

Composite experience of a shipyard



Composite experience of a shipyard

Content:

- Short introduction Damen Shipyards: Facts & Figures
- Presentation Damen Schelde Naval Shipbuilding *(MSc Aerospace L. Morel)*
“Composite research projects – DSNS”
- Presentation Damen Shipyards *(MSc Aerospace O. de Swart)*
“An overview of composite products and technologies at Damen from past to future”
- Questions & Answers



KOMMER DAMEN
TAKES OVER

DAMEN ENTERS
THE SHIPPING MARKET

GLOBAL ACTIVITIES
DAMEN SHIPYARDS GROUP

DAMEN STARTS SHIP
REPAIR IN ROTTERDAM

AXE BOW CONCEPT
DEVELOPED

INTRODUCTION
OF A NEW GENERATION
OF ASD TUGS



DAMEN SHIPYARD
FOUNDED IN GORINCHEM,
THE NETHERLANDS



THE YARD EXPANDS



WIDE RANGE OF
STANDARD HULLS IN
STOCK



GENESIS OF
DAMEN'S ASD TUGS



NAVAL VESSELS:
ROYAL SCHELDE JOINS
DAMEN



REPAIR YARD BREST JOINS
DAMEN SHIPYARDS GROUP



HARBOUR & TERMINAL



OFFSHORE



OFFSHORE WIND



SECURITY PATROL



NAVAL



YACHTING



SHIPPING



PUBLIC TRANSPORT



DREDGING



FISHING



PONTTONS & BARGES



COMPONENTS



DAMEN SERVICES



SHIPREPAIR

- Annual turnover: € 1.8bn
- 41 yards worldwide
- Over 6,000 employees
- Annual deliveries: 160 vessels
- More than 5,000 vessels delivered since 1969
- Stock hulls: > 150
- Over 1,500 repair jobs per year



TURNOVER

- Newbuilding 70%
- Repair 14%
- Services 6%
- Components 3%
- Building on site 7%



NEWBUILDING

- Harbour services and Shipping 22%
- Offshore support 20%
- Security and Patrol 20%
- Naval 20%
- Public transport 5%
- Dredging 5%
- Yachts 8%



EXPORT

- The Netherlands 24%
- Rest of Europe 33%
- Americas 11%
- Middle East 7%
- Africa 12%
- Asia 13%

DAMEN SHIPYARDS GROUP FOUNDED IN THE NETHERLANDS, GLOBAL PRESENCE

NEWBUILDING, SALES & SERVICES

THE NETHERLANDS

Damen Shipyards Gorinchem
Damen Marine Services
Damen Trading
Damen Schelde Naval Shipbuilding
Damen Schelde Gears
Damen Schelde Marine Services Vlissingen
Amels

Bodewes Binnenvaart Millingen
Damen Dredging Equipment
Damen Marine Components
Damen Shipyards Bergum
Damen Shipyards Den Helder
Damen Shipyards Hardinxveld
Maaskant Shipyards Stellendam

EUROPE

Damen Shipyards Gdynia, Poland
Damen Shipyards Kozle, Poland
Damen Marine Components Gdansk, Poland
Brixham Marine Services, United Kingdom
Damen Shipyards Galati, Romania

AMERICAS

Damex, Cuba*
Wilson, Sons, Brasil **

MIDDLE EAST

Albwardy Marine Engineering, U.A.E.*
Damen Shipyards Sharjah (FZE), U.A.E.*
Nakilat Damen Shipyards Qatar, Qatar*

AFRICA

Damen Shipyards Cape Town, South Africa

ASIA

Damen Marine Components Suzhou, China
Damen Trading Suzhou, China
Damen Yichang Shipyard, China*
Damen Shipyards Changde, China
Afai Southern Shipyard, China**
Jiangsu Ganghua Shipyard Co. Ltd, China**
Damen Song Cam Shipyard, Vietnam
Song Cam Shipyard, Vietnam**
Song Thu Shipyard, Vietnam**
189 Shipyard, Vietnam**
Damen Shipyards Singapore, Singapore
Damen Schelde Marine Services Singapore, Singapore
PT Dumas, Indonesia**
PT Pal, Indonesia**
PT Steadfast Marine, Indonesia**

* Joint venture ** Business cooperation

SHIP REPAIR

THE NETHERLANDS

Damen Shiprepair Amsterdam
Damen Shiprepair Rotterdam
Damen Shiprepair Vlissingen
Damen Anchor & Chain Factory
Damen Shipyards Den Helder
Maaskant Shipyards Stellendam
Van Brink Rotterdam

