cDynamics

The development and approval process of the first GRP car ferry in Norway

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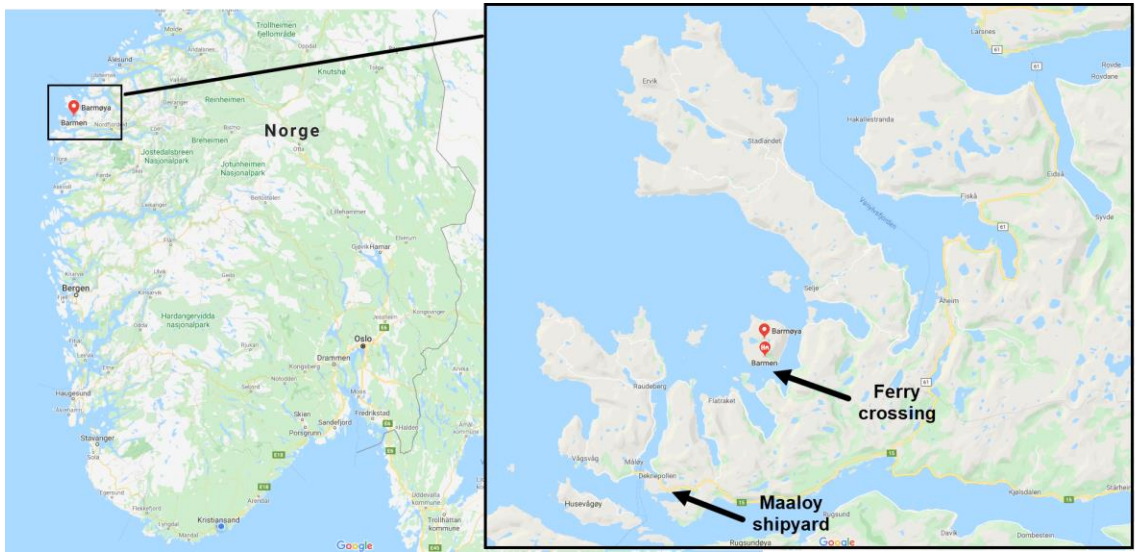
E-LASS Bremen 30-01-2020

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

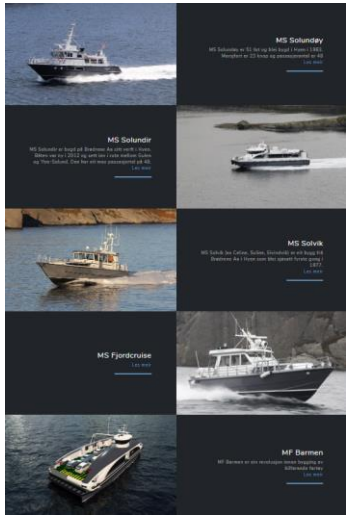


Maaloy shipyard

- 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

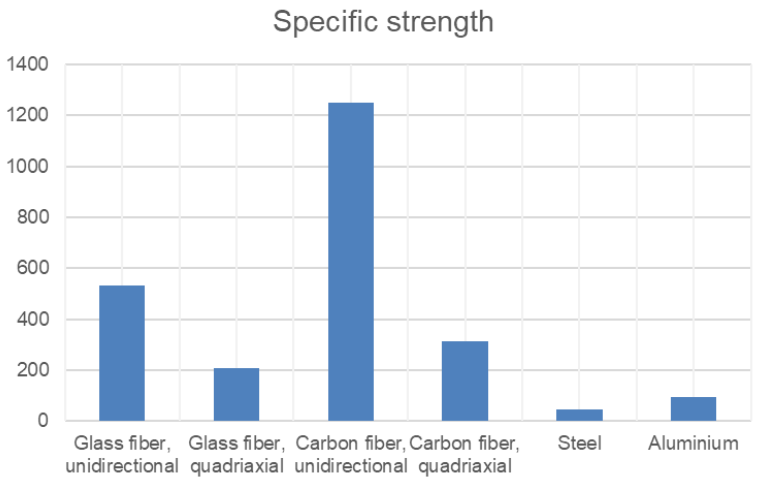


Sub-contractors:

Main data

- Name: «Barmen»
- Build: 23
- Design: Easyform / Sea Technology
- Length: 29.98
- Width: 11.00
- Tonnage: 239
- Propulsjon: All electric
- Material: GRP Sandwich

Why composites?



