

Yearlong Senior Capstone Design

Final Progress Report

Project #1402 - UMass MIE FMS 1

Liam Wasser | Tiernan O’Kane | Andri Mahegan
Aman Patel | Ethan Wlodyka

Motivation

The UMass Industrial Automation class requires a learning aid to practice Industry 4.0 concepts.

Objective

Design stations 1 & 5 to be reliable and repeatable, integrating 5 smart sensors as part of a larger assembly line serving as a learning aid for MIE 690: *Industry 4.0*.

Specifications

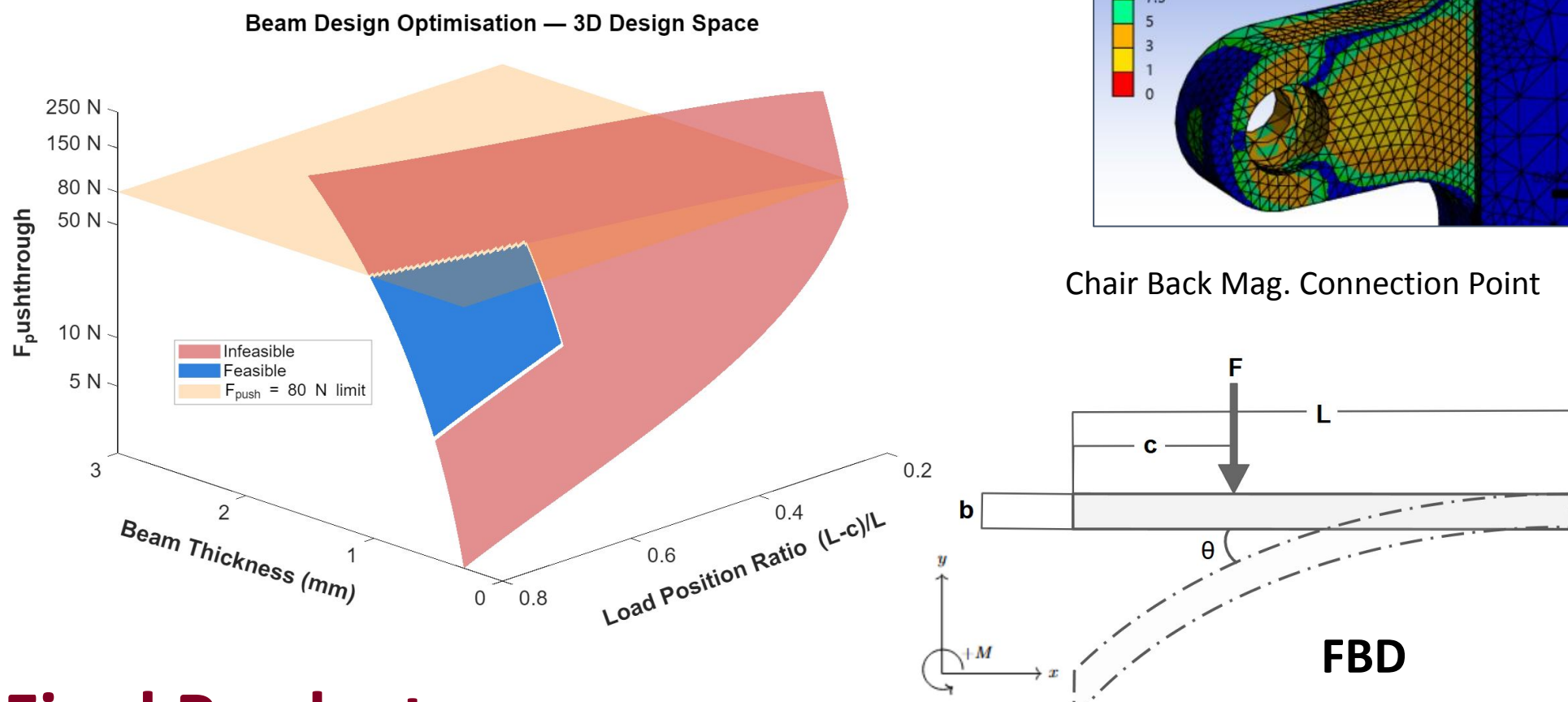
Requirements	Target Specifications
Repeatability	99% success rate
Flexible Assembly	Adaptable to table and chair assembly
Magazine Size	5 block capacity
Smart Sensors	5 smart sensors routed through IO-Link
Portability	< 50 Lb (NIOSH Lifting Equation)
Safety	<5 mm pinch points (ISO 12100:2010)

