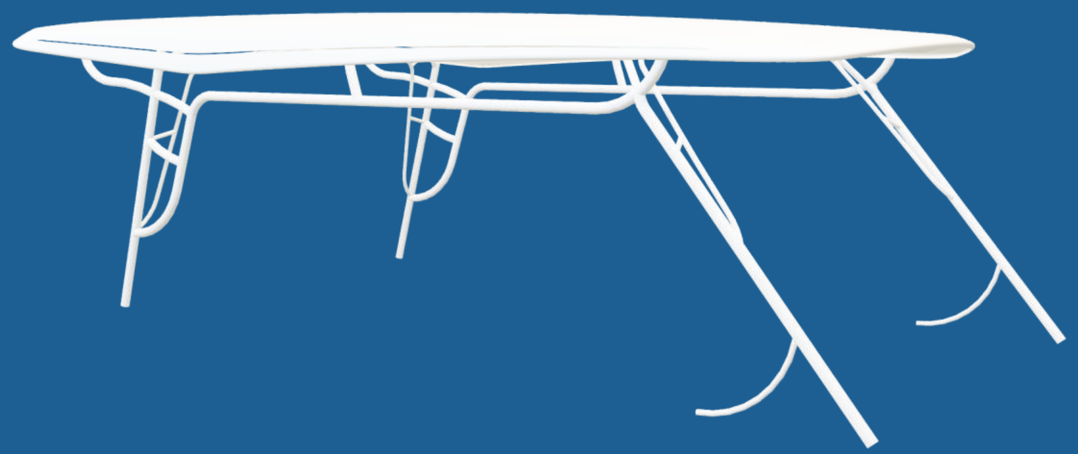
Team 511: Intrepid



Juan Tapia **John Karamitsanis** **Cory Stanley** **Erika Craft**

Intrepid - Redesigned Hardtop
Team 511

Materials Engineer
Juan 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

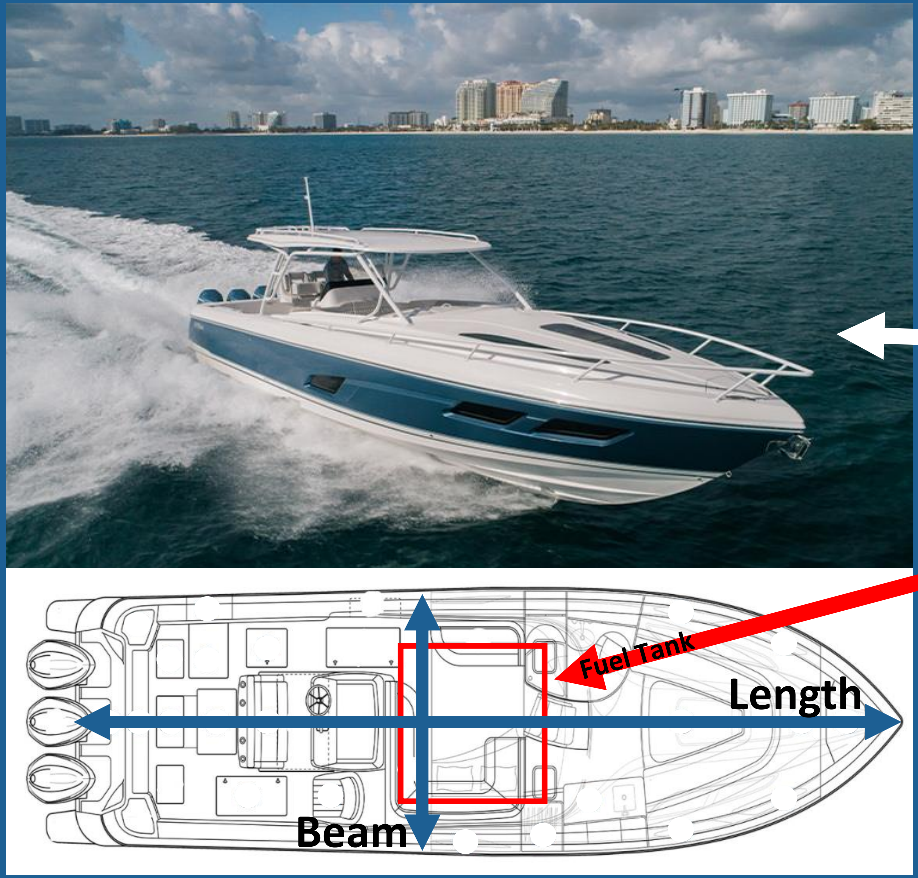
Objective

To improve the on-water performance of the Intrepid 409 Valor by manipulating hardtop parameters.

