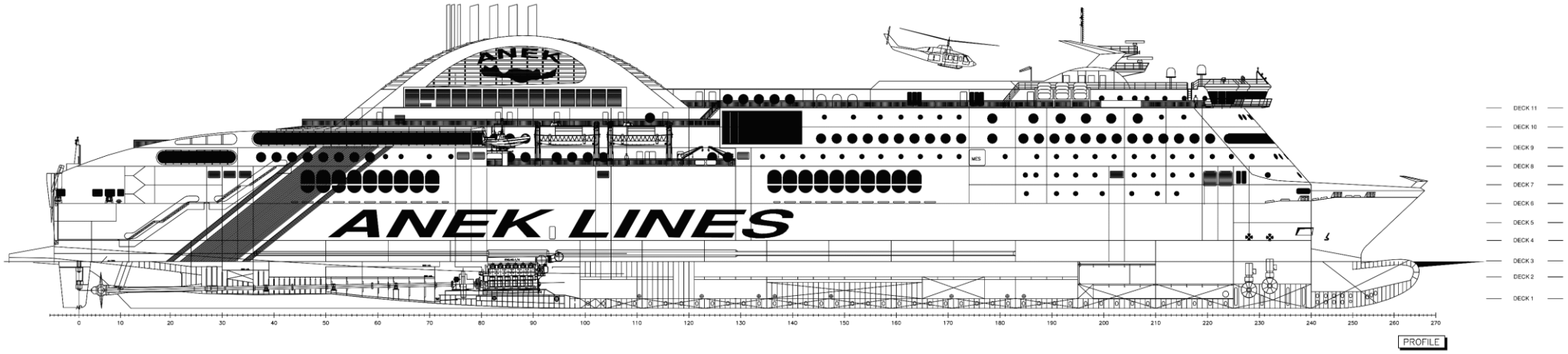
- Example of automated tape laying
- Process is still not flexible
- Process / system is very expensive
- Mostly used for small parts with high value and ratio between strength and weight

MATERIALS & PRODUCTION METHODS

Production element	Production method	Tools
Flat hull sides	VaRTM	Flat table
Curved hull sections	VaRTM	Mould
Decks	VaRTM / aut, process	Flat table
Beams	VaRTM / aut. process / hand layup	Dedicated mould
Bulkheads	VaRTM / aut. process	Flat table
Stringers/girders	VaRTM / hand layup	Dedicated mould / in-situ
Stiffeners	VaRTM / hand layup	Dedicated mould
Pipes connections		
Fin	VaRTM	Mould / in-situ