Selected Solutions

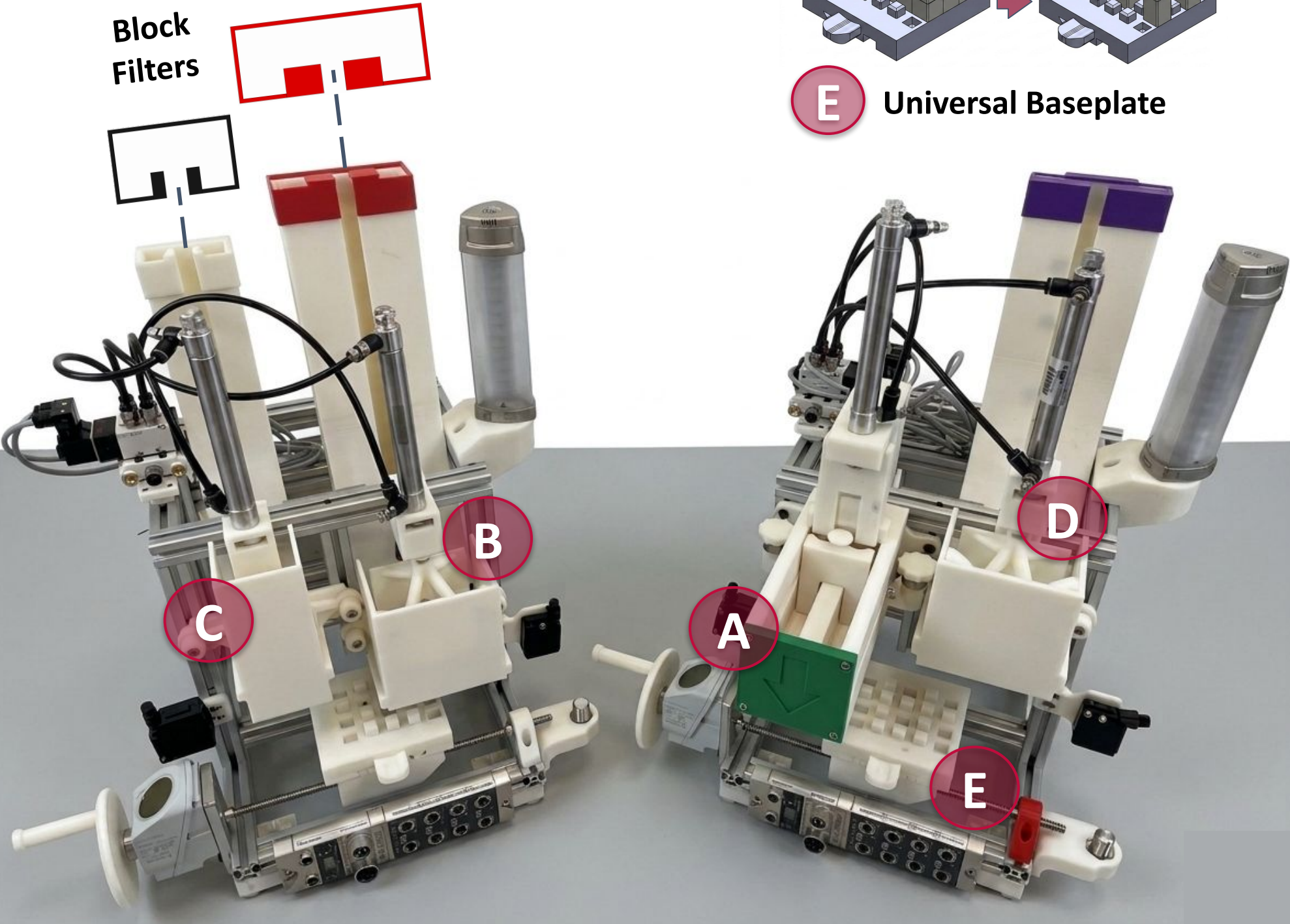
	Designs Considered and Selected			
Feeder Type	Gravity Fed	Vibratory Table	Rotational Magazine	Linear Spring Fed
Block Connection	Magnetic	Press Fit	Compliant Mechanism	
Base Plate	Universal Connection	Vacuum	Mechanical Ejection	
Stage Fixture	Detents		TPU Wings	
Piston Mount	Double Hex Nut for Tooling		Bracket w/ Threaded Insert	