EUROPE

Damen Shiprepair Götaverken, Sweden
Oskarshamnvarvet, Sweden
Damen Shiprepair Brest, France

MIDDLE EAST

Albwardy Marine Engineering, U.A.E.*
Damen Shipyards Sharjah (FZE), U.A.E.*
Nakilat Damen Shipyards Qatar, Qatar*

AFRICA

Damen Shipyards Cape Town, South Africa

ASIA

Damen Shipyards Singapore, Singapore

* Joint venture

Composite research projects - DSNS

Frigates, Corvettes & Patrol Vessels



Amphibious Support Ships, Naval Auxiliaries & Complex Commercial vessels

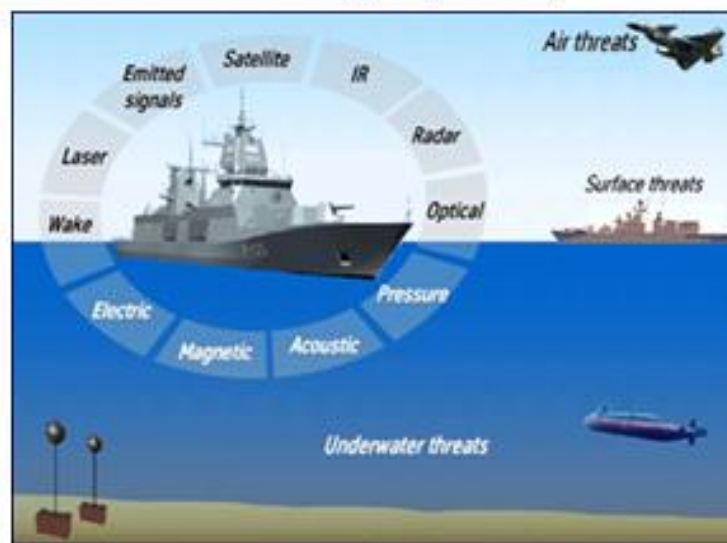


“The Stone Age did not end because of lack of stones”

“Commercial” research projects: BESST & Groot Composiet



“Naval/defence” research projects: CONVINC & HARDCORE



WOOD



STEEL



COMPOSITE

Composite research projects - DSNS

- **“Commercial” research projects**

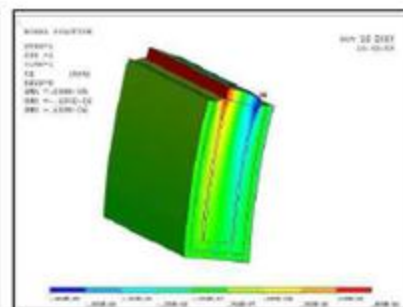
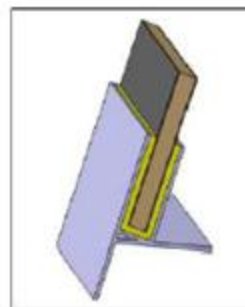
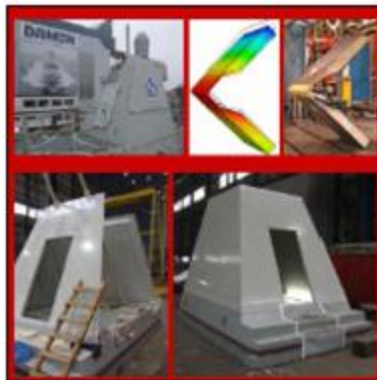
Projects:

BESST: “Breakthrough in European Ship and Shipbuilding Technologies”



Follow-up project on:

DE-Light: “Complex lightweight modules for ships and railway using risk based design methods”



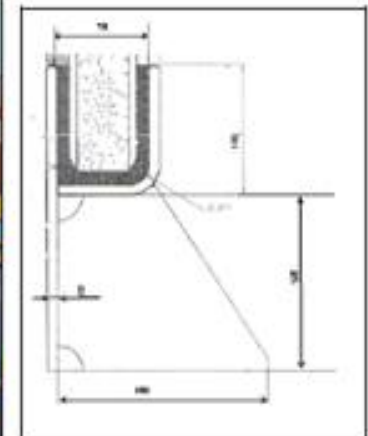
BESST-project: “Breakthrough in European Ship and Shipbuilding Technologies”

- Outfitting, namely cabling, foundations, isolation, penetrations, etc.
- Modifications and repair
- Fire protection → Full-scale flash-over fire on the DE-Light demonstrator
→ only passively protected. No active fire protection

