Team 511: Intrepid

Erika Craft
John Karamitsanis
Cory Stanley
Juan Tapia

Intrepid Powerboats
Redesigned Hardtop
Team 511

Materials Engineer
Juan Diego Tapia

Lead Engineer
John Karamitsanis

Mechanical Design Engineer
Cory Stanley

Marine Design Engineer
Erika Craft

Erika Craft

Sponsors, Advisor, & Coordinator

President
Ken Clinton

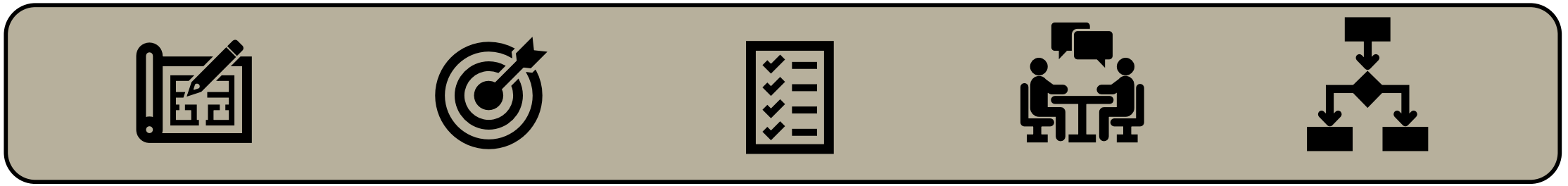
V.P. of Engineering
Richard Ahl

Academic Advisor
Dr. William Oates

Senior Design Coordinator
Dr. Shayne McConomy

Erika Craft

Project Recap



Description | Objective | Key Goals | Customer Needs | Functions

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Project Recap

- Intrepid wants to improve their vessel performance
- Current Intrepid hardtops are heavier than desired
- Improving the hardtop can solve Intrepid's problem

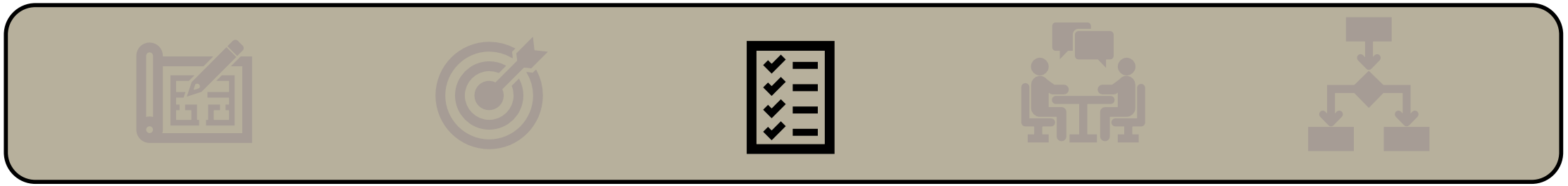
Erika Craft

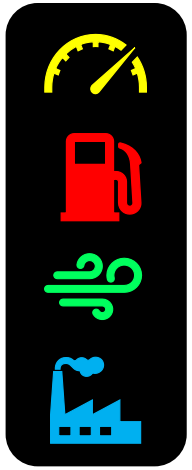
Project Recap

To improve on water performance of the 409 Valor

Erika Craft

Project Recap





- Improve boat on water performance
- Improve fuel efficiency
- Analyze and enhance aerodynamics
- Keep the design manufacturable

Erika Craft

Project Recap

Question	Interpreted Need
What materials need to be considered?	Incorporate materials used within Intrepid
Parameters of the current hardtop?	Similar dimensions retained
Can we alter wire/chase tube layout?	Exit points must stay the same
Is there a certain weight the hardtop needs to withstand?	Design withstands all nominal loads and running conditions

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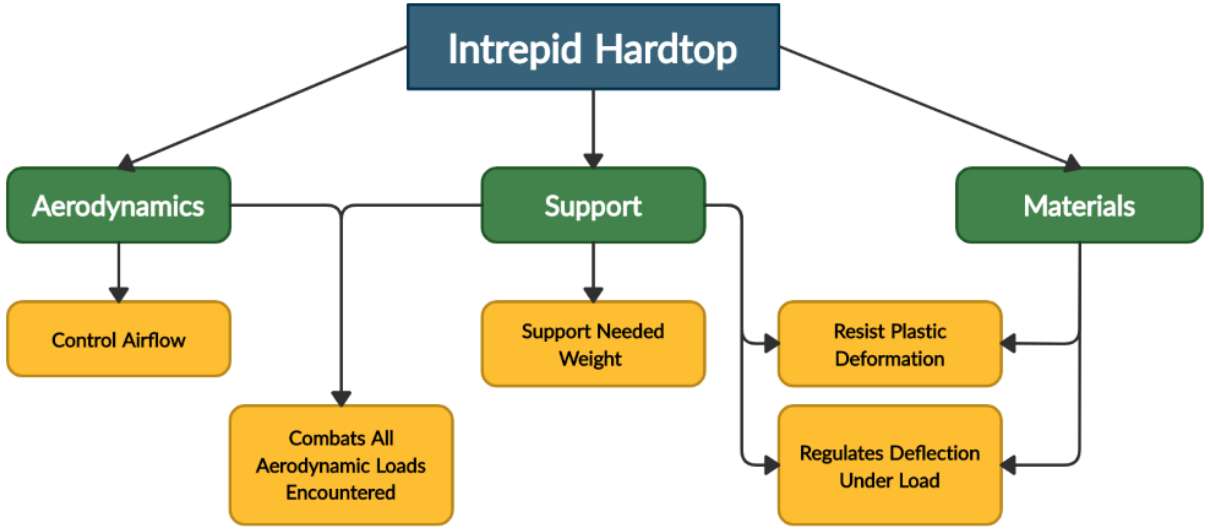
Project Recap



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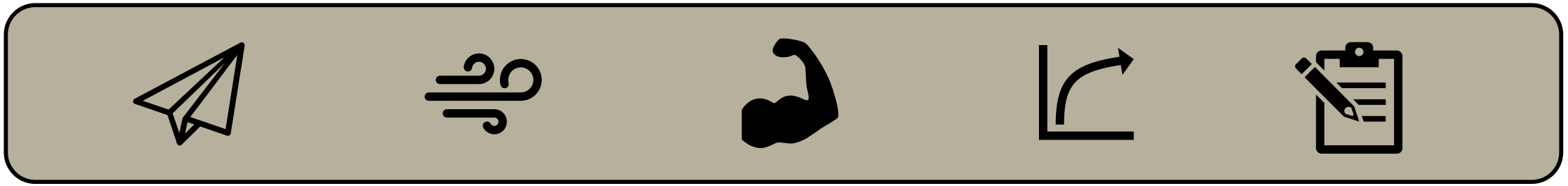
Targets & Metrics



Control Airflow

Combat Aerodynamic Load

Support Needed Weight

Resist plastic deformation

Regulate deflection under load

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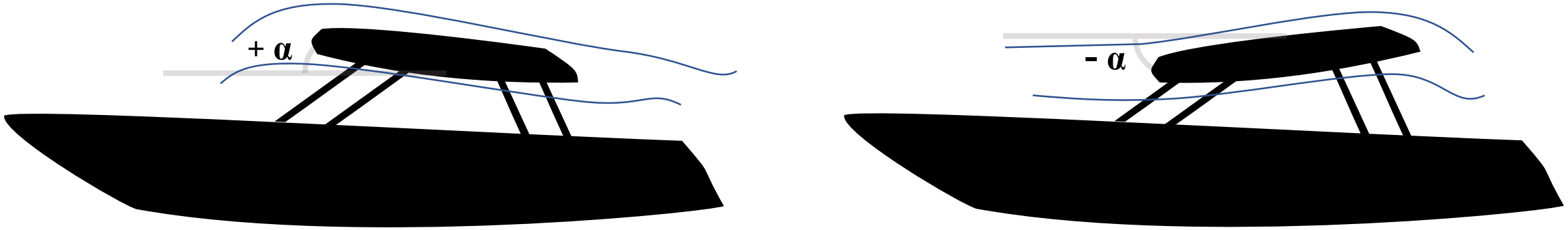
Targets & Metrics

