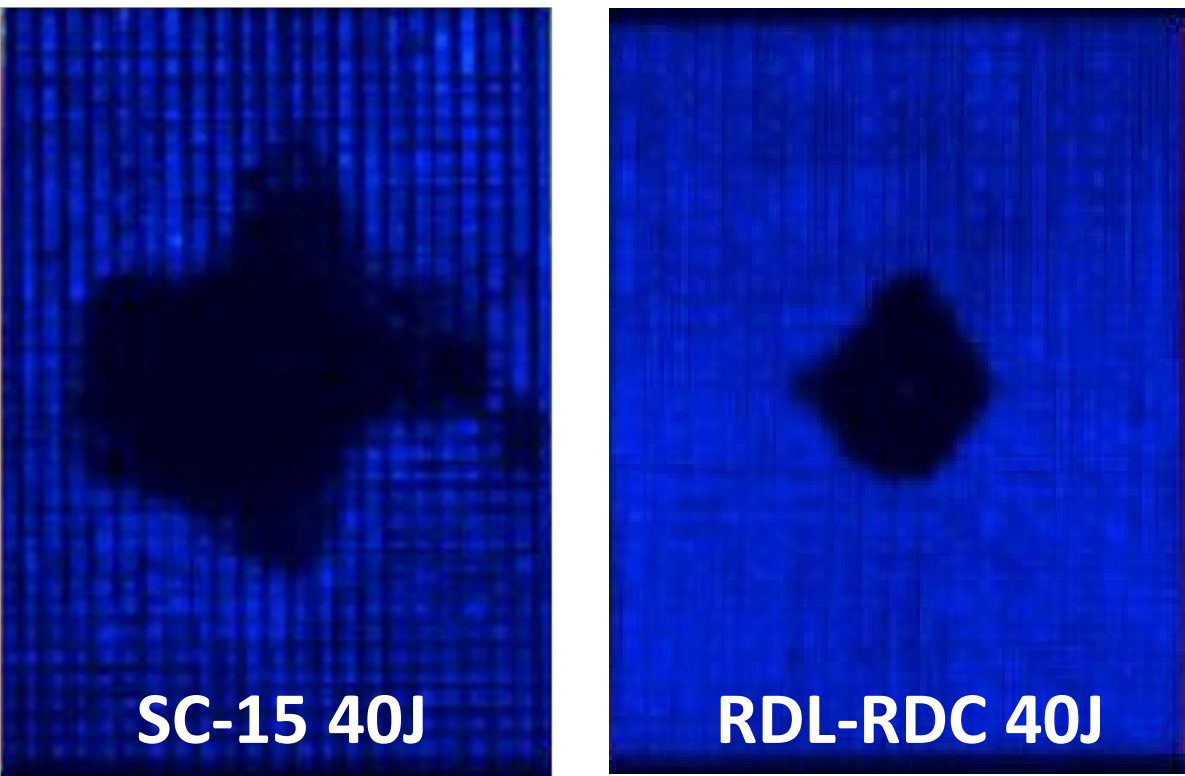


OUT-OF-PLANE COMPRESSIVE CHARACTERIZATION OF WOVEN FABRIC S-2 GLASS EPOXY COMPOSITES

Alexander Barry,(BMS)³, Lucas Castle, (BME)², Kushal Mehta, (MME)², Paul Dason Samuel, (Ph.D.M.E.)², Dr. Sagar Doshi¹, Prof. John W. Gillespie Jr.^{1,2}
University of Delaware | Center for Composite Materials¹ | Department of Mechanical Engineering² | Cornell University, Department of Material Science and Engineering³

Context and Motivation

- Need to maximize **damage tolerance** and **durability** of S-2 glass epoxy composites
- MIL 810 STDs, operating temperature range -51 to 76°C, need for toughened resins with **higher T_g**
- RDL RDC is a newly formulated resin that has higher T_g than previously used SC15