Material	Estimated relative weight difference
Carbon fiber sandwich	30%
Glass fiber sandwich	40%
Aluminium	50%
Steel	100%

Source: DNV GL HSLC - Panel calculations by cDynamics

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

…and it looks nice too!

Laws and regulations

- The ferry is all-electric, constructed in GRP material and will carry dangerous goods
- Not covered by existing laws and regulations

-> A risk based design approch acc. to MSC.Circ 1455 was therefore required by Norwegian Maritime Authorities (NMA)

MSC.1/Circ.1455

24 June 2013

GUIDELINES FOR THE APPROVAL OF ALTERNATIVES AND EQUIVALENTS AS PROVIDED FOR IN VARIOUS IMO INSTRUMENTS

MSC.Circ 1455 Process

Preliminary design phase

Alternative design description

Hazid

Test and analysis plans

Review by authorities

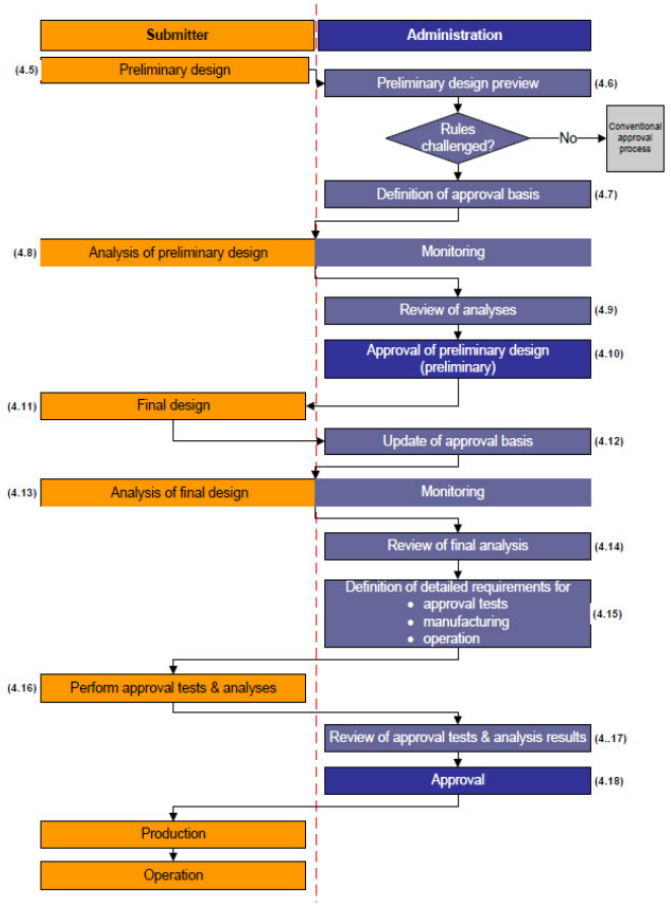
-> Approval basis established

Final design phase

Perform tasks defined in approval basis (tests and engineering analysis)

Review by authorities

-> Approval (or not..)



<u>Overall goal:</u> The alternative solution shall have an equivalent safety level as prescriptive design!

