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## MOTIVATION

- ◆ Provide design and fabrication methodology for cost-effective body part replacement program for aging aluminum panels

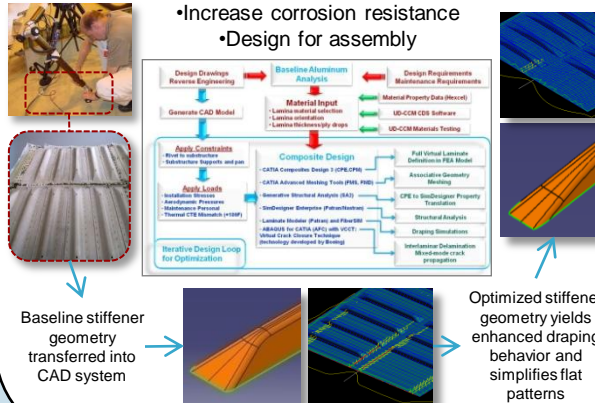


- ◆ DESIGN for matching bending and in-plane stiffness, weight reduction, parts consolidation and increased corrosion resistance
- ◆ DEVELOP processing approach to integrate hollow stiffeners matching baseline geometry
- ◆ EVALUATE VARTM-production of graphite-epoxy replacement for aluminum wing skin panel

## DESIGN AND OPTIMIZATION

Design Goals:

- Match aluminum baseline stiffness response
- Consolidation of parts into single piece
- Increase corrosion resistance
- Design for assembly

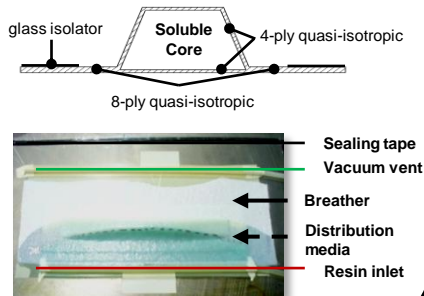


## MATERIAL SELECTION

- ◆ CYCOM® 977-20 – *Cytec Engineered Materials*
  - ◆ Modified autoclave resin system for infusion processing
  - ◆ Elevated temperature infusion required (infused @ 160°F, cured @ 350°F)
- ◆ SGP193-P carbon fabric – *Hexcel Schwebel*
  - ◆ Cost vs. Performance
  - ◆ Availability
  - ◆ Drapability
- Combined in quasi-isotropic 8-ply laminate [(0/45)<sub>2</sub>]<sub>s</sub>
  - ◆ Split to 4-ply on top/bottom of stiffening hat [(0/45)<sub>s</sub>]
  - ◆ Ply drop to match baseline thickness at mounting points
  - ◆ Glass fiber isolators to prevent galvanic corrosion
- ◆ AQUACORE™ – *Advanced Ceramics Manufacturing*
  - ◆ Temperature resistant polymer-ceramic-compound (>380F)
  - ◆ Easily formed to shape
  - ◆ WATER-SOLUBLE but sealable against resin uptake

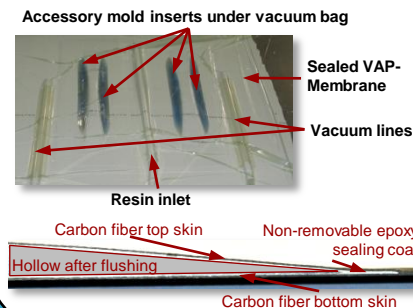
## COMPOSITE PROTOTYPE

- ◆ Room-temperature SCRIMP-infusion of sub-scale single stiffening hat (glass-epoxy)



## COMPOSITE PROTOTYPE

- ◆ Room-temperature VAP-infusion of sub-scale single stiffening hat (carbon-epoxy)



## CONCLUSIONS

- ◆ Soluble core inserts allow integration of closed-cell stiffening hats into flat panel VARTM-laminates
- ◆ Demonstration of design and fabrication approach successful on sub-scale structure
- ◆ Foundation for time and cost efficient replacement of aluminum skin panels

## Future Tasks

- ◆ Resolve CTE mismatch
- ◆ Fabrication of full-scale prototype
- ◆ Testing and characterization of full-scale prototype
- ◆ Prove flight-worthiness!

## ACKNOWLEDGEMENTS

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