Cost Effective Thermoplastic Body Structures

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Outline

- About WEAV3D® and Rebar for Plastics®
- Composite Door Design Challenge and Redesign Objectives
- Project Overview
  - Optimization
  - Prototyping
  - Validation
- Summary of Case Study Results
- Translating to New Applications
  - Production Pathways
  - Overview of Applications and Value Propositions

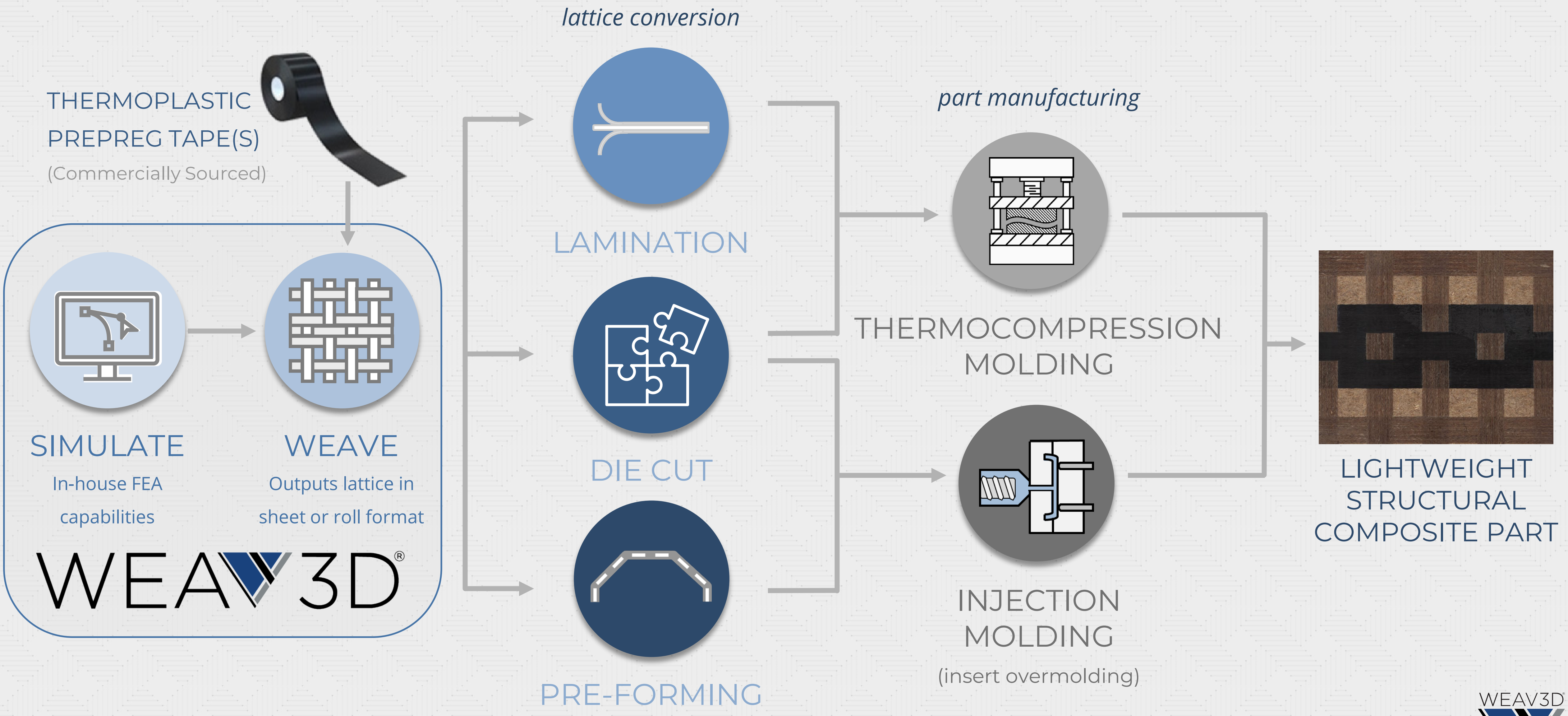
About WEAV3D

Manufacturer of composites lattice materials for automotive and construction applications

2014	2017	TODAY
Technology invented	WEAV3D founded out of Georgia Tech	Headquartered in metro Atlanta, Georgia

WEAV3D's patented **Rebar For Plastics®** solution enables cost-effective, scalable, locally tunable composite lattices for mass production.

The Process


lattice conversion
THERMOPLASTIC
PREPREG TAPE(S)
(Commercially Sourced)
LAMINATION
part manufacturing
THERMOCOMPRESSION
MOLDING
DIE CUT
SIMULATE
In-house FEA
capabilities
WEAVE
Outputs lattice in
sheet or roll format
WEAV3D®
LIGHTWEIGHT
STRUCTURAL
COMPOSITE PART
INJECTION
MOLDING
(insert overmolding)
PRE-FORMING

Why WEAV3D Composite Lattice?