CASE STUDY AND CHALLENGES

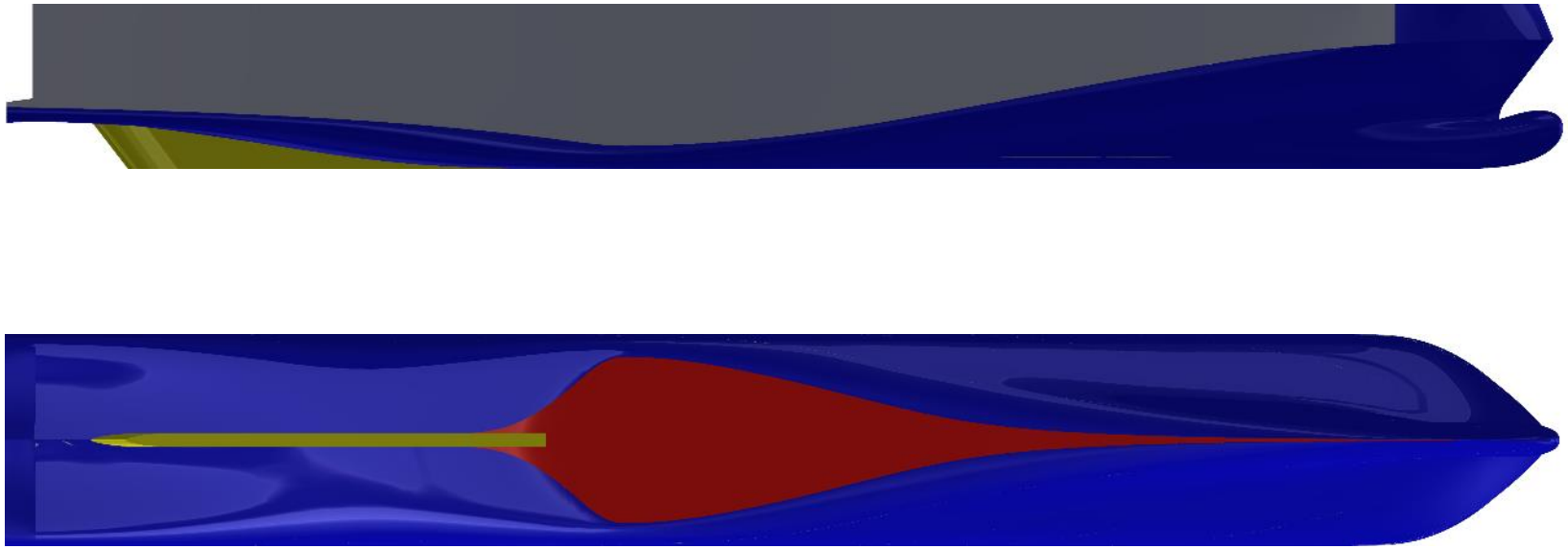
Ropax profile



CASE STUDY AND CHALLENGES

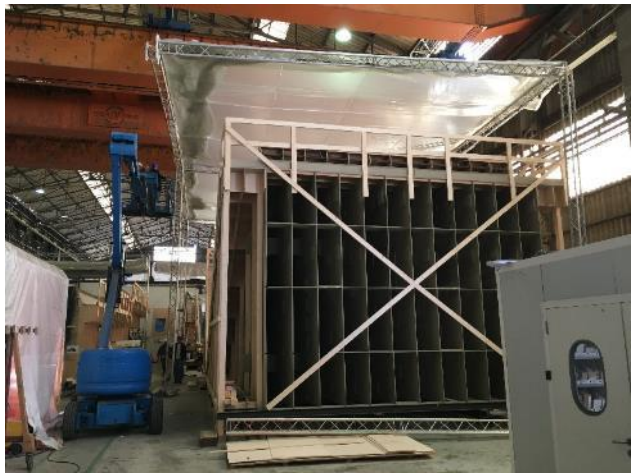
- Colour-coded profiles

  - Grey – flat side panels
    - 4.773m^2
  - Blue – curved area
    - 5.539m^2
  - Red – flat bottom panels
    - 810m^2



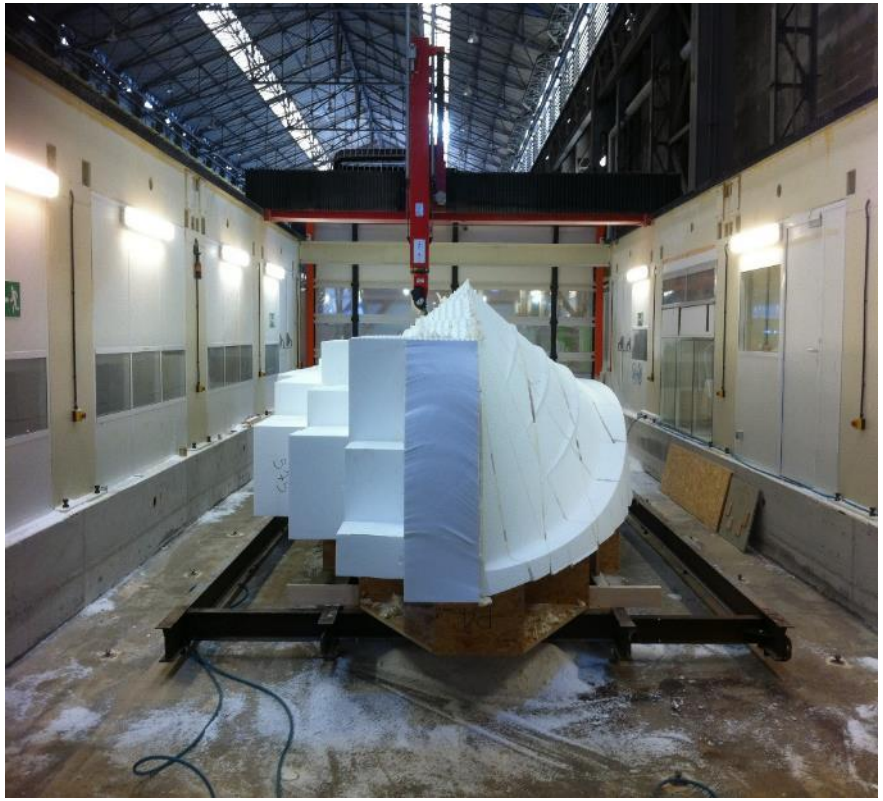
CASE STUDY AND CHALLENGES

- **Tooling as the main challenge**
  - The designated manufacturing method
  - Generally, there are two types of moulds
    - Prototype moulds