Control Airflow



Increase Lift-to-Drag Ratio

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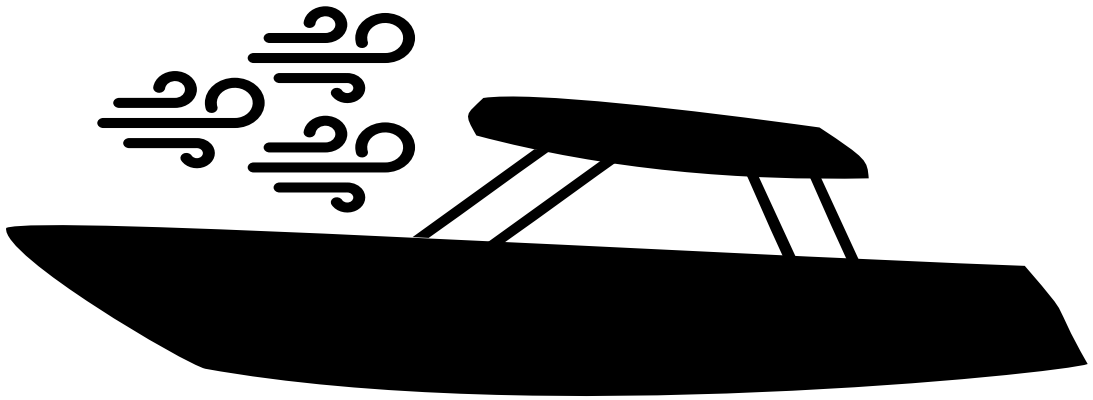
Targets & Metrics

Combat Aerodynamic Load



Remain below failure stress during operation
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Resist vibrations

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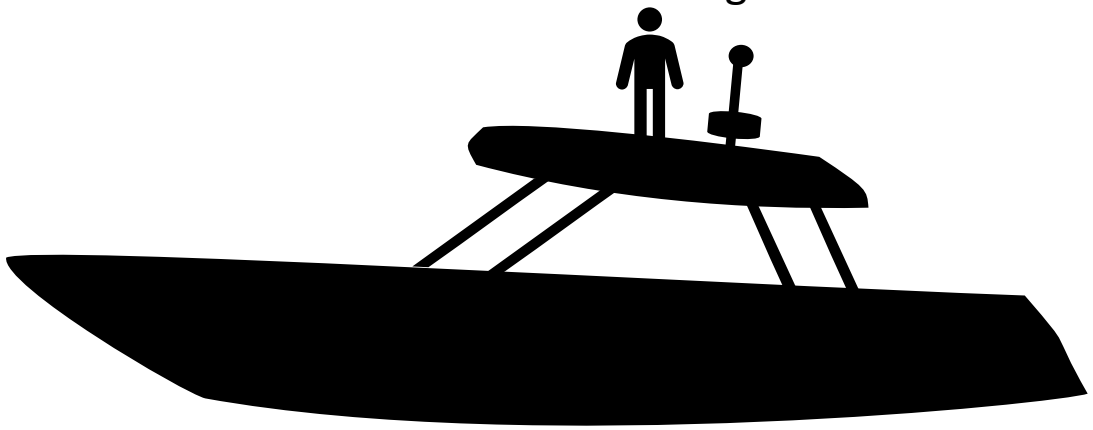
Targets & Metrics

Support Needed
Weight



Remain below failure stress during service and maintenance

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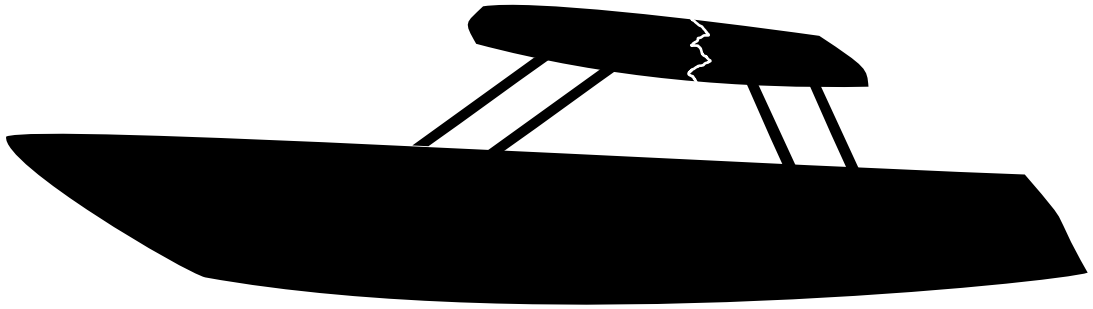
Targets & Metrics

Resist plastic deformation



Remain within elastic region

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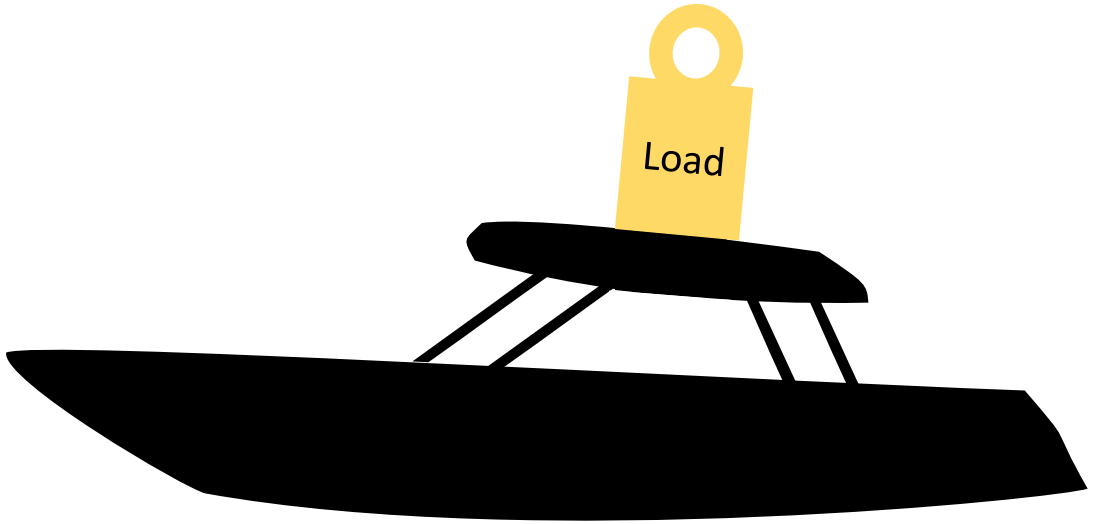
Targets & Metrics



Regulate deflection under load

Remain within specified deflection limits

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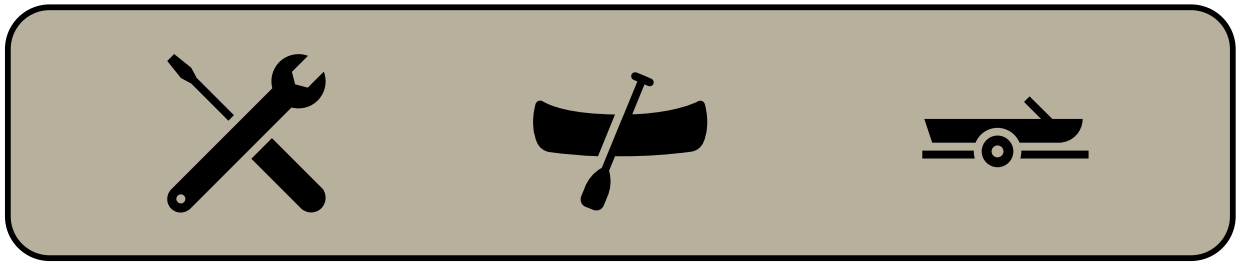
Concept Generation



Tools Medium Fidelity High Fidelity

Juan Diego Tapia

Concept Generation

Anti-Problem

?