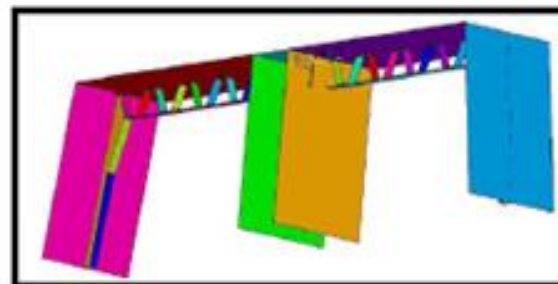


BESST-project: “Breakthrough in European Ship and Shipbuilding Technologies”

- Steel-composite connection is fully optimized and already applied on a real naval ship (Indian project by Kockums)

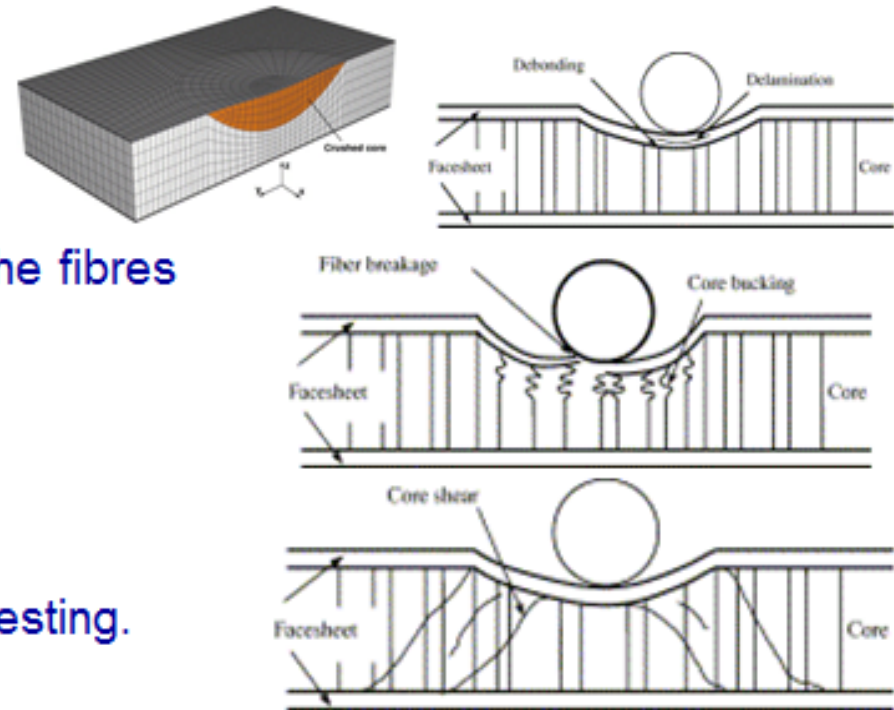


- Alternative stiffener system
 - Easier outfitting
 - Reduced deck height
 - Fulfillment of strength and stiffness requirements



Groot composiet: “Failure modes of sandwich structures under dynamic out-of-plane loads ”

- Very detailed modeling in order to predict:
 - Crack initiation in the matrix between the fibres
 - Failure of the fibres
 - Delamination between the layers
 - Failure of the foam core



Modeling will be validated by means of drop testing.

Also, all the material properties were determined by strictly following the test procedures described in the corresponding norms and standards. It could be concluded that there is a large discrepancy between the material data sheets of the supplier and the measured properties.

CONVINCE:

“Vulnerability Reduction Technologies for Large Maritime Composite Structures”

Period: 2009-2013



Follow-up project on:

Euclid 3.8: “Composite Structures - Naval Application Technology”

Period: 1994-1999



Euclid 3.21: “Survivability, Durability & Performance of Naval Composite Structures”

Period: 2000-2004



CONVINCE: Equivalent blast & fire resistance of composite bulkheads

DAMEN

COping with Naval Vulnerability through INnovative Composite Engineering



National
lead



Application Case: Composite Superstructure

Joint European Defence Agency project

CONVINCE

CONVINCE: Equivalent blast & fire resistance of composite bulkheads

DAMEN

HARPOON-missile HIT



Post-HIT damage



Steel Blast Bulkhead (BB)



