

Dovetail Core Splice Joints in High-Performance Composites Sandwich Systems with Aluminum Honeycomb Cores

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Introduction

The increase in the size of composite sandwich structures requires the introduction of core splices to join various segments.

In this study, a novel core splice joint configuration is studied and proposed for advanced composite sandwich structures consisting of an aluminum honeycomb core and carbon-fiber/epoxy facesheets.

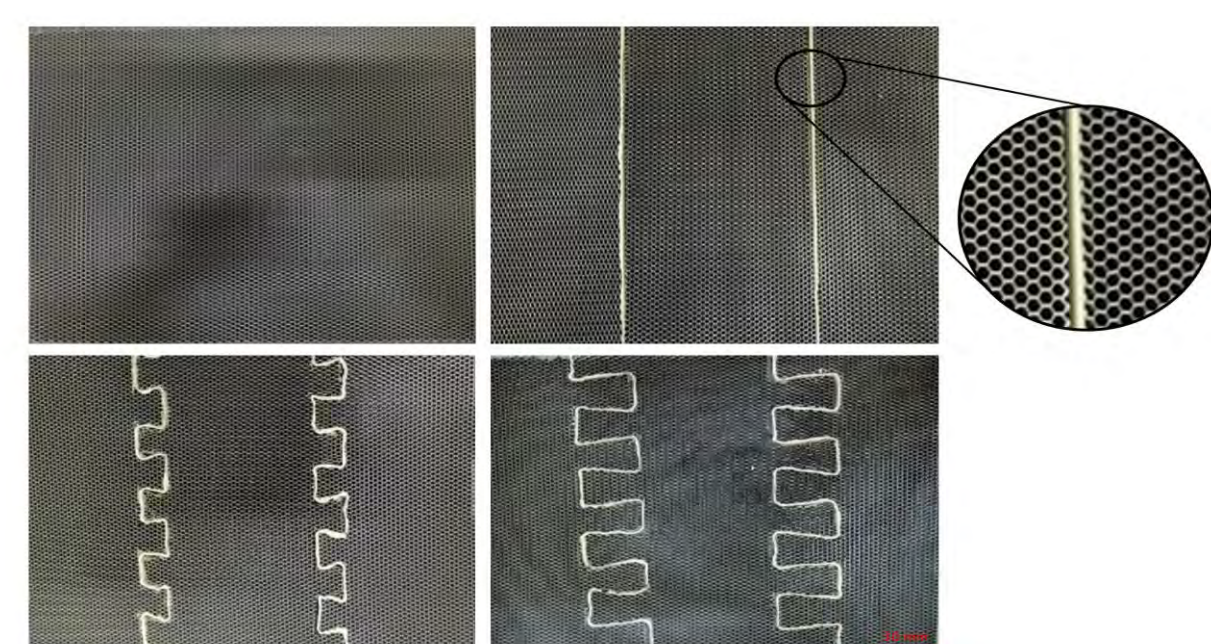
The investigation explores the effect of dovetail joints with different tenon lengths on the structural response of the composite sandwich structure both experimentally and numerically.

Research Method

Specimens are prepared using High-Performance Carbon-fiber/epoxy woven prepreps for the skin with aluminum honeycomb cores. Specimens are cured using a compression press per the manufacturer's recommended cure cycle.

