CONVINCE: Blast-resistance of three dimensional FRP-joints

Anders Lonno
FMV, Defence Materiel Administration, Stockholm, Sweden

Plats för projektsymbol

FMV

Survivability

- Susceptibility
- Vulnerability Reduction
- Recoverablity

The Visby Class Corvette

Plats för projektsymbol

FMV

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Plats för projektsymbol

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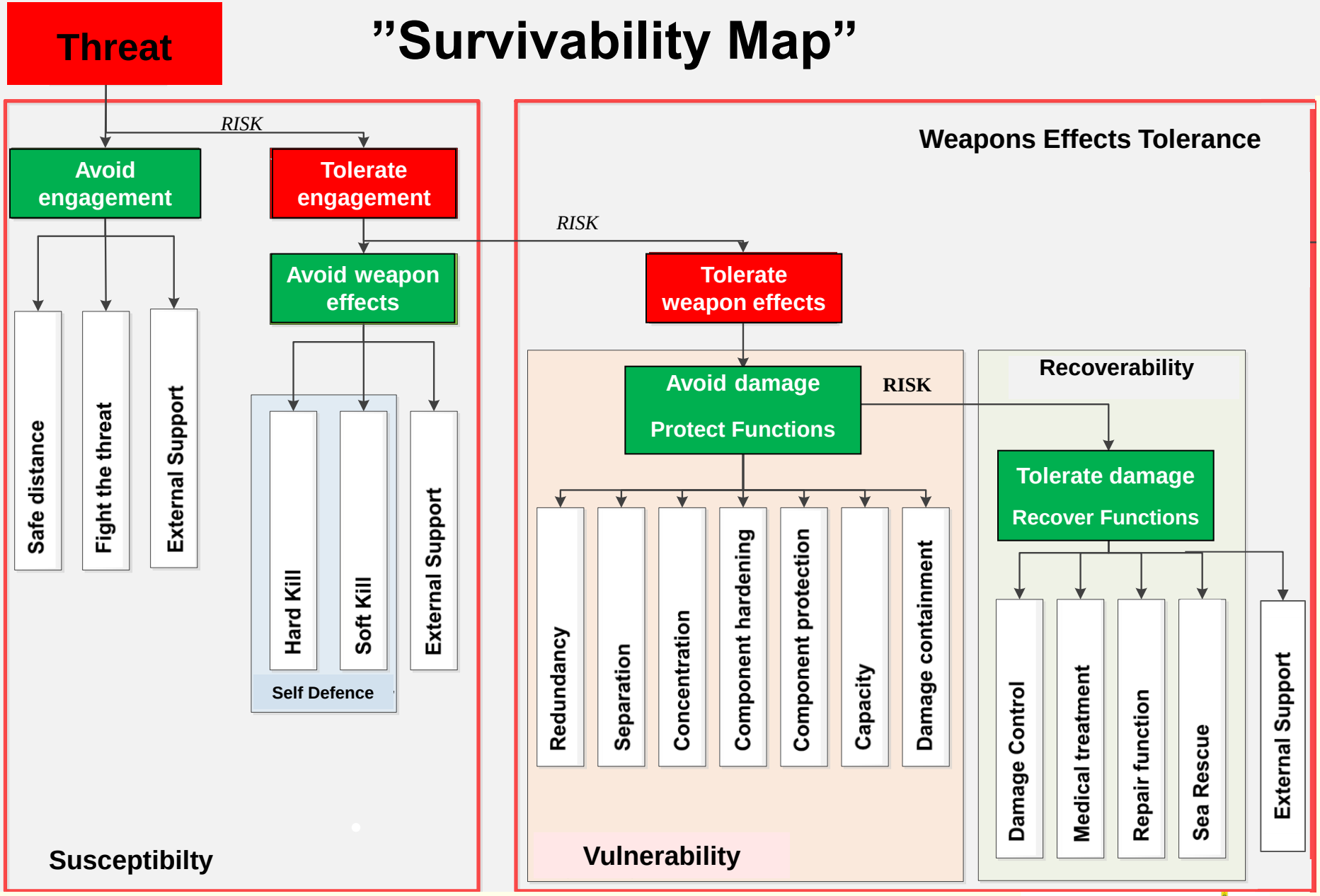
”Survivability Map”



