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INTRODUCTION

- ◆ Thick section composites using discontinuous ceramic tile arrays as a core represents a unique class of sandwich structures that has been developed to provide a balance of structural and ballistic performance at minimum weight.
- ◆ Little is known about the performance of discontinuous ceramic cored sandwich structures (DCS) near the bolted connection
- ◆ Tensile tests will be conducted to determine the interaction between the bolt and the composite.
 - ◇ Individual testing will be conducted for the face sheet to better understand the load carrying capacity and their relative failure modes.
 - ◇ Determining the failure modes will provide information to develop design charts, which will aid in design of joints.

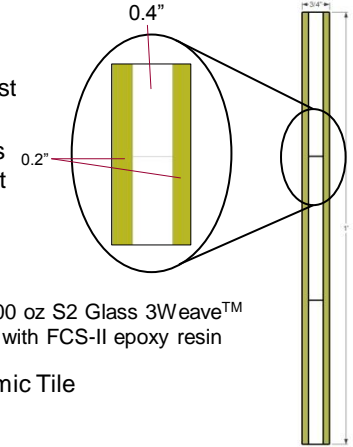
OBJECTIVE

- ◆ Understanding the performance of bolted joints in discontinuous ceramic cored sandwich structures.
 - ◇ Failure modes for thick section composites due to bolted connections are unknown. Knowing them will allow for a design chart to be created, assisting in future joint designs.
- ◆ Identify proper fastening technique based on experimentally determined failure mechanisms
 - ◇ Determine if the location of the bolt with respect to ceramic tiles will affect the performance and strength of the composite



DISCONTINUOUS CERAMIC-CORED SANDWICH STRUCTURE

- ◆ 12" Long
- ◆ Varying widths according to test matrix
- ◆ Edge distances will vary for bolt locations
- ◆ Face Sheets
 - ◇ 2 layers of 100 oz S2 Glass 3Weave™ impregnated with FCS-II epoxy resin
- ◆ Alumina Ceramic Tile



TEST MATRIX

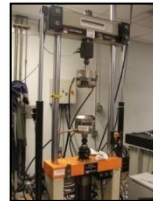
Geometrical Dimensions and Ratios for Face Sheet (e/D)				
Unit (in)	e1	e1.25	e1.5	e2
D	0.5	0.5	0.5	0.5
w	4	4	4	4
e	1	1.25	1.5	2
w/D	8	8	8	8
e/D	2	2.5	3	4

D: hole diameter, w: width, e: distance from hole center to specimen end

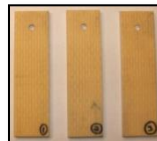
Geometrical Dimensions and Ratios for Face Sheet (w/D)				
Unit (in)	w1	w2	w3	w4
D	0.5	0.5	0.5	0.5
w	1	2	3	4
e	2	2	2	2
w/D	2	4	6	8
e/D	4	4	4	4

D: hole diameter, w: width, e: distance from hole center to specimen end

TESTING APPARATUS



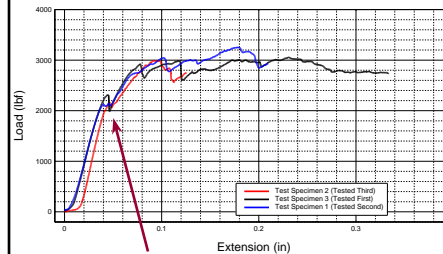
- ◆ Instron 1331
 - ◇ Used for testing ASTM standard specimens



- ◆ Specimen Dimensions
 - ◇ L = 5.5 inches
 - ◇ W = 1.5 inches
 - ◇ h = 0.2 inches
 - ◇ D = 0.25 inches

ASTM STANDARD RESULTS

Load vs. Extension

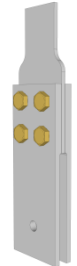


◆ Average Max Load at Bearing: 2202.5 lbf



TEST FIXTURE – 1/2" BOLT

- ◆ Width: 3 inches
- ◆ Length: 11.5 inches
- ◆ Steel: 17-4PH Stainless
- ◆ 1/2" diameter hole for bearing during testing.



ACKNOWLEDGEMENTS

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