



DAMEN NAVAL
E-LASS



DAMEN

THE QUALIFY PROJECT

ENABLING QUALIFICATION OF HYBRID
STRUCTURES FOR LIGHTWEIGHT AND
SAFE MARITIME TRANSPORT

2017-2021



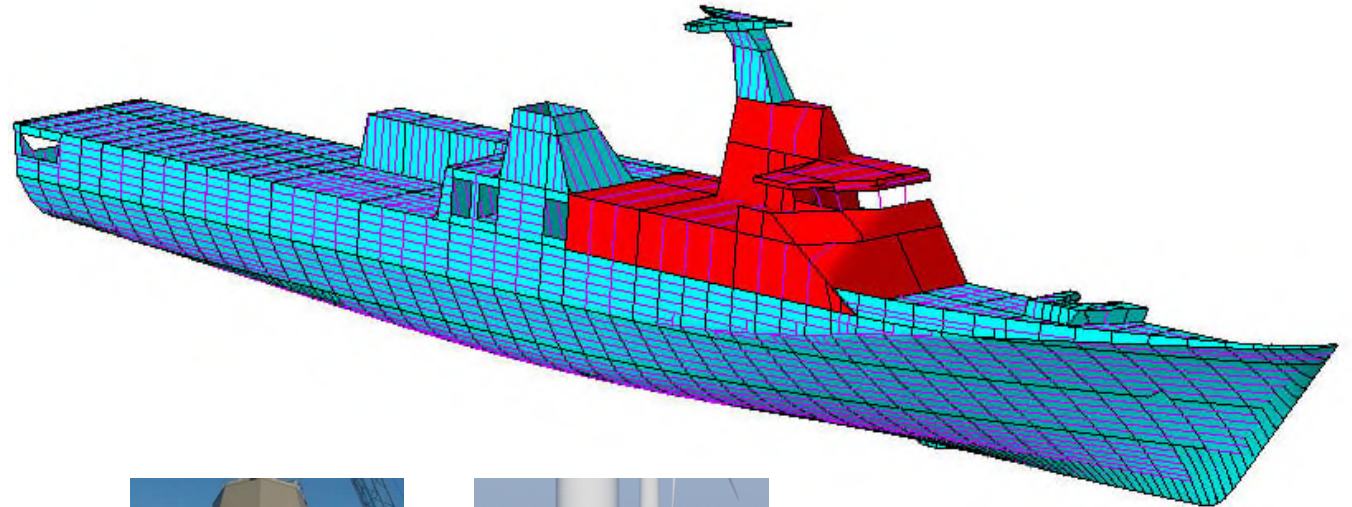
OBJECTIVES

1. Evaluate the long-term structural performance of the adhesively bonded hybrid joint under representative operational and environmental conditions;
2. Develop a reliable inspection and maintenance methodology for adhesively bonded hybrid joints;
3. Develop a procedure (Guidelines) for the qualification of adhesively bonded hybrid joints in primary structures in marine applications.

<https://www.youtube.com/watch?v=GpmHvbPZ1zE&t=2s>

DAMEN CASE STUDY

- DAMEN case
 - 90 meter corvette
 - Unrestricted sailing
 - Carbon Fibre Superstructure
 - -50% Weight superstructure
 - More functionality
 - Reduced fuel consumption
- BAE : Composite mast
- Parkwind: Composite platform



