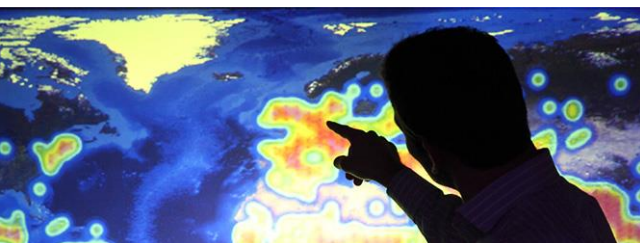


# NDT Requirements for Marine Composites

## Defence Sector Requirements

Richard Hammond



# Current use of composites

- Mine Counter Measure Vessels (Hunt Class)
  - 1978 to 1988
- Mine Hunters (Sandown Class)
  - 1988 to 2001
- Monolithic glass fibre and polyester resin construction
- Hand lay-up / resin infusion



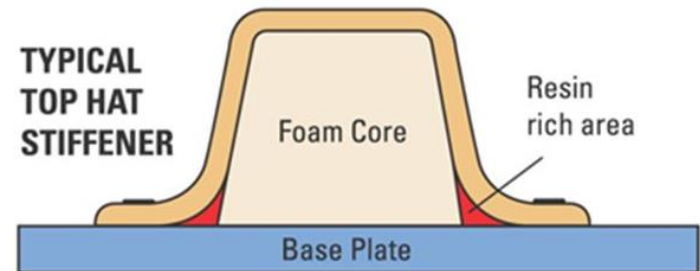
# Current NDT process

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- Paint and compartment linings are stripped
- Defects identified by
  - Visual inspection
  - Coin tapping
  - Ultrasound
- Defects are repaired
- Paint and compartment linings are reinstated




# Typical defects

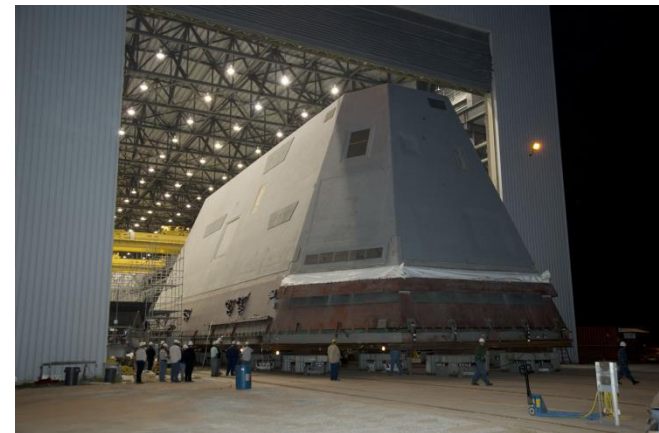
- Delamination from impact damage
  - Dropped tool
  - Impact with quayside
- Deterioration of secondary bonding
  - Whitening at stiffener roots
  - Degradation of resin properties
    - Age
    - Chemical exposure
- Pitting of the surface from the paint removal



# Future composite structures

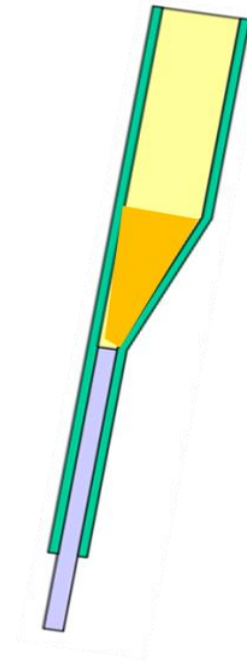
- Sandwich panel construction
  - Glass fibre
  - Balsa core
- Flat panels
  - Ease of manufacture
  - Low radar cross section
- Mast or superstructure

	Solid Material	Core Thickness $t$	Core Thickness $3t$
			
Stiffness	1.0	7.0	37.0
Flexural Strength	1.0	3.5	9.2
Weight	1.0	1.03	1.06



# Composite to steel joints

- Bonded (or bolted)
- Embedded steel plate
- Adhesively bonded in a steel channel



# Other challenges

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- Armour
- Electromagnetic screen
- Fire insulation
- Radar absorbent material

# Start of life

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- Verify structure is built as intended
- Stresses due to curing
- Stresses due to welding
- Baseline condition



# Through-life

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- Degradation of structural performance from baseline
  - Natural aging of materials
  - Environmental loadings
- Changes in stiffness
- Prediction of remaining structural life

# NDT wish list

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- Affordable
- Appropriate
  - Identify defects that matter
  - Suitable for use in a shipyard environment
  - Not impact other maintenance period activities
- Relatively easy to use
- Not require removal of paint!

# Thank you

## Any questions?

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