Plats för projektsymbol

Survivability

- **Susceptibility**
  - Self Defence – Hard Kill /Soft Kill
  - Low Signatures / Stealth
  - Low Weight – High speed, Manouverability
- **Vulnerability Reduction**
- **Recoverablity**

The Visby Class Corvette

Survivability

- ***Susceptibility***
  - ***Self Defence – Hard Kill /Soft Kill***
  - ***Low Signatures / Stealth***
  - ***Low Weight – High speed, Manouverability***
- ***Vulnerability Reduction***
- ***Recoverablity***

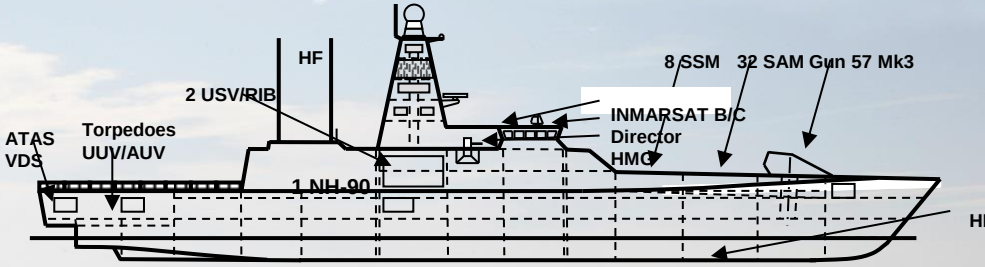
The Visby Class Corvette

- 72 m
- 16 MW Gas turbines
- 40+ knots
- CFRP – sandwich
- Vacuum Infusion
- Launched year 2000
- 5 ships in service
- Etc.

The Visby Class Corvette

Survivability

- Susceptibility
- Vulnerability Reduction
  - Resist Weapon Effects – Minimize Damage
    - Blast Pressure Wave
    - Fragments
    - Weapon Induced Fire
- Recoverablity



NGS

The Visby Class Corvette

Plats för projektsymbol

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Survivability

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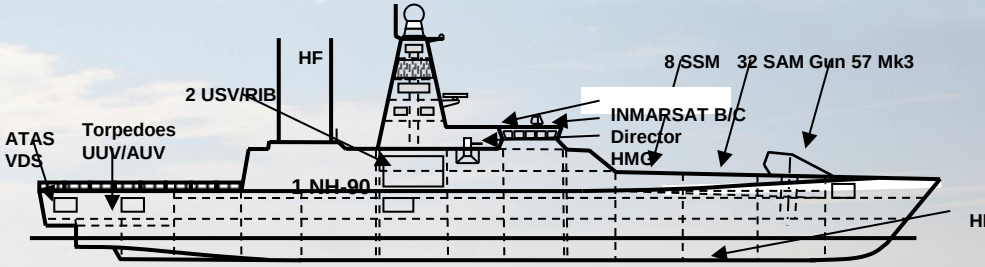