Preliminary design scope

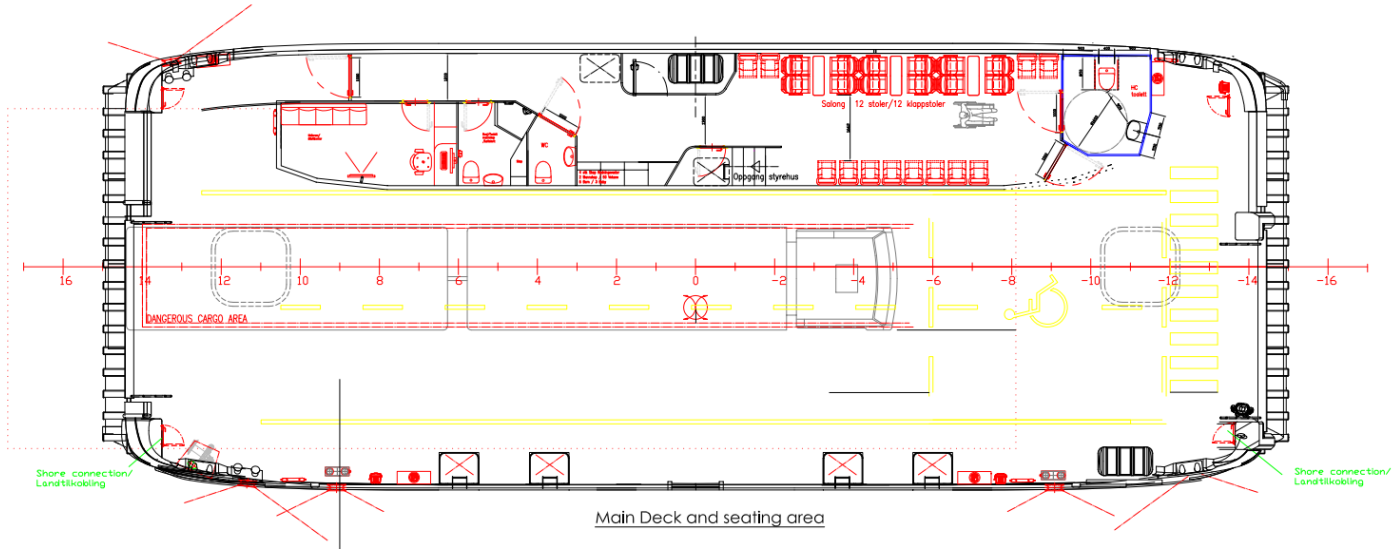
- Process to be performed with approved expertise
- Hazid
- Identify consequence for all types of ADR goods
  - Class 1 (Explosives)
  - Class 2 (Gases),
  - Class 3 (Flammable liquids)
  - Class 4 (Flammable solids)
  - Class 5 (Oxidizing agents and Organic Peroxides)
  - Class 6 (Toxic and Infectious Substances)
  - Class 7 (Radioactive Materials)
  - Class 8 (Corrosive Substances)
  - Class 9 (Miscellaneous dangerous goods)
- Preliminary design report
  - Functional description of alternative design
  - Hazid report
  - Risk assessment plan
  - Testing and analysis plan

Final design scope

- Preliminary design accepted. A simplified process was conducted from this point based on NMA review.
- Perform approval tests and engineering analysis phase
- Final report
  - Test reports
  - Final risk analysis covering passive and active fire protection describing all measures in-line with and beyond prescriptive requirements.

Specification and design drivers

- 10 cars or 1 truck
- All-electric
- Max axle load 13 tonne
- Shall carry all types of ADR dangerous goods
- 3 m zone around dangerous goods to doors, hatches, ventilation etc.



