

The Future of Composite Repairs in the Offshore Industry

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UNDE and Composite Repair Technology Timeline

NDE/NDT Technology Timeline



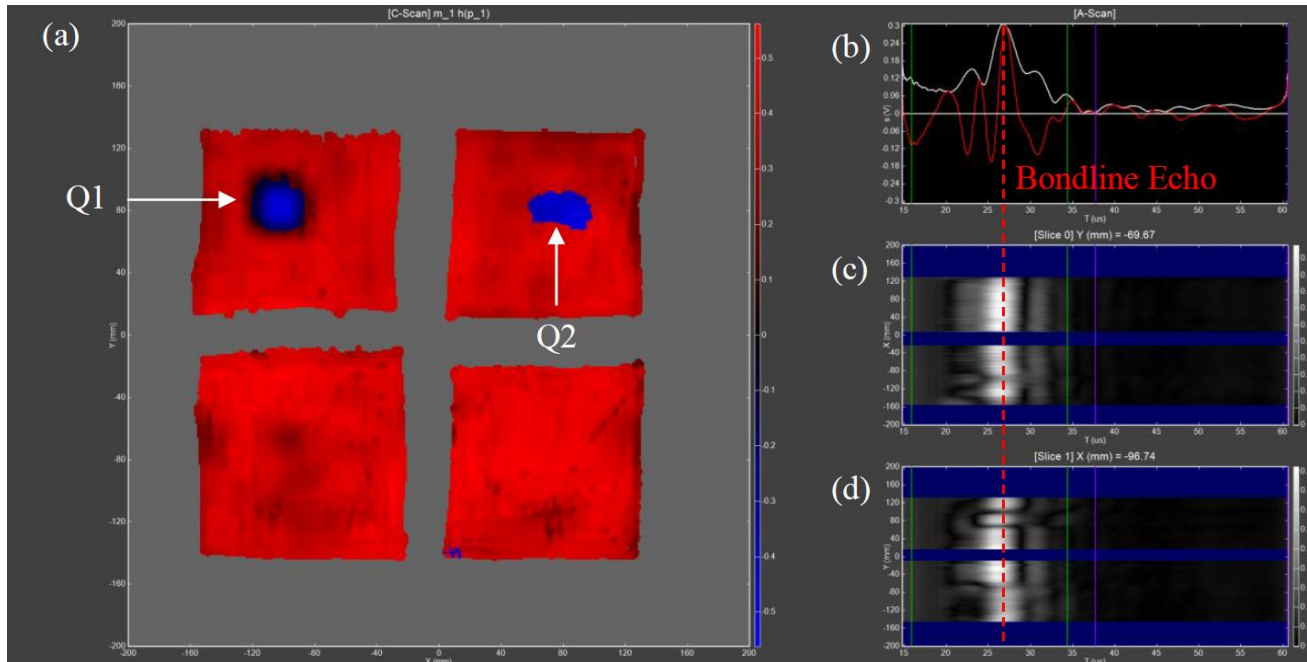
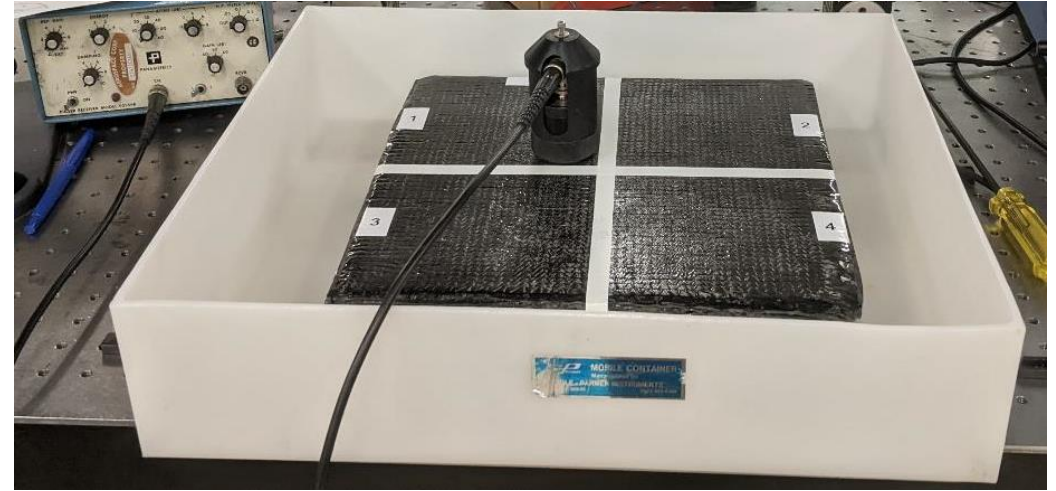
Engineered Composite Repair (ECR) Technology Timeline



Preliminary Validation Test Results – Multilayer Carbon Fiber

Detailed scans show:

