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# GRP car ferry “MF Barmen” operating experiences and updates on the “Cost-FRM” project

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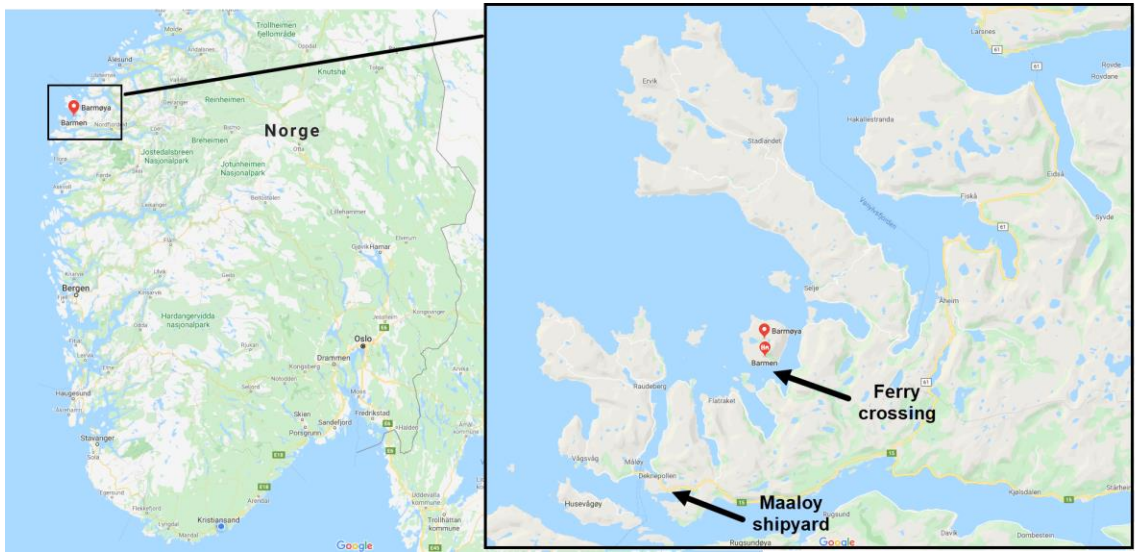
MARINE || COMPOSITES || RENEWABLES || SUBSEA

# Barmen ferry project

- April 2018: 10 year contract awarded from the Norwegian road administration (Statens Vegvesen) to shipowner Vidar Hop Skyssbåter
- Building contract awarded to Maaloy shipyard
- Operational january 2020