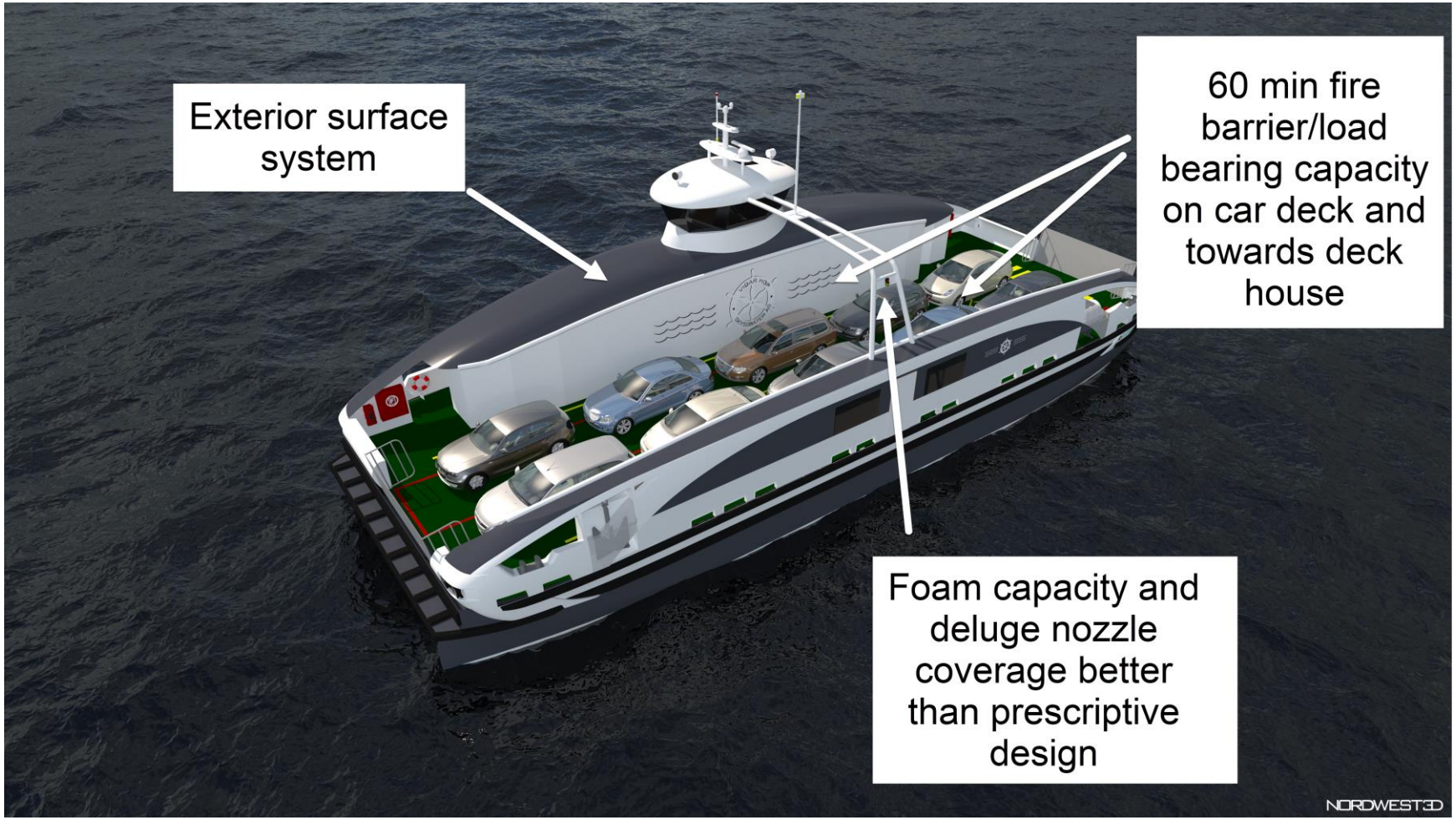
Main Deck and seating area

Approval basis – design rules

- Norwegian regulations
- Dispension sought for use of alternative design standard for fire safety.
- Fire safety acc. to IMO HSC2000 Ch.7

Discipline	Design basis
Structural design	Forskrift 01. juli 2014 nr. 1072 om bygging av skip §4 (Ships in domestic traffic): The construction requirements of a renowned classification society shall be used. Structural design acc. to DNV GL HSLC rules. The vessel is not classed.
Subdivisions and stability	Forskrift 1. juli 2014 nr. 1072 om bygging av skip
Machinery and electrical installations	Forskrift 1. juli 2014 nr. 1072 om bygging av skip
Battery systems	DNV GL RU-SHIP Pt.6 Ch.2 (2018)
Fire safety	Forskrift 01. juli 2014 nr. 1099 om brannsikring på skip Dispensation from the regulation acc. to §19 to use HSC2000 rules.