Erika Craft

Objective

To improve the on-water performance of the Intrepid 409 Valor by manipulating hardtop parameters

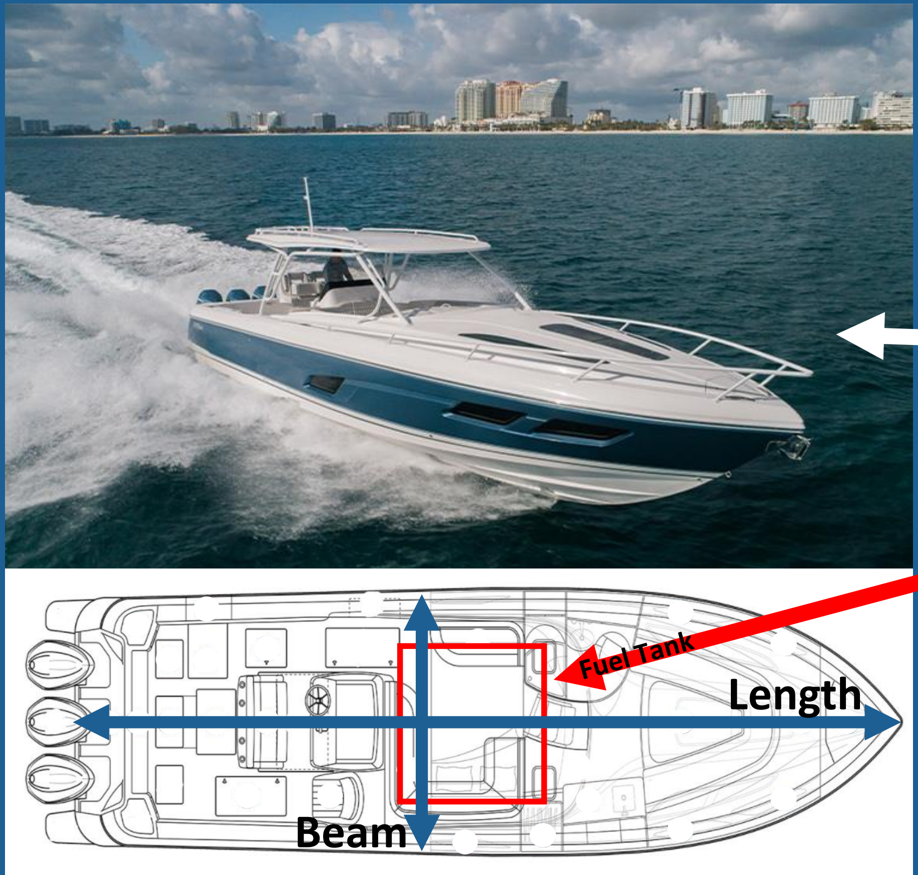


<u>Intrepid 409 Valor</u>

Length:	40’ 0”
Beam:	11’ 1”
Fuel Capacity:	438 Gallons
Top Speed:	70+ mph
Range:	

Erika Craft

Objective



To improve the on-water performance of the Intrepid 409 Valor by manipulating hardtop parameters