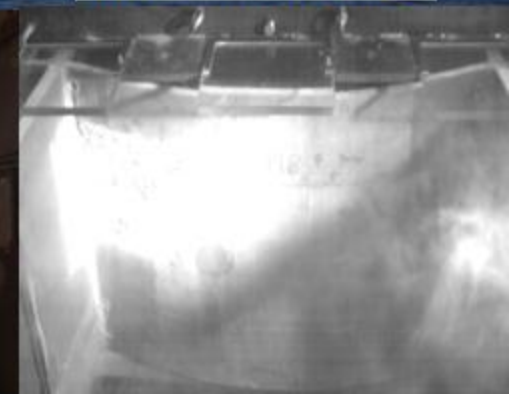
Blast test



Steel BB after blast



FRP BB during blast



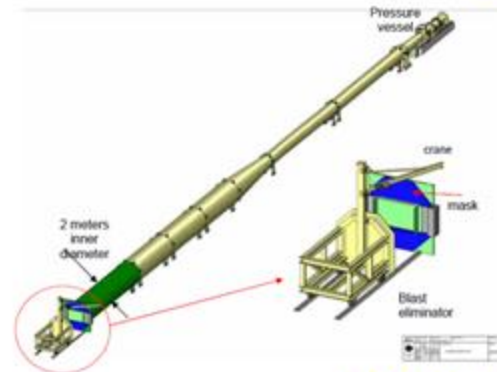
CONVINCE: Equivalent blast & fire resistance of composite bulkheads

DAMEN

- Halve scale blast tests at TNO



JOINT X: **PASS**



JOINT Y: **FAIL**



Problem: passive fire protection does not survive blast YET!

active fire protection? TBD

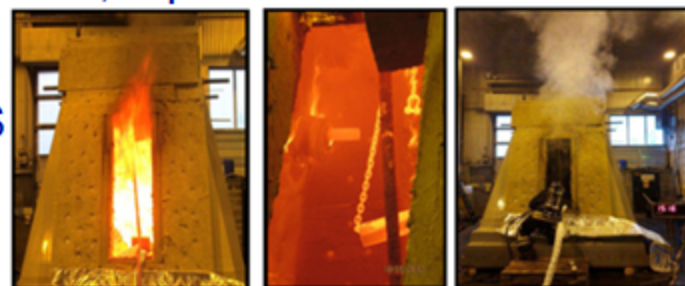
Fire resistance?!?

Design fire scenarios = Peace-time scenarios + Weapon-induced scenarios

Peace-time scenario

- external fires: helicopter re-fuelling, helicopter crash, replenishment
- hangar fire
- interior fires: classic cases according to SOLAS

Lessons learned in other projects (~ BESST, ...)



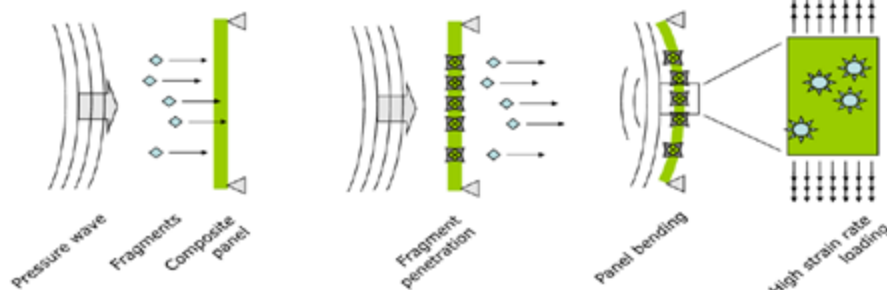
Weapon-induced scenario

- burning propellant from an un-detonated missile (~ hydro-carbon fire)
- fires initiated by weapon impact (~ big fire combined with large damage)