Barmen ferry - Fire safety design

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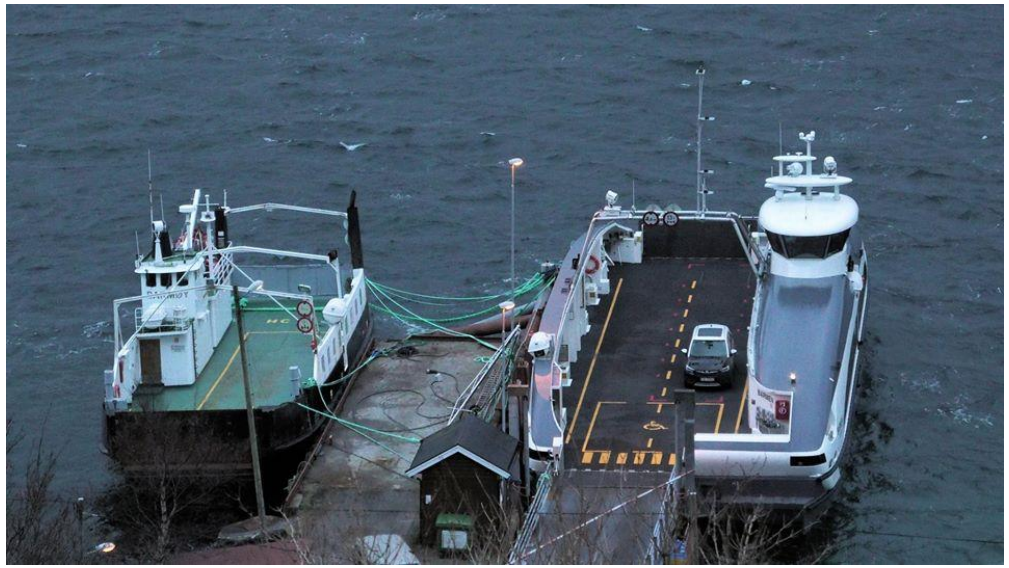


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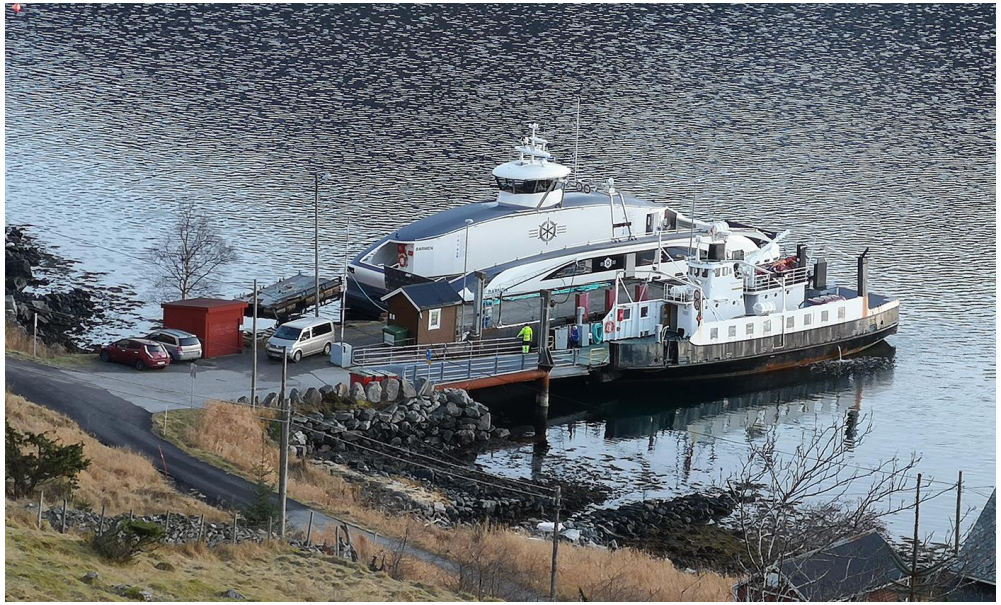


BARMEN

Summary

- Composite is a good choice for small and medium size car ferries
- Less maintanace cost, less power consumption and full design freedom are the selling arguments
- But... Some work to be done in the approval process.

Next project: Cost-effective Fire-Resisting material

- Budget 1.15 million € (50% financed)
- 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

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