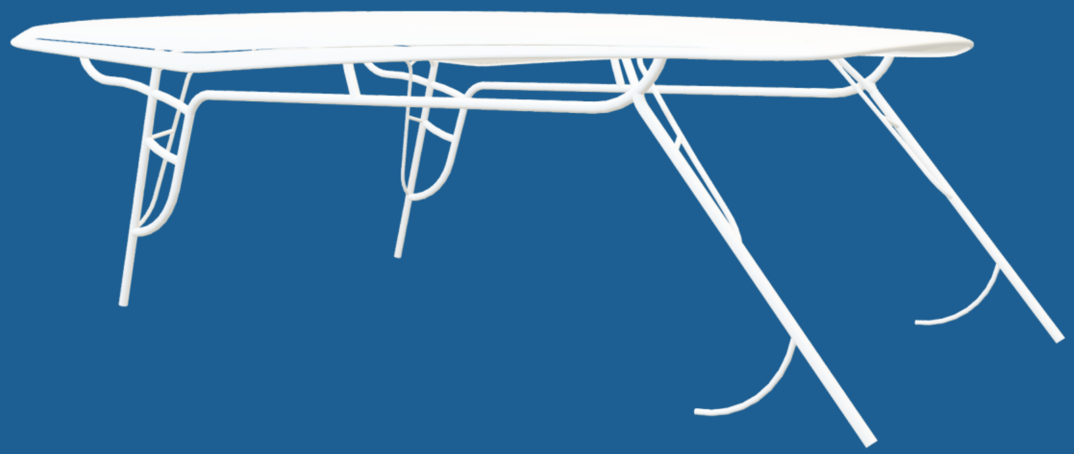
Intrepid 409 Valor

Length:	40’ 0”
Beam:	11’ 1”
Fuel Capacity:	438 Gallons
Top Speed:	70+ mph
Range:	

Increase in Lift
Reduction of Drag
Reduction of Weight

Erika Craft

Description



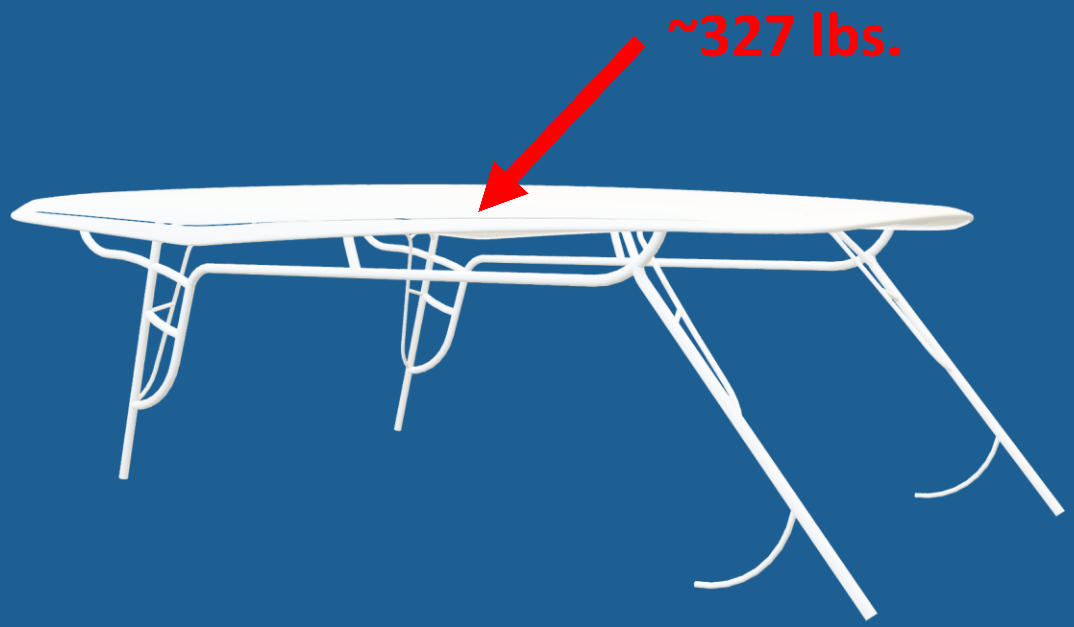
Intrepid wants to improve vessel performance