Analysis

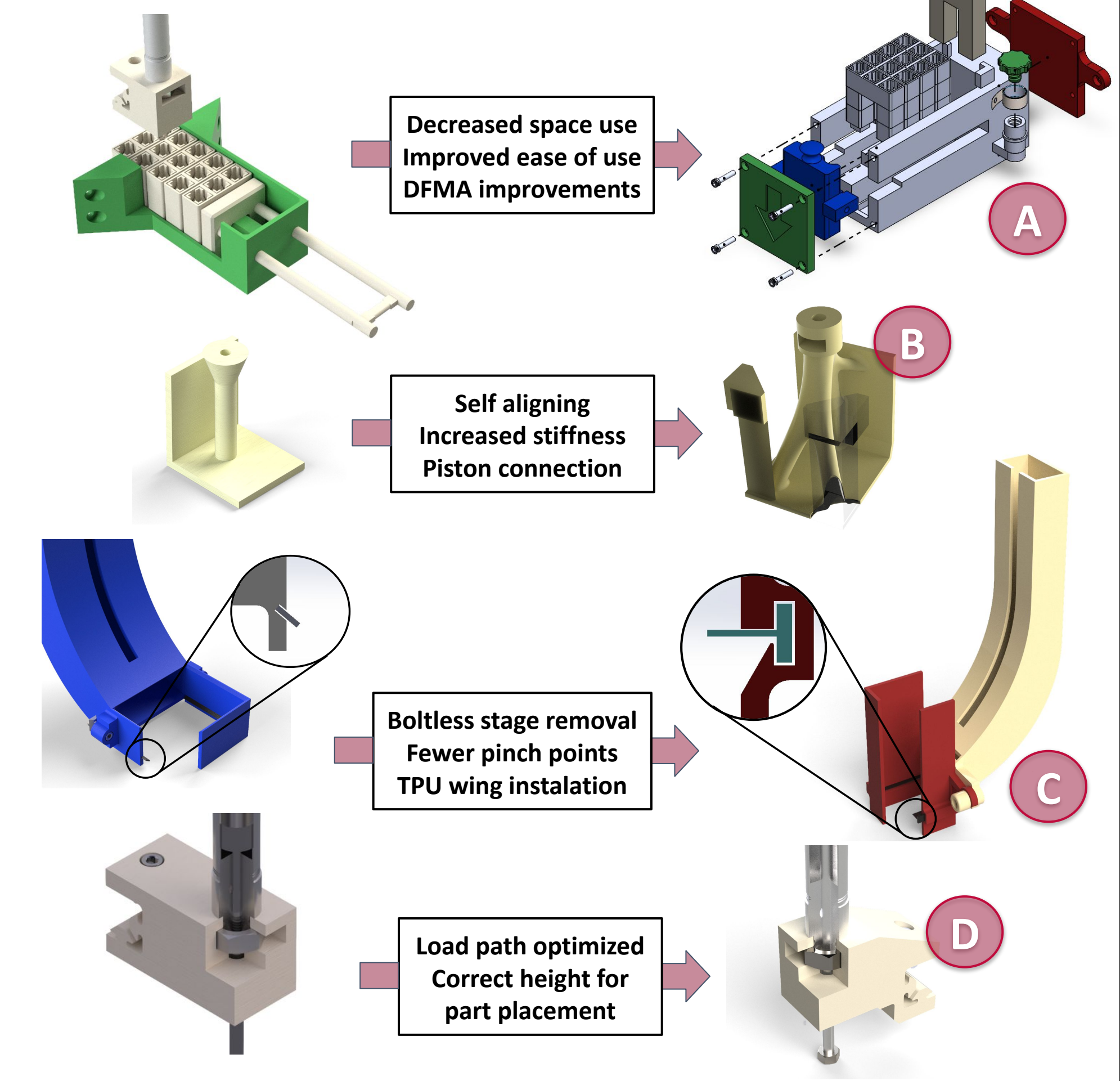
Fall: FOS Justification | Magazine Sliding | Piston Sizing | Block Ansys
Spring: TPU Wing Sizing | Spring Sizing | Magazine Loading Ansys



Final Product



Design Iterations



Performance Evaluation

Reliability and Repeatability

*N = 1000

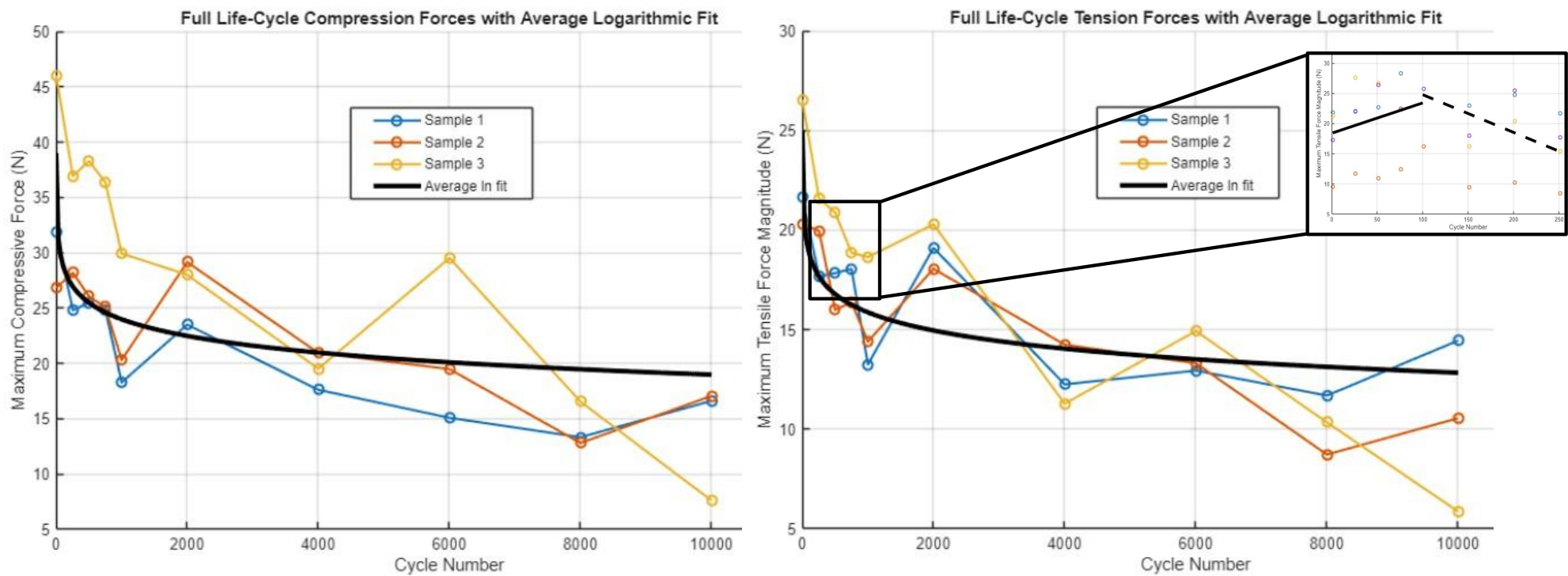
Delivery System	Station 1 Chair	Station 1 Table	Station 5 Chair	Station 5 Table
Raw Success Rate	96.53%	100.00%	99.80%	99.90%
Wilson Score	93.73%	99.73%	99.40%	99.55%