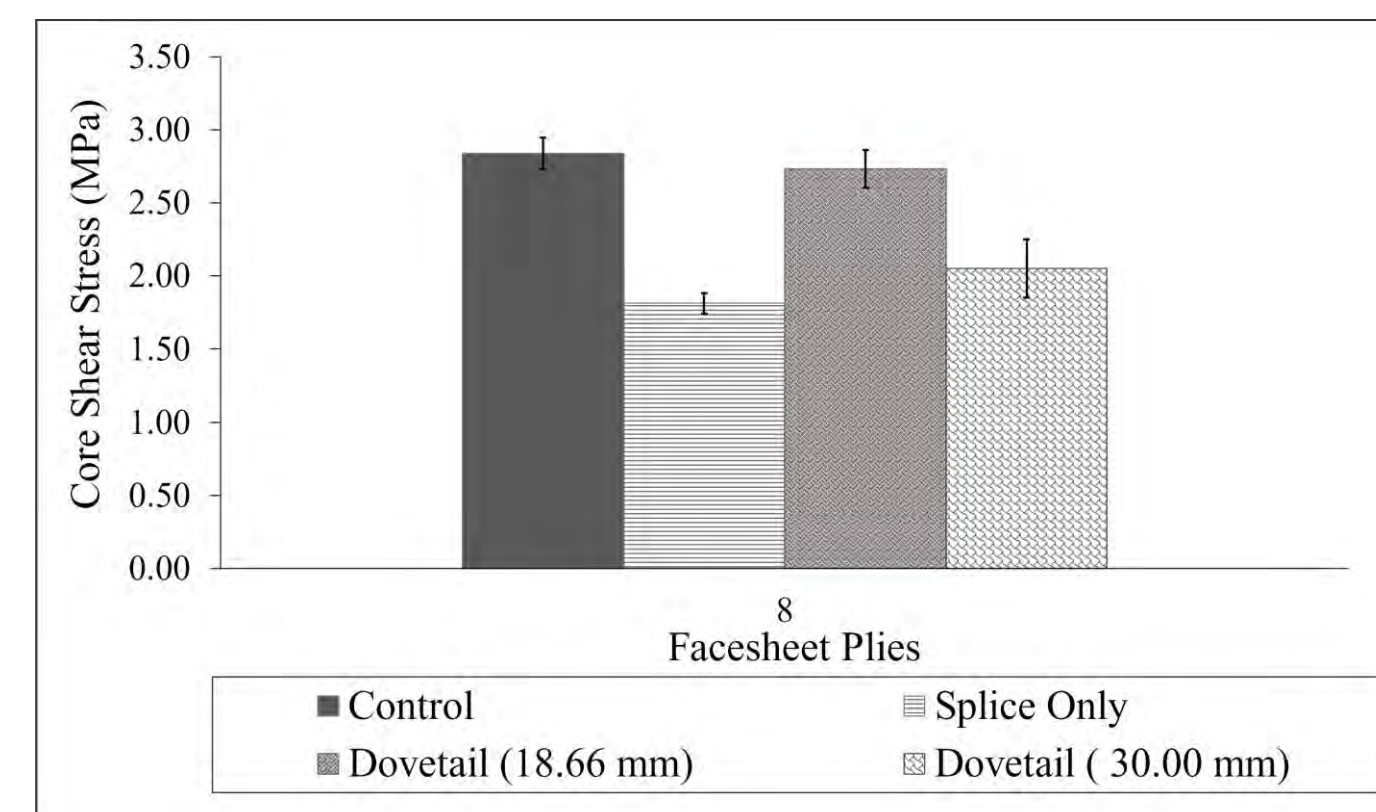
The splice configurations used are no splice, traditional butt splice, 18.66 mm, and 30.00 mm tenon heights dovetails (refer to the figure below)

The core splices in the specimens were exposed to bending and shear forces using ASTM D7249 to understand how the splice interacts with the overall structural response using the four points bending test.