The current hardtop is heavier than desired

Improving the hardtop can solve Intrepid's problem of improving performance

Erika Craft

Description



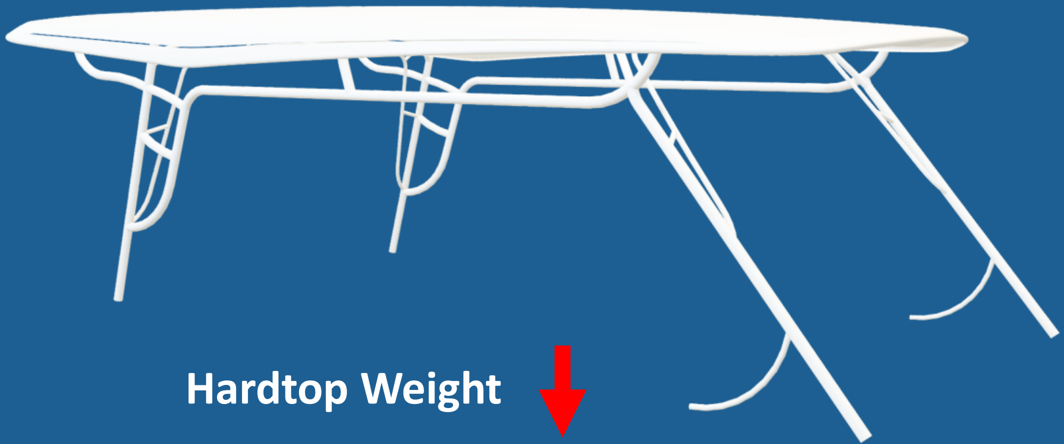
Intrepid wants to improve vessel performance

The current hardtop is heavier than desired

Improving the hardtop can solve Intrepid's problem of improving performance

Erika Craft

Description



Hardtop Weight ↓

Lift ↑

Drag ↓

Intrepid wants to improve vessel performance

The current hardtop is heavier than desired

Improving the hardtop can solve Intrepid's problem of improving performance

Erika Craft

Key Goals

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

Erika Craft

Key Goals

Weight

25% Weight Reduction

50% Weight Reduction

Cost

5% Cost Increase

25% Cost Increase

Erika Craft

Needs to Targets

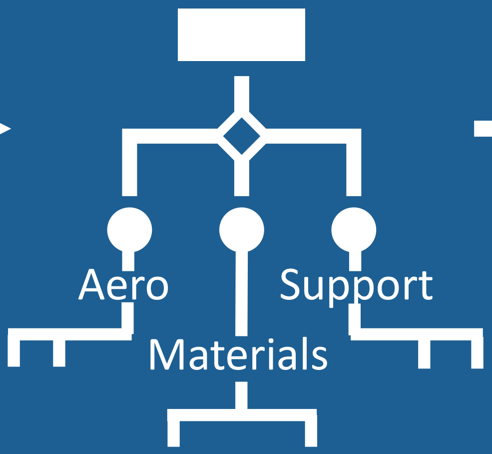
Needs

Similar materials

Same wire exit points

Retain manufacturability

Withstand all loads and conditions



Targets

Withstand Loads

Control Airflow

Support Weight

Erika Craft

Concept Generation

Generation → 100 Ideas → Medium & High Fidelity Designs → Selection

Erika Craft

Concept Selection

Selection Process

1. House of Quality
2. Pugh Chart Iterations
3. Analytical Hierarchy Process

→

Concepts Selected

Material Changes in Hardtop

Geometry Changes in Hardtop

Material & Geometry Changes

Erika Craft

Aerodynamic Calculations

$$L = \frac{1}{2} C_L \rho V^2 A$$

Increase (C_L)