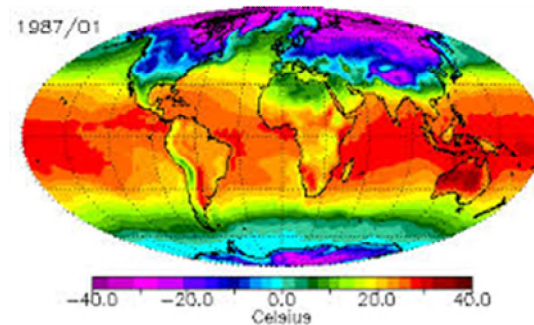
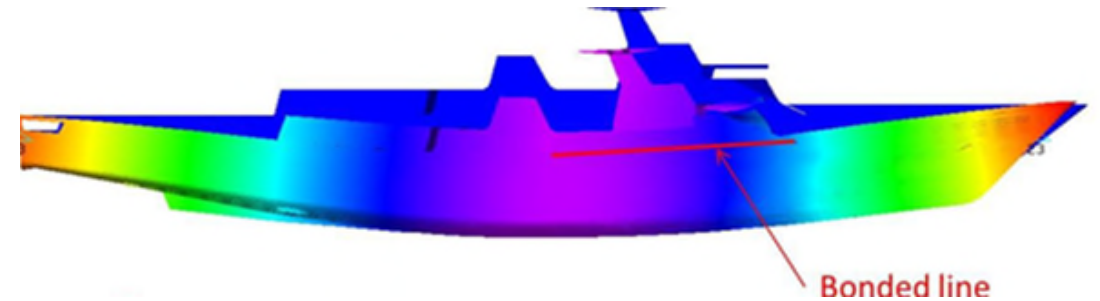
DAMEN CASE STUDY JOINT



- 10 mm MMA Adhesive
- Sealant protection
- Welded on deck

DAMEN CASE STUDY MAIN LOADS

- Wave Bending Fatigue (9e7 Cycli)
- 25 years of ageing
 - T -40...80 C



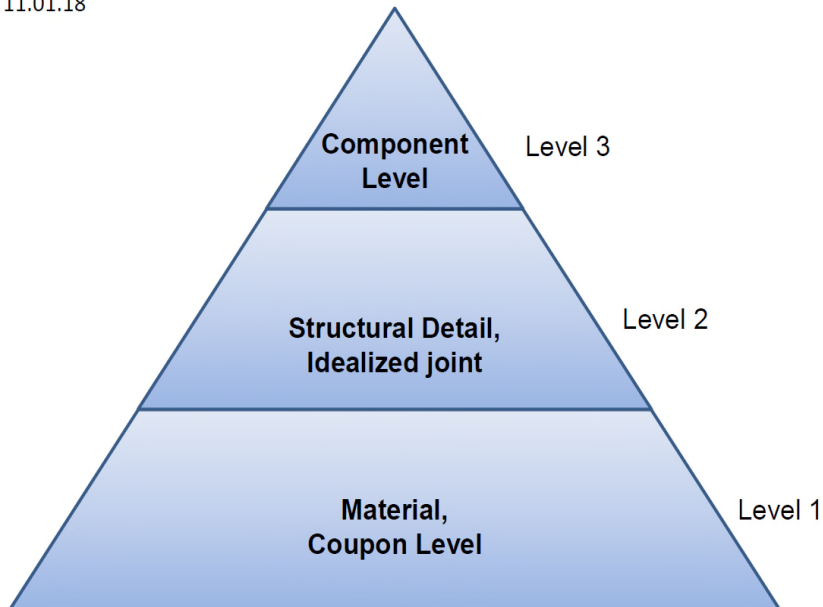
A black and white photograph of a mechanical testing machine, likely a universal testing machine, with a blue overlay on the left side. The machine's components, including a vertical column and a crosshead, are visible. The blue overlay on the left contains the word "TESTING" in white capital letters.

TESTING

TESTING & SIMULATIONS

■ Test pyramid (reviewed by class)

11.01.18

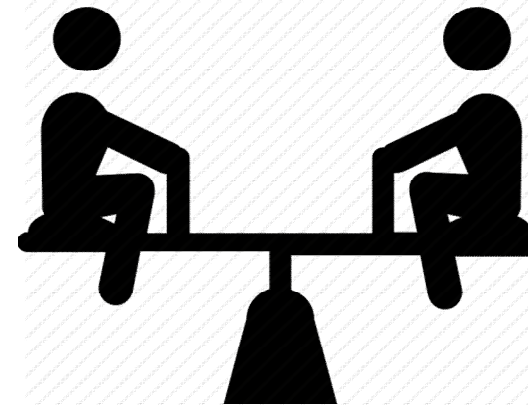


EXPERIMENTS

Characterization of materials and joints
Calibrate and validate simulations

SIMULATIONS

Development of numerical models
Value: predict complex joints, less (expensive) experiments



D1.1.1: Specifications of the demonstrator cases (Damen, BAE)