How to make hardtop heavier?

How can we reduce boat performance?

Battle of Perspectives

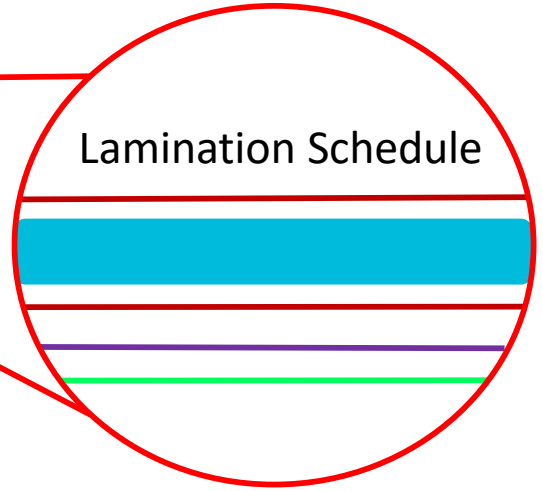
Lighter Hardtop vs Faster Boat

Buyer vs Manufacturer

Juan Diego Tapia

Concept Generation

Changes can be made to current lamination schedule



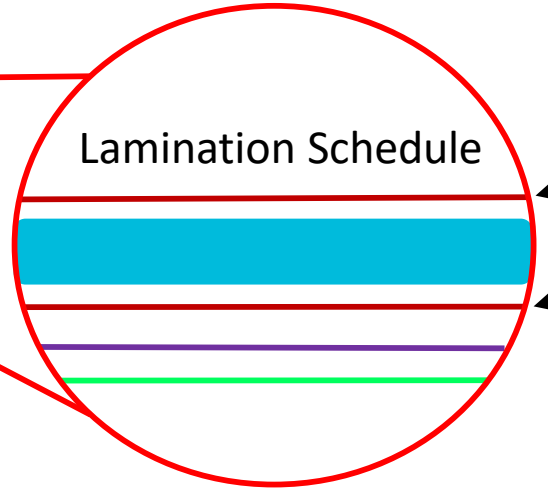
LEGEND

Material	Layer Order & Color
1708	
1.5" Core	
1708	
1.5 oz CSM	
Gelcoat	

Juan Diego Tapia

Concept Generation

Changes can be made to current lamination schedule



Less Dense Fiberglass

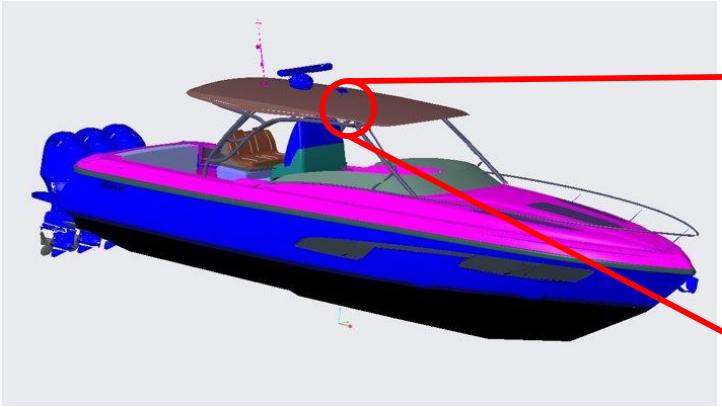
LEGEND

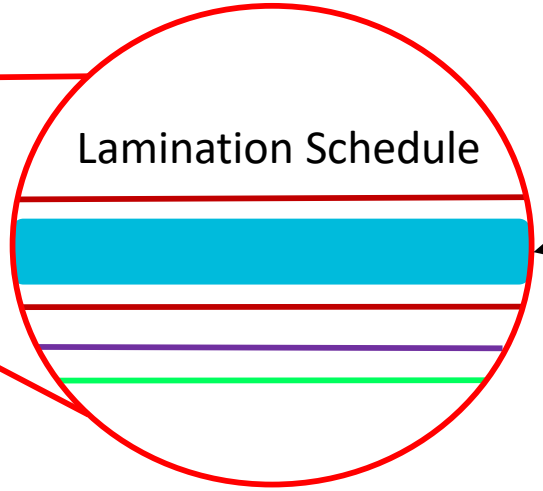
Material	Layer Order & Color
1708	
1.5" Core	
1708	
1.5 oz CSM	
Gelcoat	

Juan Diego Tapia

Concept Generation

Changes can be made to current lamination schedule





Less Dense Foam

LEGEND

Material	Layer Order & Color
1708	
1.5" Core	
1708	
1.5 oz CSM	
Gelcoat	

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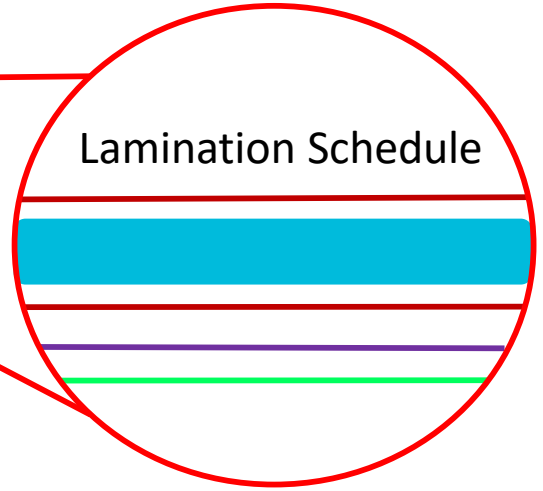
Concept Generation

Changes can be made to current lamination schedule



Explore Other Materials

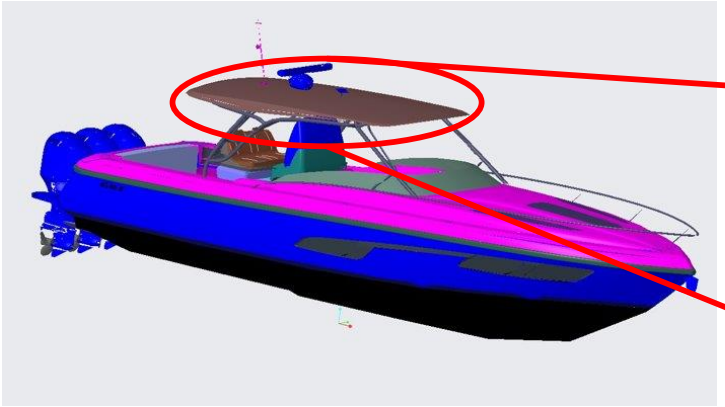
LEGEND

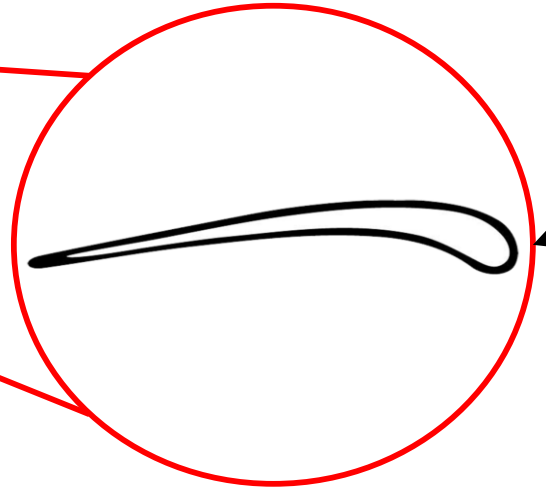
Material	Layer Order & Color
1708	
1.5" Core	
1708	
1.5 oz CSM	
Gelcoat	