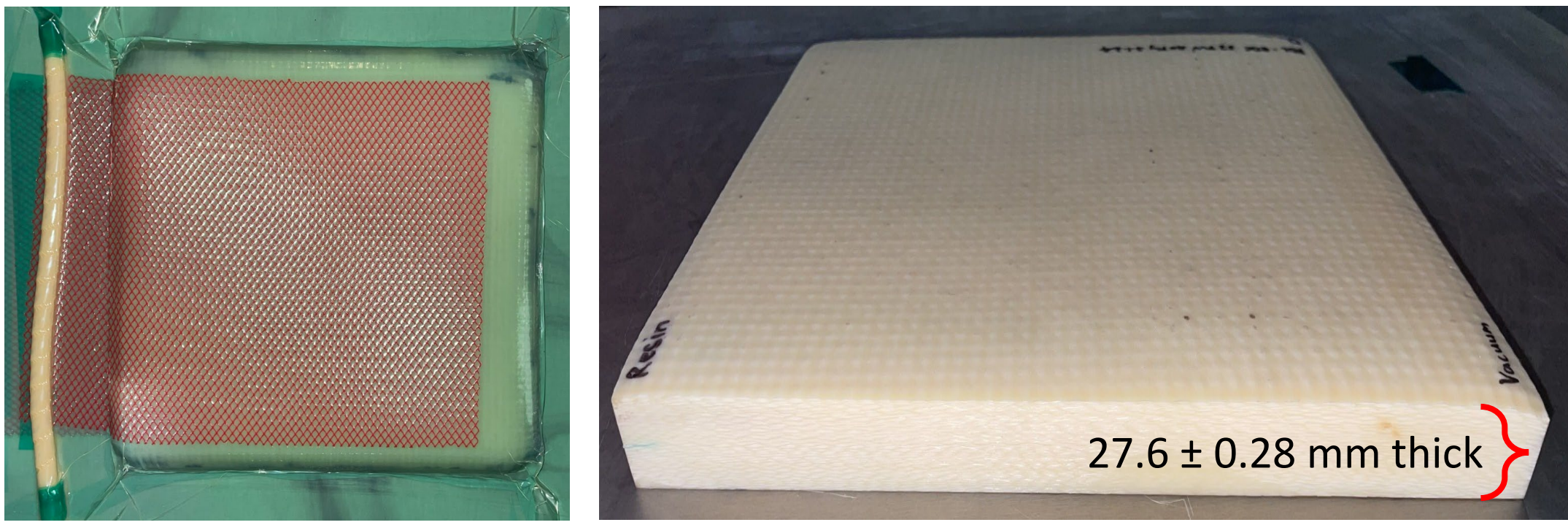


- RDL-RDC shows significantly improved LVI response – **smaller delamination area**
- New material model MAT213 enables:
 - Nonlinear inelastic deformation inputs
 - Tabulated inputs
 - Temperature dependent inputs
 - Rate dependent inputs
- Can **simulate the response of a panel to damage** without manufacturing and testing
- Obtain material properties for this material to create database used for modeling and panel generation

Tension (T)	Compression (C)	Shear (S)
PMD 11 T	PMD 11 C	PMP 12 S
PMD 22 T	PMD 22 C	PMP 23 S
PMD 33 T	PMD 33 C	PMP 31 S

Panel/Specimen Manufacturing and Quality Control

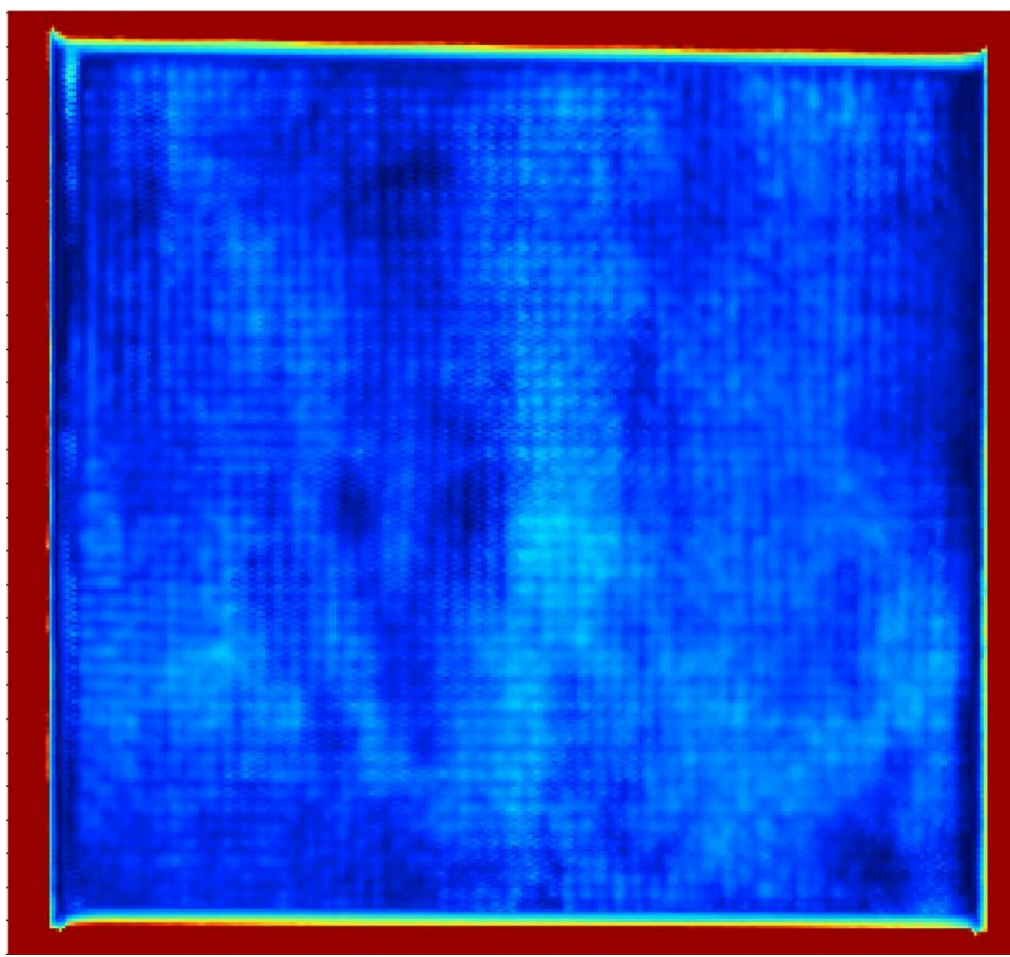
- 40 x 24 oz/yd² plies, VARTM fabrication