NGS

The Visby Class Corvette

Plats för projektsymbol

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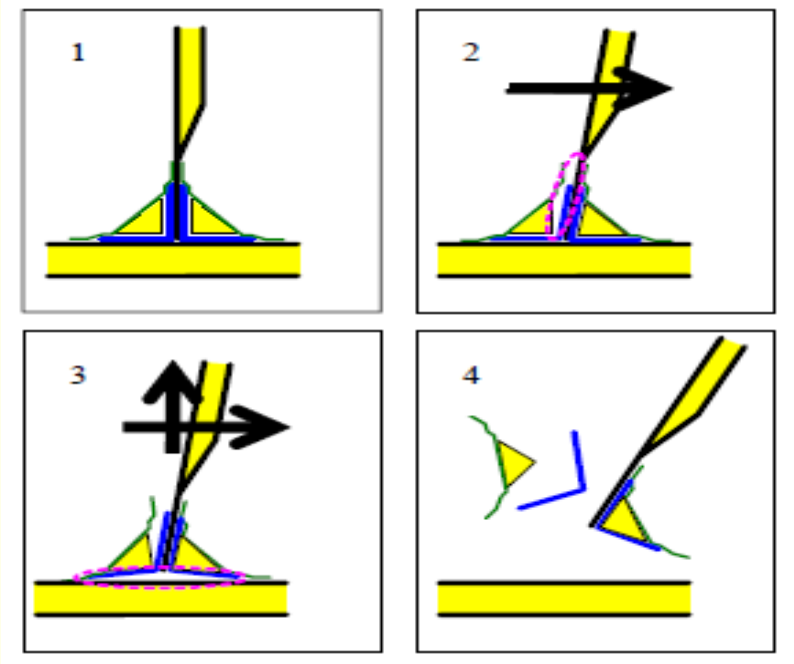
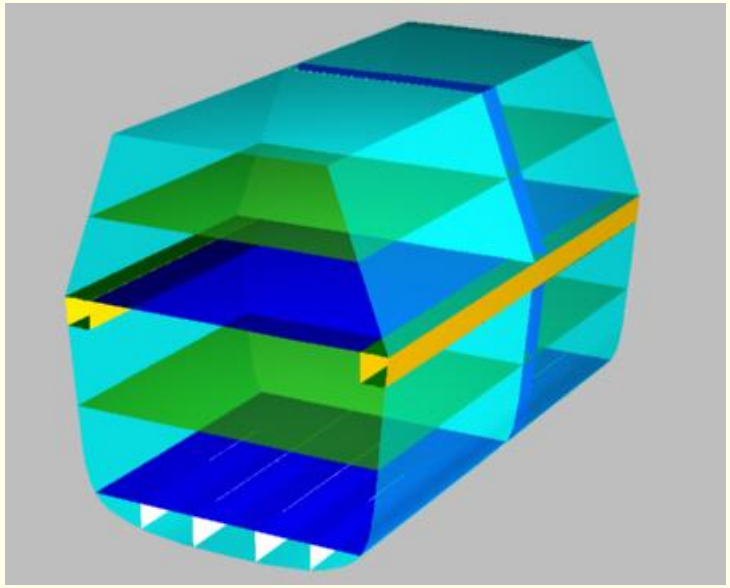
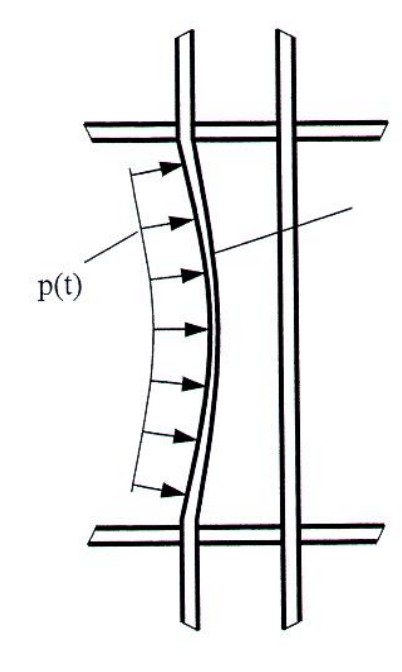
Structural Limitations of ”conventional” FRP-Sandwich structures with respect to blast vulnerability

- ✓ **Brittle behaviour => No yielding**
- ✓ **Low compression strength / Excellent tensile strength**
- ✓ **Low interlaminar strength => Bulkhead to deck joints weak**
- ✓ **Weak core**