LIGHTWEIGHT

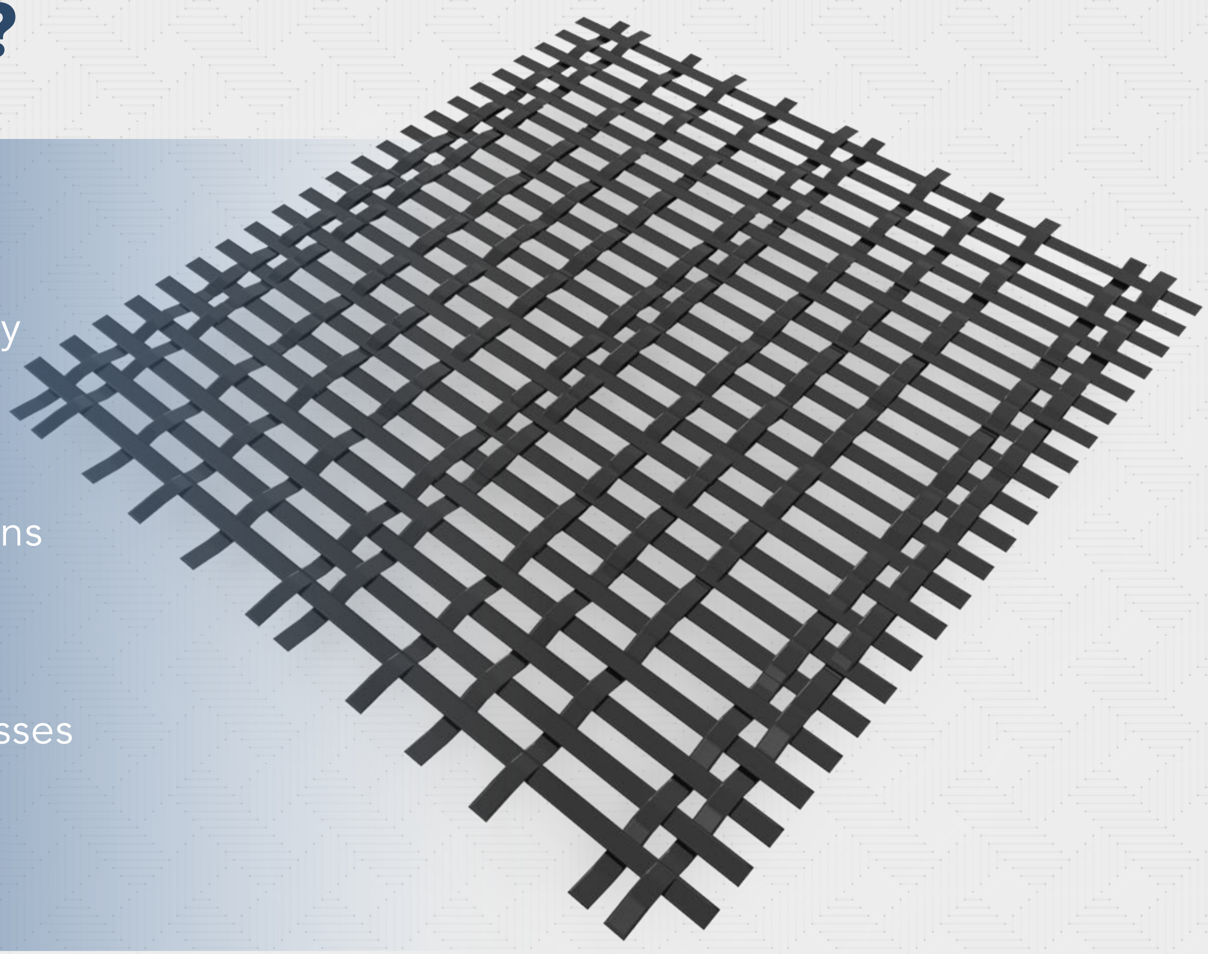
- 30% + weight reduction vs. existing solutions
- Locally optimized lattice density

COST-EFFECTIVE

- Automated continuous process
- Cost neutral vs. existing solutions
- Ability to mix tape types

COMPATIBLE

- Utilizes existing molding processes
- Sheet or roll format
- Choice of composite tape



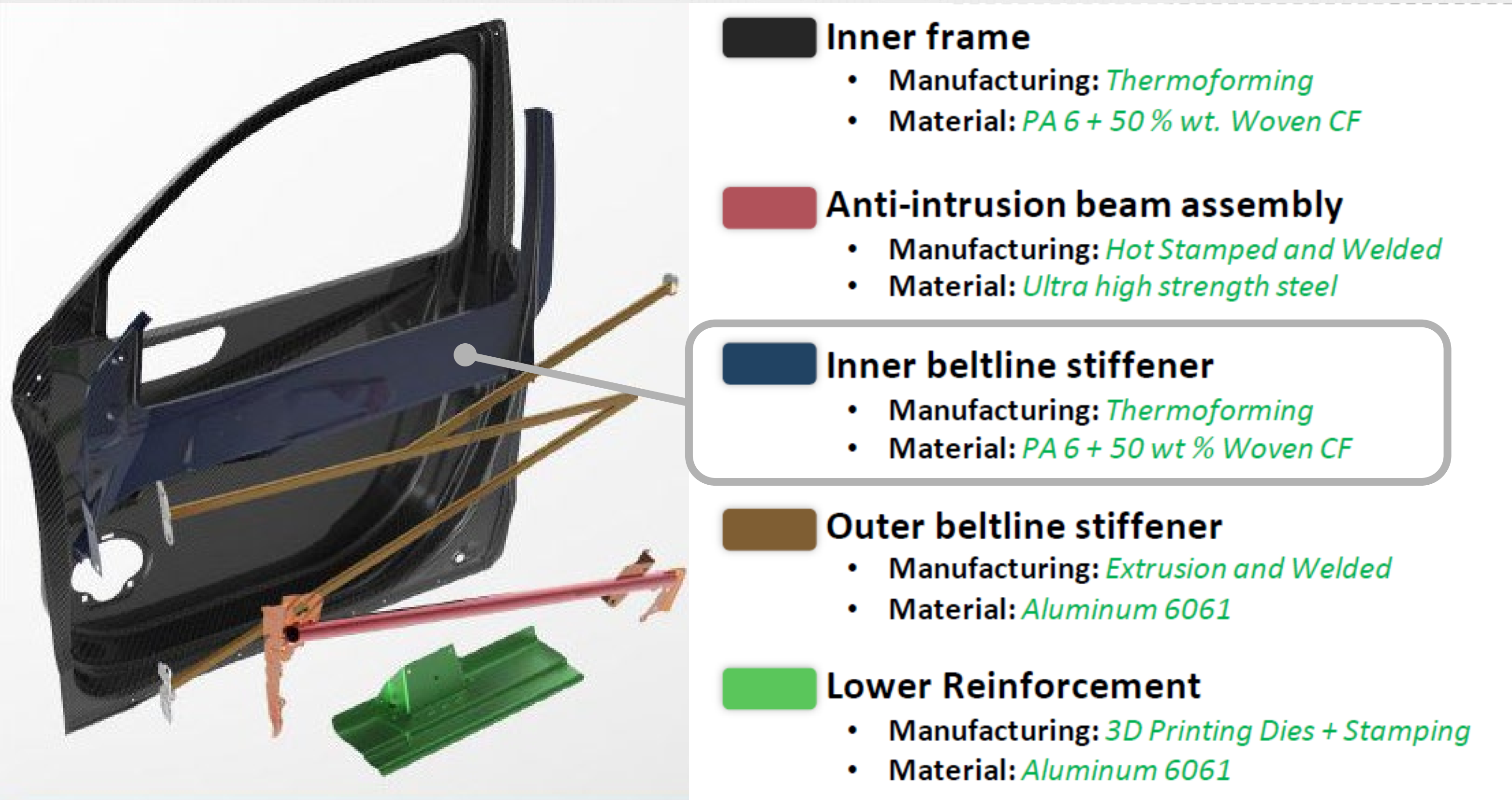
Strategic use of UD tapes in lattice provides a cost-effective and adaptable solution