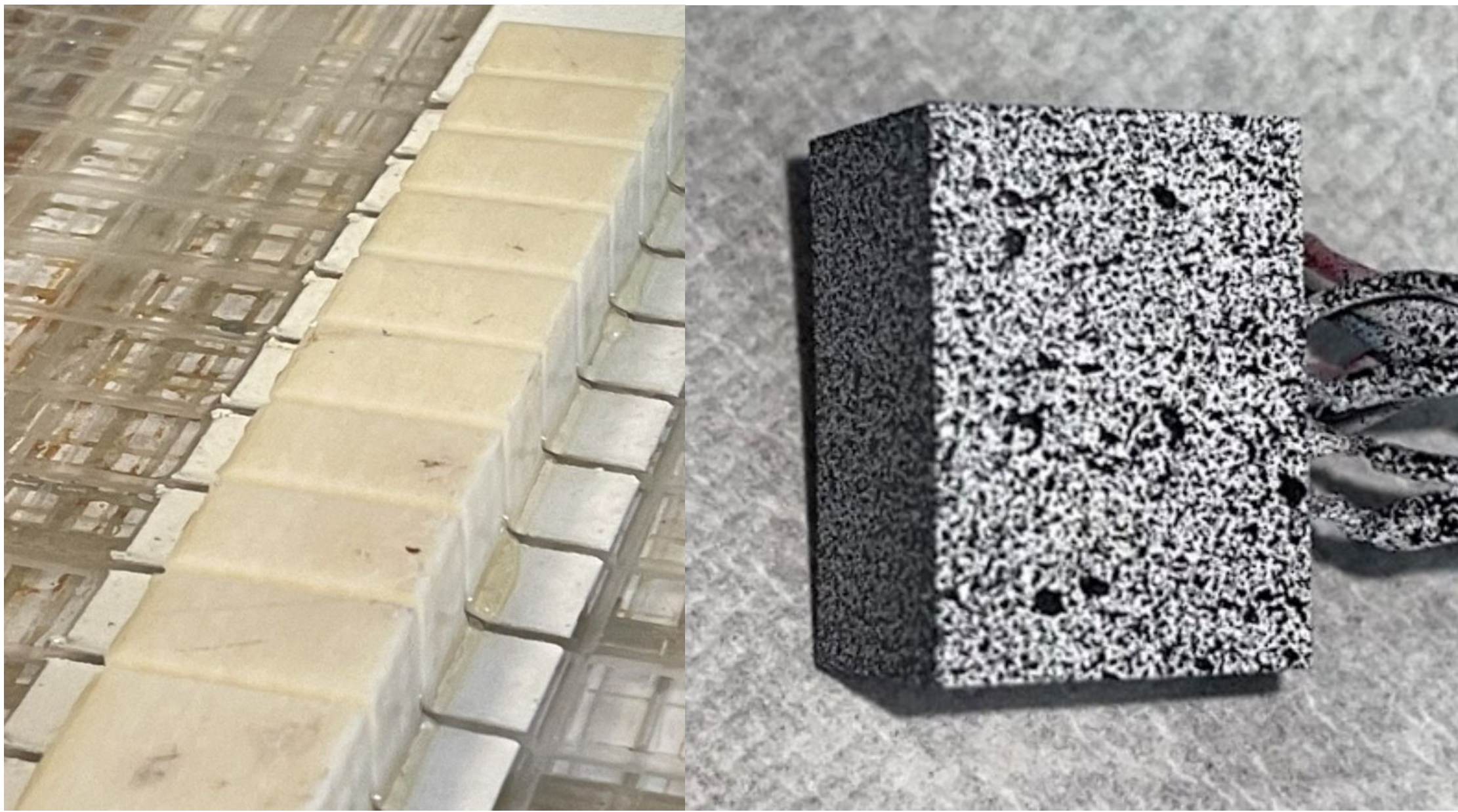
Quality Control

- C-scan good overall, samples weren't taken from darker areas
- Calculated **49.2%** fiber volume fraction; **consistent with previous panels**
- Density measured using Archimedes principle