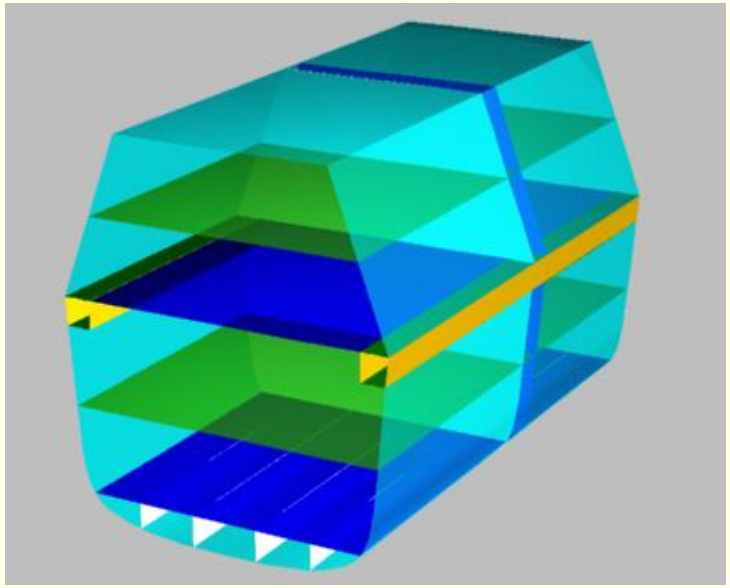
- Continuous, blast resistant bulkheads working as membranes
- ”Blow out” panels
- Box girders for global strength