STRUCTURAL HEALTH AND CONDITION MONITORING TESTS

1) Acoustic Emission: **TU Delft**
Delft University of Technology

2) Fiber Bragg Gratings: **COM&SENS**

3) Thermography: **UNIVERSITEIT GENT**

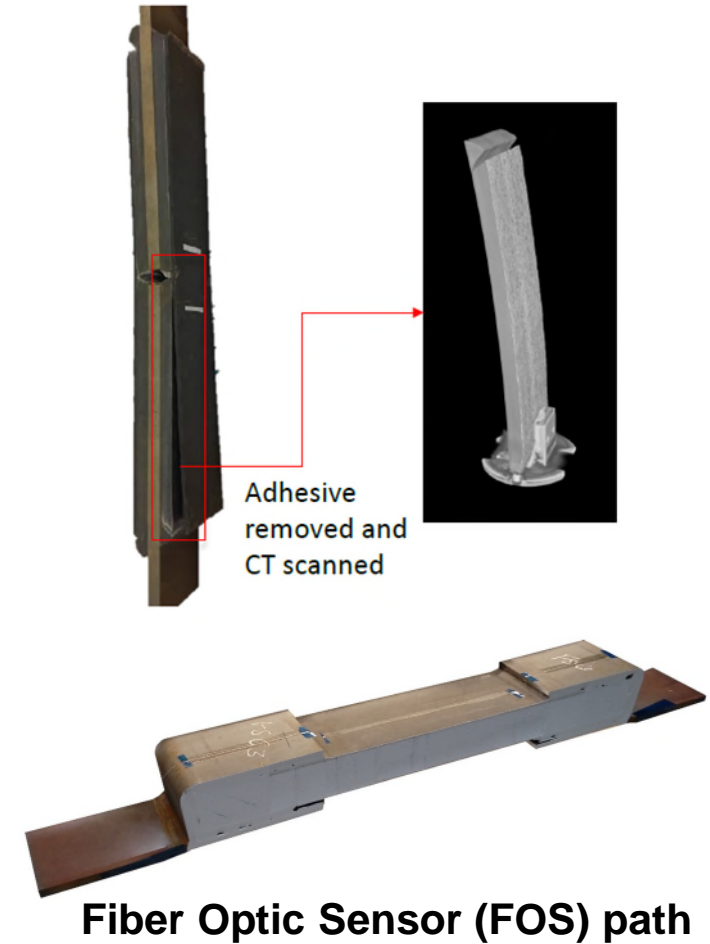
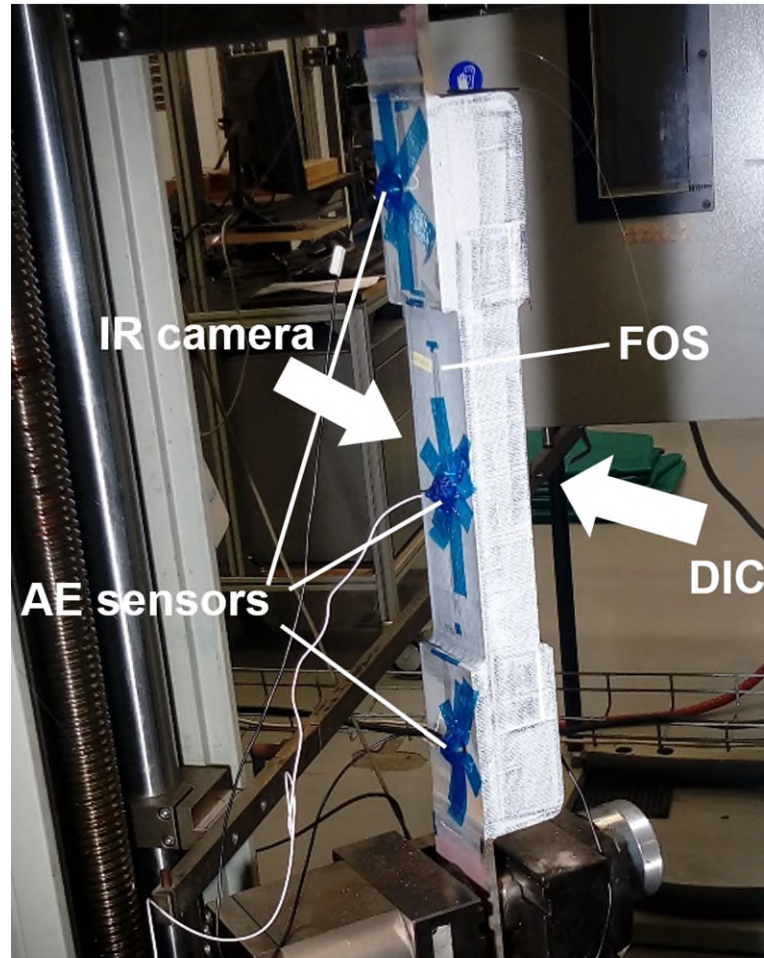
4) DIC: **UNIVERSITEIT GENT** **TU Delft**
Delft University of Technology