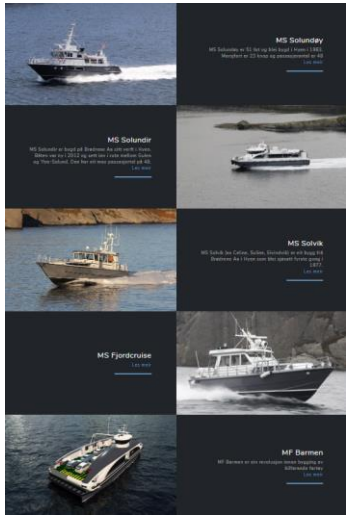


# Maaloy shipyard

- Composite shipyard in north-west between Bergen and Ålesund
- 20 employees

# Vidar Hop Rederi

- Family owned shipowner in Sogn in western Norway
- 13 vessels
- 29 employees



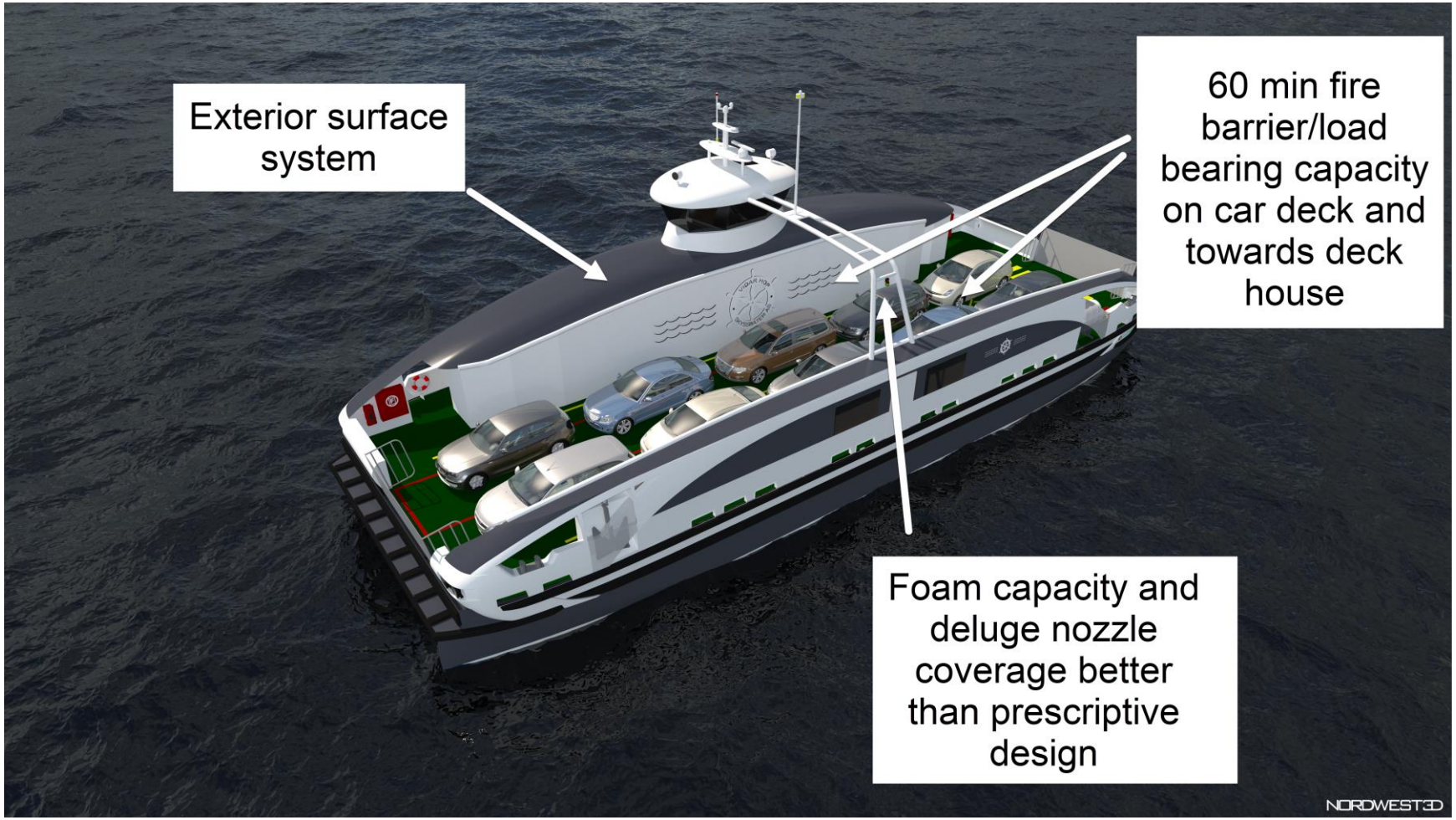

Sub-contractors:

# Main data

- Name: «Barmen»
- Build: 23
- Design: Easyform / Sea Technology
- Length: 29.98 m
- Width: 11 m
- 10 cars
- 50 passengers
- Propulsjon: All electric
- Material: GRP Sandwich


https://youtu.be/GeuNrCtJnDU

# Barmen ferry - Fire safety design



# Start up experience

- MF Barmen was the 2nd all-electric ferry in Norway. Rules and regulations have been establish during building process.
- The large uncertainties in equipment and requirements when vessel was designed led to too low hull volume/high weight. Summer of 2020 a 35m3 volume was added on inside of hull raising the WL by 250mm.
- Propulsion system – The whole system was new. Design principle to avoid single point of failure. All systems have redundancy/are dual. There has been a lot of work on getting all systems up on running smooth.