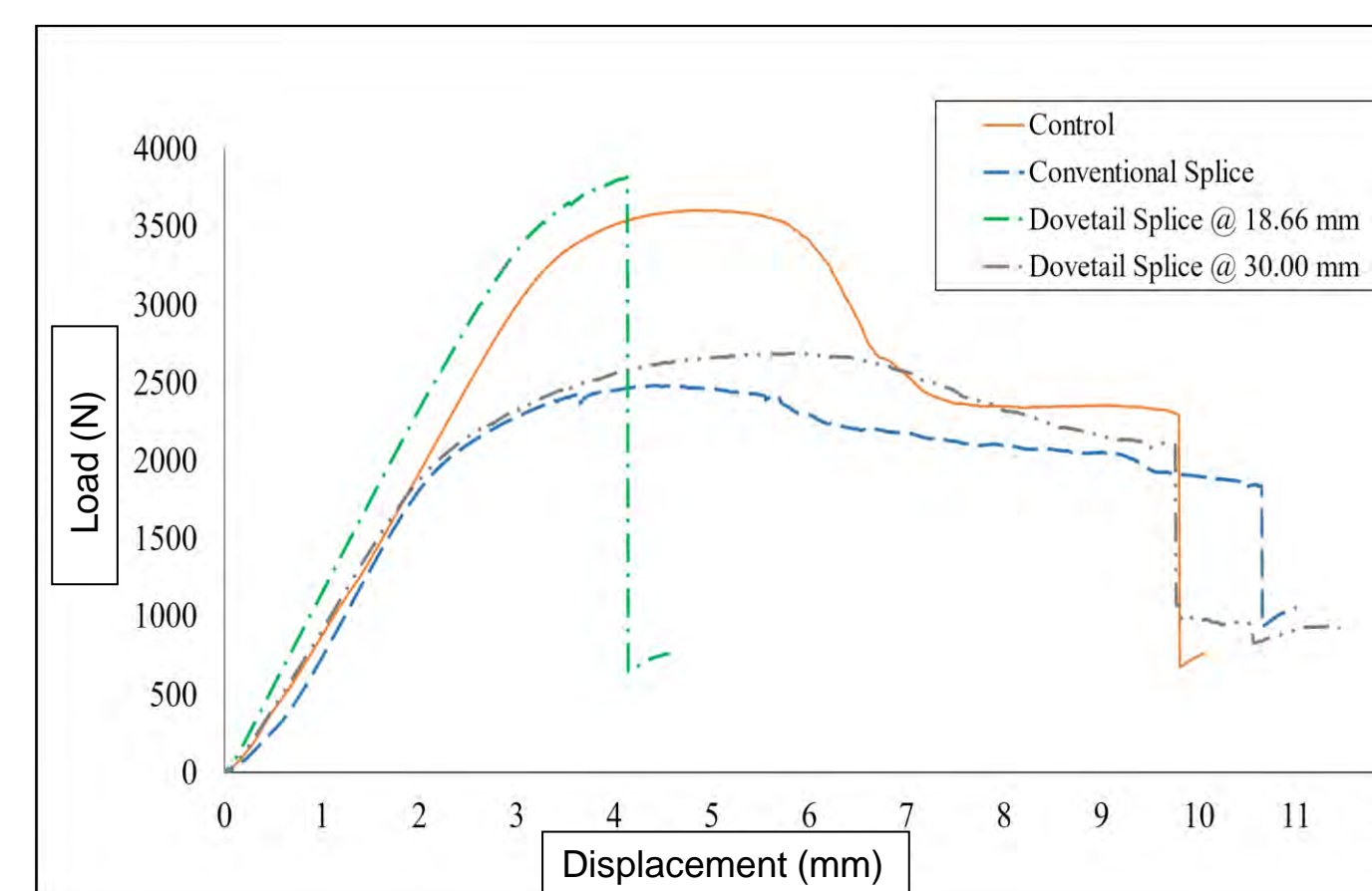


Specimen configuration/before top facesheet layup/before curing

Results

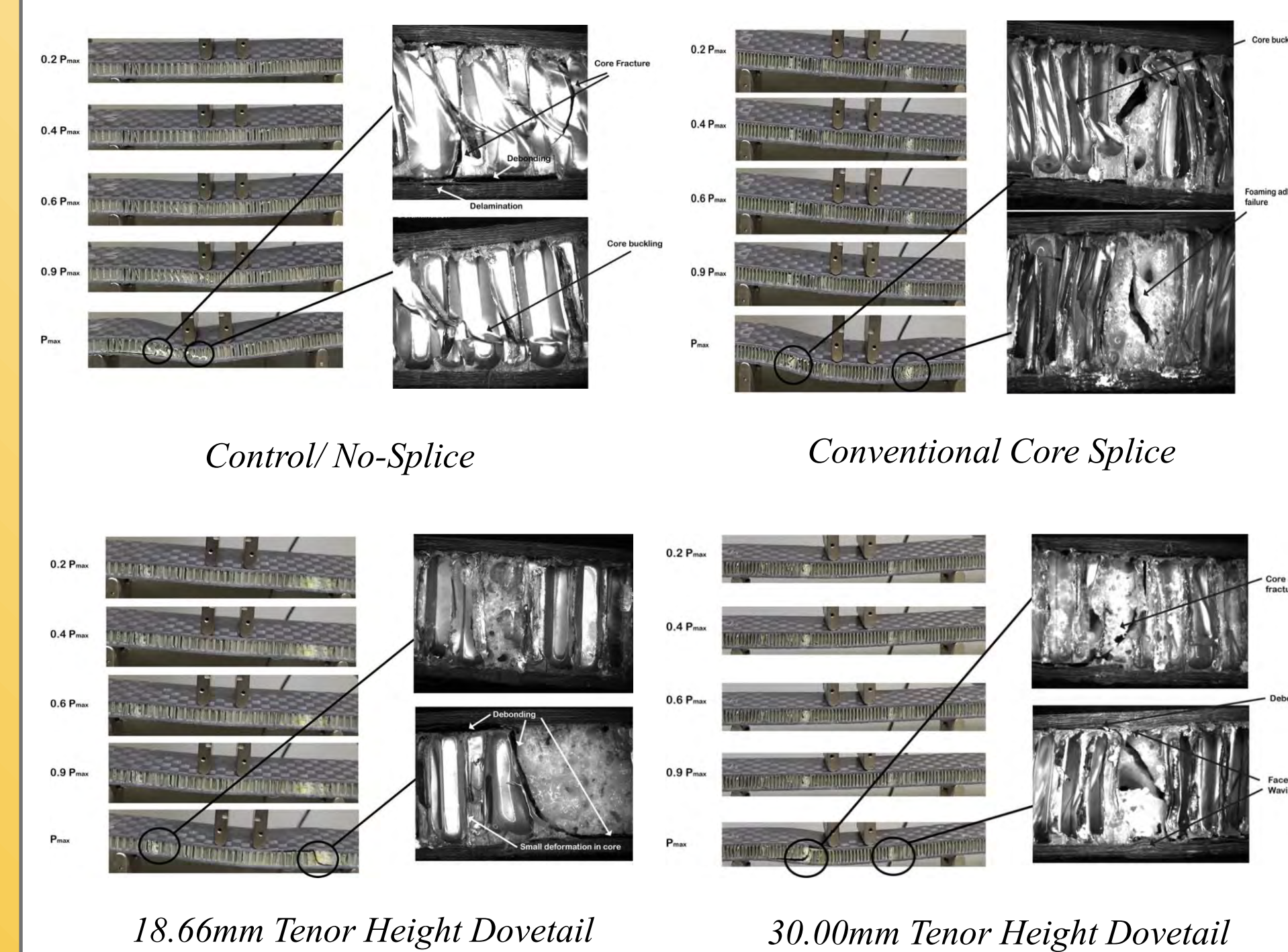


Effect of different splice configurations on maximum core shear stress. Core thickness: 12.70 mm



Load- Displacement curves for sandwich beams made of eight plies laminate on 12.7 mm core thickness.