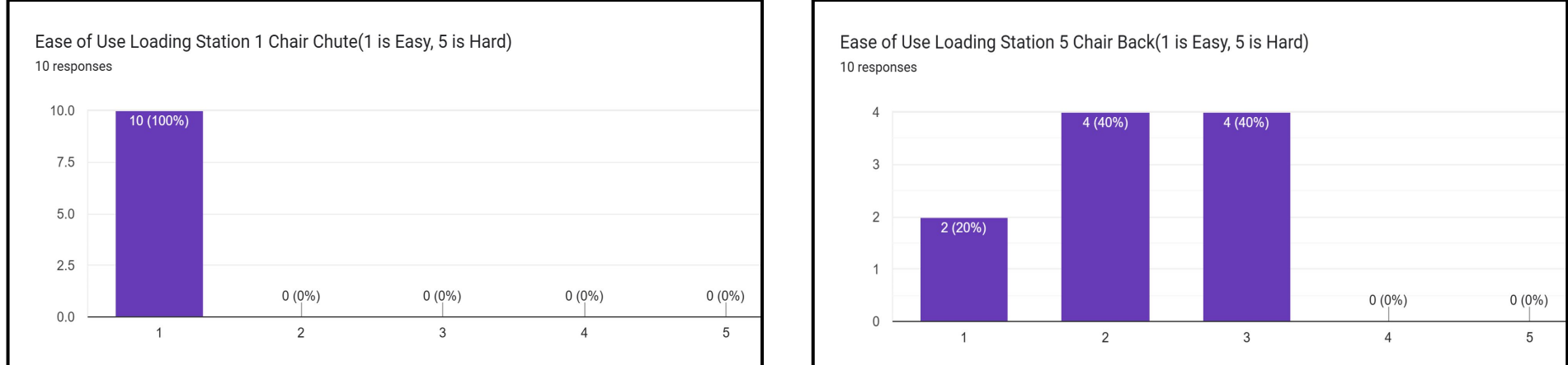
TPU Wing Force

Wing Thickness (mm)	1 mm	1.25 mm	1.5 mm
Average Force (N)	2.82	6.51	15.81

Block Force Over 10,000 Cycles



Ease of Use



Station Weight

Station	1	5
Average Weight (lb)	23.6	25

Recommendations

- Iterate Station 1 Chair Chute Design → Improve reliability
- Iterate Station 5 Chair Back → Reduce stress concentration

