Remanufacture of Marine Composite Components based on Improved Service Data and Field Diagnostics

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Developing new tools and techniques for accurate assessment of the strength of thick fibreglass composite structures

1. USE CASES

Initial design

Assessing need for repairs

Validation of structural condition

2. NON-DESTRUCTIVE TESTING

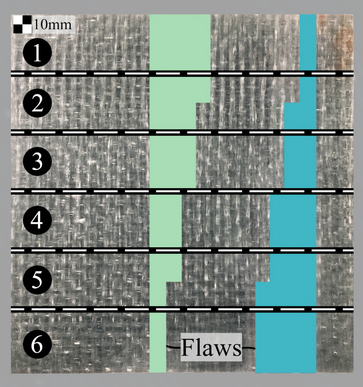
What damage can be seen with ultrasound?

An investigation into the inspection capabilities of in-field advanced-ultrasound detection, for use on ultra-thick (20 to 100mm) fibre-reinforced polymer composites was completed. Glass fibre reinforced polyester (GRP) composite plates were manufactured using custom moulding techniques, such that delamination flaws (cavities) were created at calibrated depths. The ability to see flaws, and the accuracy of their locations and dimensions is shown.

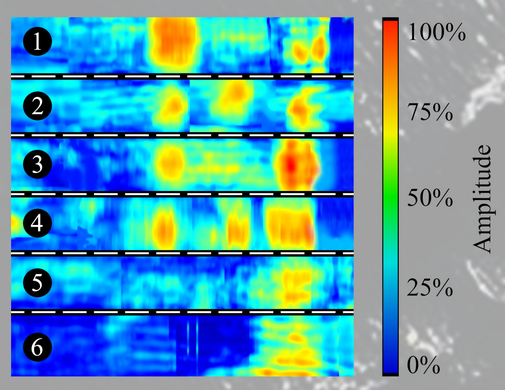
20-100mm Thick GRP

0.5MHz Probe

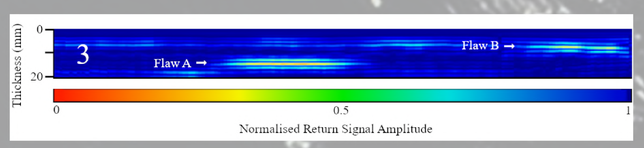
5 Variables Tested

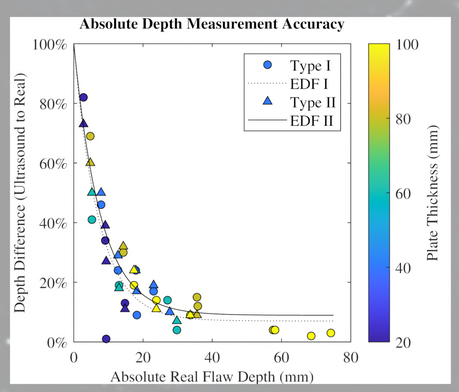


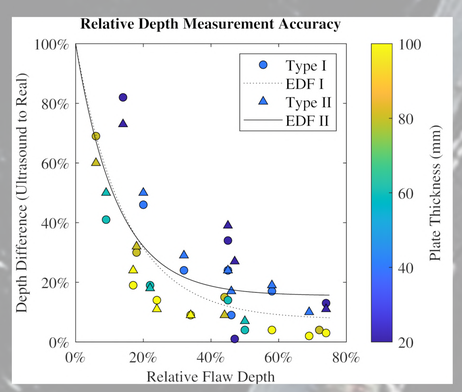
Flaw locations

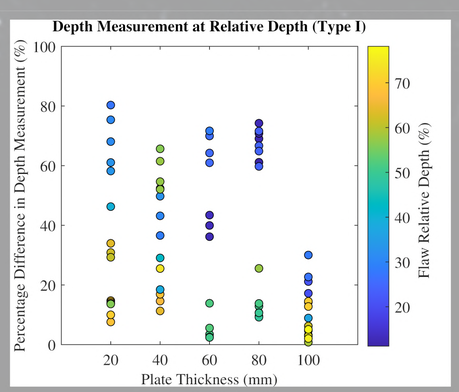


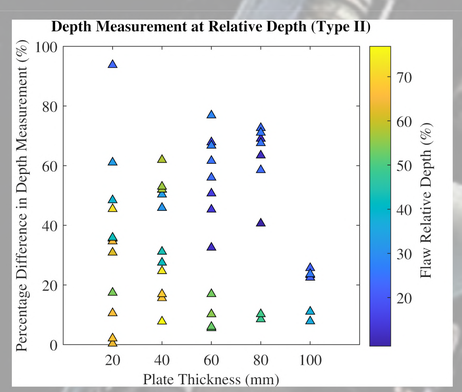
C-scans











3. FLAW CRITICALITY

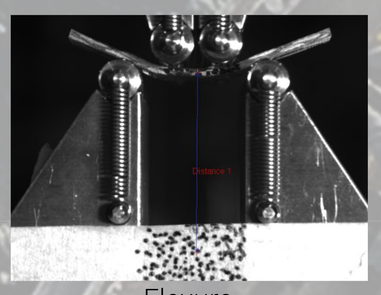
How important is damage for the structure?

Each flaw, damage or defect may affect the functionality or longevity of the structure. In-progress research will quantify how the material properties change due to the presence of delaminations. Composite plate thickness, delamination size, and delamination positioning are being considered to generate a complete set of equation for estimating material properties. In this way, non destructive inspection becomes quantitively connected to design and maintenance programmes.

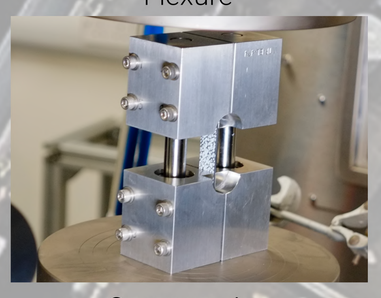
2-50mm Thick GRP

2 Load Cases

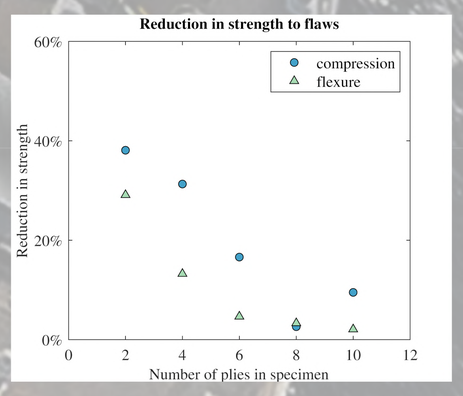
3 Variables Tested



Flexure



Compression



4. MECHANICS OF THICK COMPOSITES

How do thick composites behave under load?

Up to 80kN Load

Up to 50mm Thick

2 Load Cases

Existing theoretical equation systems, which relate stress and strain of laminated composite materials via stiffness and/or compliance can be used to predict material properties of a given layup sequence. However, these equation systems were developed by making assumptions (which generally hold for thin section composites) about the relative straining of the composite during the test. It is unknown how well these equation systems hold when the number of plies in a composite increases substantially to create a “thick” composite.

The two objectives are:

(1) Establishing the applicability of conventional theoretical equation systems, relative to the ply count in a composite.

(2) Using the data to build empirical equation systems which predict properties of high ply count components.

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