Composite Stand-Up Paddleboard

BoardSport Technologies Enterprise

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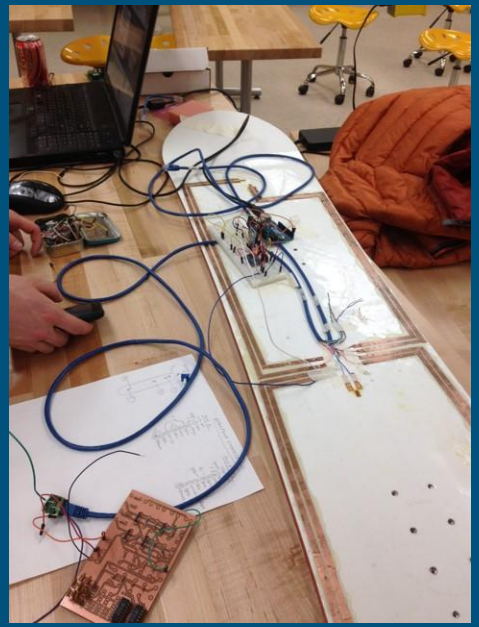
BoardSport Technologies Enterprise

- Since 2006
- Wake, Snow, Skate Teams
- Maximize performance of boards
- Design new, creative products

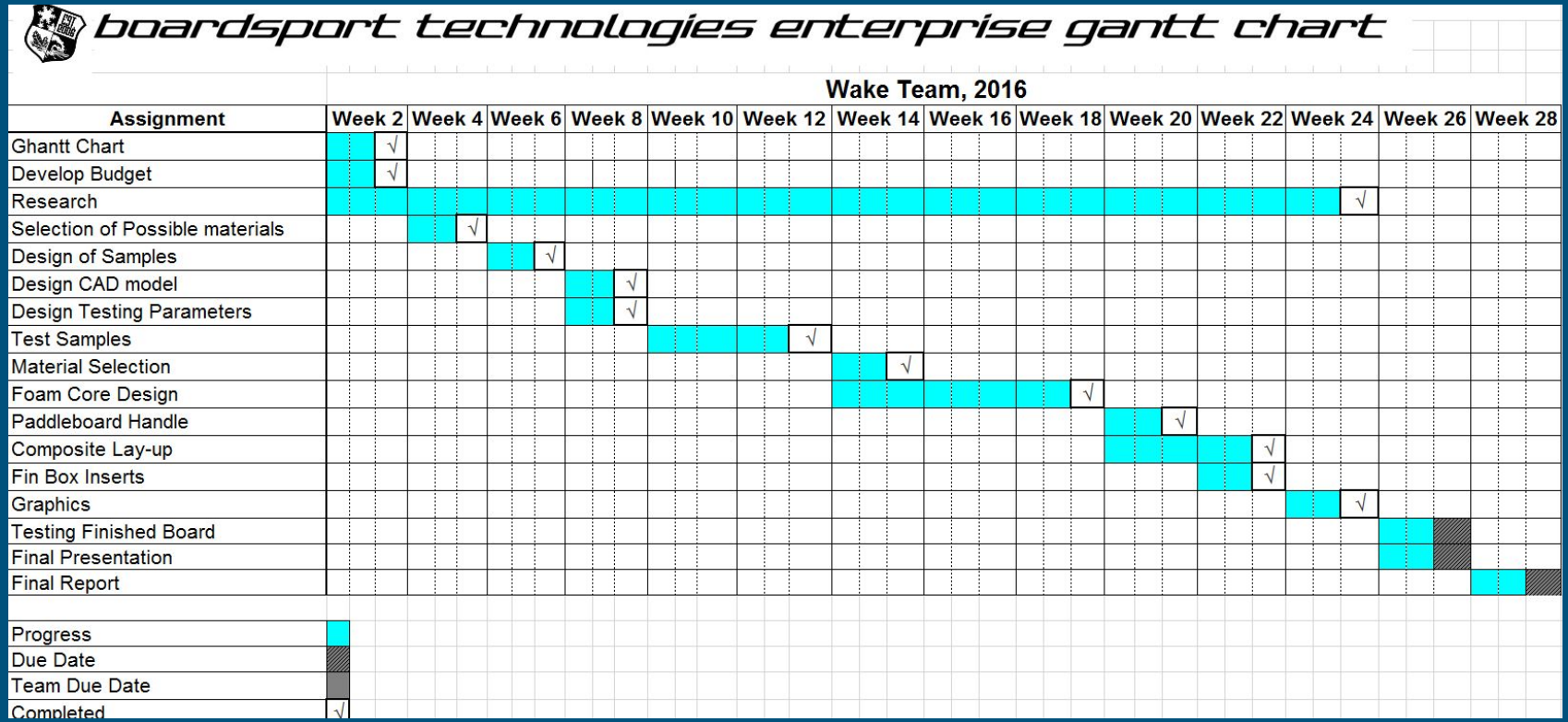


Project Objectives

To create a stand-up paddleboard (SUP) that improves performance while minimizing cost.