Juan Diego Tapia

Concept Generation

Change current hardtop to a high lift generating wing profile





High Lift Wing Alternative

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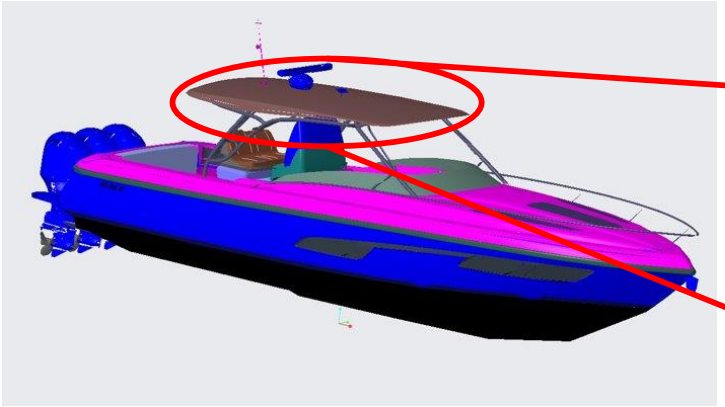
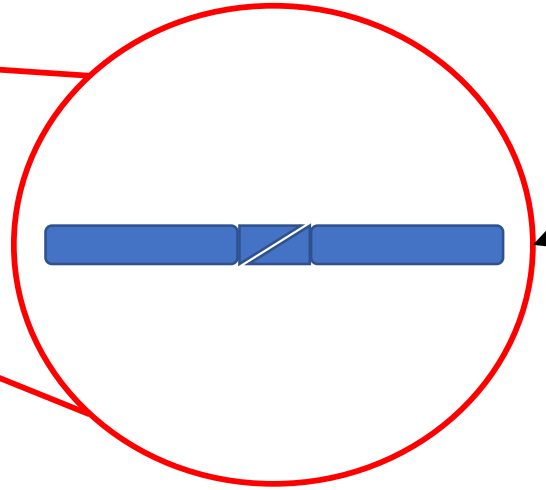
Concept Generation

Implement an active aerodynamics system into the hardtop





Active Aero Demonstration

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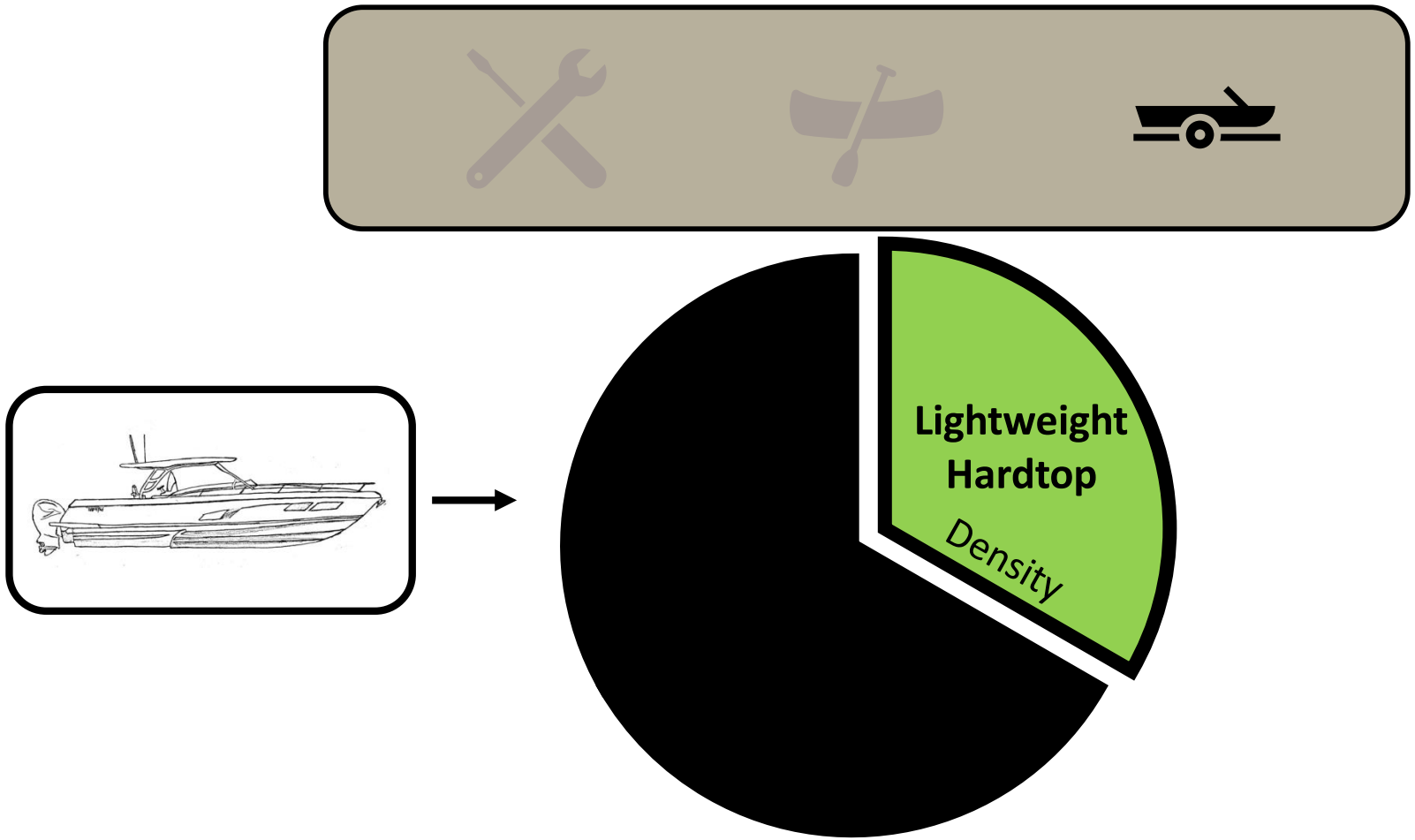
Concept Generation