Design Challenge – Automotive Door

Background

- Clemson University led a Department of Energy funded project to design an ultralightweight composite door, based on the 2016 Acura MDX.
- Carbon fiber/PA6 organosheet used for the inner frame and inner beltline stiffener, augmented with metal
- Clemson design achieved 45% weight reduction and 64% parts consolidation

Excerpt from 2021 DoE Vehicle Technologies Office Annual Merit Review



Despite meeting performance and weight objectives, the cost of the composite door assembly was twice that of the original steel door, driven by the high cost of the carbon fiber organosheet.

Redesign Objectives

Beltline Stiffener Demonstrator Goals

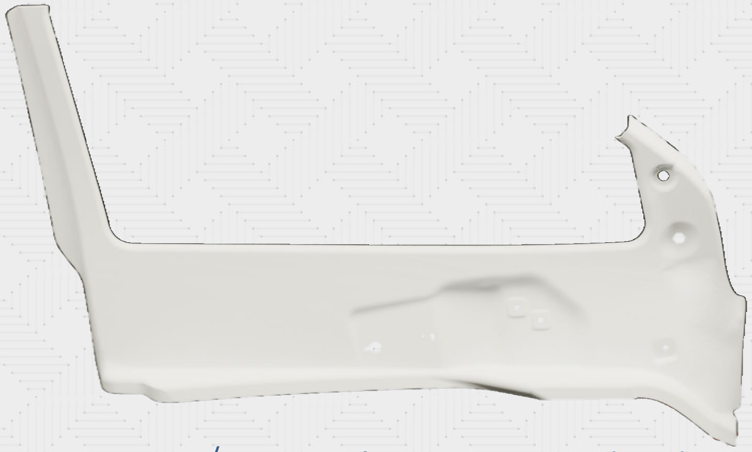
1. Reduce cost from current CF/PA6 organosheet design
2. Achieve comparable performance under side impact load case
3. Maintain weight savings
4. Maintain organosheet part geometry and thickness to utilize existing tooling

In Partnership with:

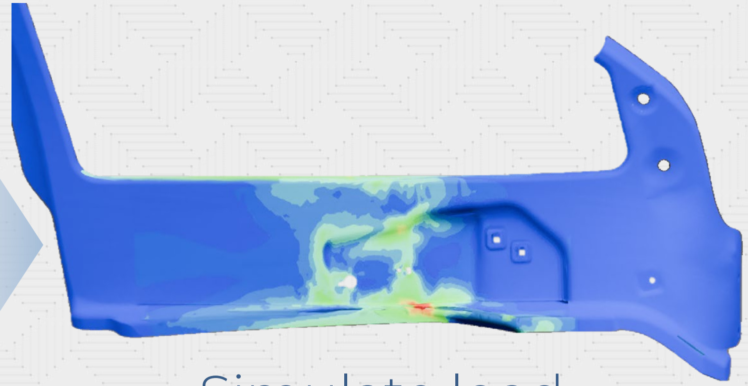
WEAV3D® Braskem

CLEMSON® COMPOSITES CENTER ALTAIR

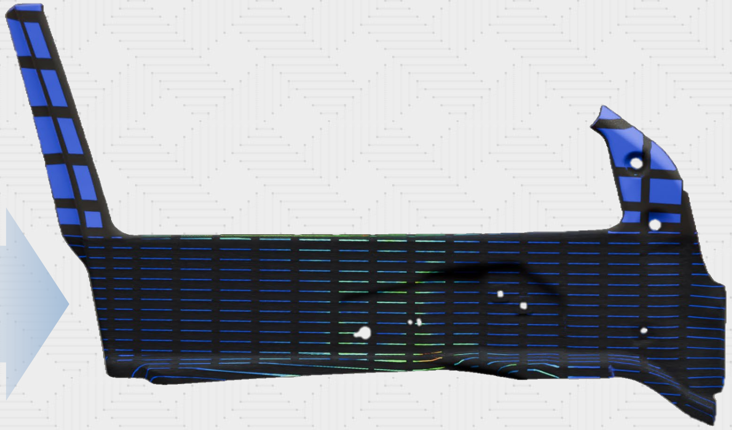
Collaborative Design: Value Optimization