$$D = \frac{1}{2} C_D \rho V^2 A$$

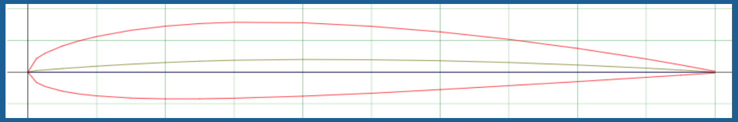
Decrease (C_D)

$\rightarrow$ $\frac{L}{D}$ *Ratio*

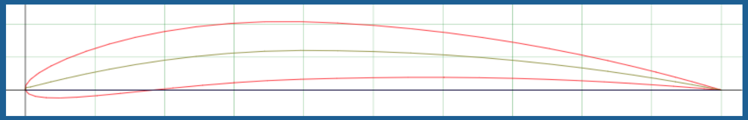
Maximize

Erika Craft

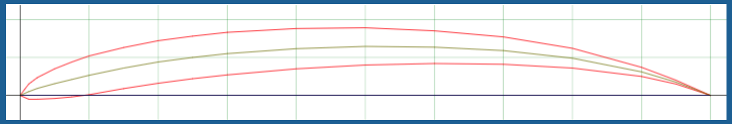
Aerodynamic Calculations



NACA 2412



NACA 6409



Eppler 58

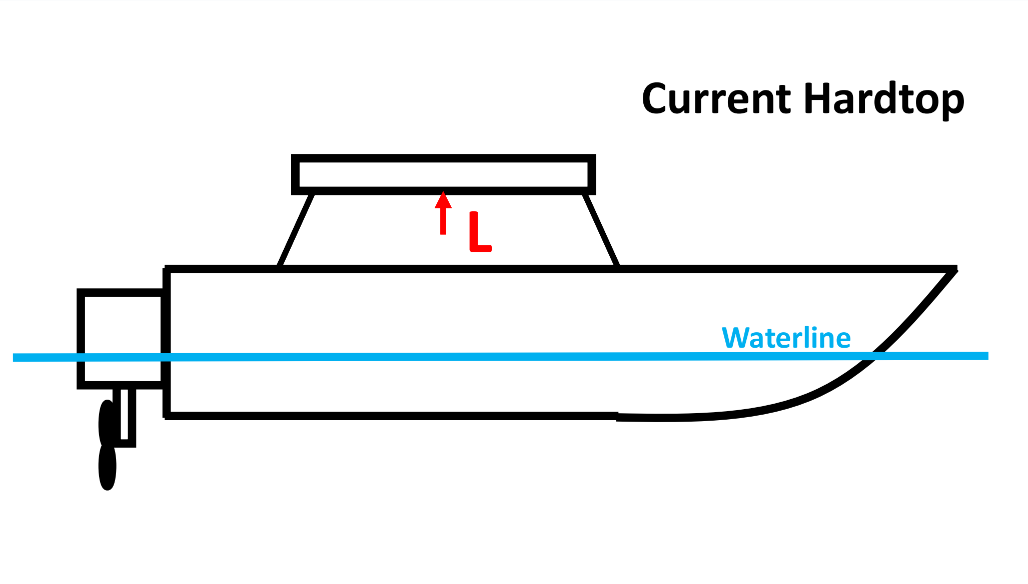
Airfoil geometry gives insight as to how hardtop can be manipulated