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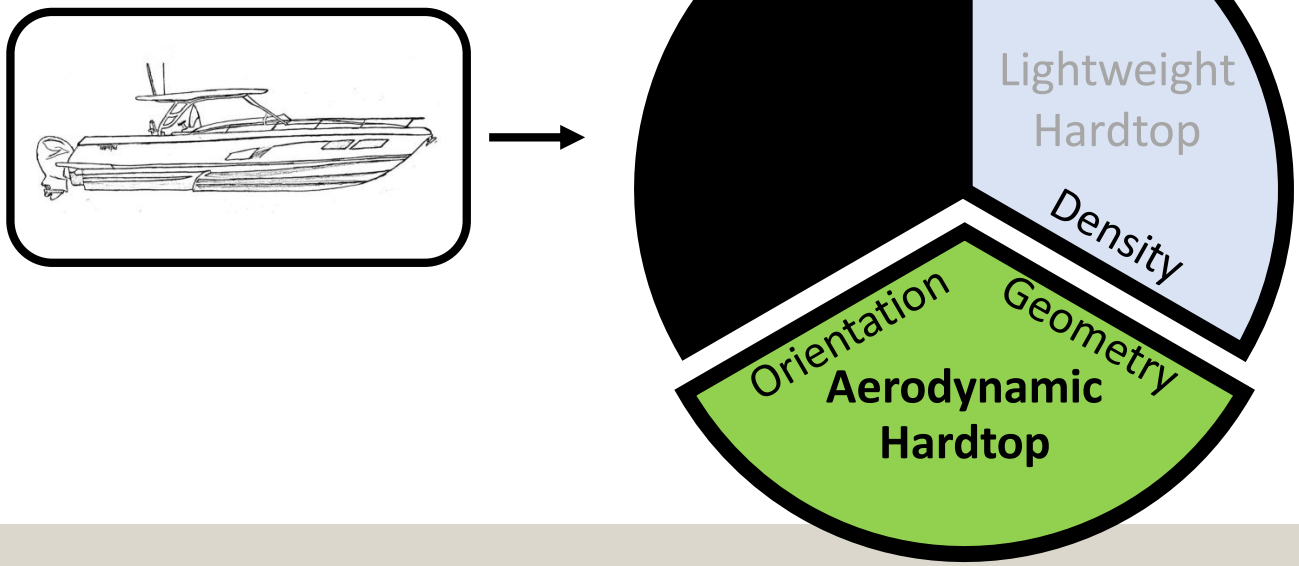
Concept Generation



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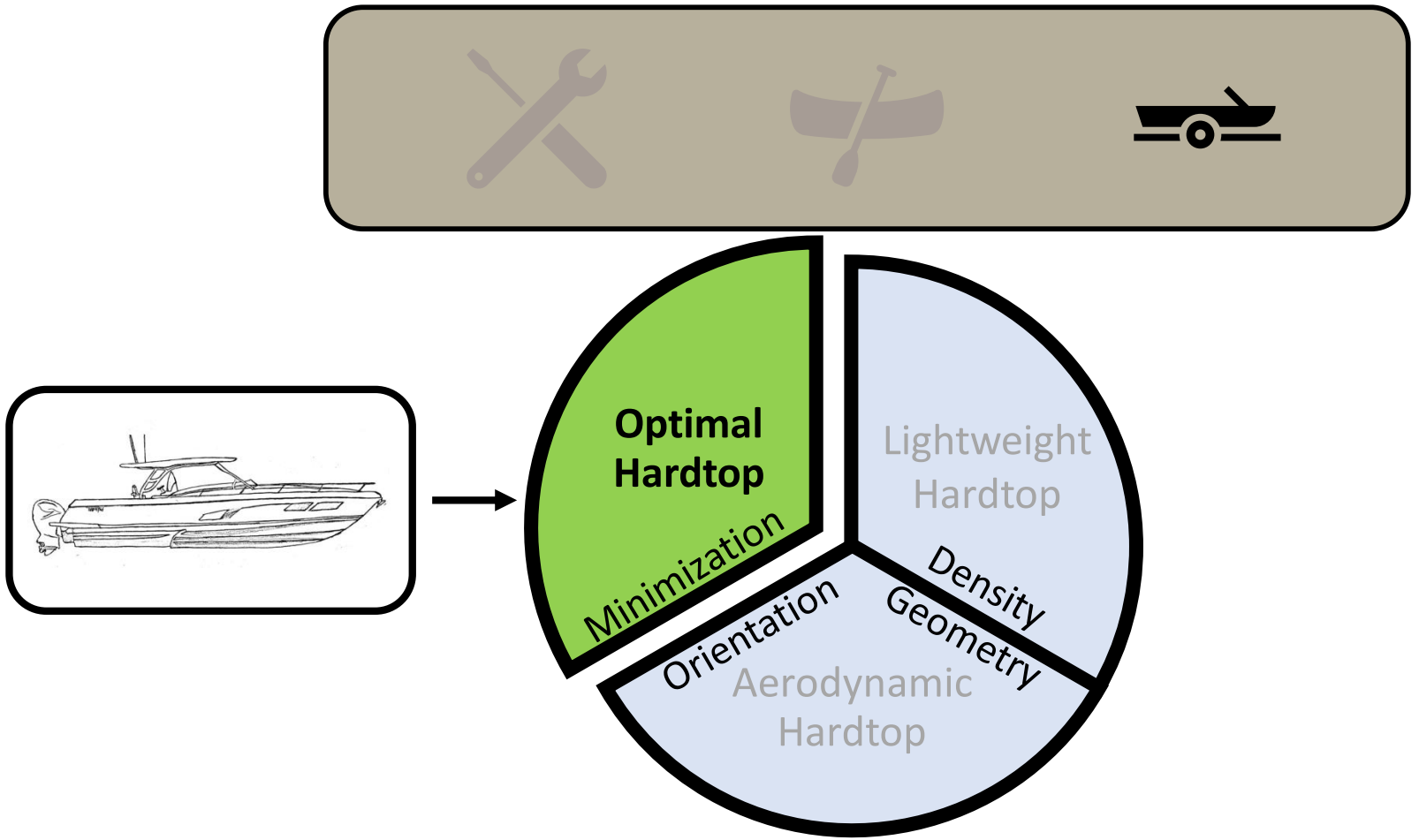
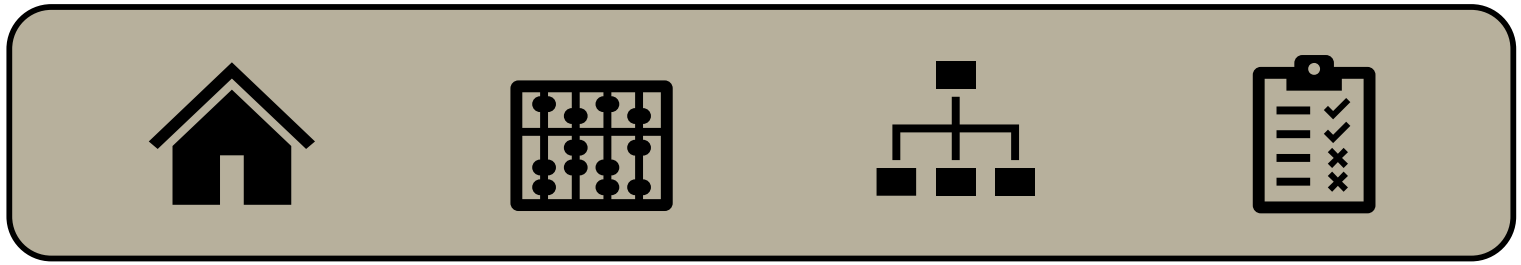
Concept Generation



