MECHANICAL TESTING OF COMPOSITE MATERIALS WITH CERAMIC COMPOSITE HYBRID STRUCTURE APPLICATIONS

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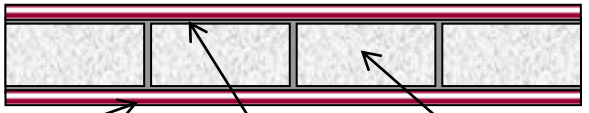
INTRODUCTION

- Goal: To evaluate mechanical properties of various material systems.
- Systems: Discontinuous ceramic core sandwich structure with adhesive interlayer, thick section laminates
- Tests performed: cyclic tension fatigue, static 3-point flexure, punch shear, and short beam shear (SBS)
- Sandwich laminates are composed of outer face sheets surrounding a discontinuous core material with finite gaps and may have an adhesive interlayer as shown below

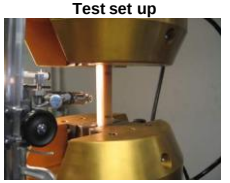


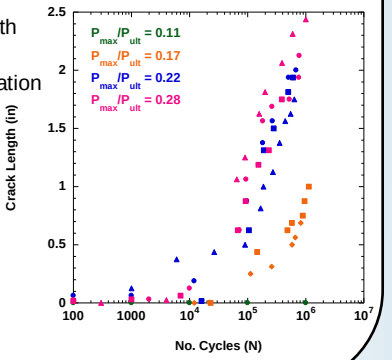
TENSION FATIGUE TESTING

- Tension-Tension Cyclic Loading of 1 inch wide sandwich specimens
- 4000-10000 lb max load (10% min)
- Measure crack growth along interface
- Digital Image Correlation

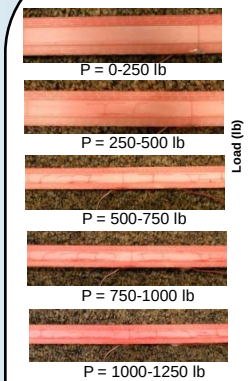

Tile crack near gap

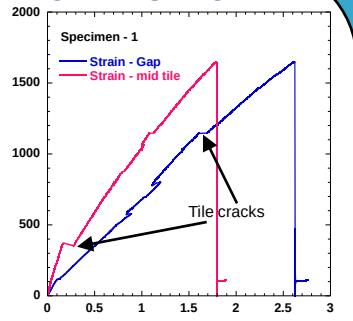
Test set up


Shown with camera setup to manually track crack growth



STATIC FLEXURE TESTING

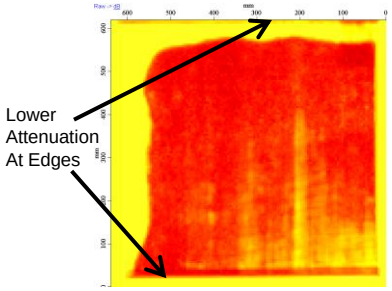




- Flexure tests (21 inch span) for center gap and center tile specimen
- Progressive loading shows crack growth and failure mode

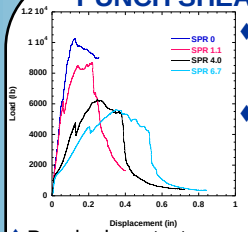

Test Set up

ULTRASONIC EVALUATION

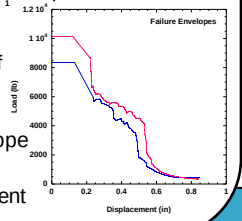


Attenuation varies in panel showing variable quality and excess resin saturation consistent with SBS testing

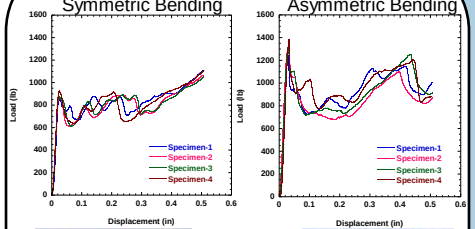
PUNCH SHEAR TESTING

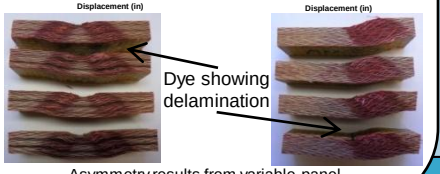


- Displacement graphs of varying span to punch ratio (left)
- Results in a failure envelope (below) that simulates a projectile impact
- Punch shear tests enable comparison of different material systems based on overlaid failure envelope
- Comparison of failure envelopes for 2 different panels (right)



SHORT BEAM SHEAR TEST





Asymmetry results from variable panel quality with resin-rich regions

SUMMARY

- Sandwich structure crack growth monitored for cyclic tensile loading and preliminary understanding of failure mode for flexure tests determined
- Punch shear tests result in failure envelopes simulating a projectile impact
- Short beam shear tests show variable quality and enable an accurate evaluation of composite laminates

ACKNOWLEDGEMENTS

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