- **Size** of defect
- **Shape** of defect
- **Depth** of defect

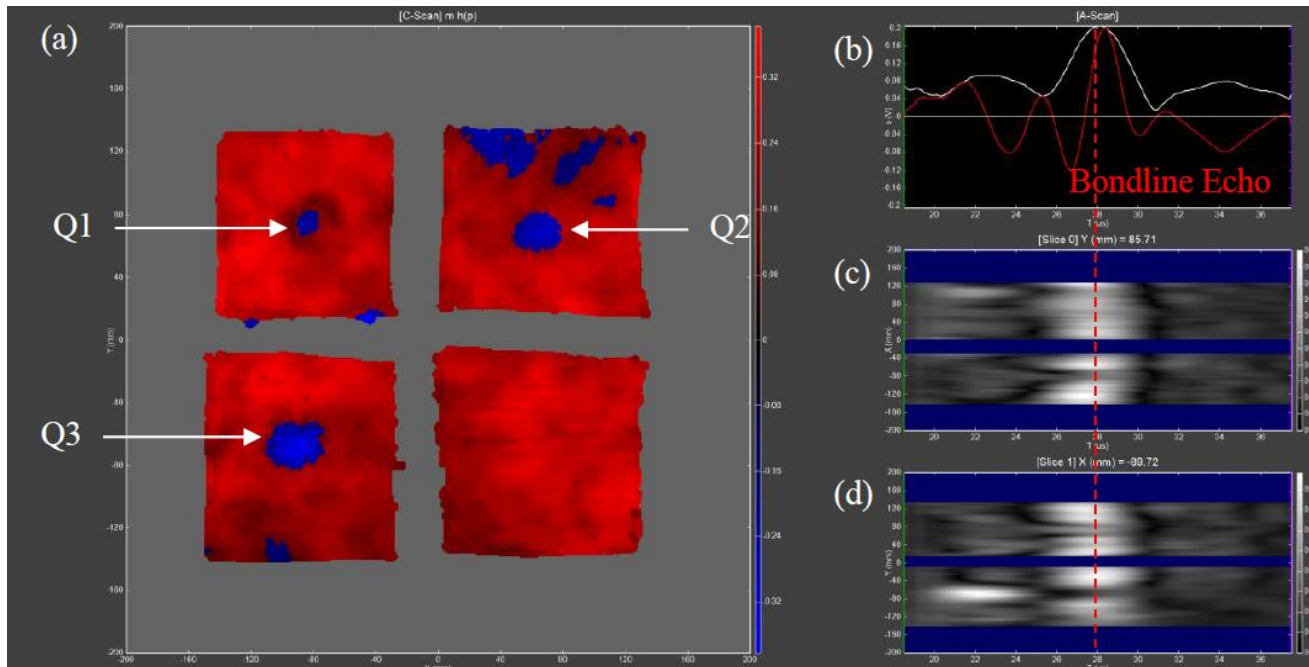
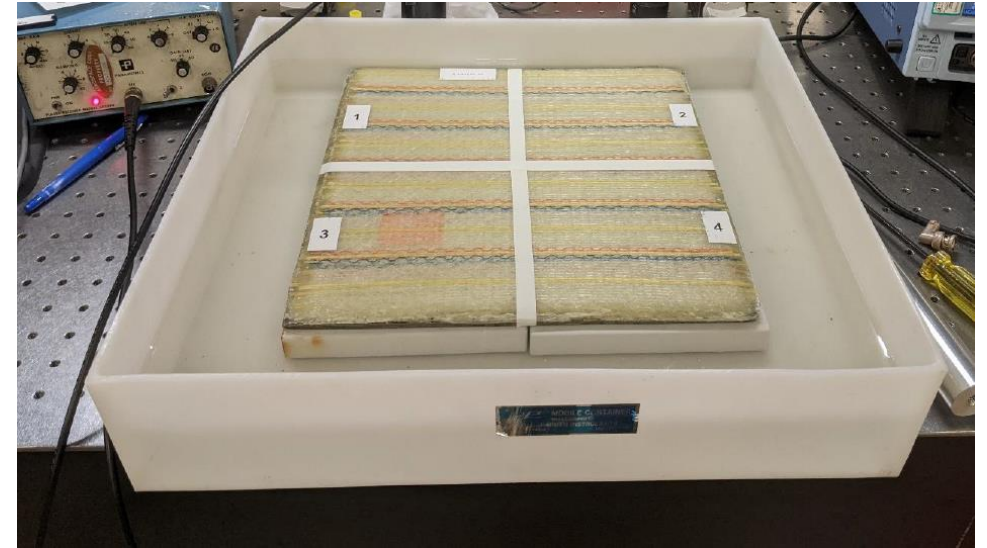