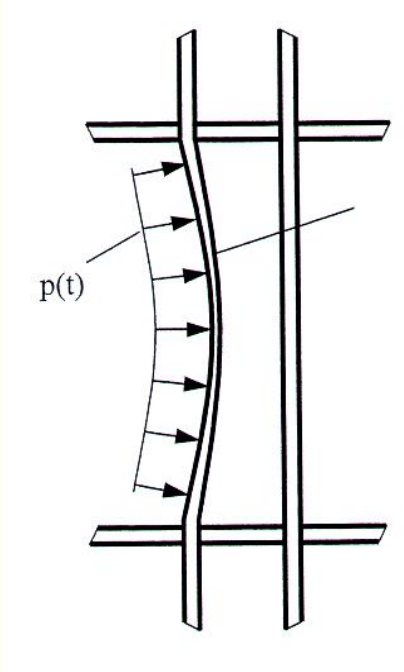


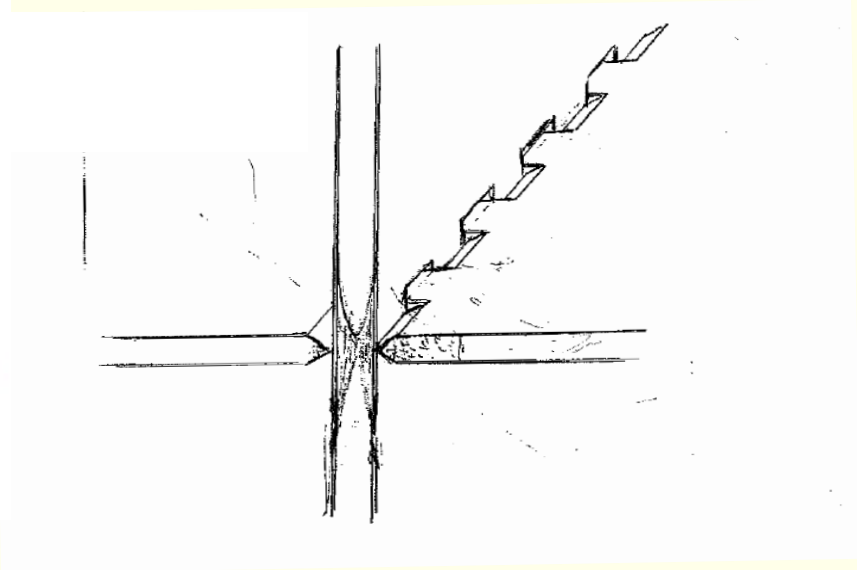


Plats för projektsymbol

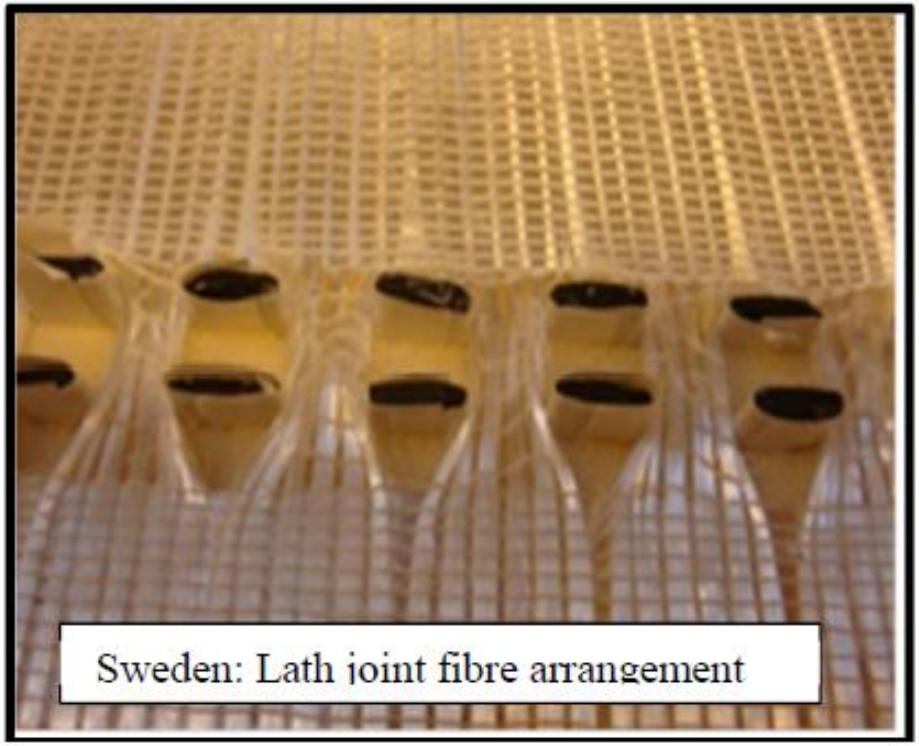
- Continuous, blast resistant bulkheads working as membranes
- ”Blow out” panels
- Box girders for global strength
- Continuous joints

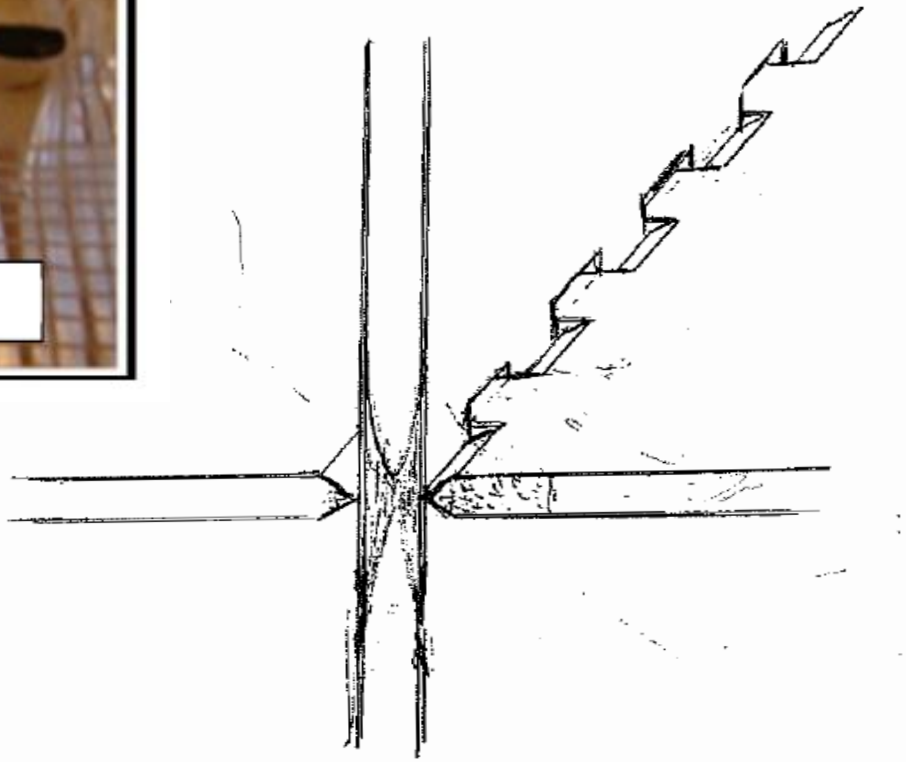






Plats för projektsymbol





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Plats för projektsymbol

EDA GEM1 Project CONVINCE - Vulnerability Reduction Technologies for Large Maritime Composite Structures

UK, FR, NL, IT, NO, SW

"vision of raising the resistance of **composites to withstand fire and blast** scenarios to levels **comparable with steel** while **maintaining the advantages of composites** compared to an equivalent metallic construction at acceptable platform cost such as: **weight reduction; enhanced stability margins; signature reduction**; etc, coupled with through life savings via such measures as **reduced fuel consumption**; through life platform flexibility and reduced ship maintenance".