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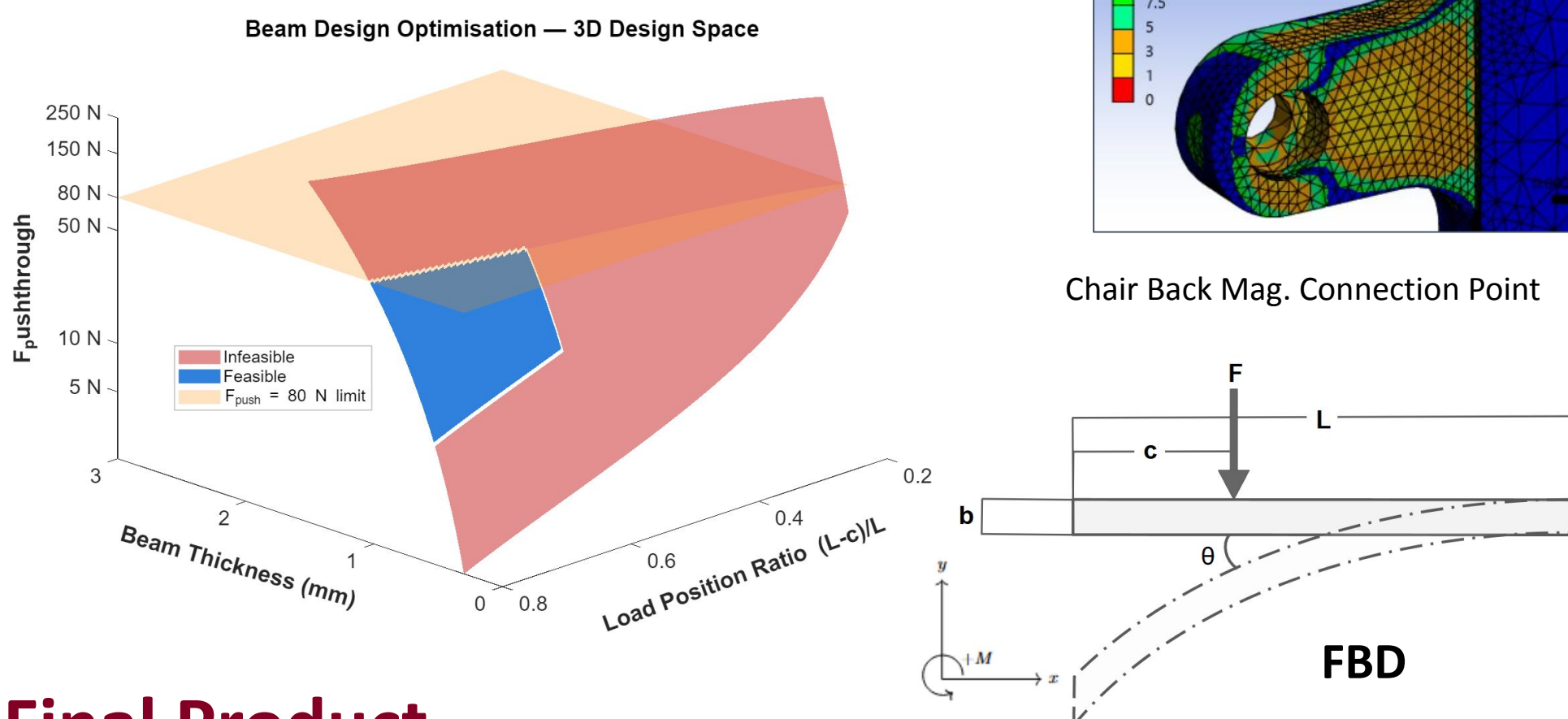
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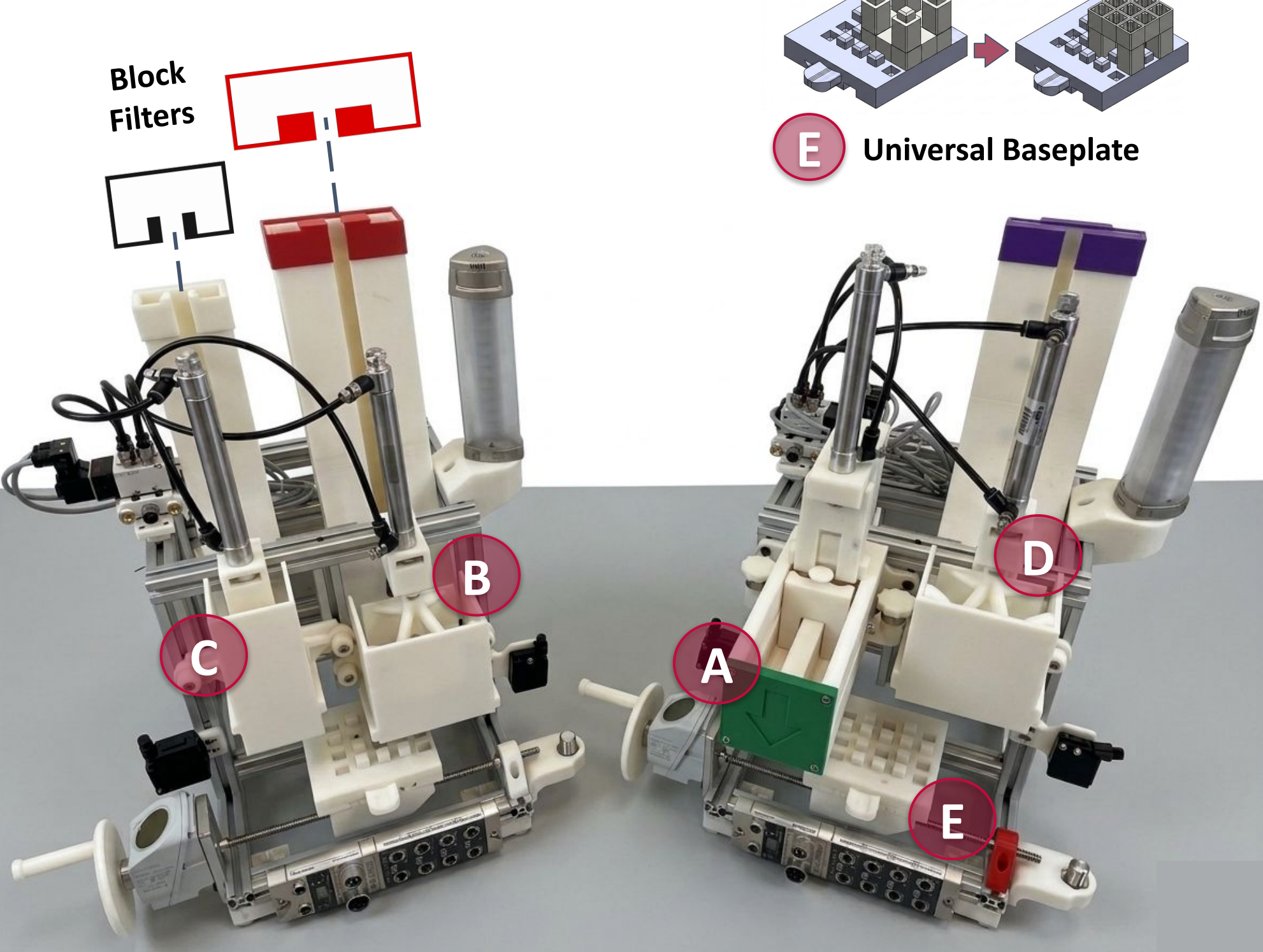