Juan Diego Tapia

Concept Selection



House of Quality | Pugh Charts | Analytical Hierarchy Process | Final Selection

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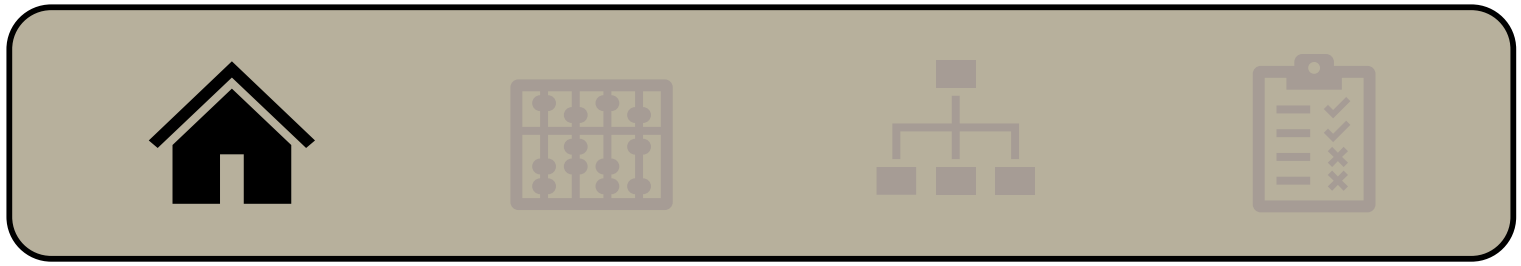
Concept Selection



Binary Pairwise Matrix	1	2	3	4	5	6	7	Total
1. Supports Needed Weight	-	1	1	0	1	0	0	3
2. Resists Plastic Deformation	0	-	0	1	0	0	0	1
3. Regulates Deflection Under Load	0	1	-	0	0	1	1	3
4. Combats All Aerodynamic Loads	1	0	1	-	1	1	1	5
5. Controls Airflow	0	1	1	0	-	1	0	3
6. Implementation Cost	1	1	0	0	0	-	0	2
7. Manufacturability	1	1	0	0	1	1	-	4
Total	3	5	3	1	3	4	2	

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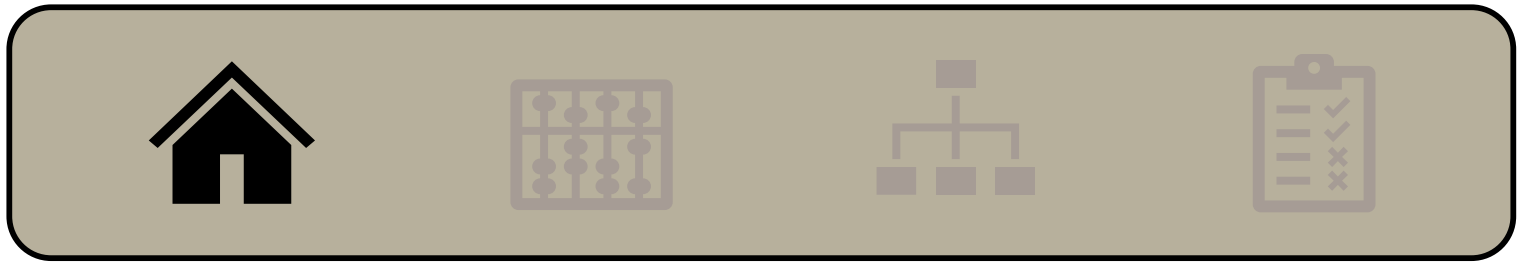
Concept Selection



Binary Pairwise Matrix		Total
1.	Supports Needed Weight	3
2.	Resists Plastic Deformation	1
3.	Regulates Deflection Under Load	3
4.	Combats All Aerodynamic Loads	5
5.	Controls Airflow	3
6.	Implementation Cost	2
7.	Manufacturability	4
Total		

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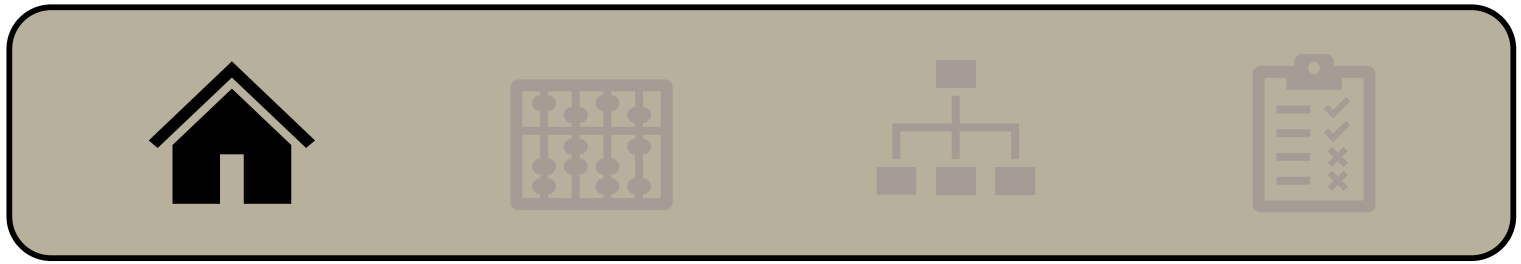
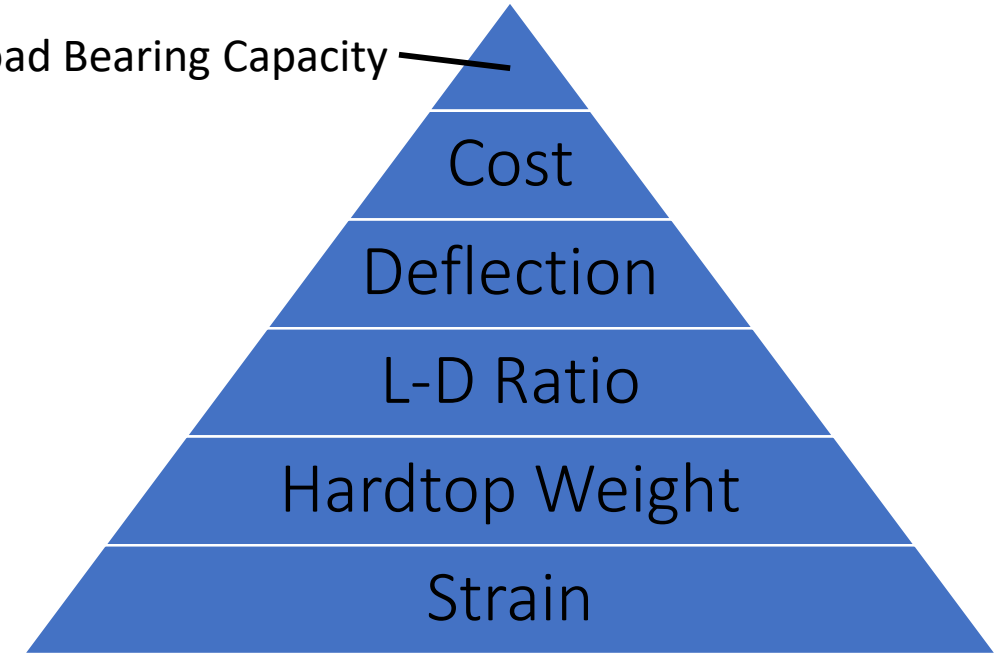
Concept Selection





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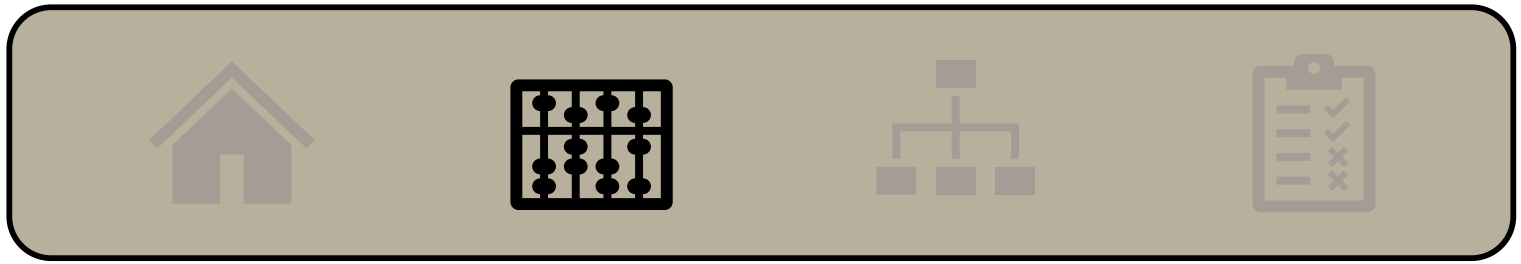
Concept Selection



