



Fluid Ingression Damage Mechanism in Composite Sandwich Structures

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PASTE
SCHOOL
LOGO
HERE



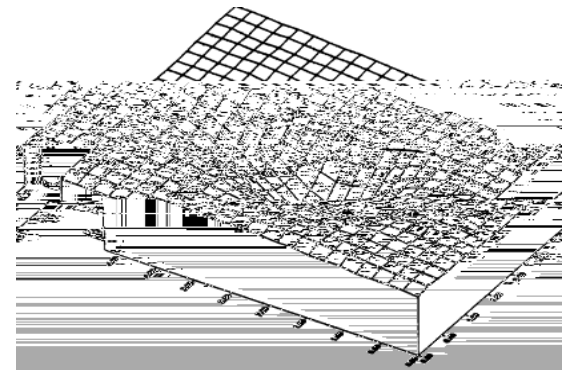
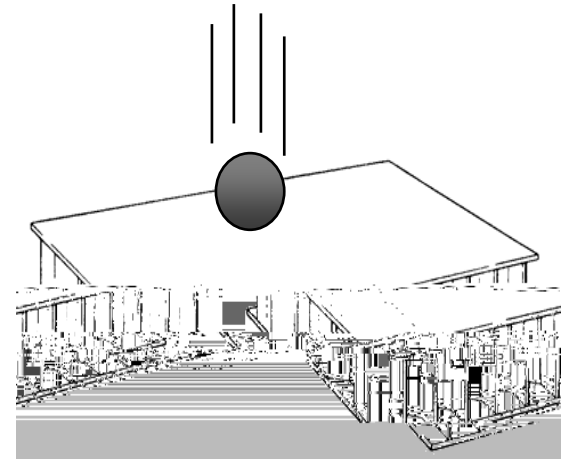
FAA Sponsored Project Information



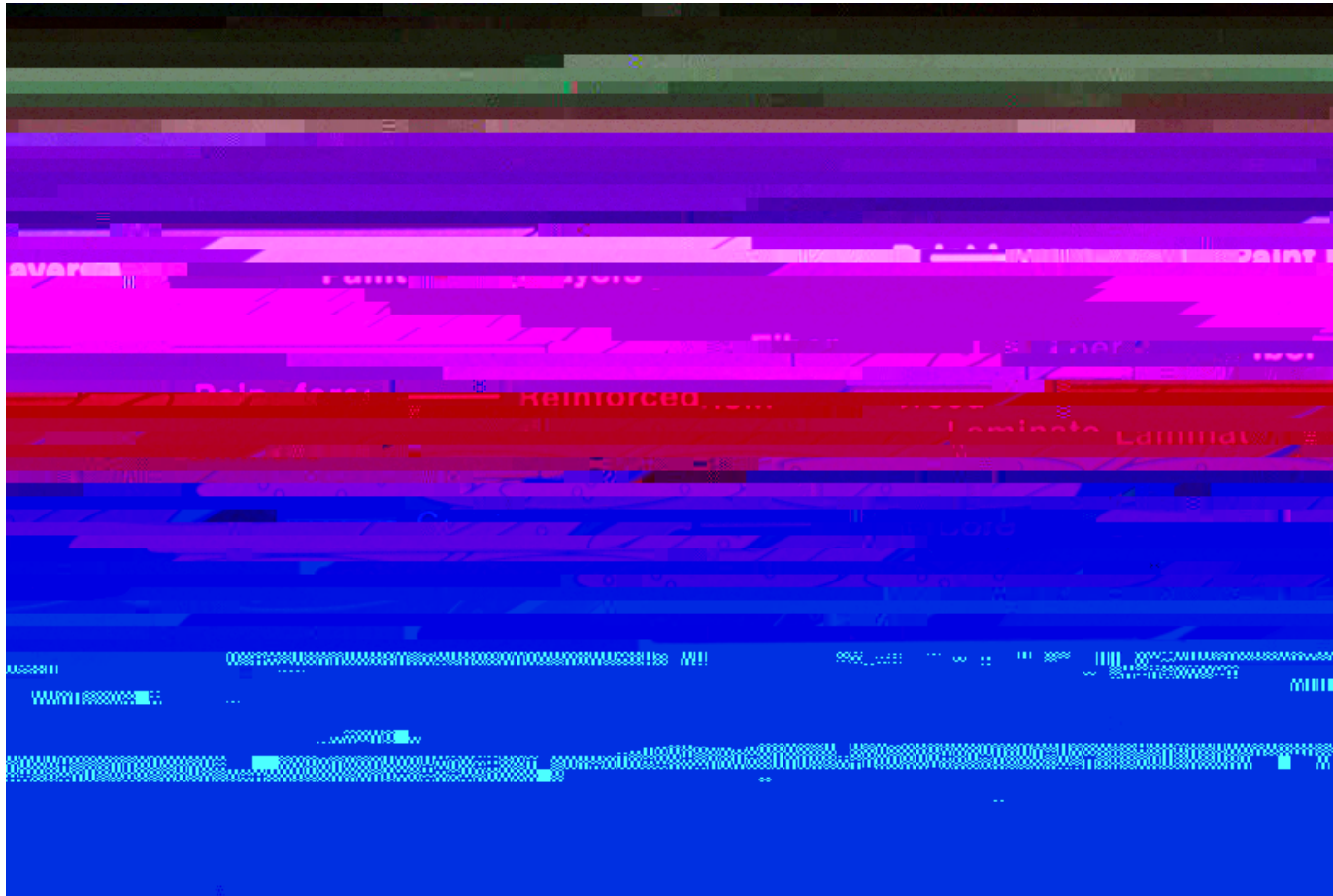
- Principal Investigators & Researchers
 - John Tomblin and Allison Crockett
- FAA Technical Monitor
 - Curt Davies
- Other FAA Personnel Involved
 - Larry Ilcewicz
- Industry Participation
 - Hal Loken, Consultant