5) Fiber optic sensor: **TU Delft**
Delft University of Technology

6) Visual inspection: **TU Delft** **UNIVERSITEIT GENT**
Delft University of Technology

7) Micro CT: **UNIVERSITY OF CAMBRIDGE**

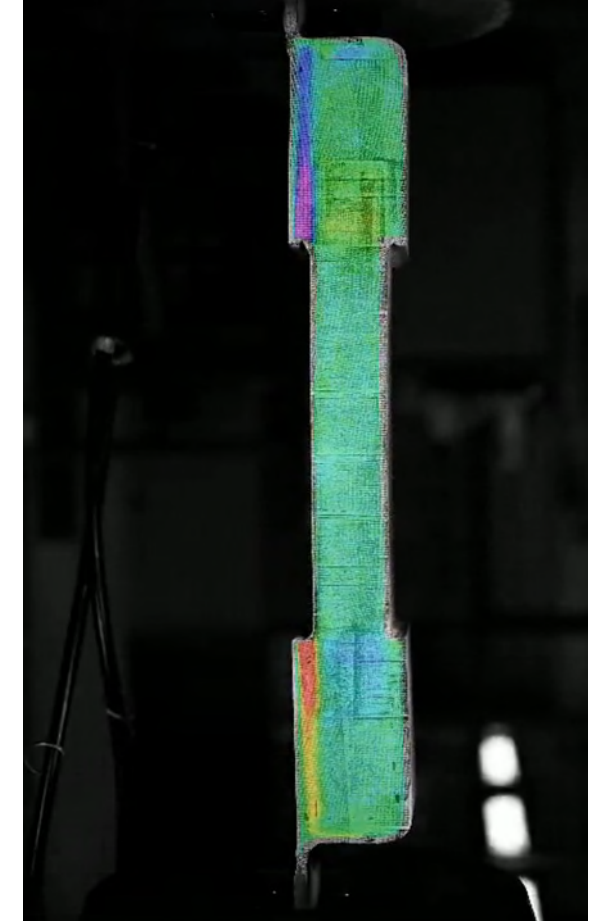
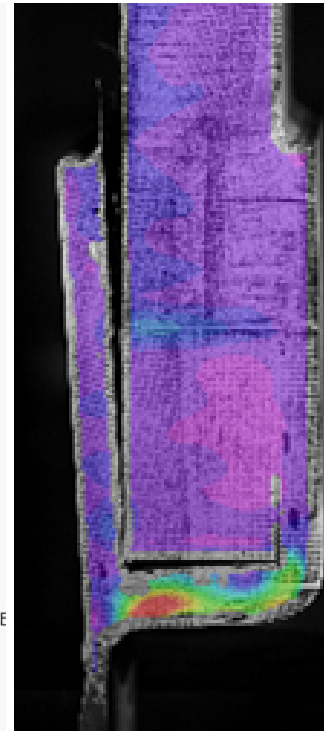
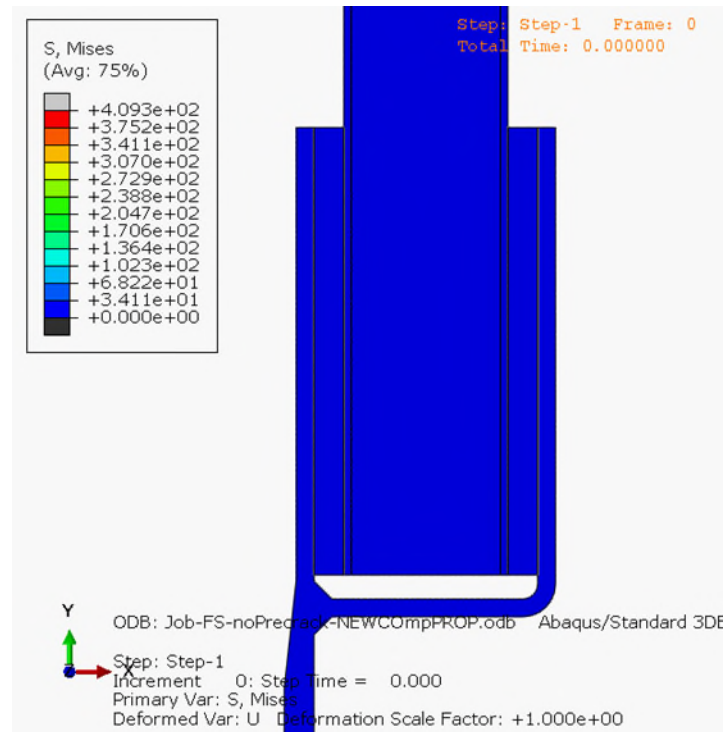
8) Ultrasonic C-scan: **UNIVERSITEIT GENT**