Specimen	Density (g/cm ³)
Sp #1	1.788
Sp #2	1.787
Sp #3	1.790



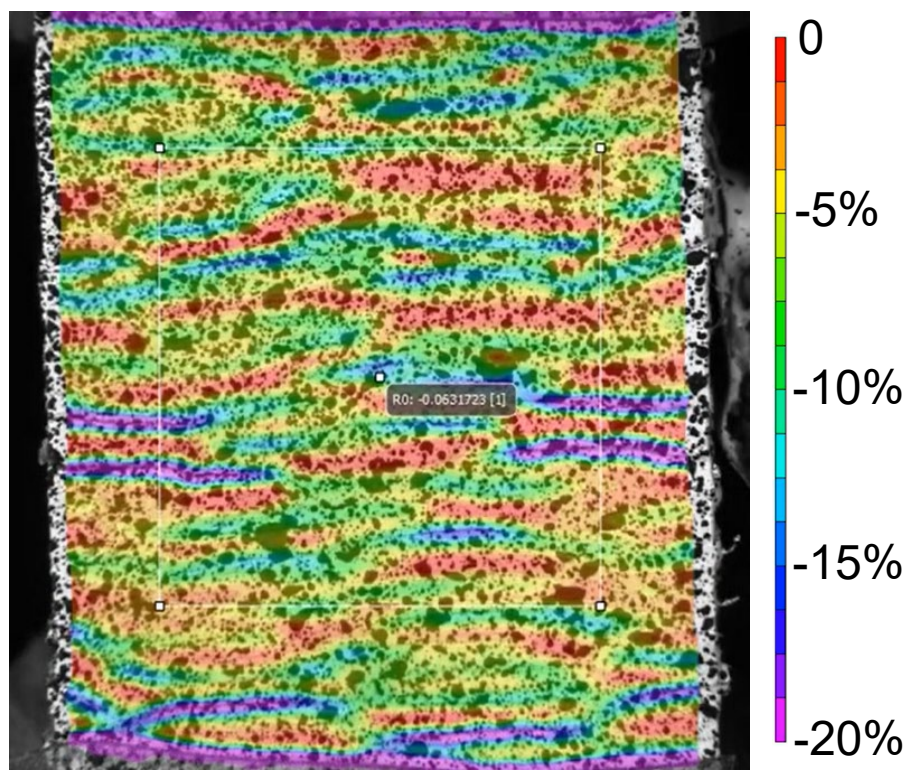
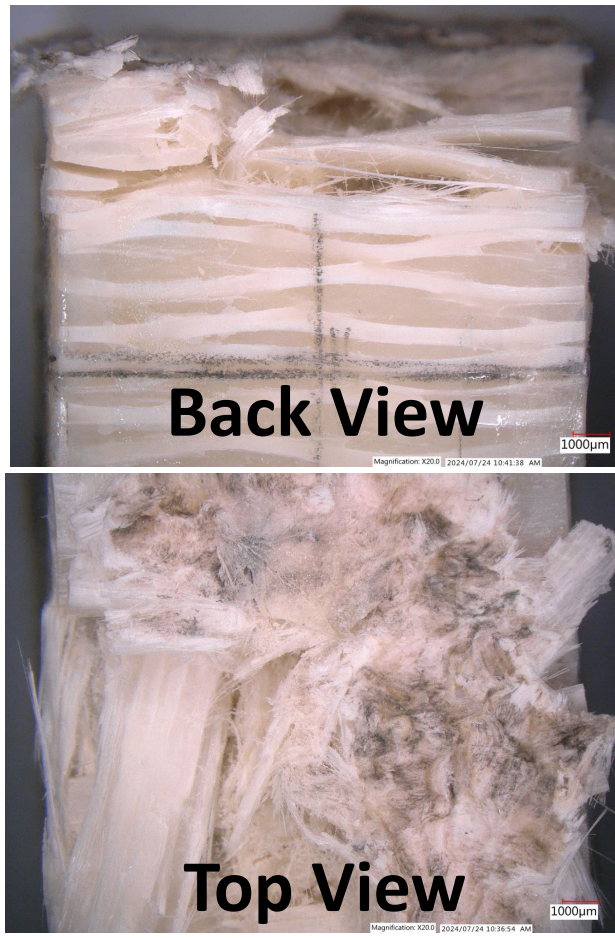