# Overall

- Allthough some start-up issues.
- The overall cost-effect for choosing GRP is confirmed.
- Composite car ferry gives
  - less maintanace cost
  - less power consumption
  - full design freedom
- Composite is a good choice for small and medium size car ferries.

| **Parameter** | **Steel Ferry (Estimated)** | **GRP Composite ferry (Barmen ferry)** | **Cost effect** | **Comment** |
|---|---|---|---|---|
| Hull material (CAPEX) | Steel hull weight 125 tonne | GRP Sandwich hull weight 50 tonne | +10 MNOK | Building cost hull |
| Hull material (OPEX) | | | -6.2 MNOK | Maintenance cost reduction: -0.5 MNOK pr year |
| Battery pack (CAPEX) | 250 kWh | 150 kWh | -0.25 MNOK | Smaller battery pack |
| Propulsion (CAPEX) | 2 x 250 kW (2 x 4000 kg) | 2 x 150 kW (2 x 2300 kg) | -0.2 MNOK | Smaller engine |
| Lifetime energy consumption 1),2),6) | 1167 MWh x 20 = 23 TWh | 700 MWh x 20 = 14 TWh | -5.8 MNOK | Energy consumption reduction: -0.47 MNOK pr year |
| **Total cost reduction** | | | **-2.45 MNOK** | |

Assumptions:

1) Steel ferry total operational displacement: 200 t
2) GRP ferry total operational displacement: 120 t
3) Battery pack and thruster capacity increases linearly by weight (simplification)
4) Energy cost: 1 NOK/kWh
5) Present value interest rate: 5%
6) 20 years, 3000h/year, 70% of installed effect, 10% power loss during charging

# Cost-effective Fire-Resisting material (Cost-FRM)

- Budget 1.15 million €
- Direct spin-off from the Barmen ferry project
- Funded by Norwegian Research council
- Partners:
  - Sea Technology/Maaloy verft - Shipyard
  - Libra plast – Manufacturar of ship doors and hatches
  - cDynamics – Project management and consultancy
  - RISE – Develop new fire models and perform fire tests
- The outcome of the project will be new solutions for composite panel and door constructions, complying to the International code for application of fire test procedures (FTP Code).

The Research Council of Norway

Libra™

Måløy Verft

RI. SE

cDynamics

# Work packages

| | Name | Leader | Other participants | Description |
|---|---|---|---|---|
| **WP1** | Fire resistant layups | cDynamics | RISE, Sea Technology, Måløy Verft, Easy Form, Libra | Industrial research<br>Review existing composite panels and their components. Identify alternative material solutions. Define promising new layups. |
| **WP2** | Fire resistant panel | Sea Technology | RISE, cDynamics, Måløy Verft, Easy Form | Industrial research<br>Experimental production of panel with integrated fire protection system. Develop fire resistant panels. Test panels. |
| **WP3** | Fire resistant door | Libra | RISE, cDynamics | Industrial research<br>Experimental production of door with integrated fire protection. Develop fire resistant doors. Test doors. |
| **WP4** | Fire-spread model | RISE | | Industrial research<br>Review literature and state-of-the-art technology on fire-spread prediction. Analyse empirical data from WP2 and WP3. Develop fire property prediction model. |

# Progress plan

- 2020-2022: Studies (WP1/WP4)
- 2022: Small scale testing (WP2/WP3)
- 2023: Large scale testing (WP2/WP3)
- 2024: Develop fire spread model

| Hovedaktivitet /Milepæl | Fra år | Kvartal | Til år | Kvartal |
|---|---|---|---|---|
| WP 1: Fire resistant layups | 2020 | 1 | 2022 | 4 |
| WP 2: Fire resistant panel | 2022 | 1 | 2023 | 4 |
| WP 3: Fire resistant door | 2022 | 1 | 2024 | 4 |
| WP 4: Fire-spread model | 2020 | 1 | 2024 | 4 |
| M1.1 Fire resistant systems report | 2022 | 4 | 2022 | 4 |
| M1.2 Define fire resistant layups for tests | 2022 | 4 | 2022 | 4 |
| M2.1 Experimental production of panel | 2023 | 2 | 2023 | 2 |
| M2.2 Test results small scale panel | 2022 | 3 | 2022 | 3 |
| M2.3 Test results for full scale panel | 2023 | 3 | 2023 | 3 |
| M3.1 Test results full scale door | 2024 | 2 | 2024 | 2 |
| M4.1 Sumarize fire-spread report | 2024 | 2 | 2024 | 2 |
| M4.2 Prototype of fire-spread model | 2024 | 3 | 2024 | 3 |