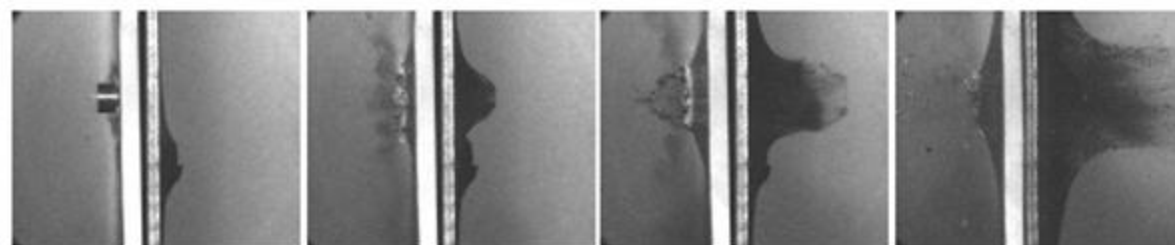
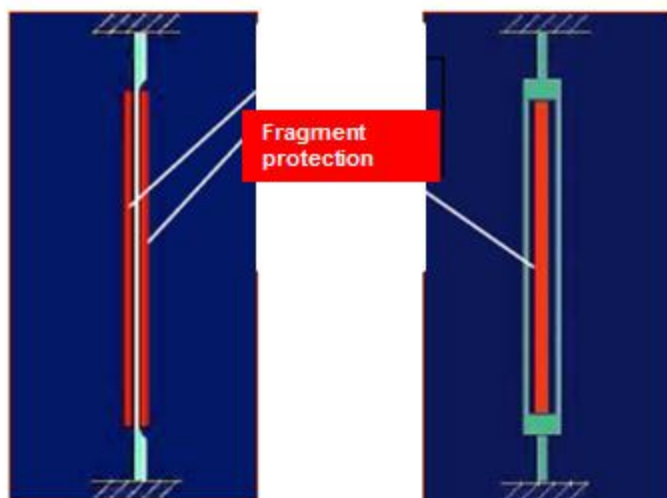
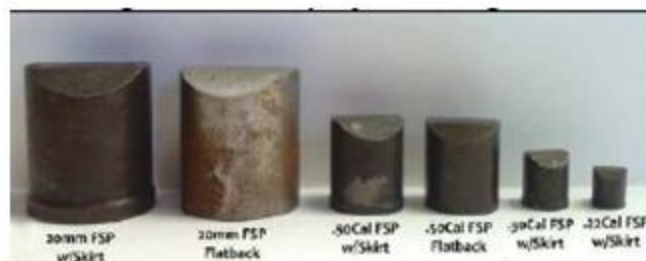
ASSUMPTION = fragments are not considered as fire ignition source, but only as a damage source to fire protection systems, components and structures.



Damen Schelde Naval Shipbuilding



Hardcore-project: fire and fragment resistant blast bulkhead



Various protective concepts, utilizing different materials, were developed and tested, as to create comparative results.

Questions at the end of presentation

DAMEN

1

Birth

Form question in
your mind



2

Evaluate

Is it a reasonable
question?



3

Remember

Until you can
ask the question



4

Courage

To ask the
question out loud



Power of the Mk 48 Torpedo

Contents

An overview of composite products and technologies at Damen from past to future



1960's-80's: Patrol vessels & Tenders

Introduction of composites at the yard

Production processes

- Hand lamination

Assembly processes

- Lamination

Structures

- Plywood stiffeners
- Robust solid laminate
- First experiments with sandwich laminates



2000's-2010: Fast Crew Suppliers & Patrol vessels

External production and engineering

Production processes

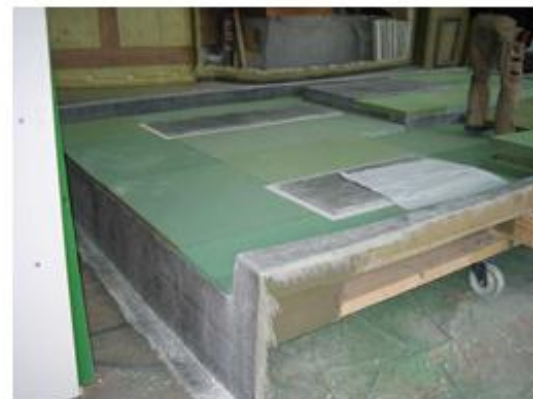
- MDF plugs
- Spray up
- Core bonding
- Hand lamination

Assembly processes

- Lamination
- Introduction of bonding

Structures

- Sandwich & solid laminates



2010 - Now: Fast Crew Suppliers

*Worldwide production based on previous experience &
Enhanced external and internal engineering capabilities*

Production processes

- Vacuum infusion of sandwiches

Assembly processes

- Bonding

Structures

- Mainly sandwich laminates
- Bonded stiffeners

Analysis

- FEA analysis natural frequencies



2010 – Now: Interceptors

Fundamental and applied research & development
Collaboration and built up experience