CASE STUDY AND CHALLENGES

- Tooling as the main challenge
  - Production moulds



CASE STUDY AND CHALLENGES

- CHALLENGES
  - Approval of large composite ships by the rules
  - Economically viable strategies for employment of methods for production of larges structures.
  - Scaling and adaptation of existing facilities and transformation of work flows and supply chains
    - Facilities (drydock, quays, buildings, cranes, storage of raw materials etc)
    - Moulds (logistics, building, movement and storage)
    - Industrialisation (flat panels, beams)
    - Workforce (engineering / design, workshop)
    - Safety and environment (chemical products, dust)
    - Subcontracting (standardised elements)
    - Competitiveness
      - Composites vs. steel
      - Balance of economy between steel and composite has to include fuel savings and reduced maintenance and not only production cost.

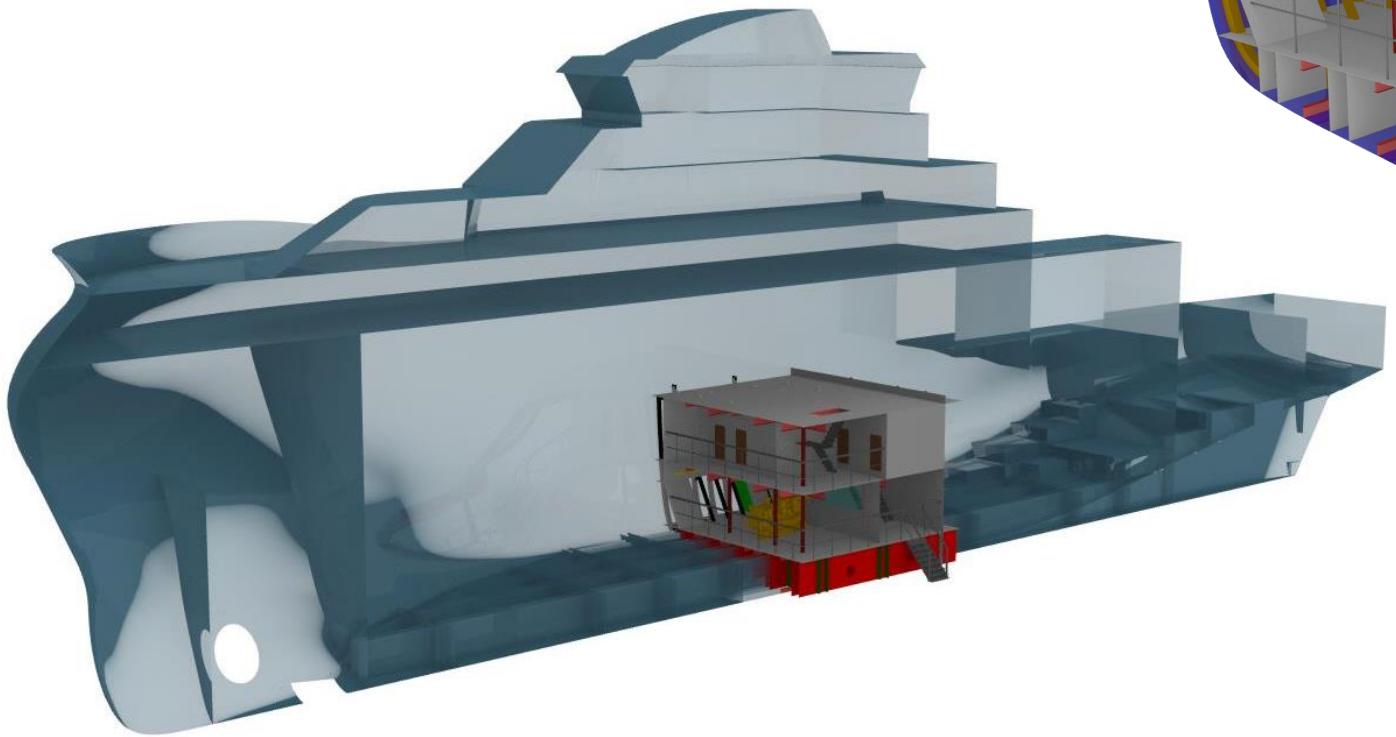
CONCLUSIONS – PRODUCTION

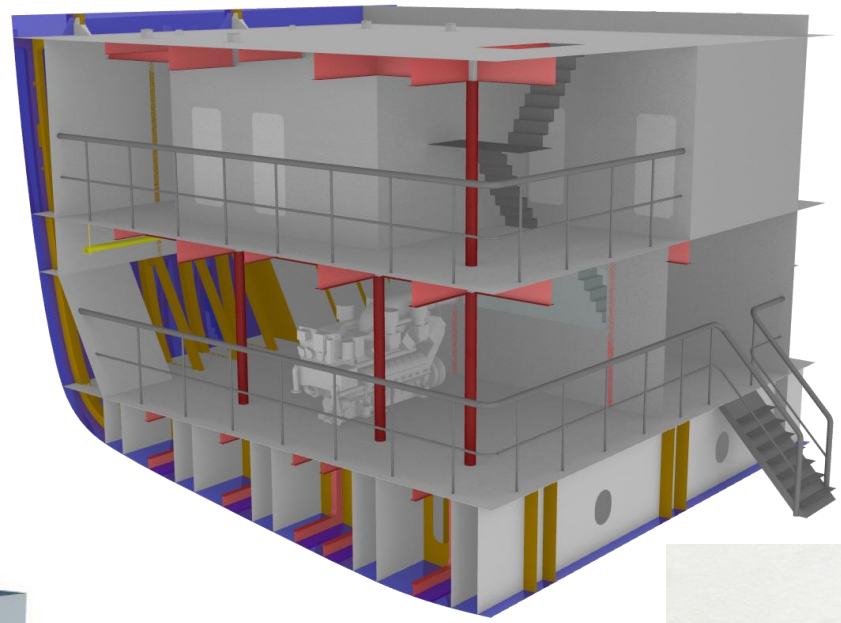
- **Main conclusion:**