OEM/Supplier provided
3D part model



Simulate load
with FEA

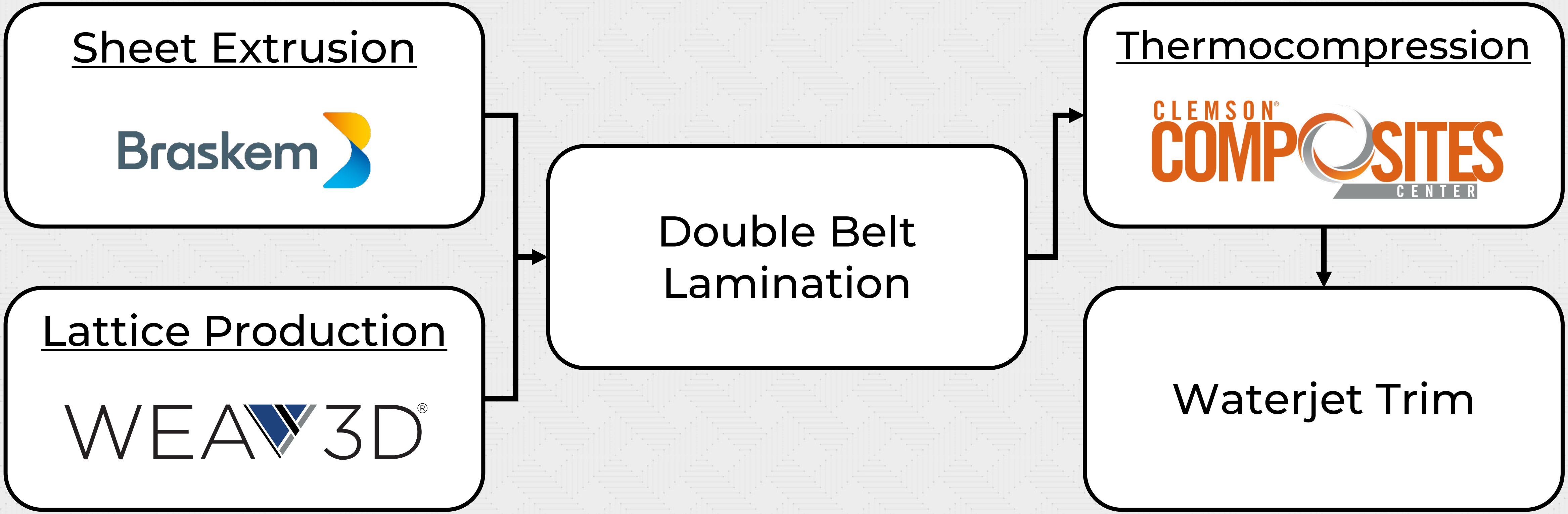


Redesign with
WEAV3D lattice

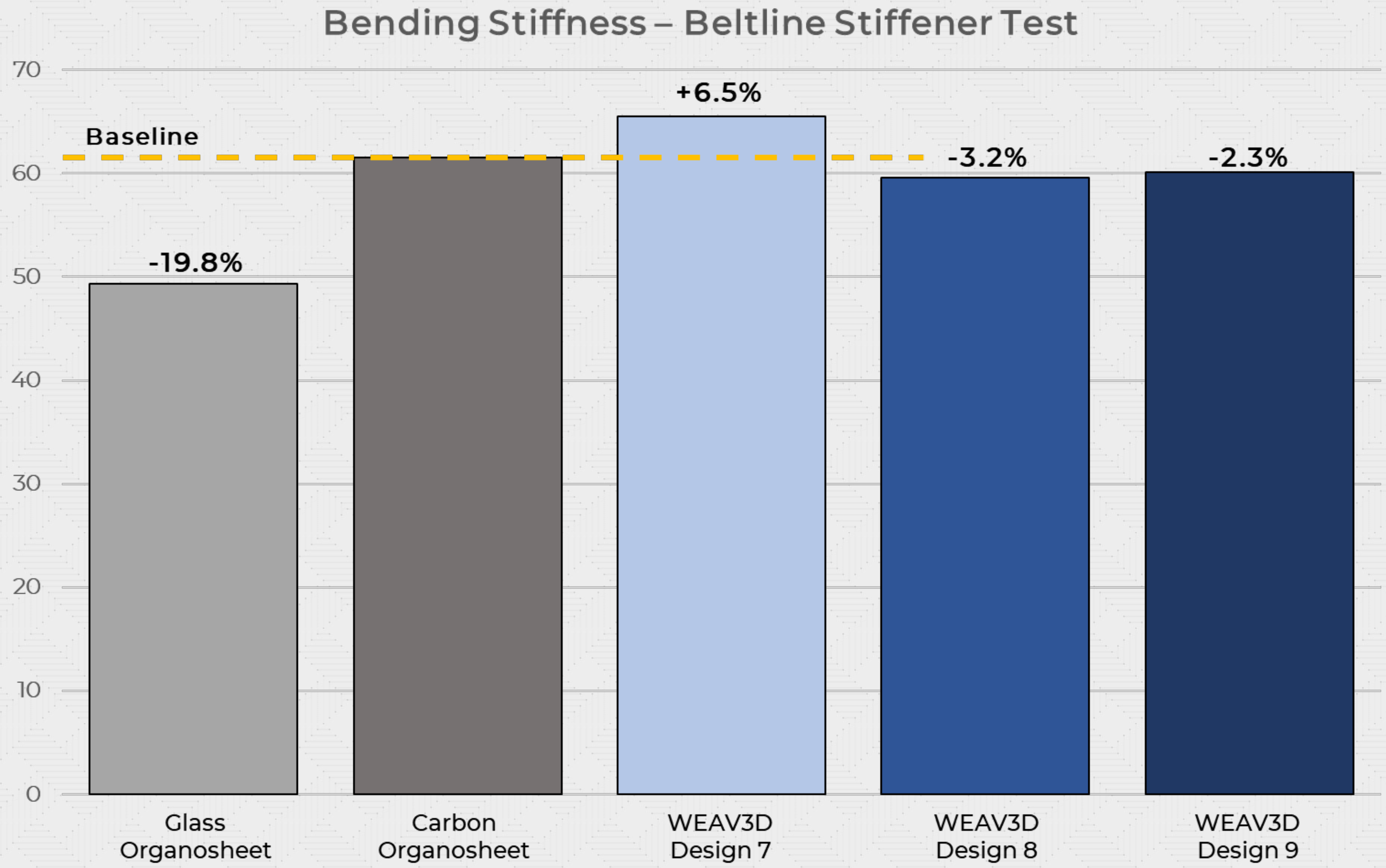
Rapid iteration of
pattern and materials

