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Reducing Flagging and Fraying in Composite Sandwich Panel Machining

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Reducing Flagging and Fraying in Composite Sandwich Panel Machining

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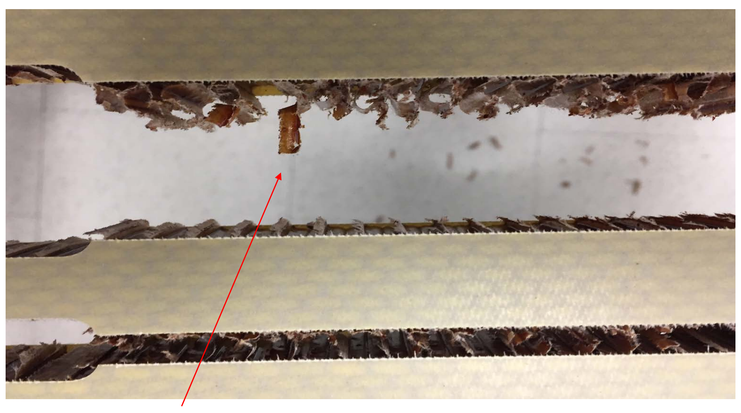
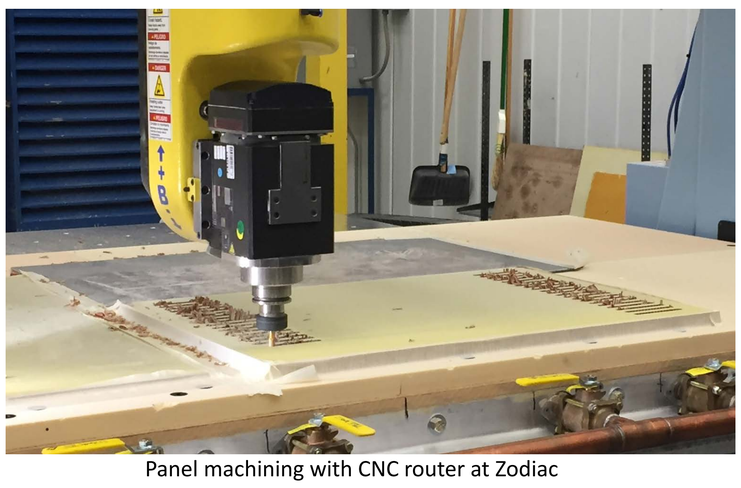
Western Washington University
Zodiac Aerospace Cabin Interiors

Background

- Composite sandwich panels provide a lightweight and strong alternative to traditional materials
- Zodiac Aerospace fabricates panels for aircraft interiors
- CNC milling causes flagging and fraying
- Flagging and fraying causes out of tolerance parts and assemblies
- Employees manually remove flags and sand rough fiberglass edges
- Secondary processing increases cycle time





Panel machining with CNC router at Zodiac

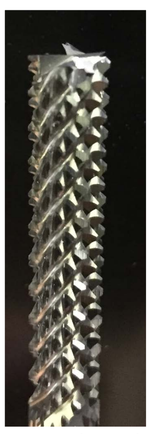
Innovation

- Analyze cutting process using high speed videography
  - Photron Fastcam Mini AX200
- Improve 5-axis machining strategies
- Optimize cutting parameters
- Optimize cutting strategies
  - Lead and lag
- Investigate a variety of cutting tools