Depth of Indications Using 0.5 MHz 1-inch Transducer

Quadrant	Measured t (μ s)	Calculated d (mm)
Q1	26.4	7.50
Q2	25.3	5.81
Q3	-	-

Preliminary Validation Test Results – Multilayer E-Glass

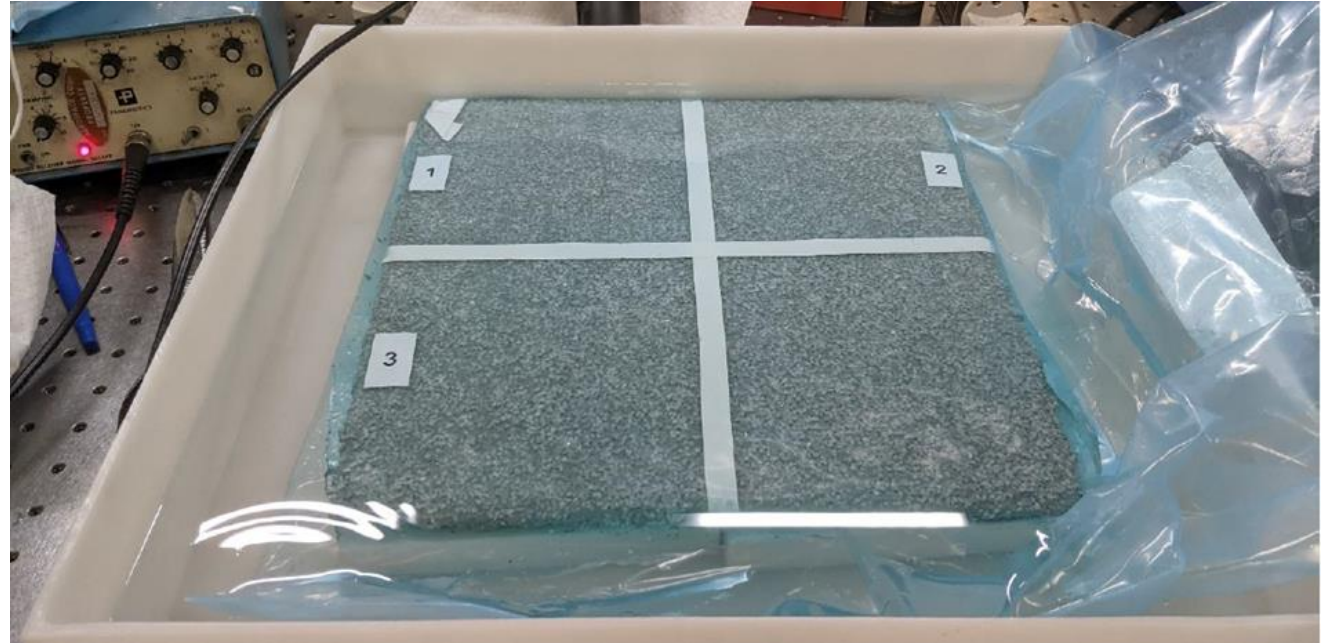
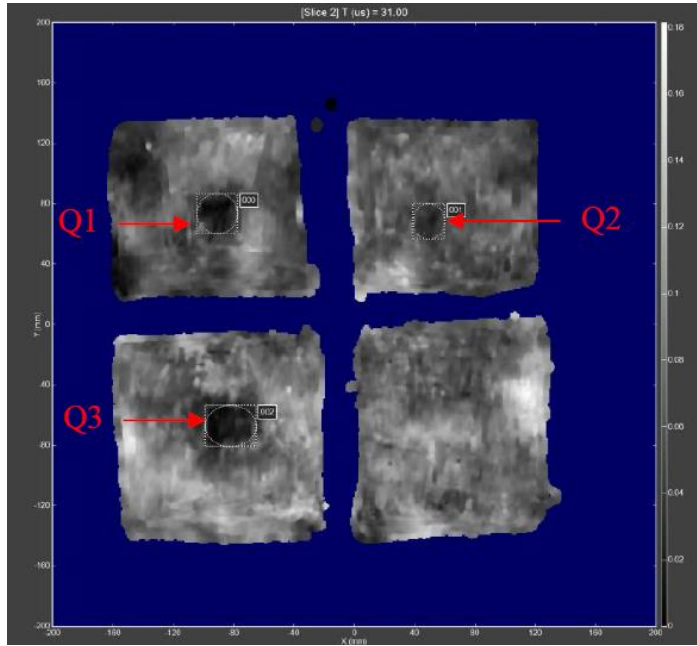
- Technology can identify defects in **Real Time**
- Location of defects in underlying substrate material
- Detect defects in composite material several inches thick



Depth of Indications Using 0.5 MHz 1-inch Transducer

Quadrant	Measured t (μ s)	Calculated d (mm)
Q1	27.6	6.4
Q2	26.1	4.8
Q3	22.3	0.8

Preliminary Validation Test Results – Current Limitations



- Specimen consists of 6 layers of DRS on top of steel substrate **with a rough aluminum oxide top-coat**
- 0.5 MHz, 1 mm brush size used on the previous specimens had difficulty reading through aluminum oxide. **A roller probe would be preferable** in this instance, which will be calibrated for future tests.

Common Uses of Engineered Composite Repairs



Large OD Cooling Water Lines



Sub-sea Repairs



Structural Repair to Jetty



Deck Repair



Caissons designed for 100 and 1000 year wave loading



Future Use of Engineered Composite Repairs

Greater uptake in the following:


- ✓ Repairs to production critical systems
- ✓ Longer design lives and design life extension
- ✓ Structural repair solutions

A robust, documented inspection procedure leads to verified performance and condition of in service repairs

Thank You

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