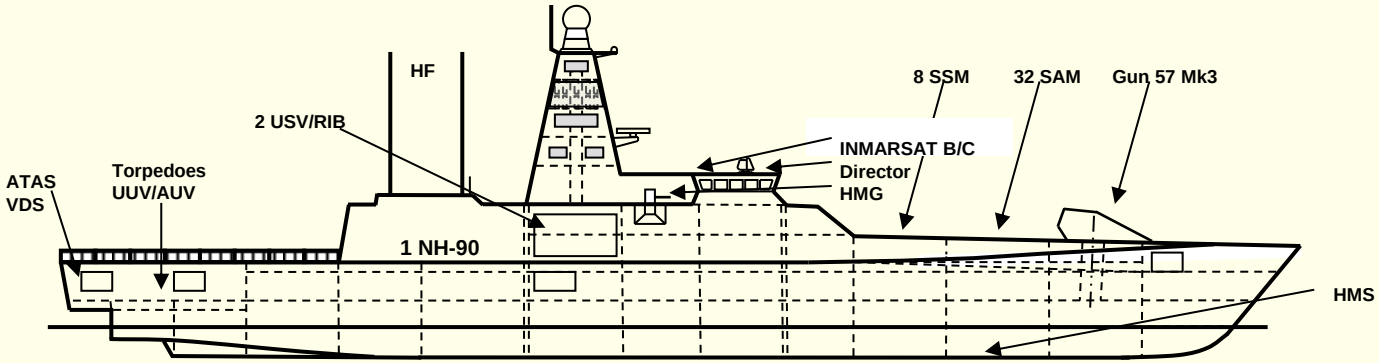
Total budget 8 400 000 € - 3 years 2011-2013

WPs	KTs		CET	OTO	ITM	CSI
WP0	0.1	Project management	x			
	0.2	Close technical co-ordination across all work packages	x			
	0.3	Definition of application case	x			
	0.4	Materials and Structure Identification	x			
	0.5	Understanding of threat definitions provided by TAMG	x			
	0.6	Thermal and Fire Insulations	x			
	0.7	Electro-Magnetic Signatures (EMS) Solutions		x		
	0.8	Affordability	x			
WP1: Fire engineering	1.0	WP coordination	x			
	1.1	Fire engineering methodology	x		x	x
	1.2	Fire safe concepts	x	x	x	x
		1.2.1 - Passive fire safety systems	x	x	x	x
		1.2.2 - Fire sensors and active fire safety systems				
	1.3	Manufacturing and testing			x	x
		1.3.1 - Manufacturing			x	
		1.3.2 - Testing				x
	1.4	Simulations	x			
		1.4.1 - Fire simulation				
		1.4.2 - Thermo mechanical behaviour	x			
	1.5	Guidelines	x	x	x	x
WP 2: Blast Response of Marine Composites	2.0	WP coordination	x			
	2.1	Definition of blast loading, fragment attack & other functional requirements	x	x		
	2.2	Simulation tools and Simulation	x			
	2.3	Structure, joint & panel design		x	x	
	2.4	Manufacture			x	
	2.5	Small Scale Blast Trials and Fragment Resistance		x		
	2.6	Large scale blast trials		x		
	2.7	Inspections & evaluation of residual behaviour (mechanical, fire and EMS)		x		x
	2.8	Guidelines	x	x	x	x