Production processes

- Moulding all composite components including frames
- CNC milled foam plugs

Assembly processes

- Bonding of complete stiffening structures
- Very tight tolerances

Structures

- Fully orthotropic laminates
- Bonded stiffeners
- Hybrid laminates



2010 – Now: Pilot vessels & Passenger ferries

Industrialization & scale up

Production processes

- Vacuum infusion of large hull sections

Assembly processes

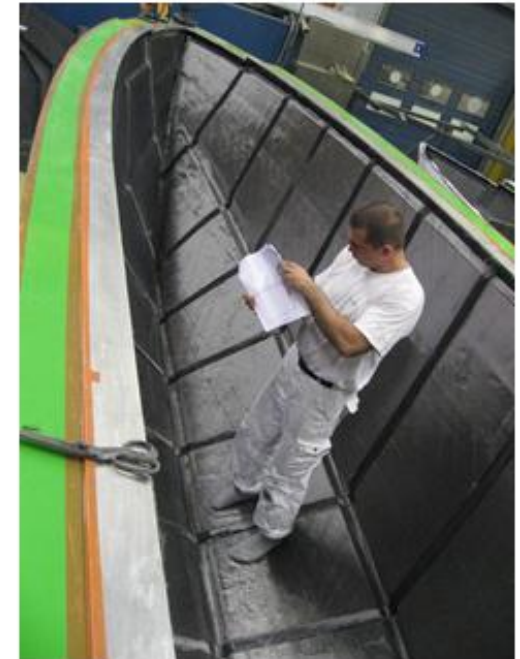
- Bonding of complete stiffening structures

Structures

- Bonded stiffeners
- Carbon fiber
- Fully orthotropic laminates

Analysis

- FEA full structures, sound & vibrations



2013: Rescue vessels

Prototyping and advanced production processes

Production processes

- RTM
- Infusion
- Pultrusions

Assembly processes

- Underwater adhesive applications

Analysis

- FEA Structural details with solid cores
- FEA Fin breakage



2013 - Now: Small passenger Ferries & Fast Crew Suppliers

Focus on production, industrialization & mass customization

Production processes

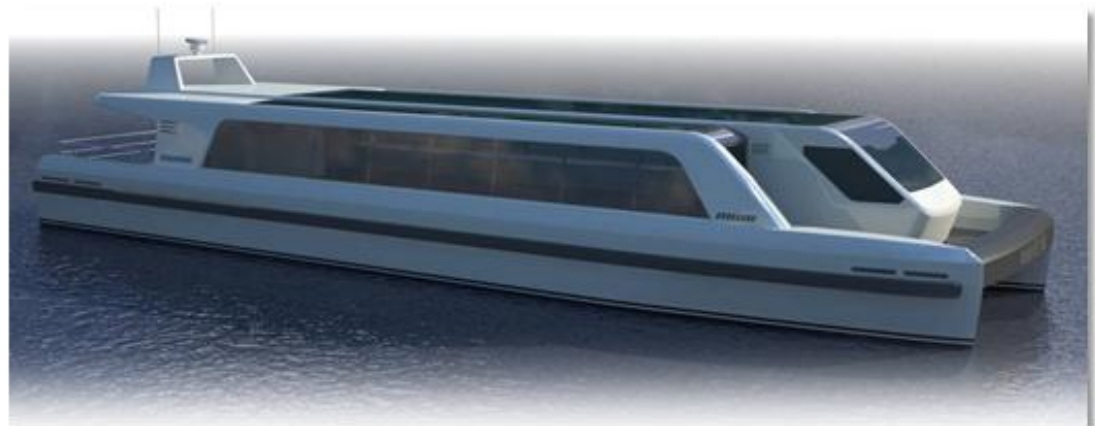
- Design for production
- Infusion
- RTM

Assembly processes

- Design for assembly
- Modular assembly process

Structures

- Fire resistance certification according to EC
- Design for cost



Now-Future: Large carbon ferries

Enhanced scale & weight management

- Production processes
 - Full CFRP technology
 - 3D Infusion
- Assembly processes
 - Focus on weight
- Structures
 - Full structural weight optimization
 - Advanced robustness analysis and insight





Damen Gorinchem Composite Products overview

Recently built <ul style="list-style-type: none">• DFF1004: Carbon fiber• DI 1102: Glass/carbon fiber hybrid• FCS 1204: Superstructure• FCS 1605: Superstructure• FCS 1905: Superstructure	Under construction <ul style="list-style-type: none">• SAR 1906: Superstructure• SPi 2205: Glass fiber
In development <ul style="list-style-type: none">• FCS 1605: Glass fiber• Modular Waterbus: Glass fiber	Requests <ul style="list-style-type: none">• Fast Ferries up to 45 m: Carbon fiber

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STANDARD OF EXCELLENCE

Q&A

You have

Questions

We have

Answers