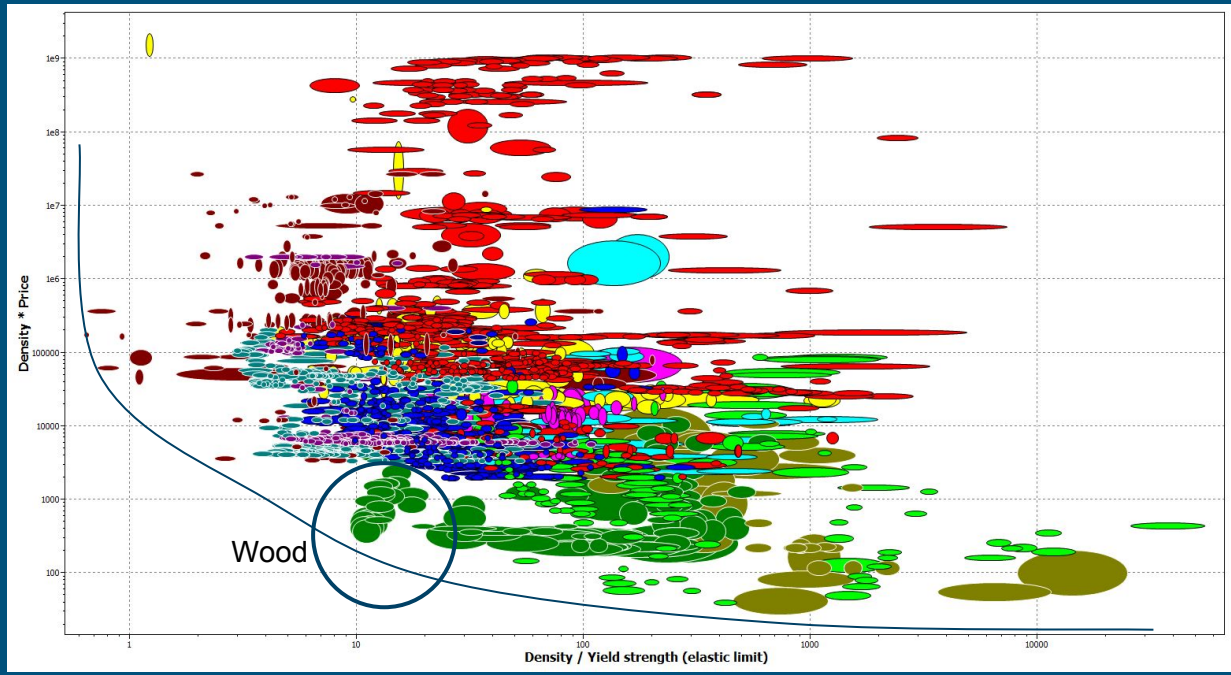
- Performance is defined as:
  - Maximize stability
  - Maximize speed
  - Minimize weight
  - Maximize strength

Timeline


boardsport technologies enterprise gantt chart
Wake Team, 2016
Assignment
Week 2
Week 4
Week 6
Week 8
Week 10
Week 12
Week 14
Week 16
Week 18
Week 20
Week 22
Week 24
Week 26
Week 28
Ghantt Chart
Develop Budget
Research
Selection of Possible materials
Design of Samples
Design CAD model
Design Testing Parameters
Test Samples
Material Selection
Foam Core Design
Paddleboard Handle
Composite Lay-up
Fin Box Inserts
Graphics
Testing Finished Board
Final Presentation
Final Report
Progress
Due Date
Team Due Date
Completed

Composite Design

- SUP Types
  - Inflatable
  - Foam/Fiber
  - Wood
- Fiber/Foam/Fiber
- Baseline:
  - Weight: ~28 lbs
  - Length: 9 feet
  - Fiber: Fiberglass
  - Epoxy: Standard 2 part
  - Foam: Polystyrene
  - Cost: ~ $1200