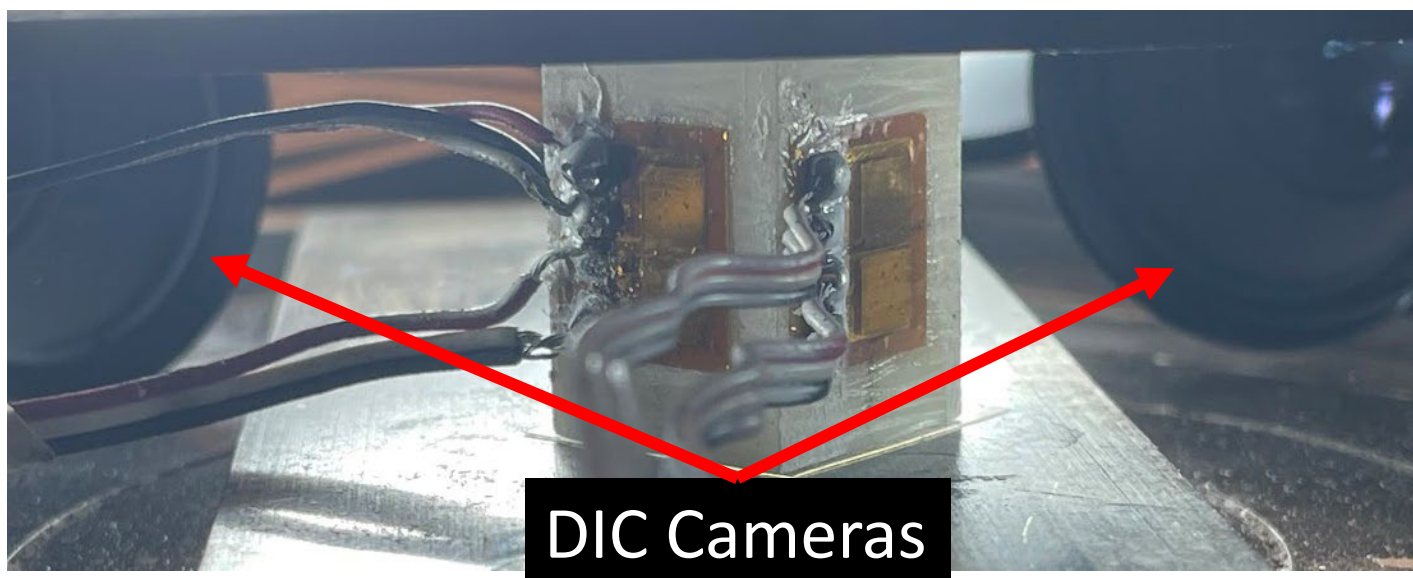
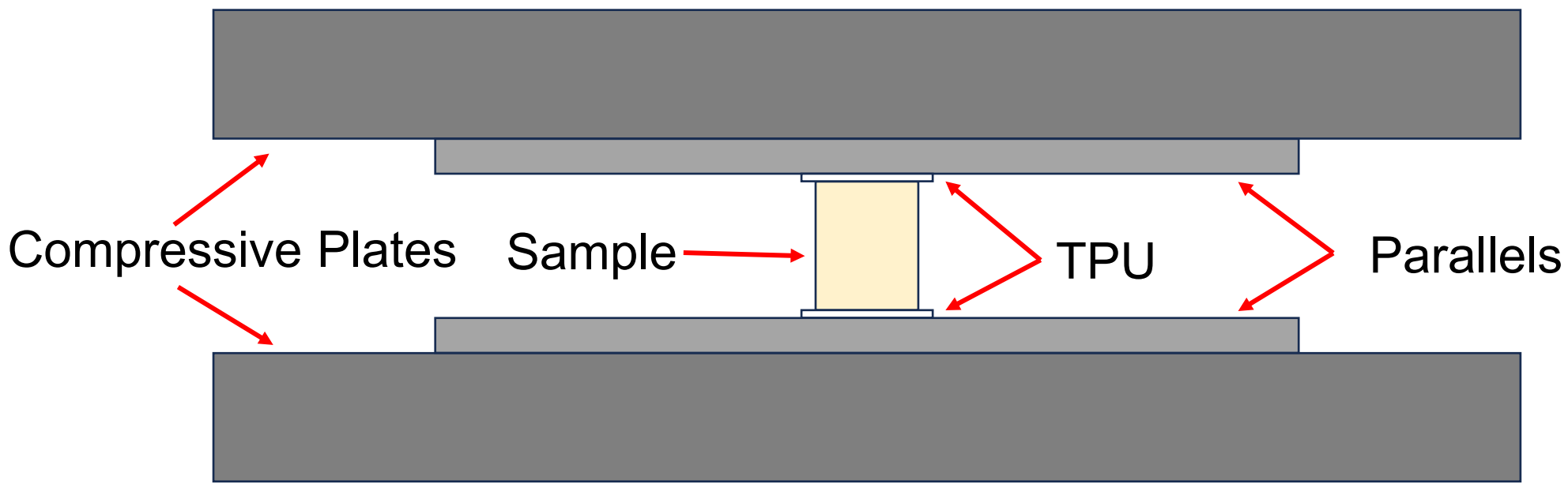
- Cut into 15 x 15 x 19 mm³ samples
- Speckled for DIC on 2 sides