Research Objective

Characterize the fluid ingress phenomenon in composite sandwich structures as well as to document the damage mechanisms which allow the fluid ingress to propagate and potentially degrade the structural performance



Perfect Composite Sandwich Structure



Problematic Composite Sandwich Structure

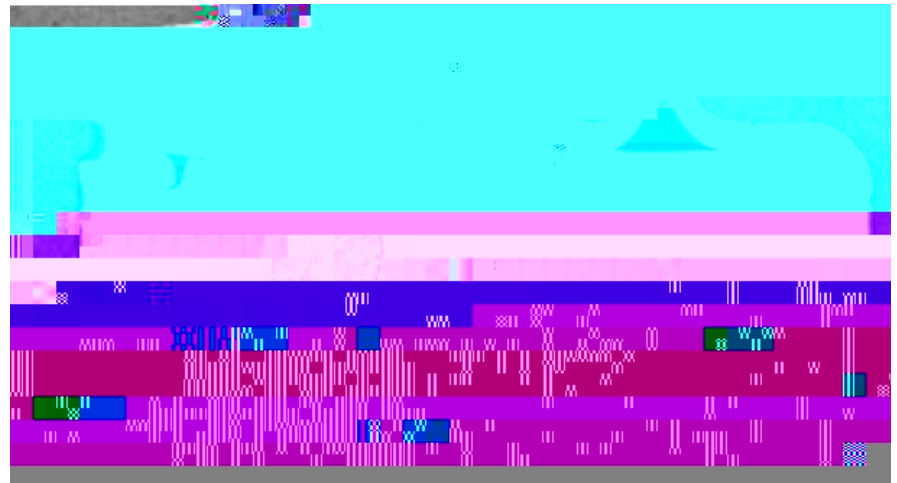


- One of the biggest problems for an airline operator is when large hailstones strike at a major airport.
- Composite sandwich fixed trailing edge panels are typically damaged by the hailstones
- If not sealed or repaired, these panels will later develop water ingress into the honeycomb core at the spot where each large hailstone struck.
- Research will establish a cost effective standard for hailstone resistance.





- This septum design allows fluid to migrate easily between the two cores and one ply of fabric.
- From the rudder series with the Z-Profile design a fluid path is created with the blind rivet used.