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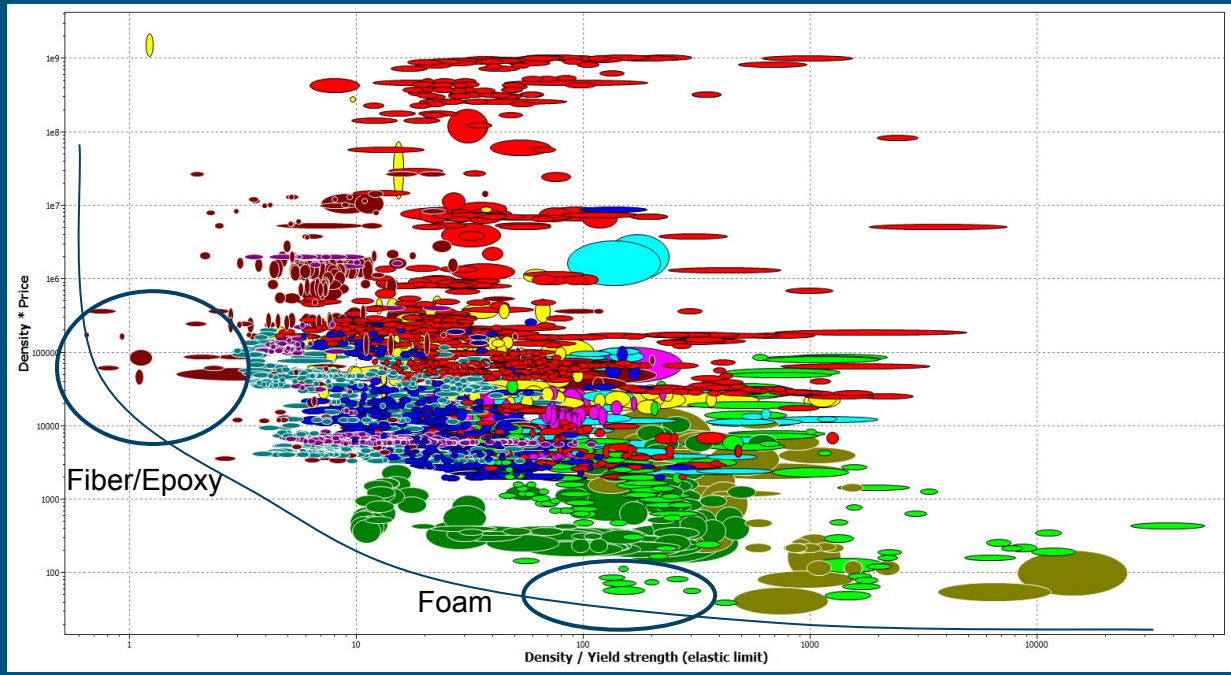

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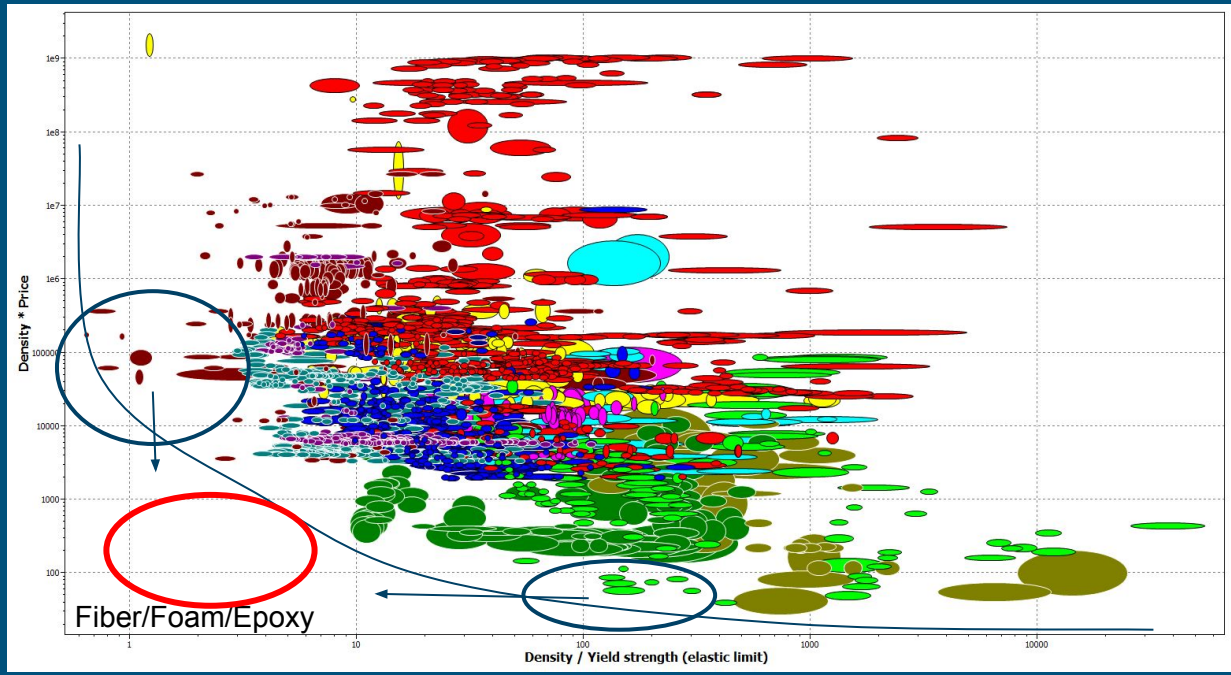
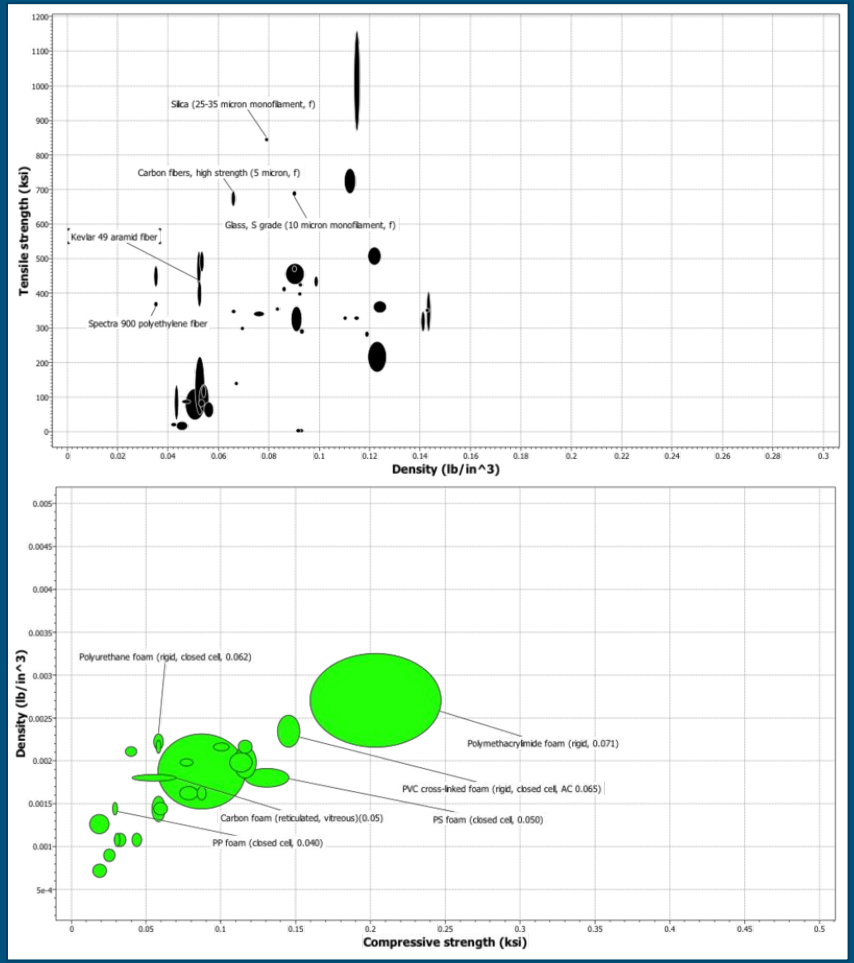