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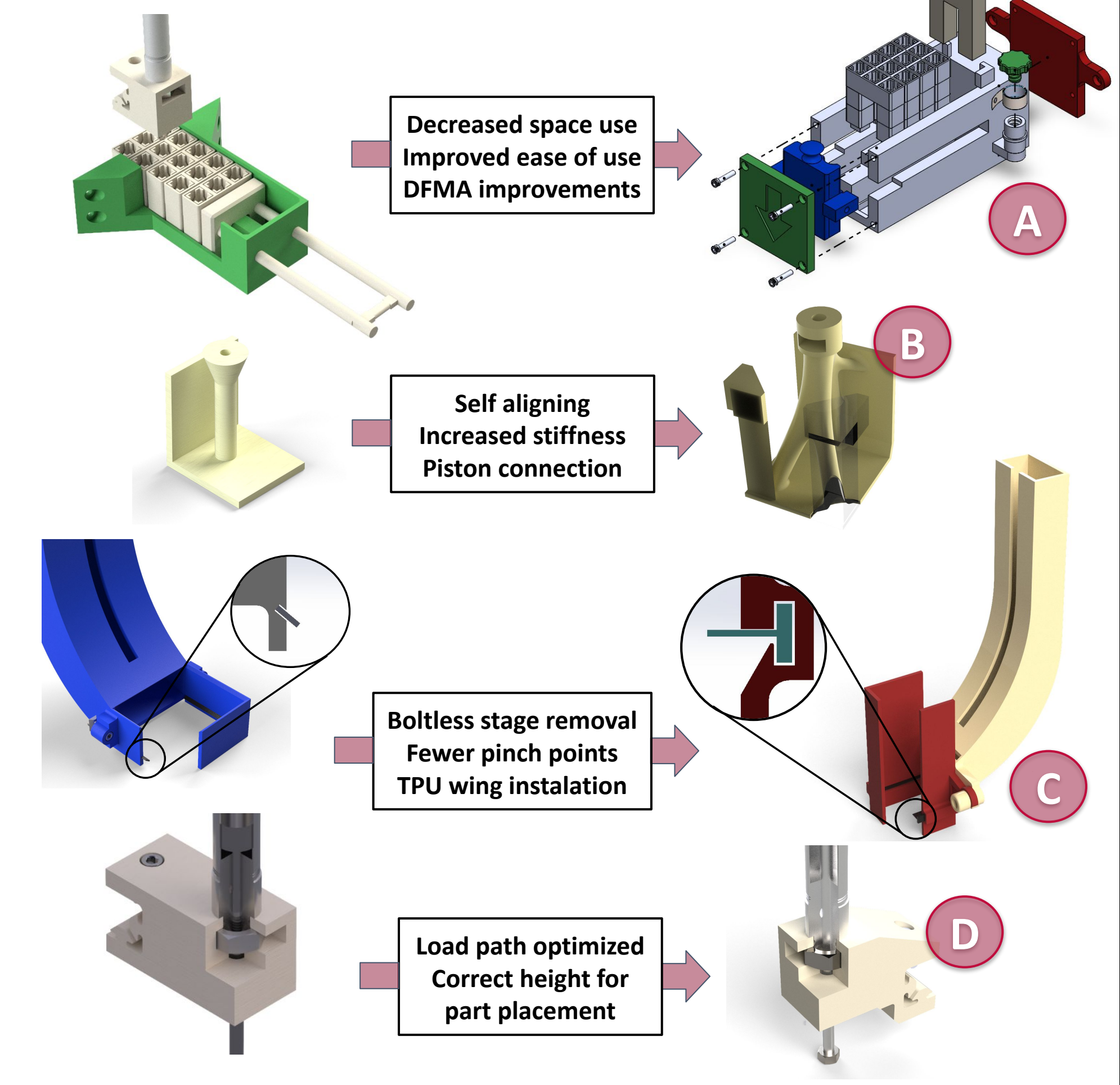
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Final Product