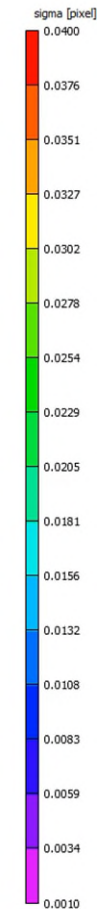
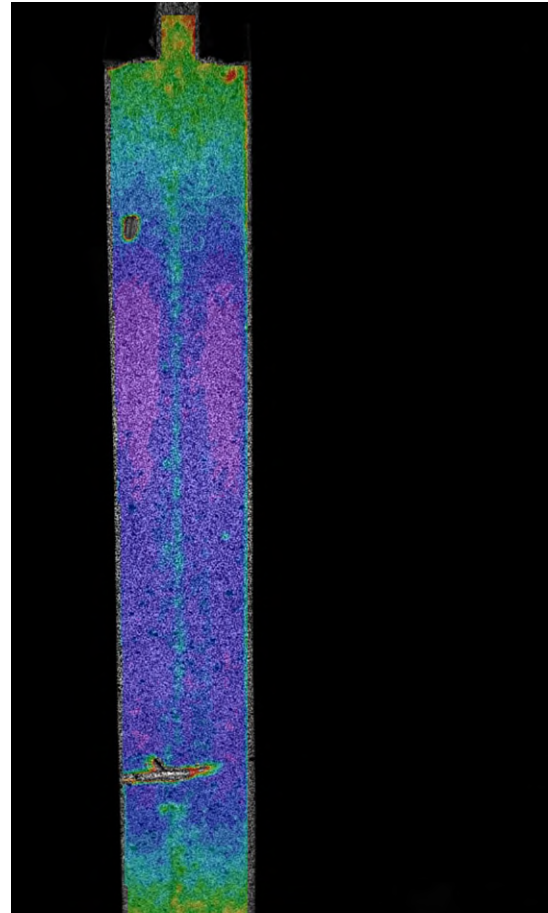
QUALIFY
LIGHTWEIGHT