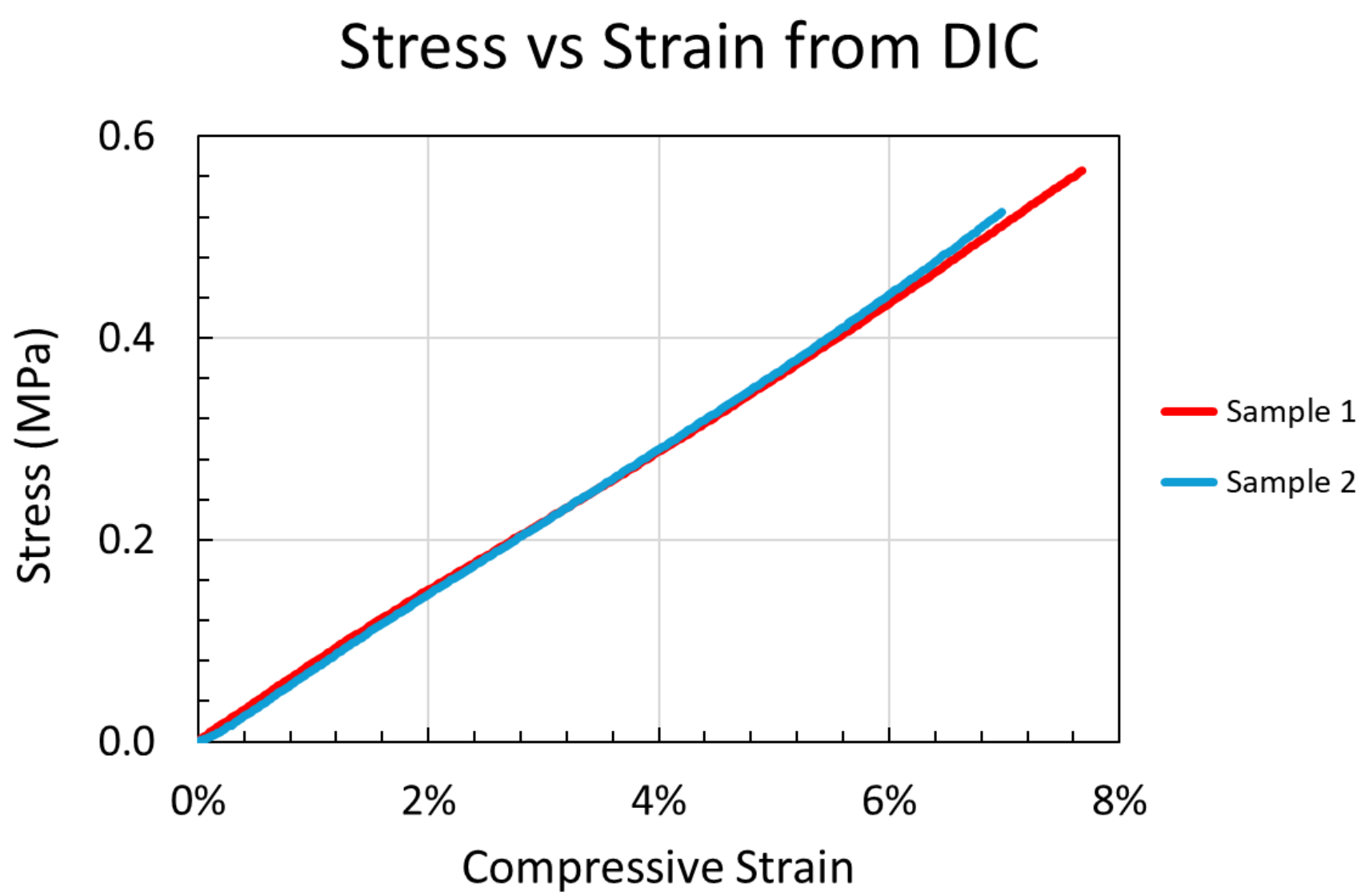
Testing and Results

- 5 samples tested in compression, 0.05 in/min loading rate
- Compressive strength: 555.6 ± 34.2 MPa, CoV: 6.2% - matches expectations

Testing Setup:



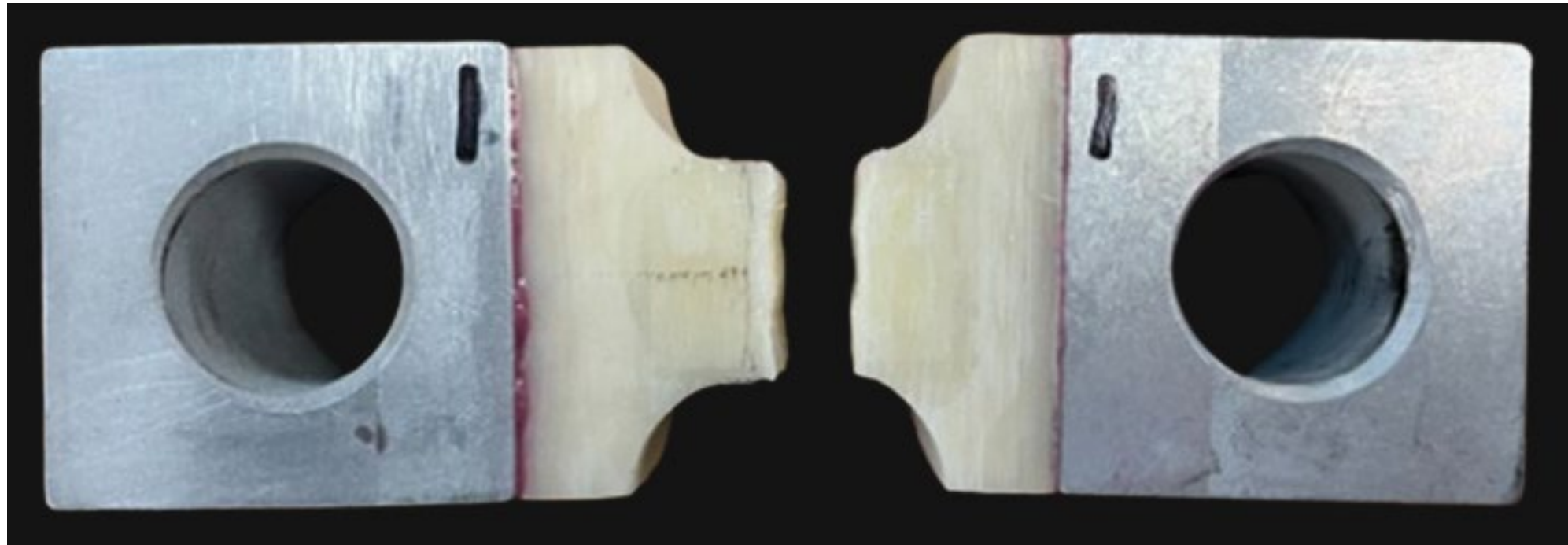
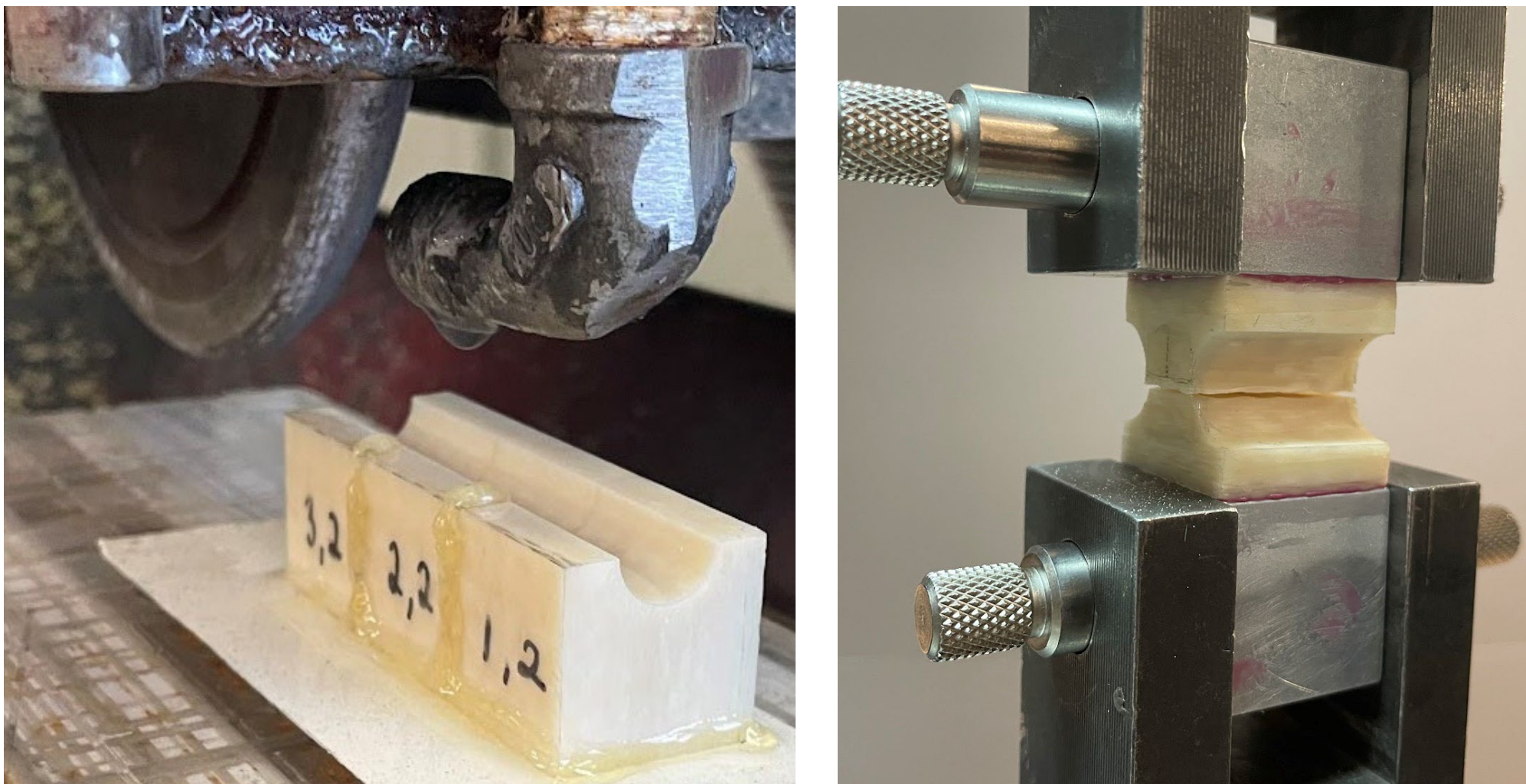
- Bands of high strain** seen concentrated on plies throughout the sample before failure



	Modulus (0.5-1% strain) (GPa)	Modulus (1-2% strain) (GPa)
Sample 1 - Side 1	7.27	7.18
Sample 1 - Side 2	7.83	7.09
Sample 2 - Side 1	7.15	7.13
Sample 2 - Side 2	8.26	7.72
Average	7.63 ± 0.51	7.28 ± 0.29

Summary and Future Work

- Measured through thickness compressive strength and modulus
- Obtained stress vs strain curves for inputs to MAT213
- Necessary to test additional samples to validate results further
- Through thickness tension testing in progress
- Successfully caused composite failure after implementing hourglass geometries
- Need to modify test setup to ensure samples are uniformly loaded



Acknowledgements

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