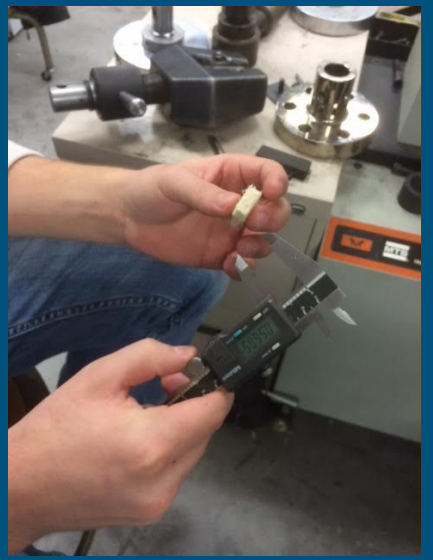
Material Selection

- Fiber Selection
  - Carbon Fiber
  - E-Glass
  - S-Glass
- Foam Selection
  - Divinycell
  - Expanded Polystyrene
  - Polypropylene Foam
- Epoxy Choice
  - Standard resin
  - UV cure resin



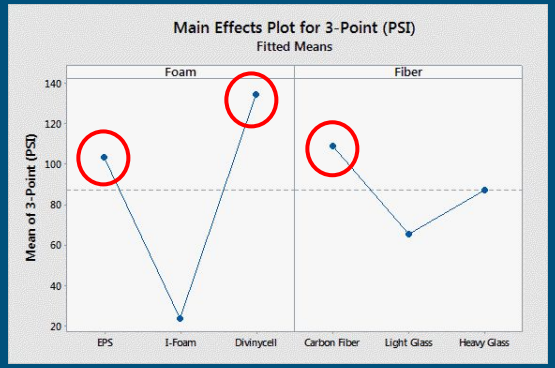
Material Testing

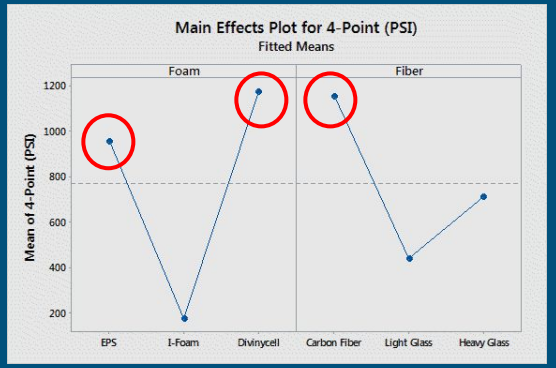
- Full DOE
- ASTM D2344
  - Laminate strength
- ASTM D7264
  - Flexural strength
- Failure modes
  - Fracture of board
  - Delamination