WEAV3D leverages FEA topology optimization to tune cost and performance

Prototype Manufacturing



Results of Part Fixtured Flex Testing



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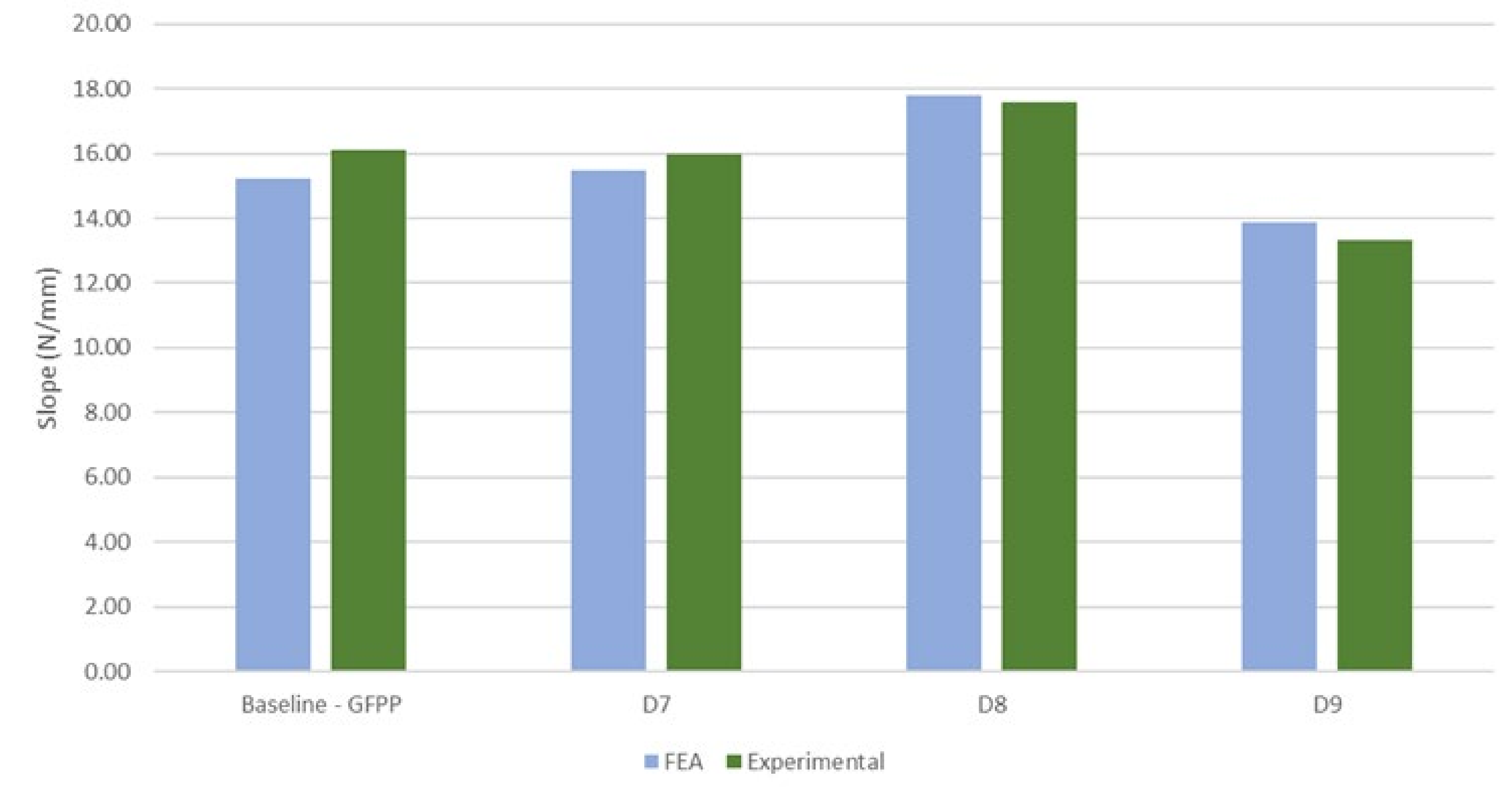
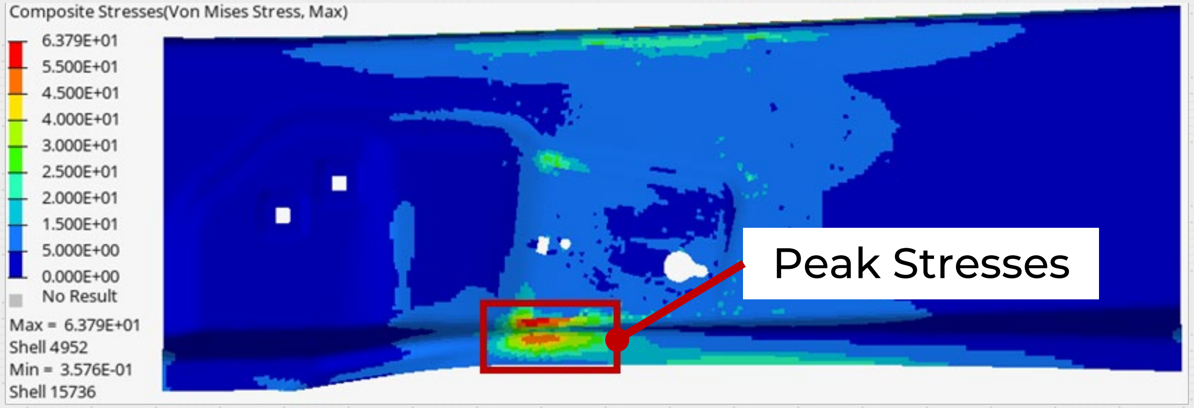
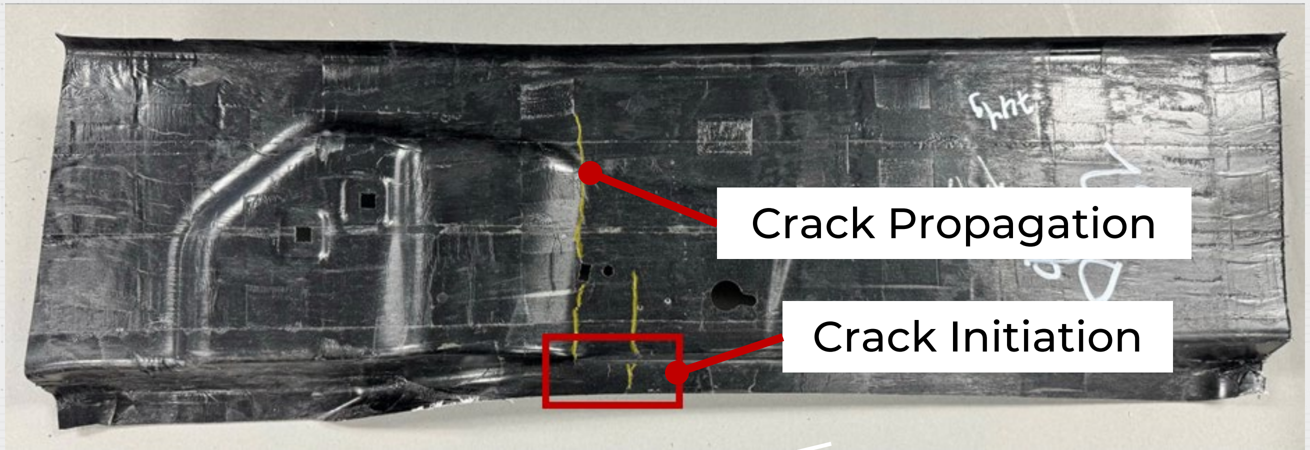
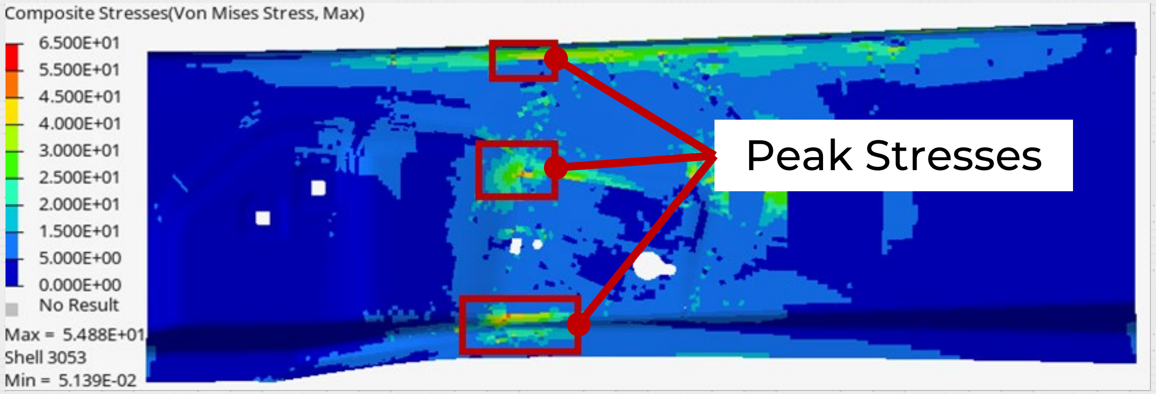
Results of Sub-Part FEA Validation (Stiffness)