Design Iterations



Performance Evaluation

Reliability and Repeatability

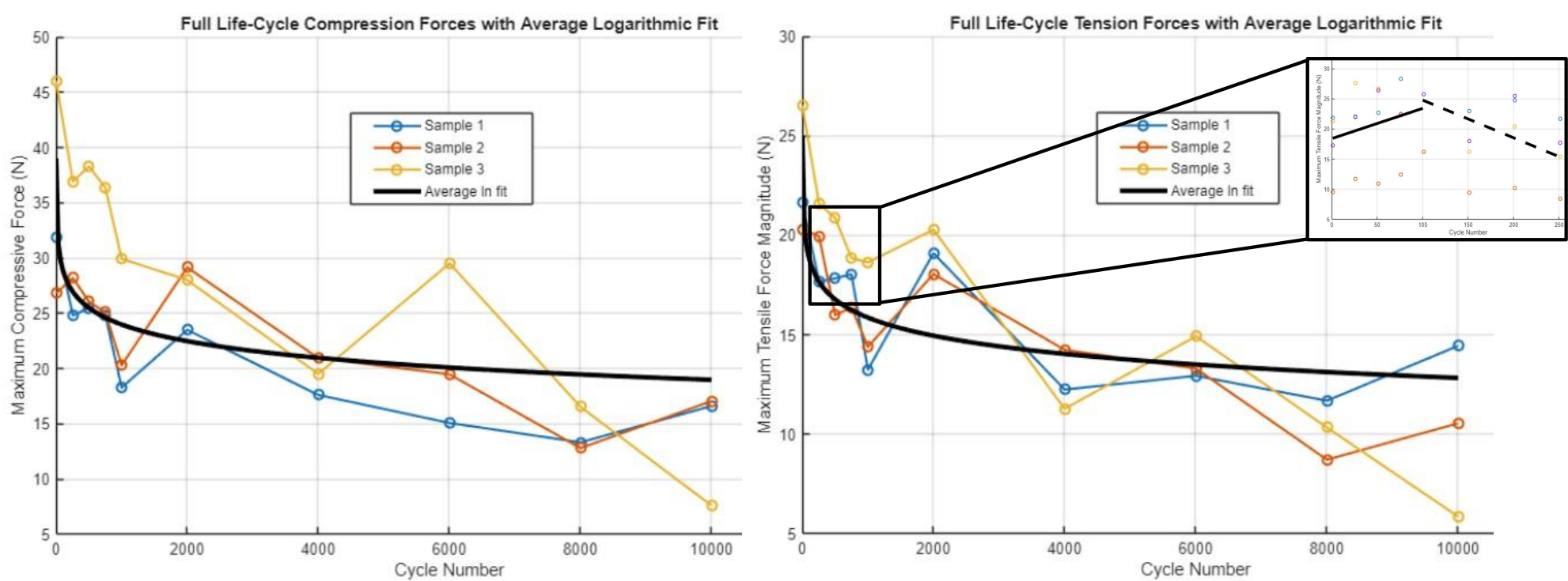
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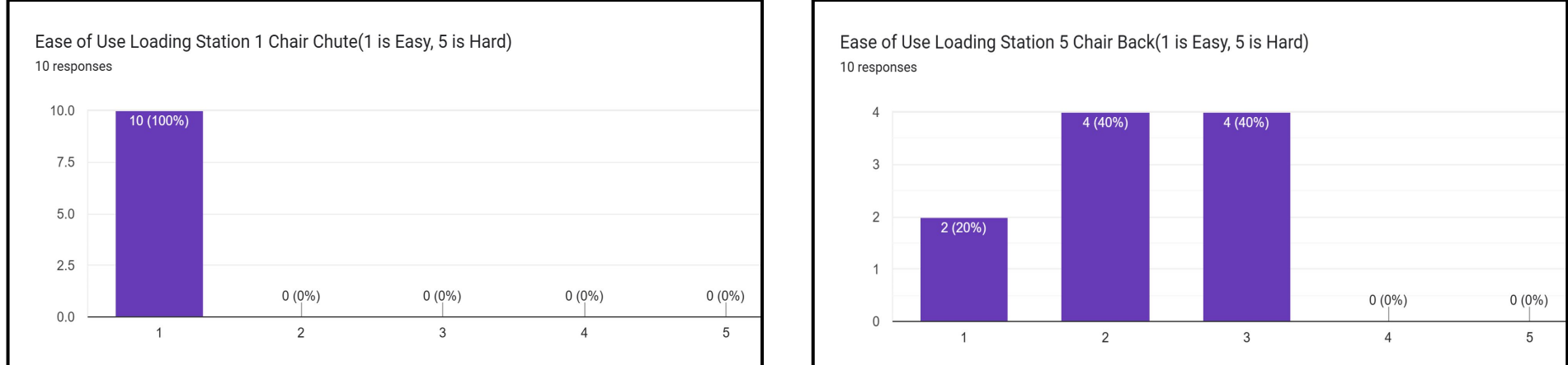
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Ease of Use



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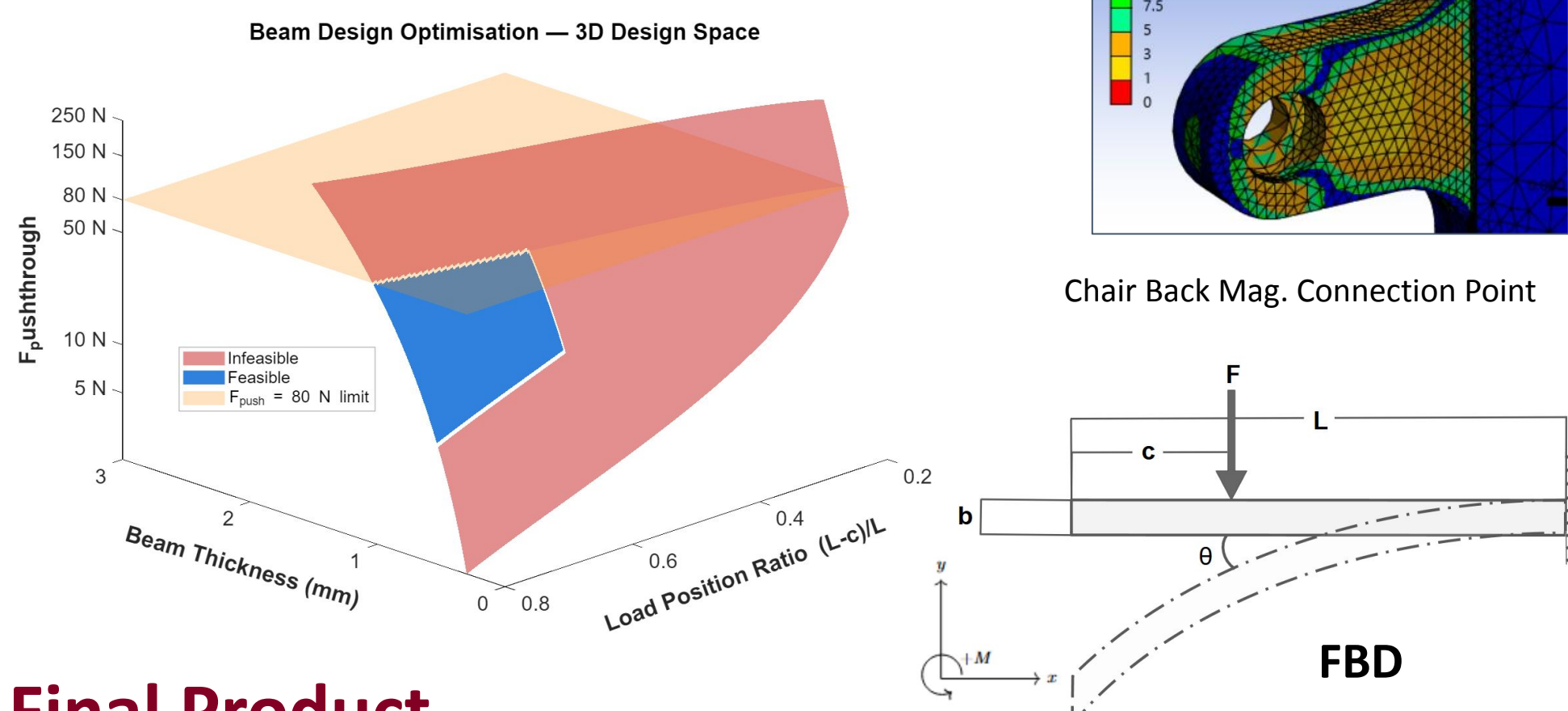
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Recommendations

