

Design Development and Structural Substantiation of Bonded Structure - Summary of Breakout Sessions -

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Bonded Structure Design

- Design/size structure to fail outside the adhesive
 - Know failure mode and location
 - In composite joints, failures typically occur outside adhesive but not outside joint area
- Redundant design features
 - Varied opinions on value vs. damage tolerance approach
 - Part 23 requirement
 - Not effective for global process failure
 - Not required for co-cured structure/sandwich
- Establish defect and damage sizes
 - Most agreed on value, need better linkage to analysis and test
- Define max allowable repair size on primary structure
 - Debate over max size limit for bonded repair.
 - Need for some load capability requirement in case of failed repair?
 - Bolted-bonded repairs?

Bonded Structure Data and Analyses

- Material properties and Statistical allowables
 - Data must align with criteria and analysis
 - Debate over value of thick-adherend adhesive data, develop statistics at this level? Appropriate level for allowables development?
 - Value of adhesive data, when composite joints often have other failure modes. Adherend data? Fracture toughness data?
 - Dealing with material and process changes, showing equivalency back to certification database.
 - Need to capture manufacturing variations
- Environmental durability
 - Not design data but process validation
 - Strength loss vs. time is not a design knockdown but a process problem
- Environment “knockdowns”
 - What to apply to full-scale RT test? From worst case coupon level effects?
- Analysis Methods
 - Should be linked to failure modes, drives data needs

Bonded Structure Substantiation

- Static Strength
 - Validation of analysis methods
 - Key is to verify failure mode at element and subcomponent level
 - Validation of manufacturing process
 - Need to play “what if” game? Look at all worst case scenarios? To what level to consider process failures?
- Durability
 - Capture environmental durability service experience and data and feed it back into the design and test loop
 - Large scale tests at environment
 - Test at highest scale feasible (usually not economic at full scale)
 - Test to demonstrate growth? Verifying “no growth” doesn’t tell you where threshold is.
- Damage Tolerance
 - What level to incorporate damage/ flaw testing?
 - Demonstrate inspectability of potential damage
 - Structural health monitoring issues

Standards, Guidance, and R&D Needs

- Standards/Guidance
 - Durability test standards (environmental)
 - wedge test? DCB?
 - Equivalency guidance for adhesives and bonded processes
 - Building block guidance for bonded structure
 - Guidance on statistical allowables for bonded joints
 - Need fracture toughness test standards to support evolving methods
 - More usable data into Mil-17
 - adhesive data
 - preliminary design data ok
 - Bonded structures certification guidance (AC or policy memo)
- R&D Needs
 - Improved inspection methods
 - Effective G_c , R-curve effects for bonded joints