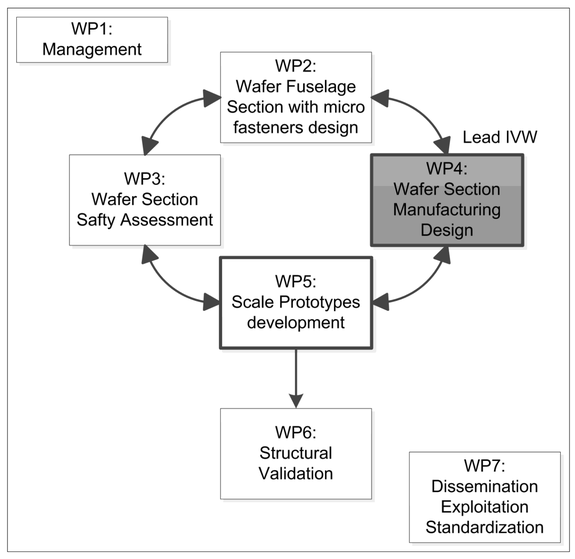
PROCESSING OF UNIDIRECTIONAL FRPC
Composite Fuselage Section Wafer Design Approach for Safety Increasing in Worst Case Situations and Joints Minimizing

Mack, J.; Mitschang, P.

OBJECTIVES

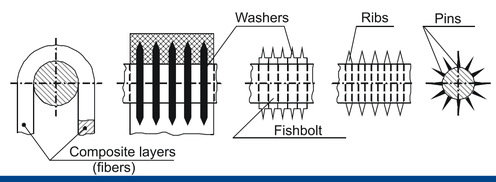
- The project WASIS is funded by the European Commission for 42 months
- 11 companies / research institutes from 9 different countries (8 EU + Ukraine) are involved
  - Project partners classified by composition :
    - Manufacturer: CirComp GmbH; Institut für Verbundwerkstoffe GmbH (IVW); Institute of Mechanical Engineering and Industrial Management (INEGI)
    - Simulation, design, material tests, project coordination, standardization : AOES; Materials Engineering Research Laboratory Ltd (MerI); National Aerospace University “KhAI”; Univeristy of Patras - Department of Mechanical Engineering and Aeronautics; NetComposites Ltd; Foundation CIDAUT; Comite Europeen De Normalisation (CEN)
    - End user: Piaggio Aero Industries S.p.A.
- The main objective of the WASIS project is the development of a composite fuselage structure based on the following four points:
  - Reduce composite fuselage section weight (wafer structure / lattice stiffening concept)
  - Reduce aircraft fuselage weight (using innovative micro-fastener joining elements)
  - Increase fuselage section safety in worst case situations (higher damage tolerance with the used structure)
  - Reduce aircraft manufacturing costs (fully automated manufacturing process)



STATE OF THE ART

References

- Aircraft Piaggio Aero P180 Avanti II
- Composite structures developed by Vasiliev
- Tape Placement – Thermoset
- Carbon fiber prepreg tapes with epoxy thermoset resin (60 % FVC)



CHALLENGES

Crossing Point Analysis

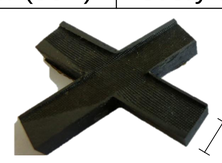
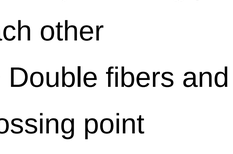
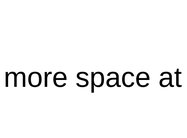
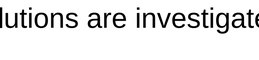
- At every crossing point two or more ribs are crossing each other
- ➔ Double fibers and matrix need more space at the crossing point
- Four different crossing point solutions are investigated

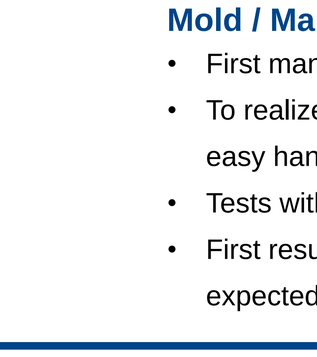
Mold / Manufacturing

- First manufacturing trails were with a metallic mold
- To realize a suitable fuselage manufacturing process an easy handling tool system is required
- Tests with a silicon mold already started
- First results regarding the compression and voids are expected at the end of the year

RESULTS

Crossing Point Analysis

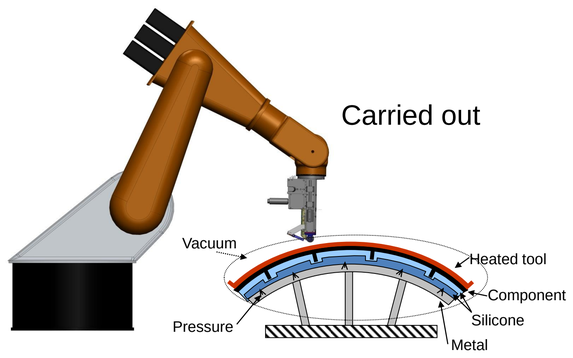
Alternate tape cutting in every second layer (90 °)	Alternate tape cutting in every second layer (72 °)
	
	
Fibers are deflected into the height	Fibers are deflected into the width
	
	



- In the left figure the crossing point (top view) for a 90° cutting solution is shown (µ-CT figure with an resolution of 10 µm)
- Areas with voids around the cutting lines are obvious

➔Void reduction is possible due to process optimization

- Every crossing solution will also be mechanically characterized



NEXT STEPS

- First results show a weight reduction combined with a safety increase
- The crossing point analysis is nearly finished - the next step (micro-pin) implementation can be started
- Tool design and tool geometry can start after the suitable micro-pin implementation is analyzed

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Institut für Verbundwerkstoffe GmbH, Erwin-Schrödinger-Straße, Geb. 58, 67663 Kaiserslautern, Germany