

## **Session 3: Adhesive-bonded Joint Inspection requirements**

For decades we have heard that NDT is not delivering the required confidence.

The 'Holy Grail' of NDT is to detect kissing disbonds.

Several phases of research funding have not solved the problem, although emerging methods may have done.

But how do we know when we have not defined success?

## **Session 3: Adhesive-bonded joint inspection requirements**

- Do we need to actually measure and/or map bond strength?
- Or is it sufficient to provide confidence that there is no evidence of any kissing disbonds?
- Or would an ultrasonic 'proof-test' be adequate?
- What do we need to do or prove in order to satisfy regulators that adhesive joints and co-bonds are safe without secondary fasteners?

## **Session 3: Adhesive-bonded joint inspection**

**3b** The kissing disbond – Avoidance and detection. Jeff Kapp, 3M

**3c** Assessment and Criticality of Defects and Damage in Adhesively Bonded Composite Structures. Dr Bill Broughton, NPL

**3d** Analysis of kissing disbonds in metallics. Prof Felicity Guild, Imperial College.

**3e** Bonded joints in military composite. Dr Barbara Gordon, for BAE Systems.

**3f Panel Session**

## Session 3 Panel discussion

Panel members:

Dr Tim Barden (Chair),

Dr Simon Waite, EASA

Dr Bill Broughton, NPL

Jeff Kapp, 3M

Prof Felicity Guild, Imperial College

Dr Barbara Gordon, University of Bristol/BAE Systems

We are seeing an upsurge in funding for NDT of adhesive joints.

- On which failure mechanism(s) should we focus?
- Should we be trying to a) measure a strength-related parameter, or b) find defects?
- What do we need to achieve in order to remove the need for 'chicken rivets' to carry limit load?

What do we need to do to demonstrate ABJ are acceptable?

- Environment. Defining so you can model it.
- Finding problem area. Repairs are known locations.
- In-service – worst case. Repairs. Confirm repair is good.
- Can monitoring be a surface strain measurement?
- Fibre optic continuous strain measurement?
- Lateral strain (Poisson ratio) variation seen in weak bond.
- Get smarter with bonded areas. Load arresters?
  - Repair should at least give limit load
- Is continuous adhesive area best way to go, or best to have crack arrester regions?
- Potential to avoid problem by controlling process.
  - No chicken rivets.
  - No fasteners but could have arrest features. Design shows can stand limit load.

- Can we remove proof loading?
- Proof test shock-wave system?
  - Vibro-thermography etc, are all stressing the joint.
- Is a reduction from 10% to 0% of some areas a problem?
- Could we apply a treatment that makes it visible. 2<sup>nd</sup> stage to measure.
- Lateral strain measurement – eg DIC, under shear load.
  
- Could we measure strain in other ways?
- Raman Spectroscopy for CFRP.
- NCC kissing bond DCB specimens – being tested at NPL – but potential large scatter in fracture toughness.
  
- Conversation regarding sandwich structure.
  - Problems with understanding failure modes and linking with detection and characterisation of different defect types. This has led to move to monolithic but solving these problems could lead to renewed usage of sandwich structure
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