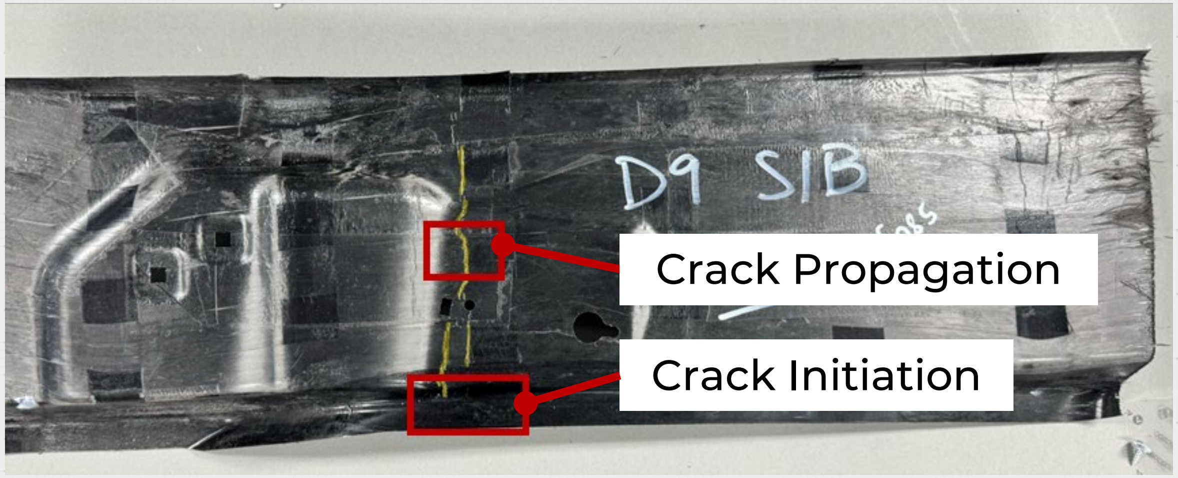


Results of Sub-Part FEA Validation (Fracture)