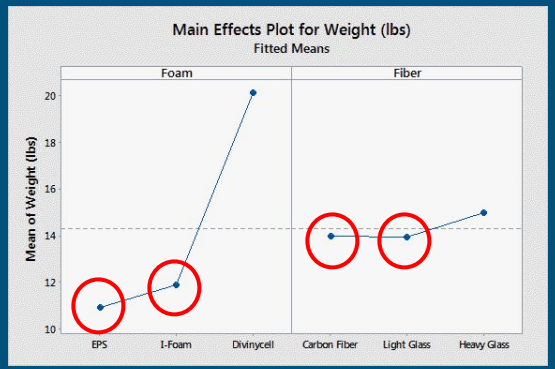


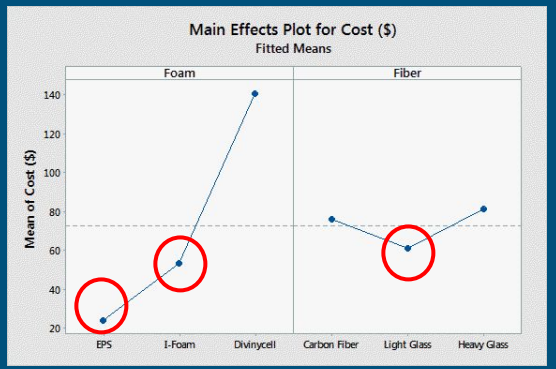
Data Analysis

Material	Density	Yield or Compressive Strength	Images
Carbon Fiber	0.0004637 lbs./in^2	580 ksi yield	
E-Glass Light	0.0004409 lbs./in^2	268 ksi yield	
E-Glass Heavy	0.0007874 lbs./in^2	592 ksi yield	
EPS Foam	0.000795 lbs./in^3	0.0232 ksi compressive	
Divinycell Foam	0.00159 lbs./in^3	0.0624 ksi compressive	
I-Foam	0.000880 lbs./in^3	Undetermined	
PP Foam	0.00159 lbs./in^3	0.0305 ksi compressive	N/A



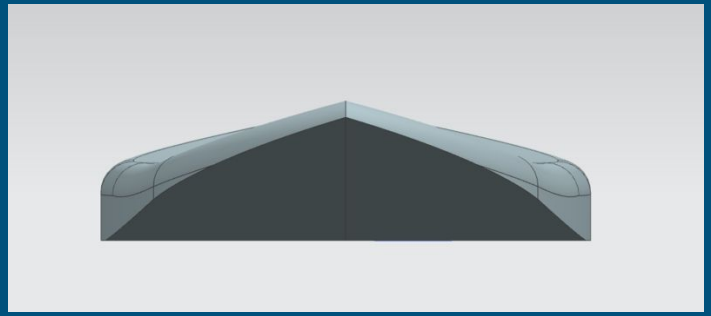


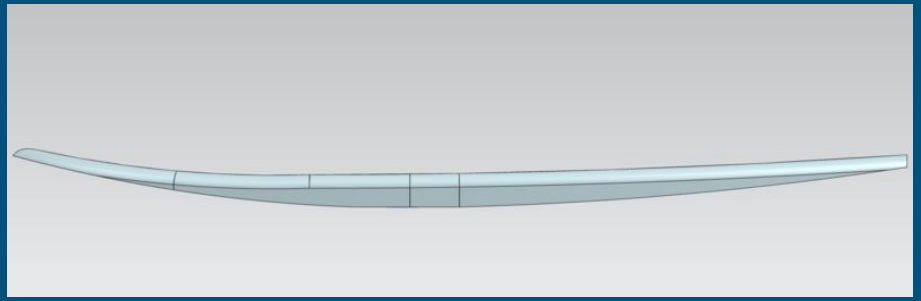


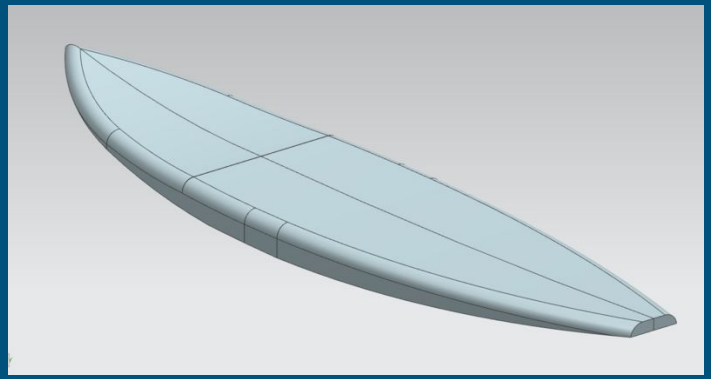


Model Design

- Hybrid hull shape
  - Planing
  - Displacement
- Increases speed (pointed tip)
- Increases stability (flat bottom)