Video link

# Project focus area

- Materials to be suitable for shipyards
- Material production processes to be suitable for shipyards
  - Similar to already established processes for composite
  - As low investment cost as possible in new production equipment
  - Low curing temperatures
- Low/reasonable cost materials

# WP2 - Panel development

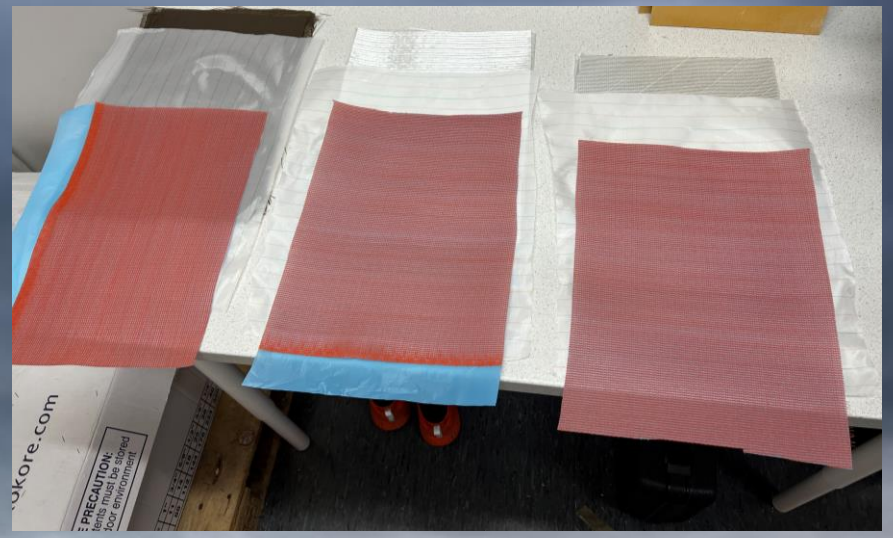
- Resins
  - Phenolics
  - Benzoxazine
  - Polyfurfuryl (PFA)
  - Combined with vinylesters, polyesters, epoxy
- Fibers
  - Glass
  - Carbon
  - Basalt

- Core
  - Phenolics
  - Balsa
- Surface
  - Ceramic paint
  - Intumescent paint/gelcoat
  - Other surface
  - Challenge: Finding a good quality surface that fulfills requirements

Configurations

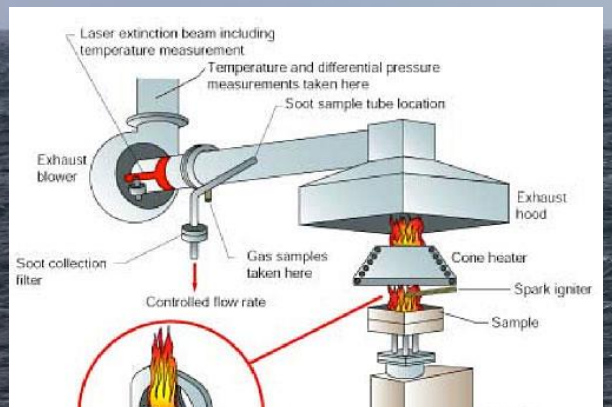
- Single material laminate
- Hybrid laminate
  - Thickness/layup of each material