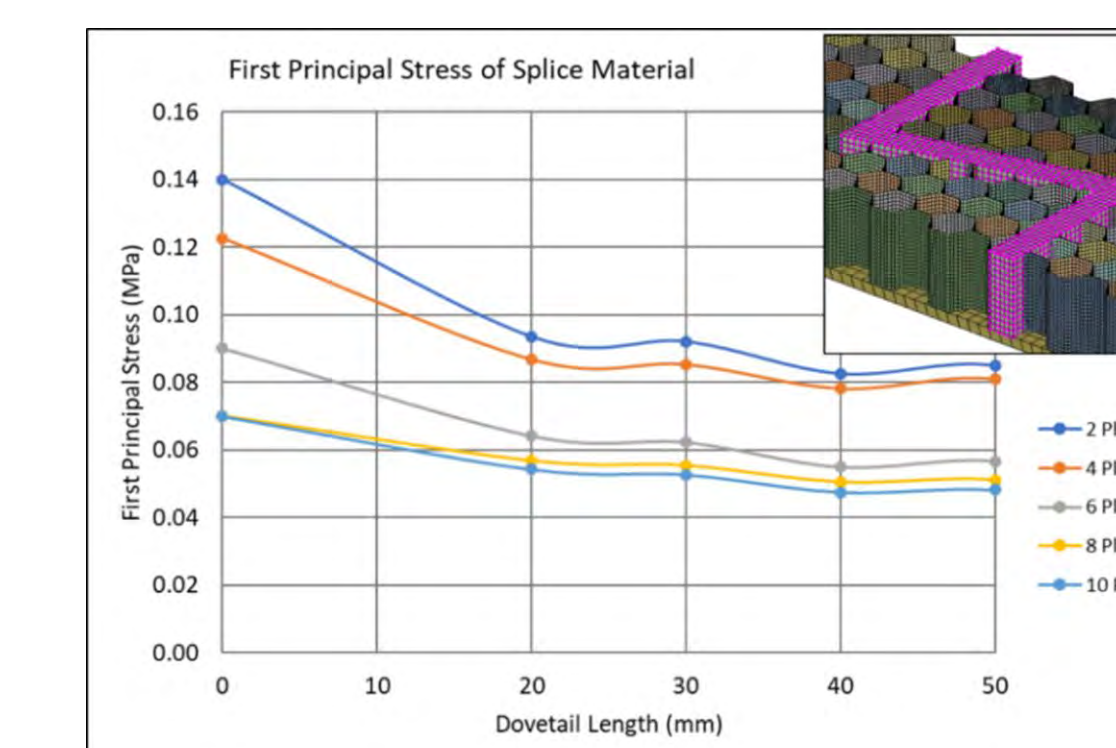
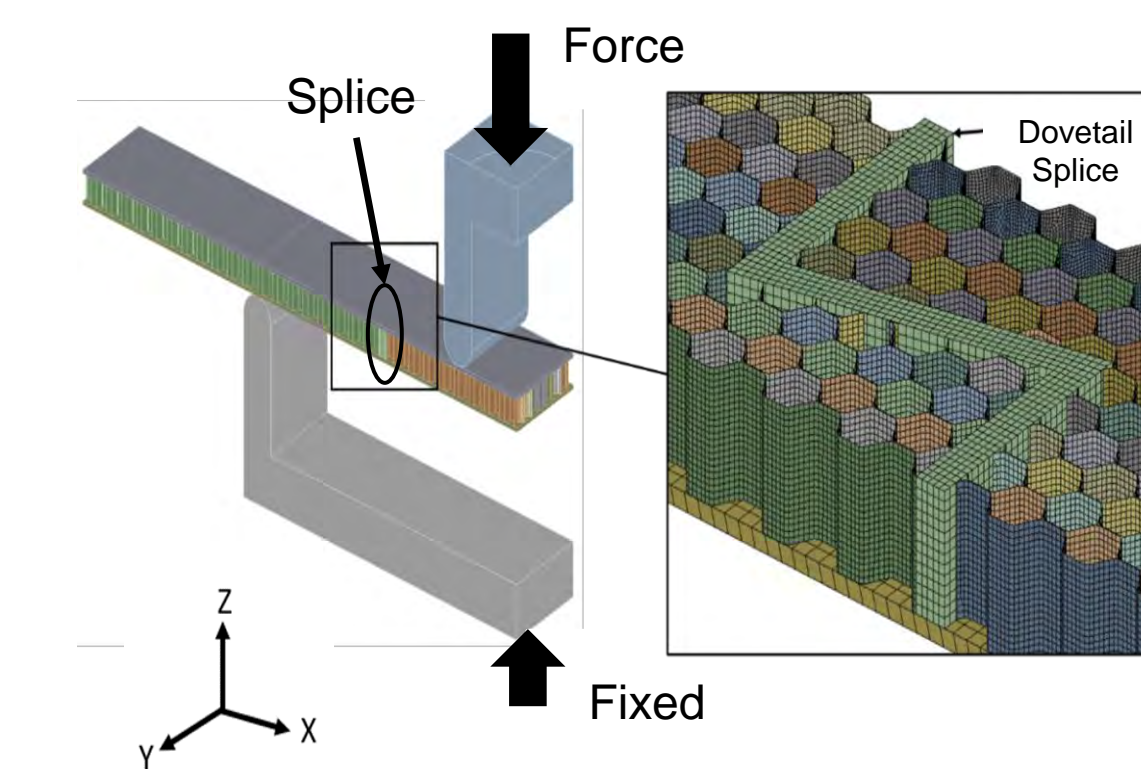
Progressive failure under 4-point loading under increasing load