- A320 Elevators
 - Affected Areas: Trailing edge inserts, bonding straps, panel surface.
- A300/A310 Rudders
 - Disbonds between skin and honeycomb cores
 - Water and Skydrol contamination
 - Incorrect repairs, not bonded correctly and excessive paint build-up
- Water ingress leads to
 - Deterioration on the honeycomb/skin bonding line
 - Delamination
 - Weight Increase





**Fluid Ingression
Damage Tolerance**

*Resistance to the propagation
of damage due to fluid
ingression and degradation of
structural performance*

**Fluid Ingression
Damage Resistance**

*Material performance, design
details and maintenance
practices which resist fluid
ingression into the core*

**Proposed research program will focus on
Fluid Ingression Damage Tolerance**

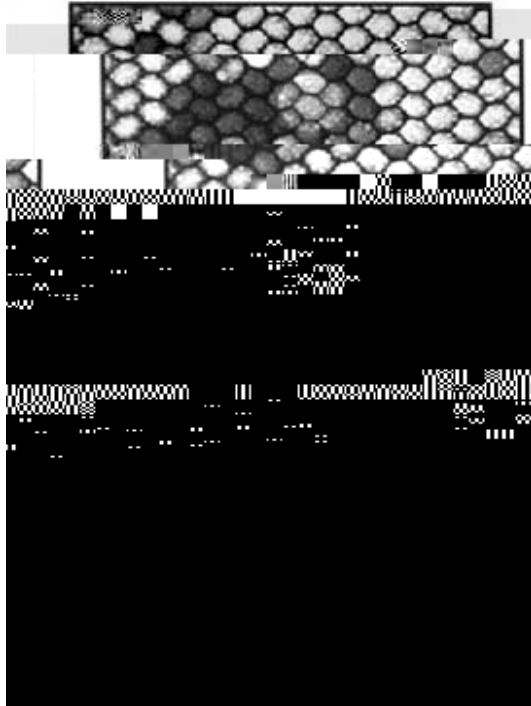
The Joint Advanced Materials and Structures Center of Excellence

BASIC ASSUMPTIONS

- Fluid ingress path is established and
- Ingression HAS occurred

GOAL

Characterize the fluid ingress growth mechanisms and rates due to hygrothermal exposure based upon a number of variables



- Proposed Experimental Laboratory Variables
 - Different Core Types
 - Aluminum, m-aramid, p-aramid, and glass.
 - Different Core Densities
 - Different Fluid Types
 - Water, Skydrol, Hydraulic

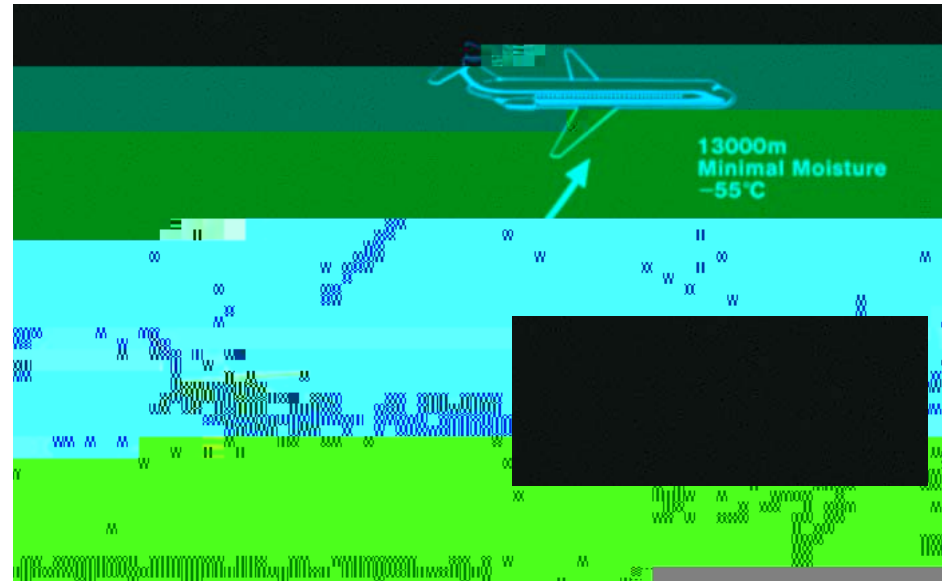
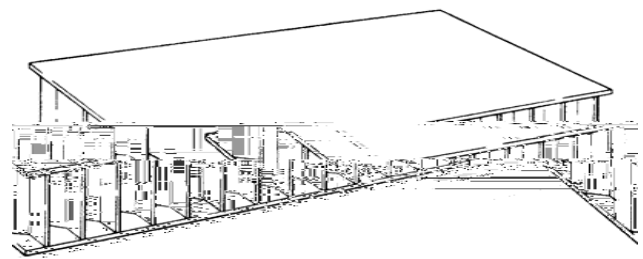
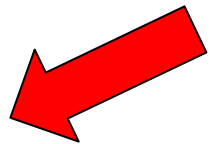
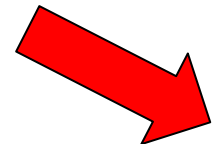
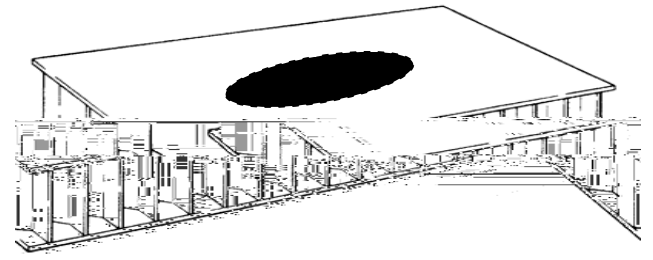