- A production method has been identified and qualified, which suits the materials and designs developed in Fibreship.
- Difficult to reuse molds, low cost mold development is important
- Today automated process are not developed for large composite shipbuilding activities
- Transformation of shipyards
  - From existing large steel yard to composite yard
  - Small composite yard to large composite yard
  - Small composite yard sub-contracting parts/blocks to large yards

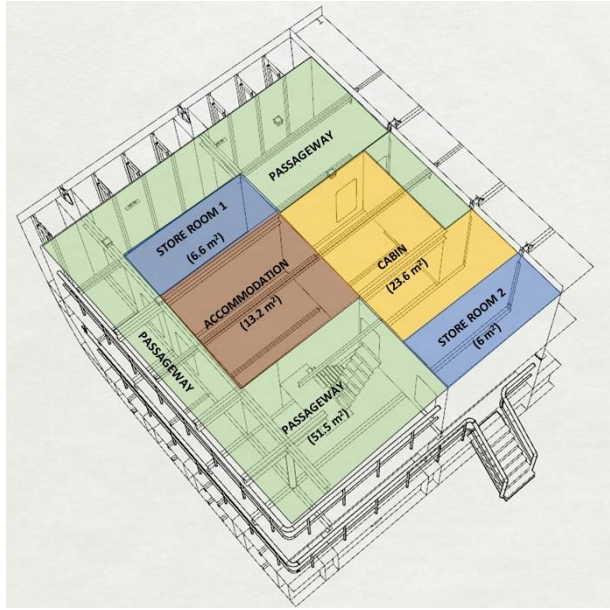
DEMONSTRATOR

DEMONSTRATOR

- Block of a 85m Fishing Research Vessel







DEMONSTRATOR

- GENERAL OBJECTIVE
  - Demonstrate the technical feasibility
- Specific objectives
  - Adaptation of the tooling due to the size
  - High thickness monolithic hull with “fire resistant system”
  - Bloc junction
  - Structure designed for large composite ship
  - Insertion of fittings we can encounter on a ship
  - Lab tests related to the demonstrator

DEMONSTRATOR

https://www.youtube.com/watch?v=iO9S1uSPehg

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www.fibreship.eu