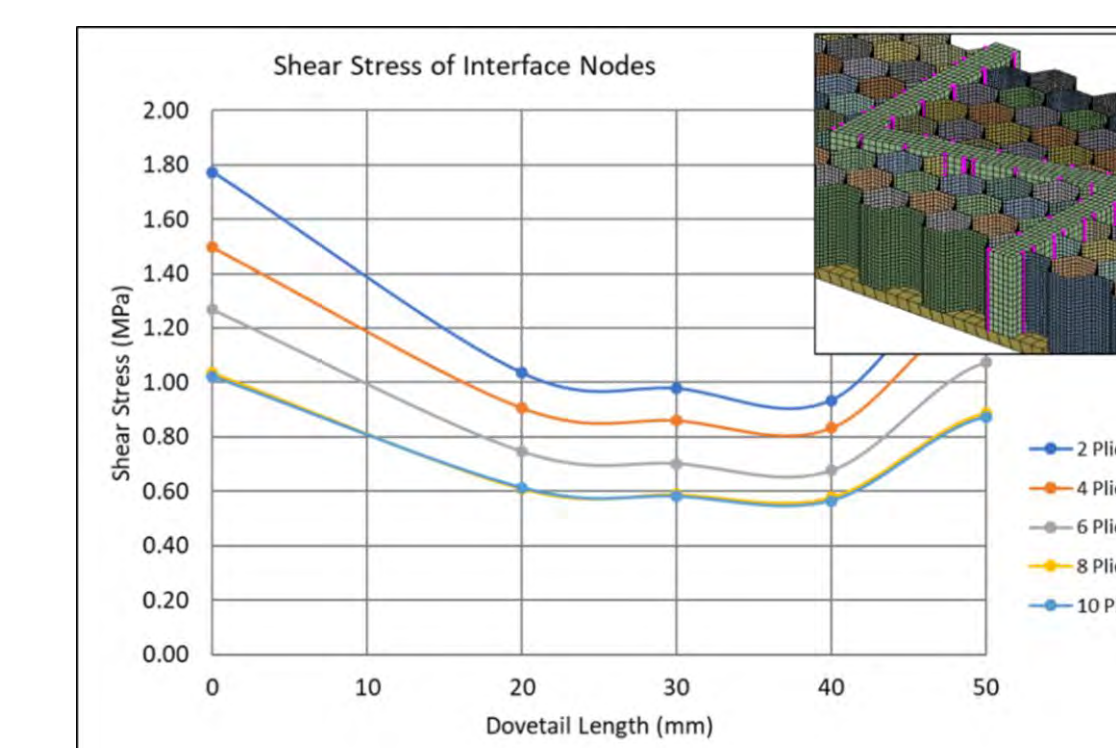
18.66mm Tenor Height Dovetail

30.00mm Tenor Height Dovetail

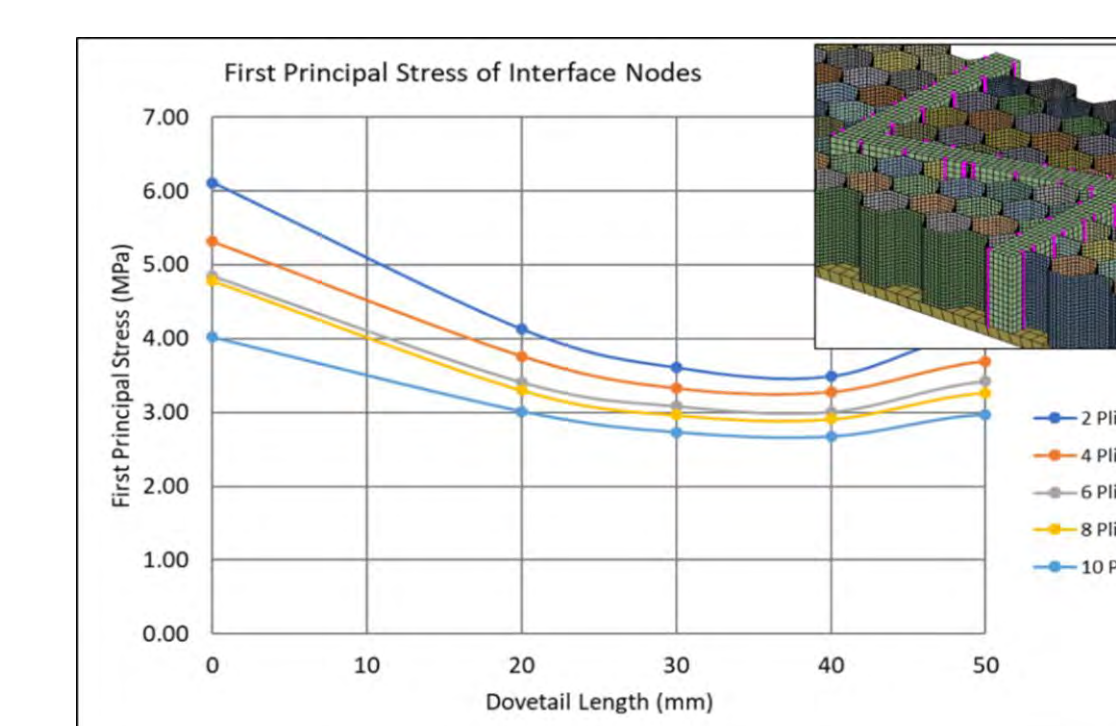
Finite Element Model



First principal stress in the splice material



Shear stress of the interface nodes between the honeycomb core and dovetail



First principal stress of the interface nodes between the honeycomb core and dovetail.

Conclusions

- The improvement obtained in the splicing process using a dovetail splice joint is a reliable approach for the core splicing of large structures.
- A match to the control specimen with a 7% surcharge in core shear strength is found experimentally when using a dovetail with 18.66 mm tenon height in the splicing process.
- Most failures started at the core adhesive material itself and propagated to the aluminum honeycomb material at a later stage resulting in a fracture in the metal core.
- Core buckling and facesheet to core debonding were also very present in the failure process of all samples.
- The finite element model indicates a significant decrease of the first principal stress and shear stress in the splice material and splice/core interface, respectively, when comparing the traditional straight splice and dovetail tenor lengths of 15.00 mm and 30.00 mm.
- Both the experimental and numerical data correlate in that the optimized dovetail length is between 15.00 mm and 30.00 mm

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