Two application cases

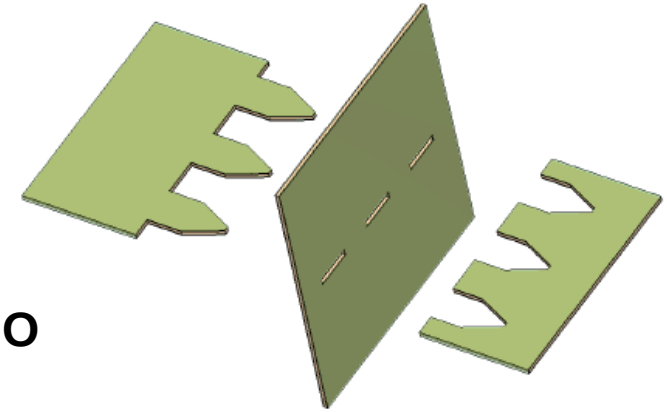
- (1) a 140m frigate with a composite superstructure
  - NSC Ship Type B acc. Ch.1 Reg.2 Para.1.38
  - expected DNV class notation 1A1 Naval

- (2) a 110m full composite large corvette
  - NSC Ship Type B(H) Ch.1 Reg.2 Para.1.38
  - The adapted HSC is only applicable to ships up to 100 m length and 100 persons onboard CH.VI Para.5 Table 0-1
  - expected DNV class notation 1A1 LC R1 Naval