		Concepts					
Selection Criteria	Existing Hardtop	1	2	3	4	5	6
Load Bearing Capacity	DATUM	+	–	S	S	–	S
Strain		S	–	+	–	–	–
Deflection		–	+	+	S	+	+
Hardtop Weight		+	+	+	S	S	+
Lift-to-Drag Ratio		S	+	+	+	+	–
Implementation Cost		S	S	S	s	–	–
Manufacturability		S	S	–	–	–	S
Number of +		**2**	**3**	**4**	**1**	**3**	**2**
Number of -		**1**	**2**	**2**	**2**	**4**	**3**

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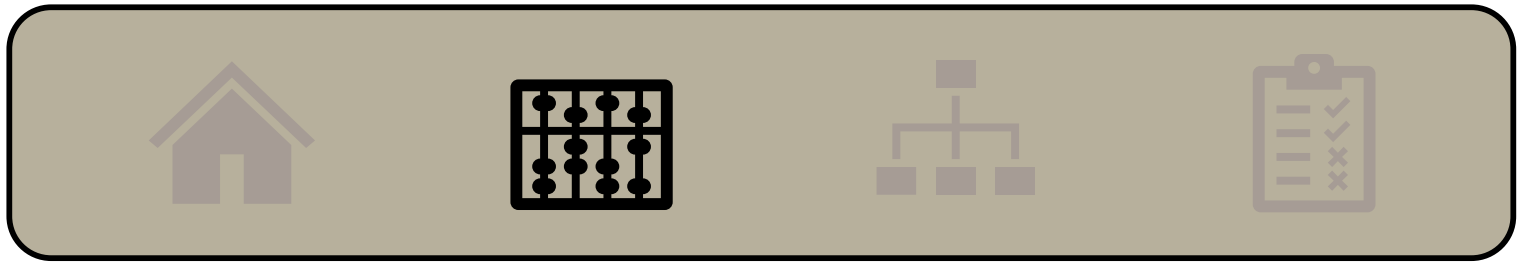
Concept Selection



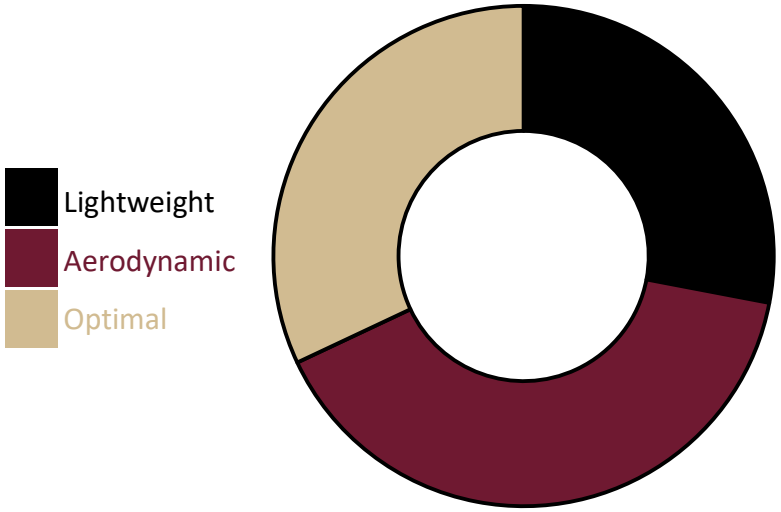
Selection Criteria	Concept 4	1	2	3
Load Bearing Capacity	DATUM	S	–	s
Strain		s	s	s
Deflection		s	s	s
Hardtop Weight		+	s	+
Lift-to-Drag Ratio		–	+	–
Implementation Cost		+	+	+
Manufacturability		+	+	+
Number of +		**3**	**3**	**3**
Number of -		**1**	**1**	**1**

Juan Diego Tapia

Concept Selection

Aerodynamic hardtop has highest ranking following AHP

This design provides the most improvements through minor changes in the current hardtops design



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Concept Selection

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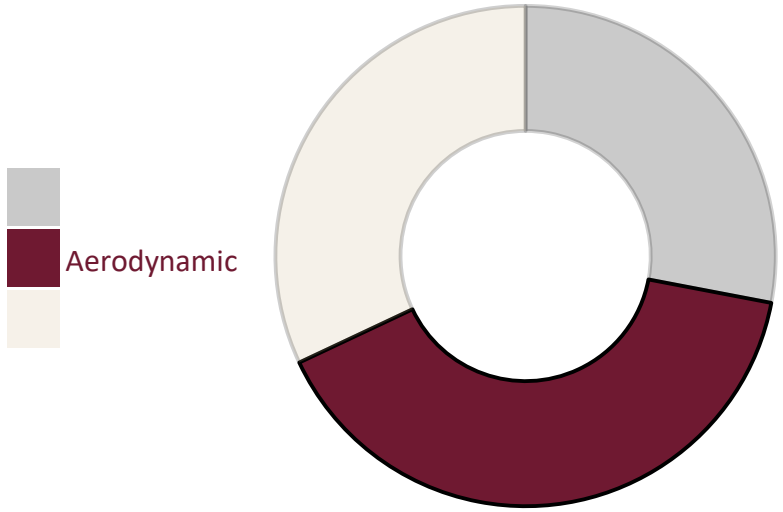

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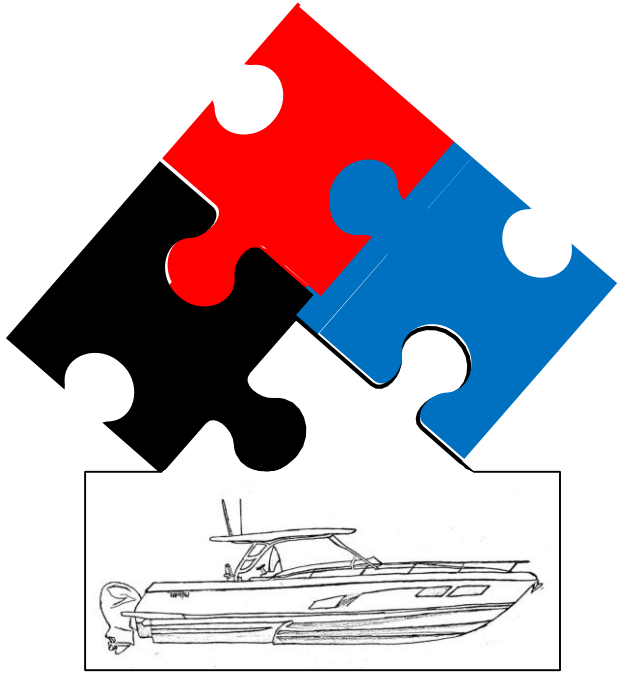
Final Selection ✓