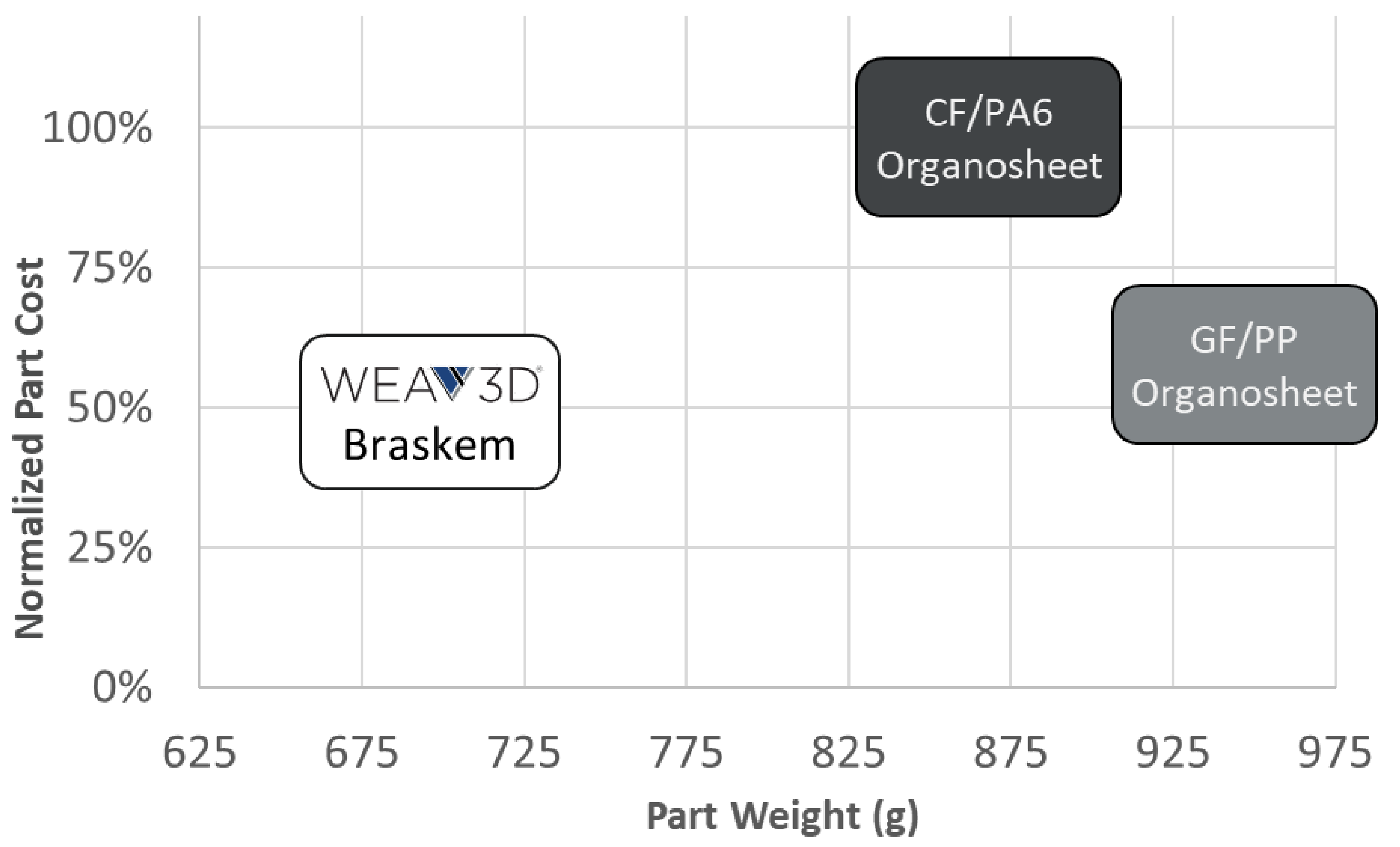
Design 8

2-Layer 100% Dense
Carbon Inner, Glass Outer

Design 9

2-Layer 100% Dense Carbon Upper
2-Layer 100% Dense Glass Lower

Cost Advantages Over Organosheet



Relative to CF/PA6 baseline,
WEAV3D lattice optimization:

- Reduced part weight (-23%)
- Reduced cost (-50%)
- Increased trim yield from 27% to 44% by weight
- Reduced trim waste (-62%)

Summary of Beltline Case Study

Beltline Stiffener Demonstrator

1. 50% cost reduction from baseline (CF/PA6 organosheet)
2. Comparable performance in high-rate full-scale bending load case
3. 23% weight reduction from baseline
4. Good correlation between FEA and experiment in simplified load case

How do we translate this success to other parts and processes?

Production Pathways (Low/Med Complexity)

Thermoplastic Sheet Forming Processes

(Low-Med Volume)

WEAVE → LAMINATE → THERMOCOMPRESSION MOLDING → TRIM

Nonwoven Compression Molding Processes

(Med-High Volume)

WEAVE → DIE CUT → *Tack and Co-Mold* → THERMOCOMPRESSION MOLDING → *In-Mold Shear Trim*

Production Pathways (Med/High Complexity)

DLFT Compression Forming Processes

(Med Volume)

WEAVE → DIE CUT → PRE-FORMING → COMPRESSION MOLDING

Injection Overmolding Processes

(Med-High Volume)