High speed camera setup at WWU labs

Compression router style tool

Capturing footage of a cut utilizing lead



Burr style tool

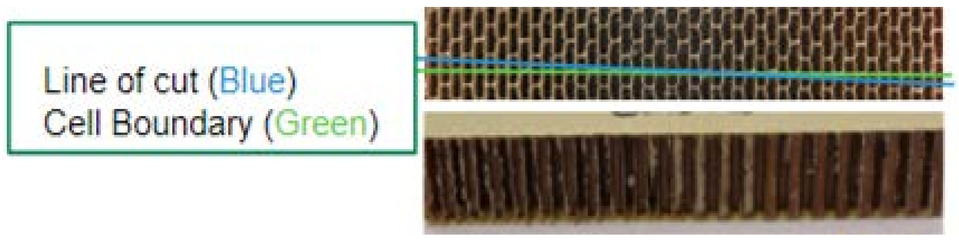
Project Description

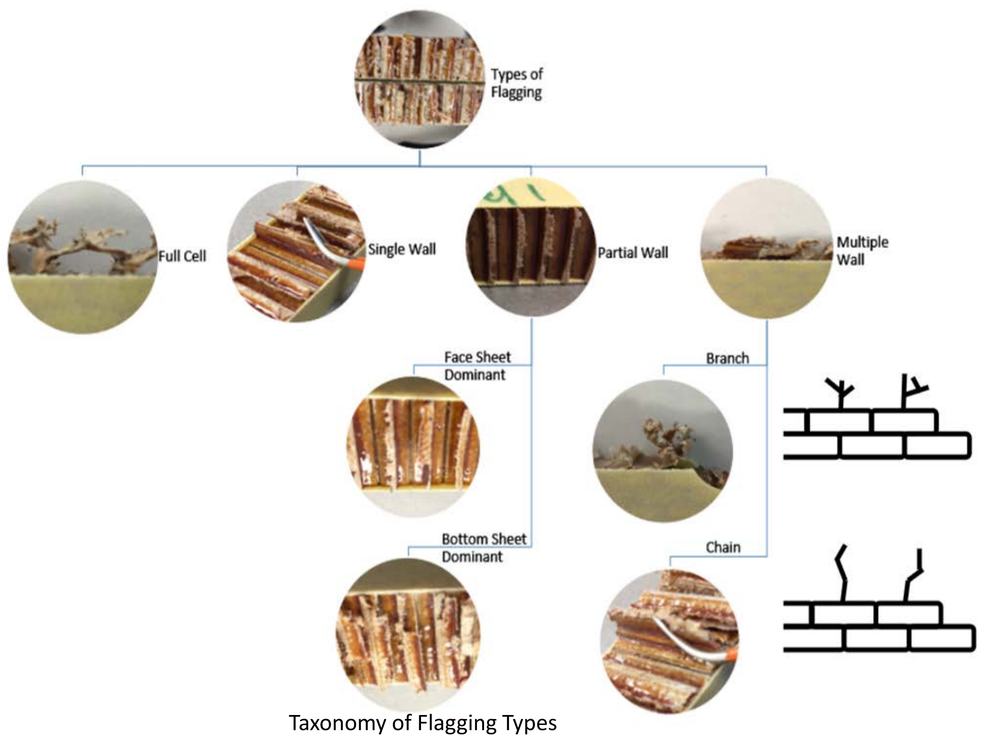
Assumptions and Limitations:

- Develop solution compatible with current CNC routers and tools
- Add no additional processes
- Maintain or improve production

Observations:

- Top and bottom face sheets have different fraying attributes
- Current tool engages the fiberglass only every half rotation
- Flag creation is dependent on cell boundary



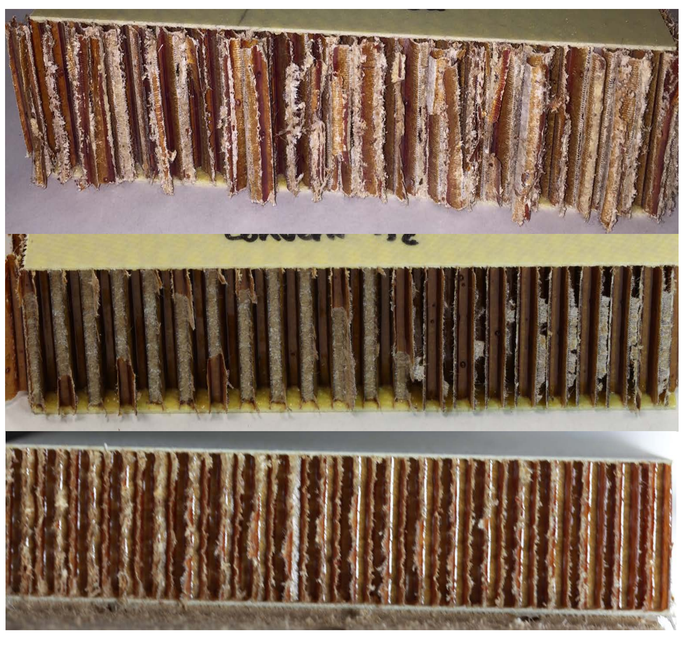


Taxonomy of Flagging Types

Climb

Conventional

45° Lead Con.