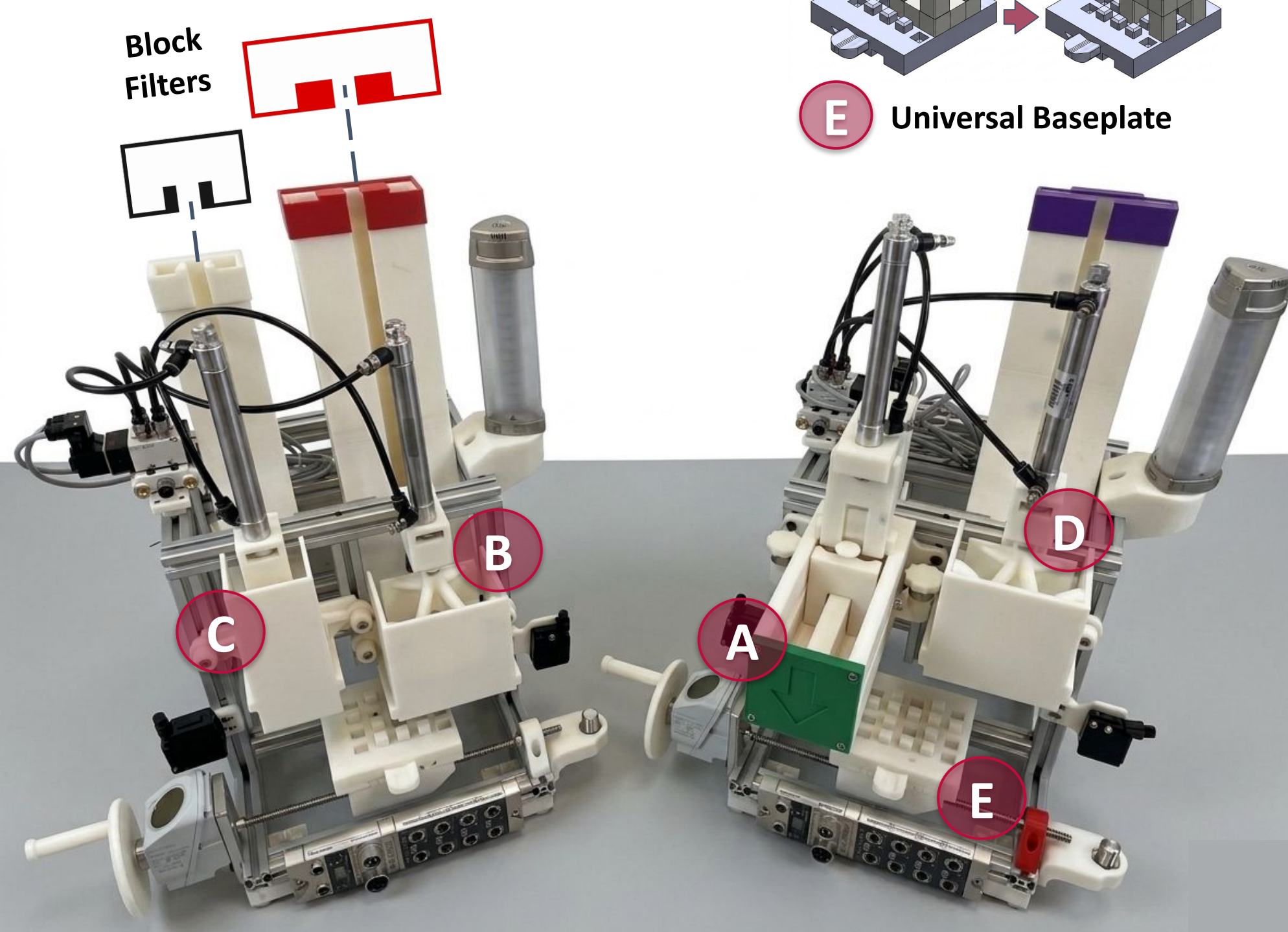
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