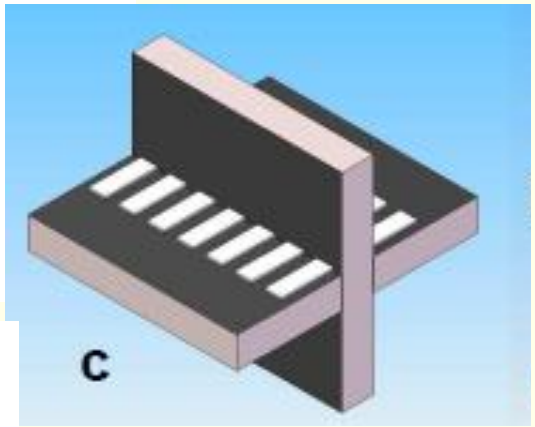


Plats för projektsymbol

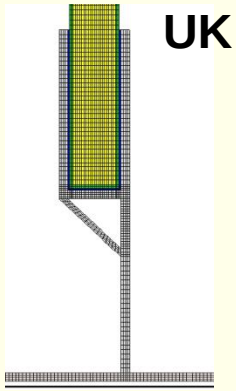
NO



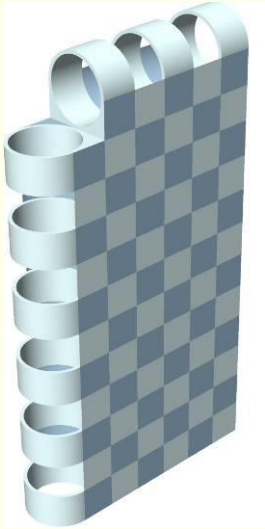
SWE

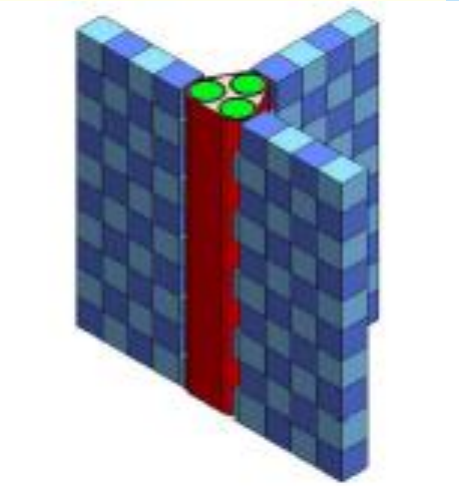


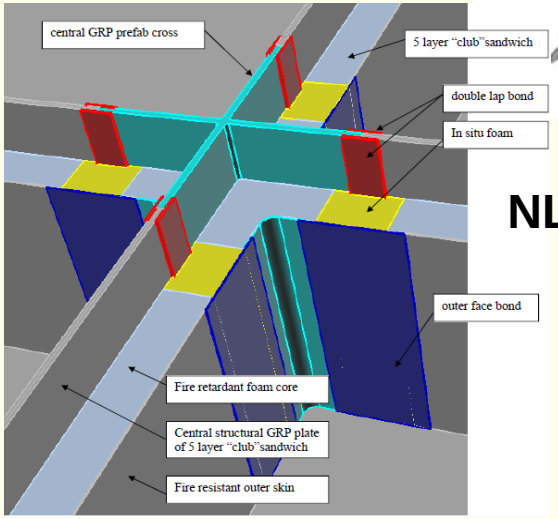
UK



NL







NL/SWE

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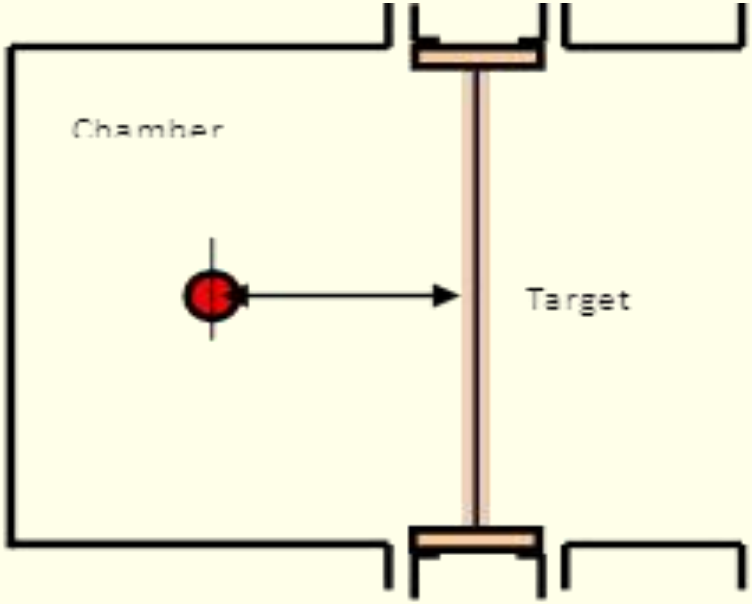
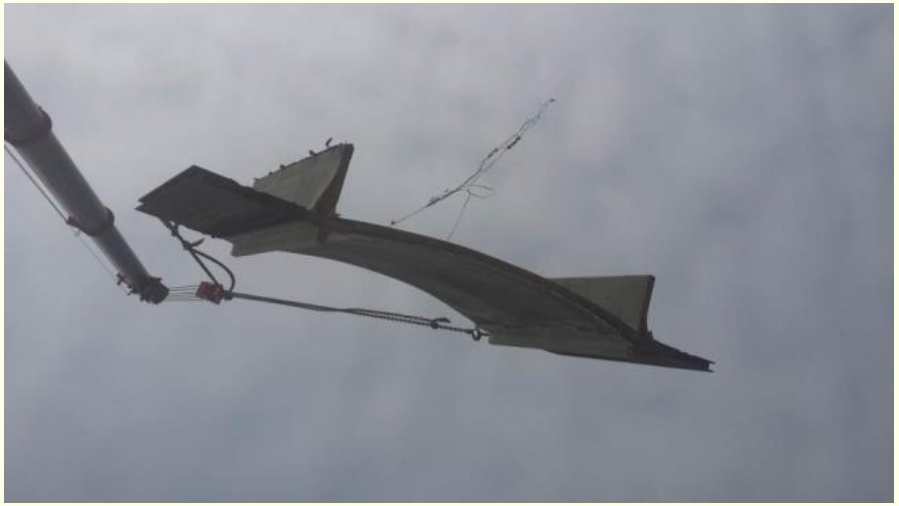
FMV

BTF – Pendine test range





Datum , Bild 18, Författare

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UNCLASSIFIED

CONVINCE

Publishable Executive Summary

VULNERABILITY REDUCTION TECHNOLOGIES FOR LARGE MARITIME COMPOSITE STRUCTURES

Document reference: QINETIQ/MARITIME/PUB1400439
Issue: 1
Date: 2014-10-17
Pages: 6

EDA B0054-GEM1-ERG

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End – Questions!