Current Proposed Solutions:

- Prioritize conventional cutting
- Lead angle of 45°
- 50% radial engagement
- Blind pocketing operations should be performed on the rough face sheet to reduce fraying

Taxonomy of Flagging Types

Anticipated Impact

Zodiac Aerospace Benefits:

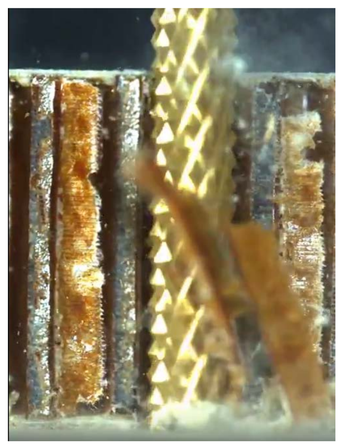
- Reduced cost of composite sandwich panel machining
- Eliminate secondary operation of manual flag removal

Industry Benefits: If the cost of machining is reduced composite sandwich panels and their benefits will be more accessible to a broader range of industries

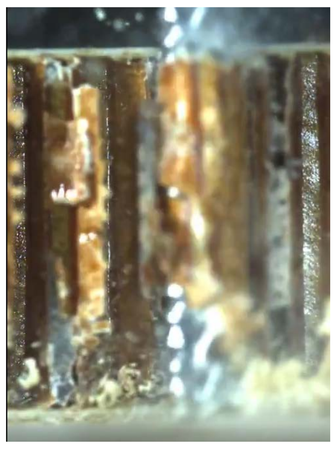
- Electric Automotive
- Performance Marine

Path Forward

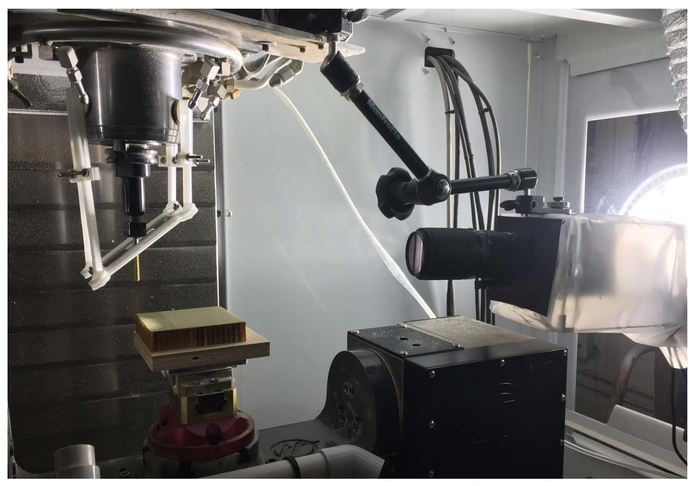
- Reduce flagging and fraying using a technique that can be implemented by Zodiac Aerospace
- Use high speed videography to analyze different tool cutting behaviors
- Standardize tool used across the company
- Develop ideal cutting parameters
- Identify a tool that would be better suited for the composite material



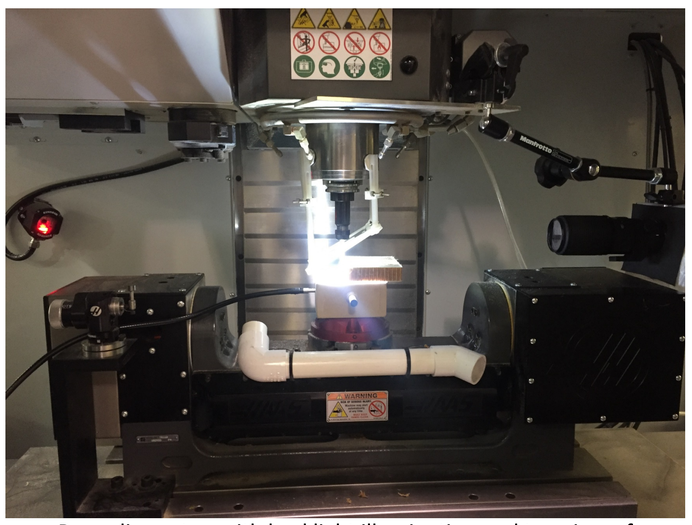
Mastercut tool throwing a chip



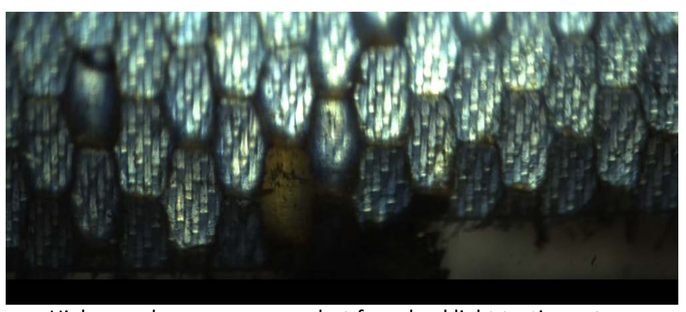
Fullerton tool wrapping up a chip



Recording setup with ventilated camera bag and mirror fixture on tool for top view of cutting



Recording setup with backlight illumination and top view of cutting



High speed camera screen shot from backlight testing setup