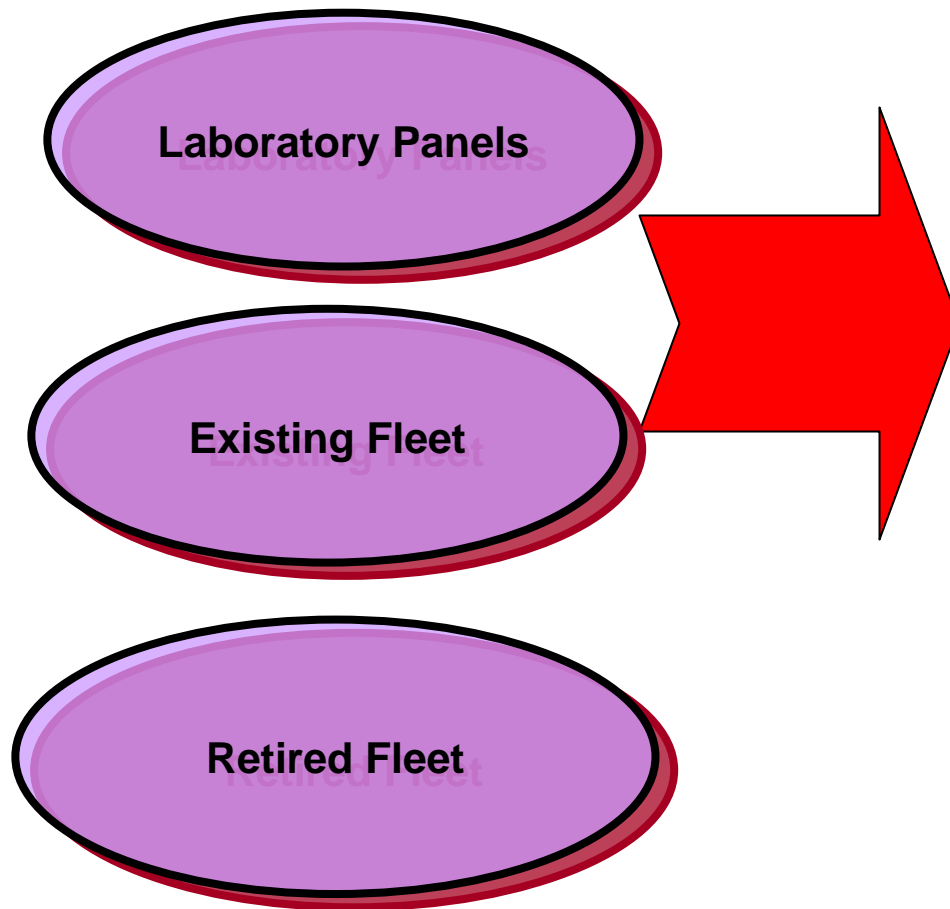
Existing Fleet & Recently Retired



Characterize existing structural parts and configurations (with potential aging effects)

JAMS Proposed Program Highlights





- Intercellular diffusion (good cell wall)
- Permeable cell wall
- Permeability as a function of age/load sensitivity
- Filleting quality
- Poorly machined honeycomb (poor bond)
- Freeze/thaw
- Porous or discontinuous adhesive (adhesive type/process)

- How resistant is core?
- Is fluid ingress noticeable without impact?
- Should there be a process control for core?
- Can foams be added to the test matrix?

JAMS Current Industry Contributors



- As a result of Amsterdam the following people will contribute parts from the flying fleet:
 - AIRBUS Anna Rodriguez Bellido of Airbus Spain: 320 Elevators
 - Boeing – fixed trailing edge panels on upper surface of Early 747 wings
 - David Mills ICES Corporation – variety of parts with core and fluid ingress

A Look Forward