WEAVE → DIE CUT → PRE-FORMING → INJECTION MOLDING

WEAV3D Automotive Applications

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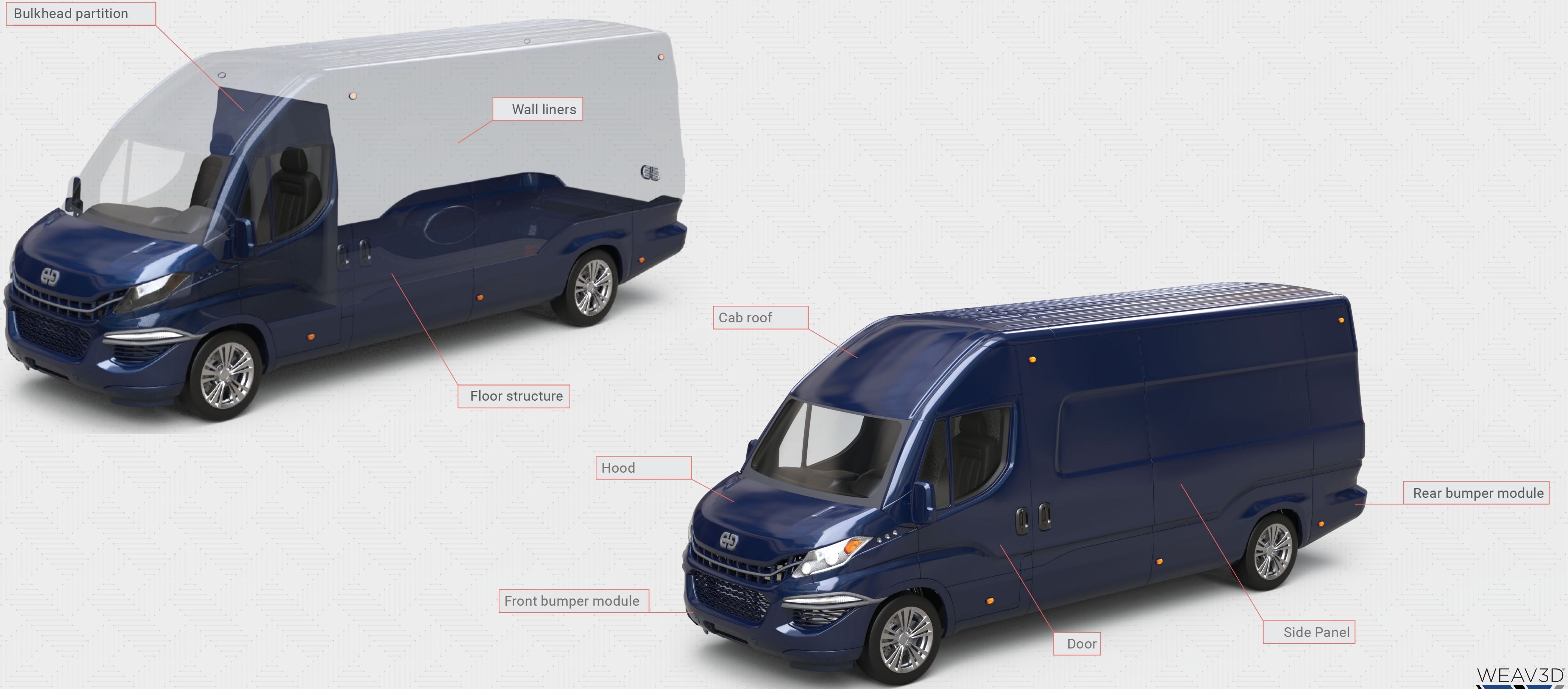
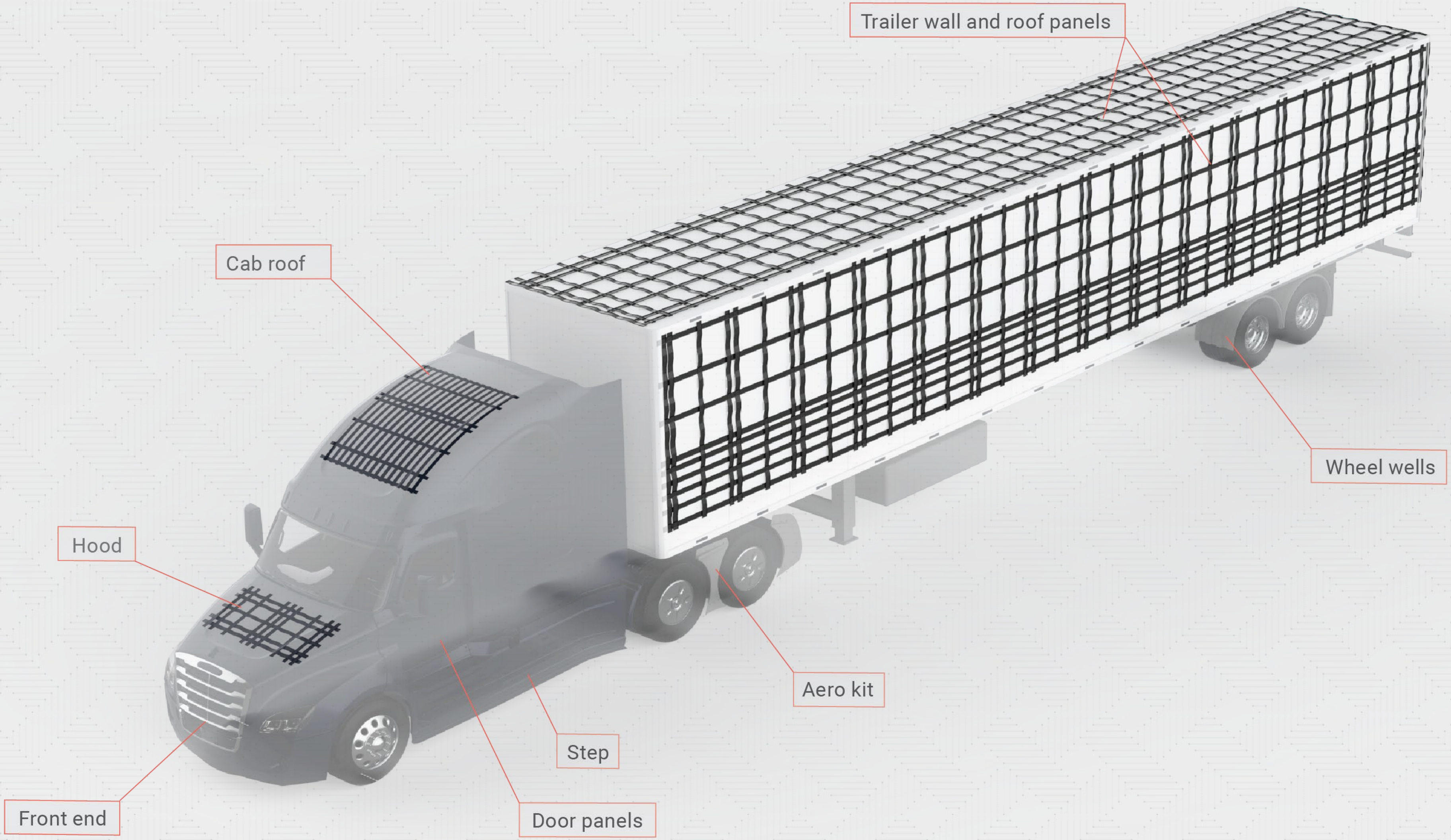
WEAV3D

WEAV3D Commercial Vehicle Applications



WEAV3D Heavy Truck Applications



WEAV3D Applications & Value Proposition

	Structural Metal Replacement	Structuralizing Molded Plastics	Composite Optimization
Example Application	Body in White	Interior Panels	SMC Panels
Weight Reduction	+++	++	++
Part Count Reduction	++	+++	+
Upcycling of Recycled Reinforcements	++	++	+
Expanded Use of Natural Fillers	+	+++	+

To learn more about how WEAV3D can improve your products, contact us at info@weav3d.com

Automotive Body Structures

Sustainable Automotive Interiors

Lightweighting for the Masses™