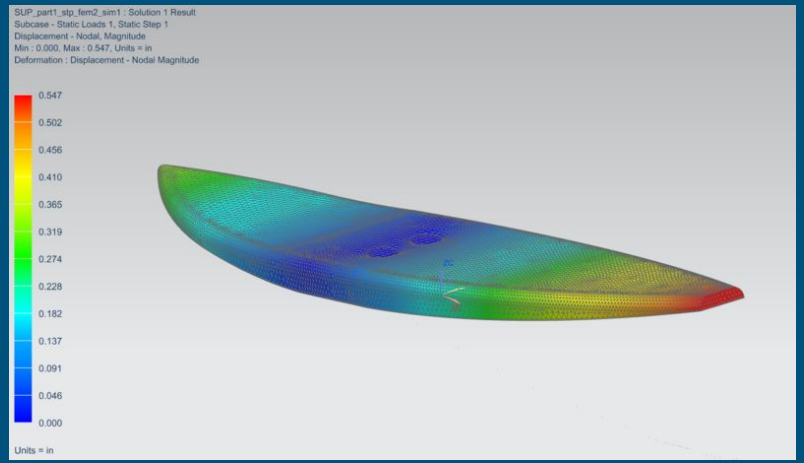


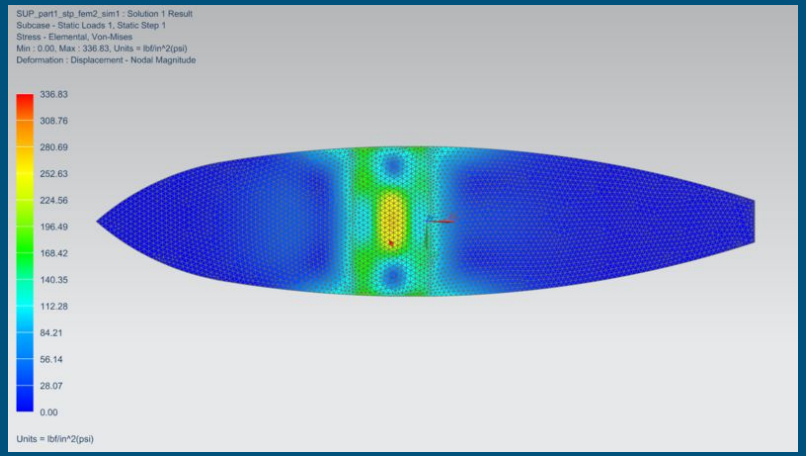




Finite Element Analysis

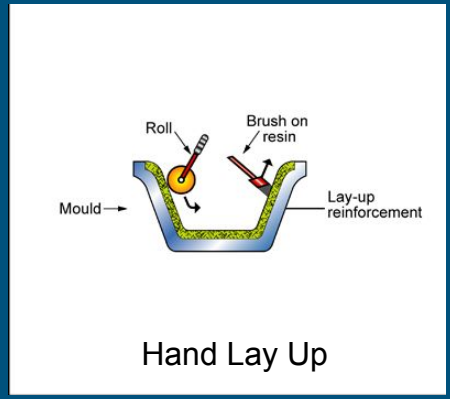
- Max displacement of 0.5 in
  - Helps with cresting waves
- Max stress of 262 psi
  - Safety factor of 3.3