STRUCTURAL HEALTH AND CONDITION MONITORING TESTS

- Joint failure = delamination within composite



FATIGUE SCOPING TESTS



Specimen tested at a maximum value of 1.25MPa nominal average shear stress

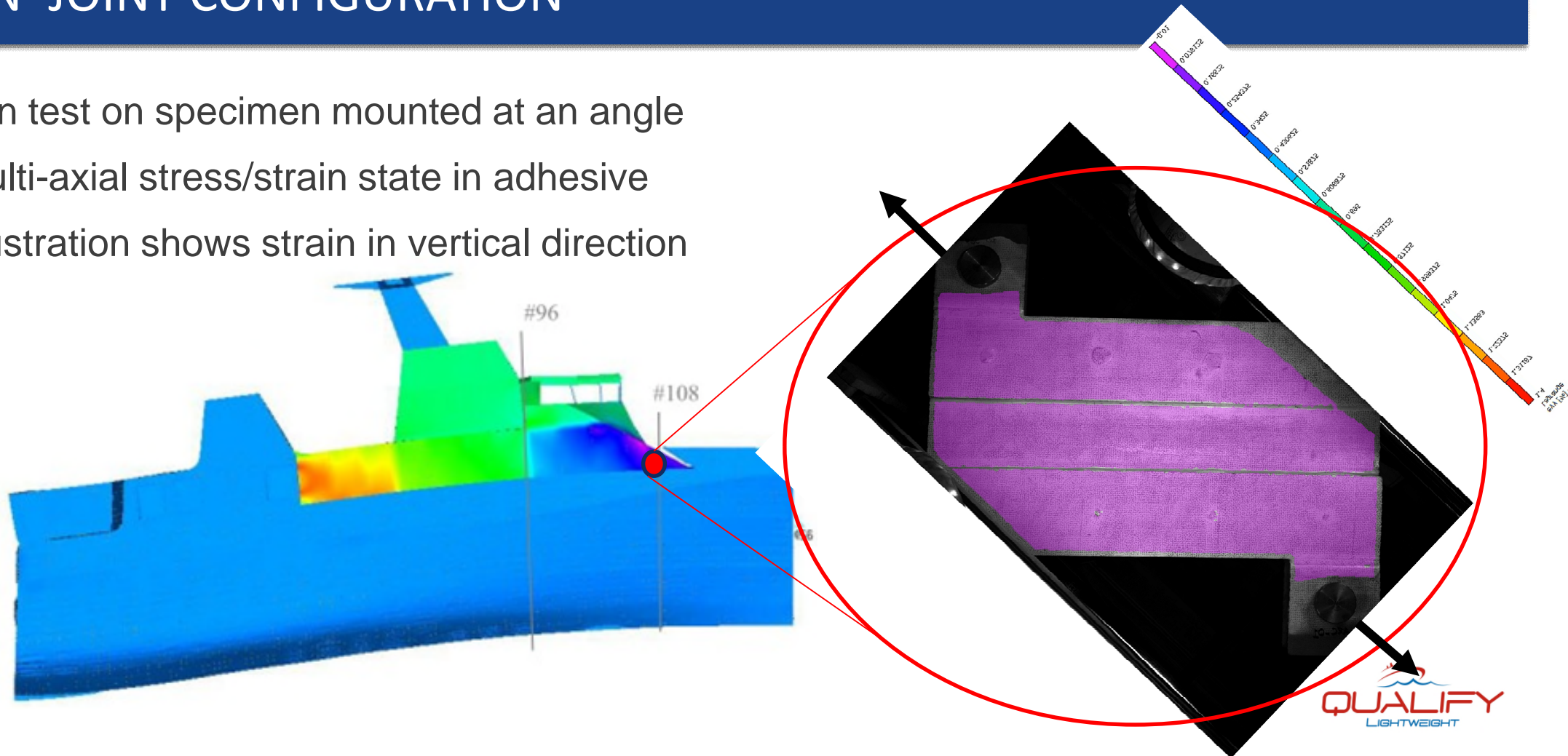
- Disbond between the steel-composite interfaces at 1 million cycles*
- Formation of hackles at 1.45 million cycles*

FATIGUE SCOPING TESTS

- Average shear stress versus number of cycles
- Link with damage
 - Hackles in adhesive
 - Interface disbond
 - Final rupture

MIXED MODE TEST ON LARGE-SCALE 'DAMEN' JOINT CONFIGURATION

- Tension test on specimen mounted at an angle
 - Multi-axial stress/strain state in adhesive
 - Illustration shows strain in vertical direction



TAILOR MADE EQUIPMENT FOR AGEING BY IMMERSION IN ARTIFICIAL SEAWATER

- Artificial seawater of 3.5% salinity @50°C
- Simulates 5 years in tropic conditions (diffusion mechanism)
- Pre-crack and paint removed
 - Paint removed to have corrosion initiation