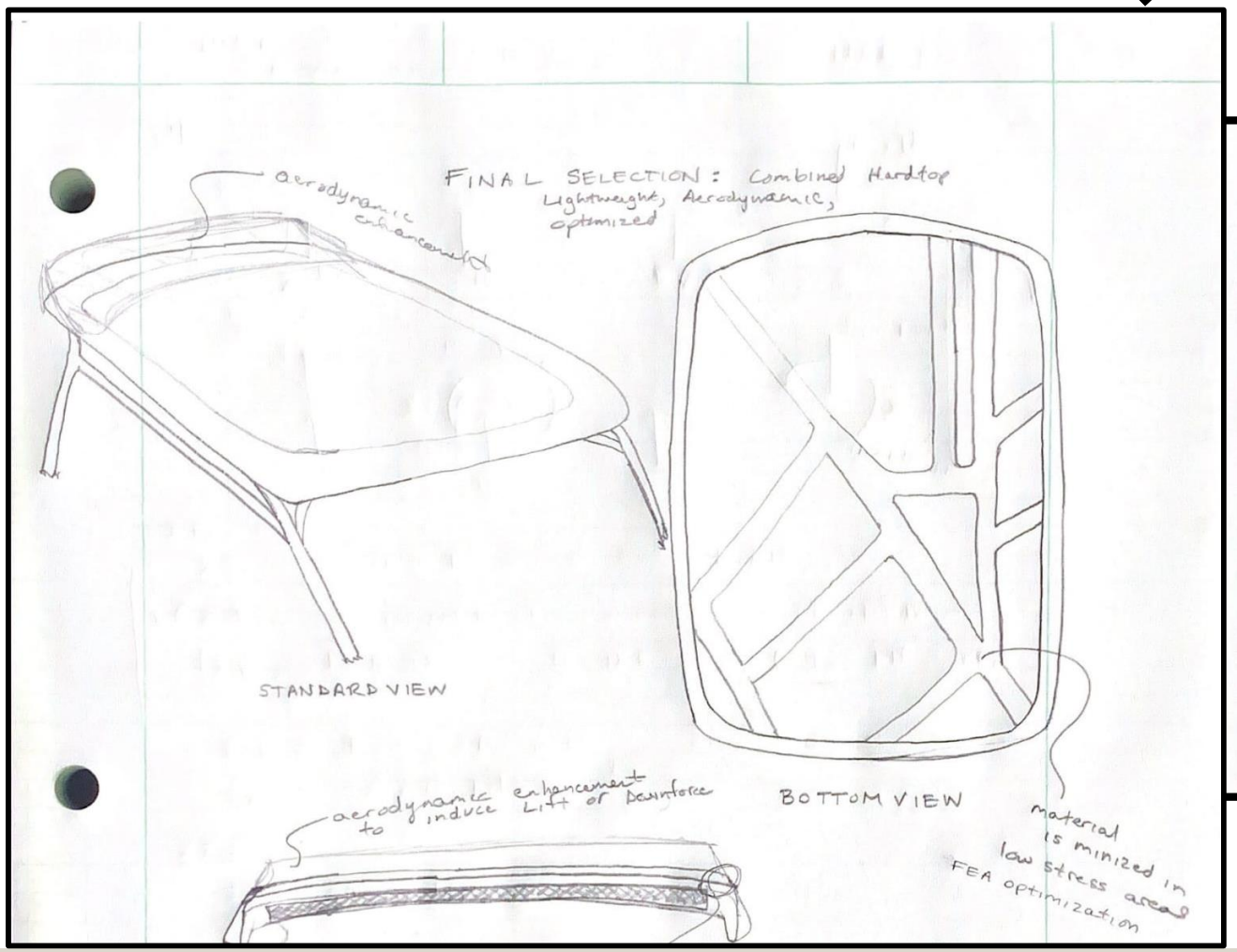
- Lightweight Hardtop
- Aerodynamic Hardtop
- Optimized Hardtop

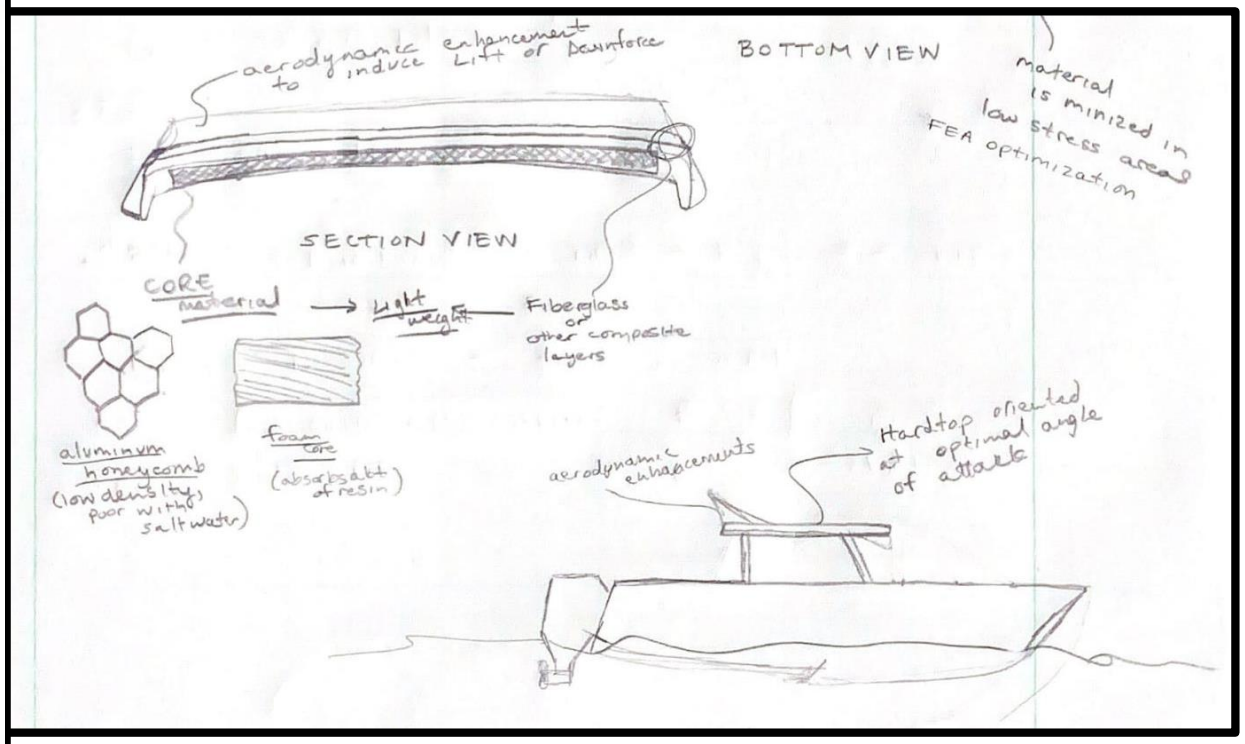


Final design can incorporate light weighting, aerodynamics, and optimization to create enhanced benefits.

Juan Diego Tapia

Final Selection ✓





Juan Diego Tapia

Gantt Chart

	1/6/2021	1/15/2021	1/22/2021	2/5/2021	2/26/2021	3/12/2021	3/15/2021	4/14/2021	4/23/2021
Start of Semester									
Detailed analysis									
Initial Design									
VDR3									
Design Iteration									
VDR4									
Senior Design Day									
Graduation									

Juan Diego Tapia

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References

409 Valor. (n.d.). Retrieved October 15, 2020, from https://www.intrepidpowerboats.com/boats/409-valor/

McConomy, S. (2020, October 6). Retrieved October 15, 2020, from https://famu-fsu-eng.instructure.com/courses/4476/discussion_topics/18526

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