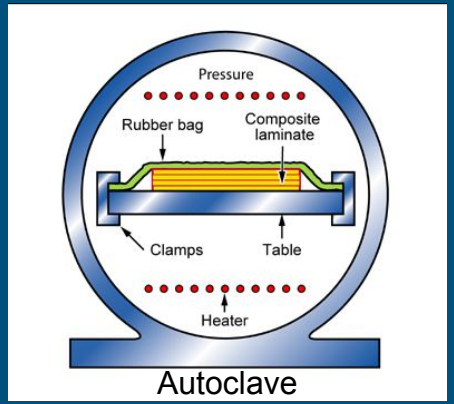


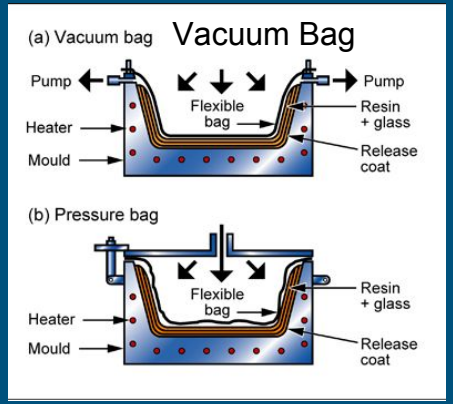


Manufacturing Process Selection

- 3 Possible processes
  - Autoclave
  - Vacuum Bag
  - Hand Lay Up







Manufacturing Process Selection

- 3 Possible processes
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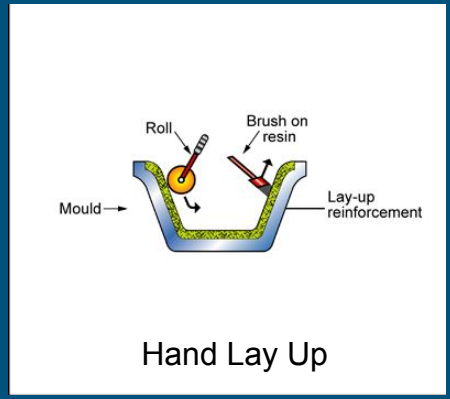

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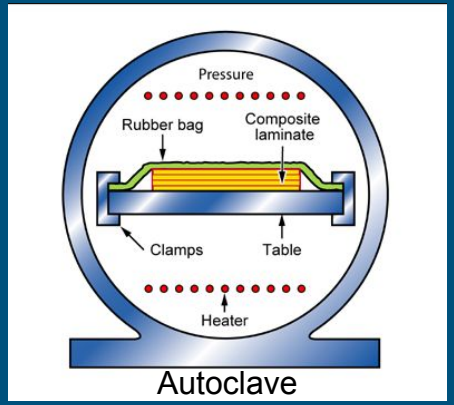
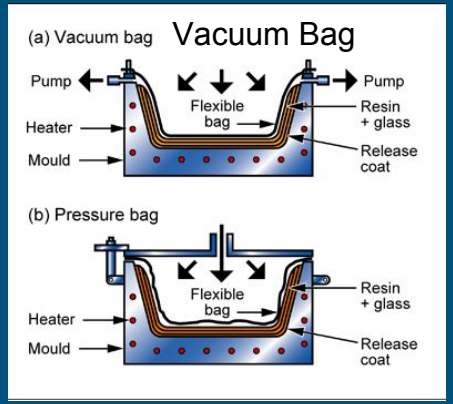


Autoclave



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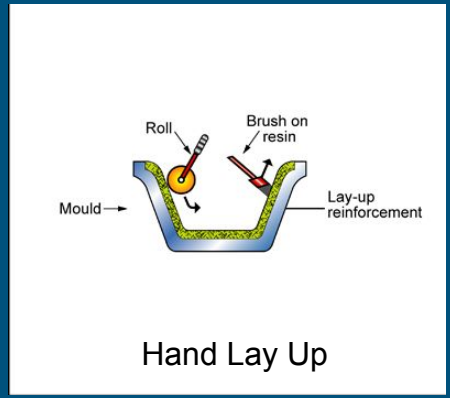
  - Vacuum Bag - requires large pump
  - Hand Lay Up



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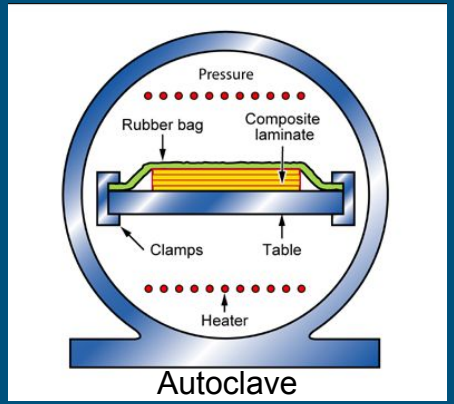

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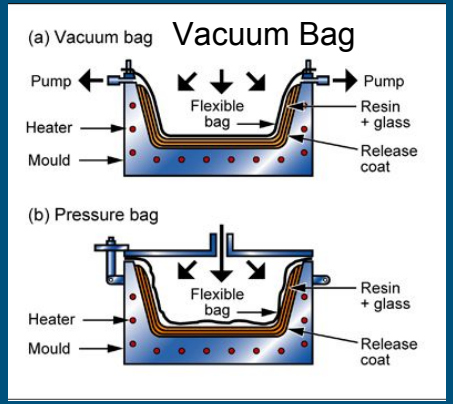

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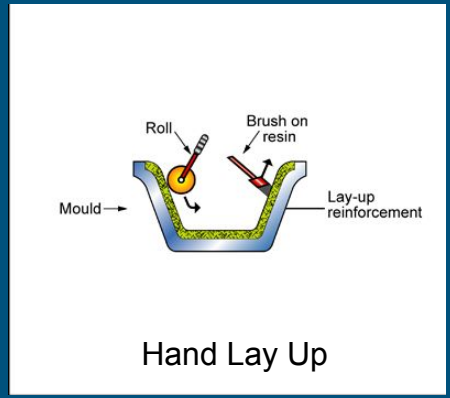