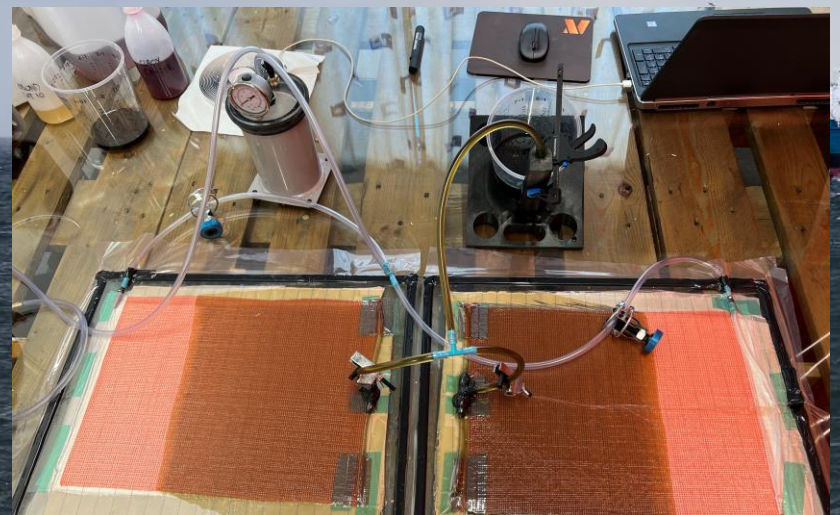
# Status CostFRM – July 2022



Different layups for first vacuum infusion.

11 layups prepared for cone calorimeter testing.

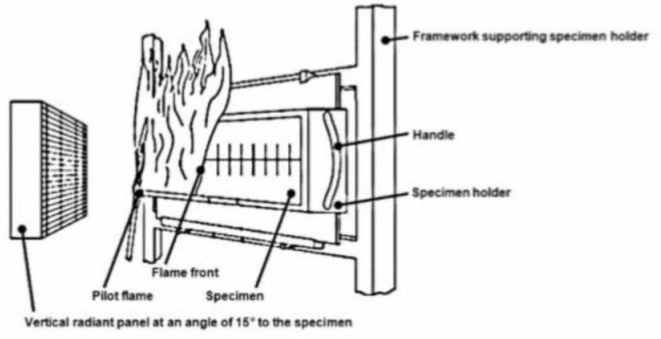


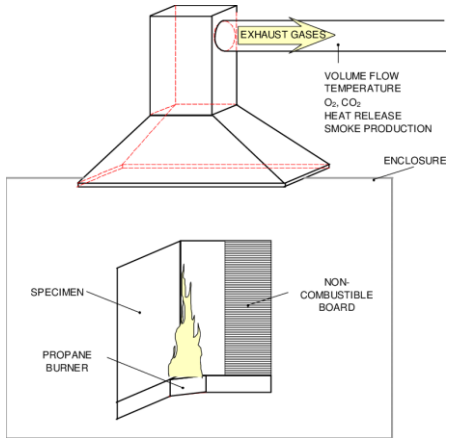
# Further work

- WP2 – Composite panel
  - Evaluate Cone Calorimeter results
  - Progress with larger scale test
    - FTP Code Part 5 / ISO 5658-2 “Surface flammability”
    - SBI (Single Burning Item) – Building standard test, lower cost than “Room Corner test”
    - Room Corner Test
- Use panel results (WP2) for door design (WP3)
- Establish fire spread model (WP4)

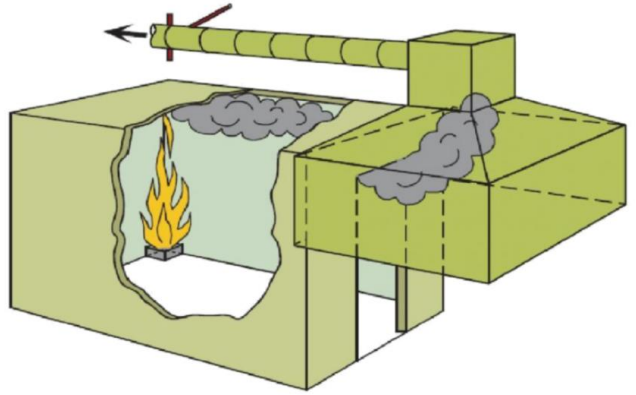
Part 5 – Surface flammability




SBI - Single Burning item




Room corner test



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# EXPERTS IN ENGINEERING SIMULATION

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