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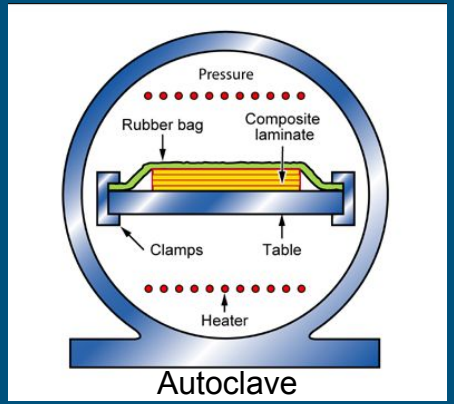

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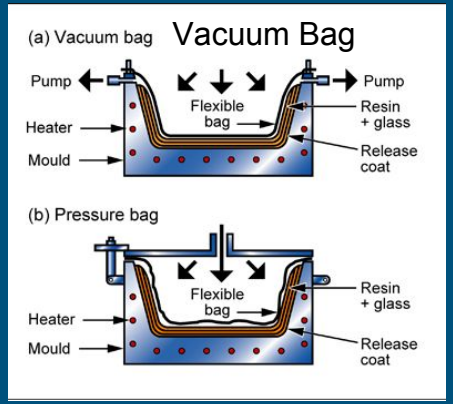


Construction

1. Machine foam blank

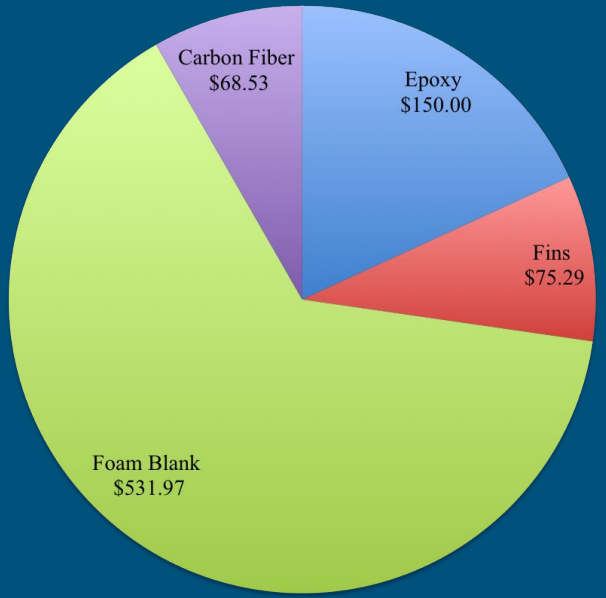
2. Apply carbon fiber

3. Apply fiberglass

4. Attach fins

Objective Verification

- Final performance
  - Stability and Speed
    - Hybrid hull
  - Final Weight: 18 lbs, 10 lbs under goal
  - Design Strength: 180 lbs
    - Safety Factor: 3.3
    - ~600 lbs center load
- Final Cost
  - ~ $825, $500 under goal
  - Donated materials and 3D printed parts reduced cost

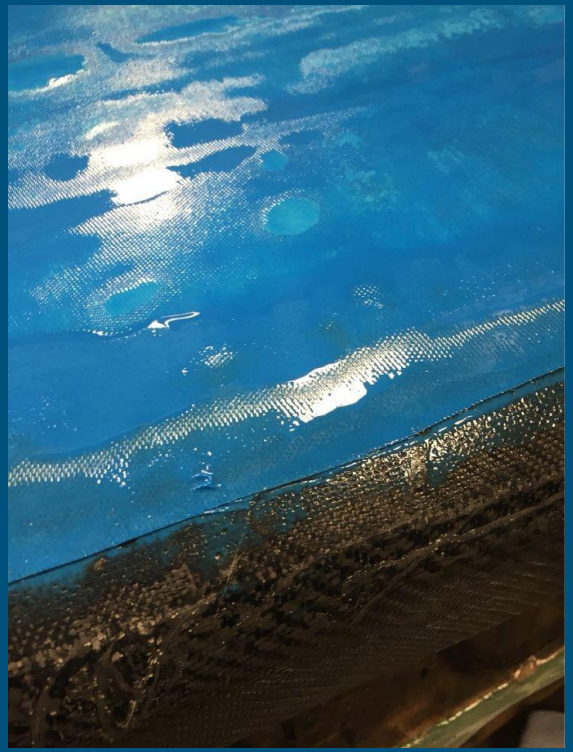


Problems with Final Product

- Inexperience with hand lay up process
- Not enough sun for UV epoxy
- Storage

Future Goals

- Improve cut-lap process
- Purchase UV light bulb
- More epoxy testing
- More testing on paddleboard



Questions?