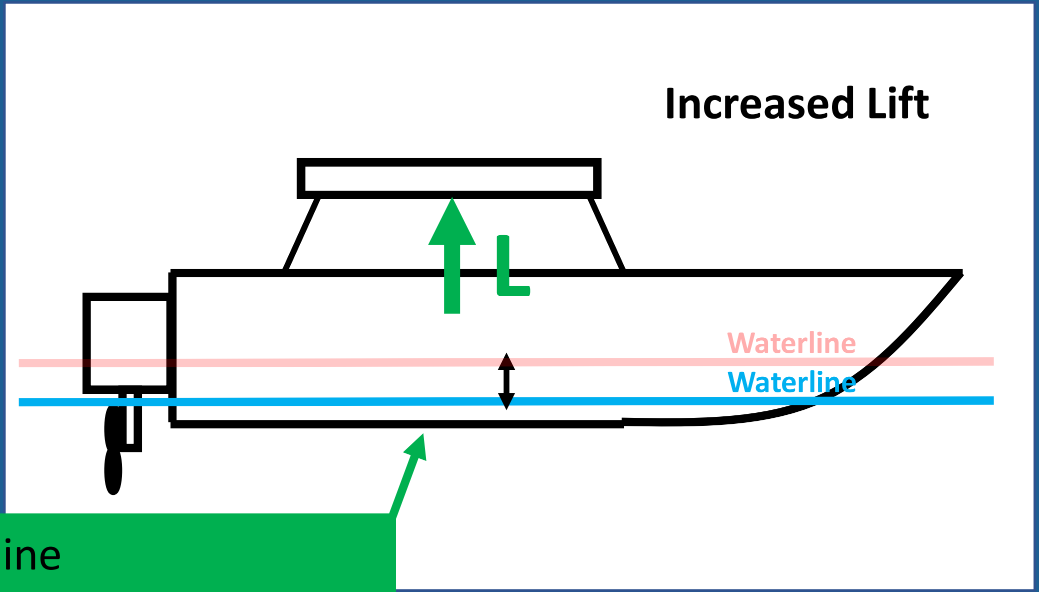
Erika Craft

Key Goals

Improve boat on water performance

Increasing stability at higher speeds can help achieve this goal





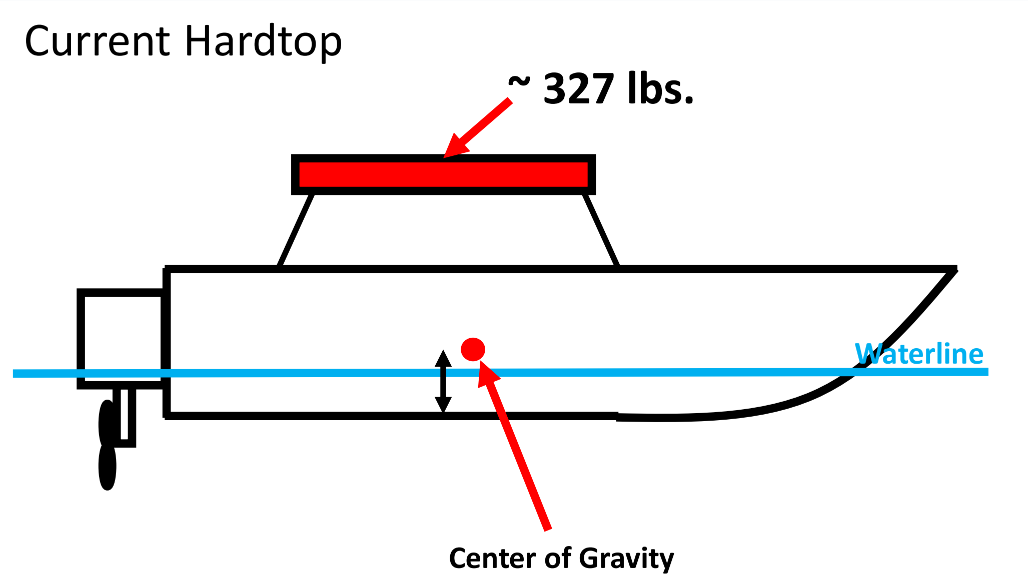
Lower water line
- Less friction/water resistance
- Air cushion provides stability

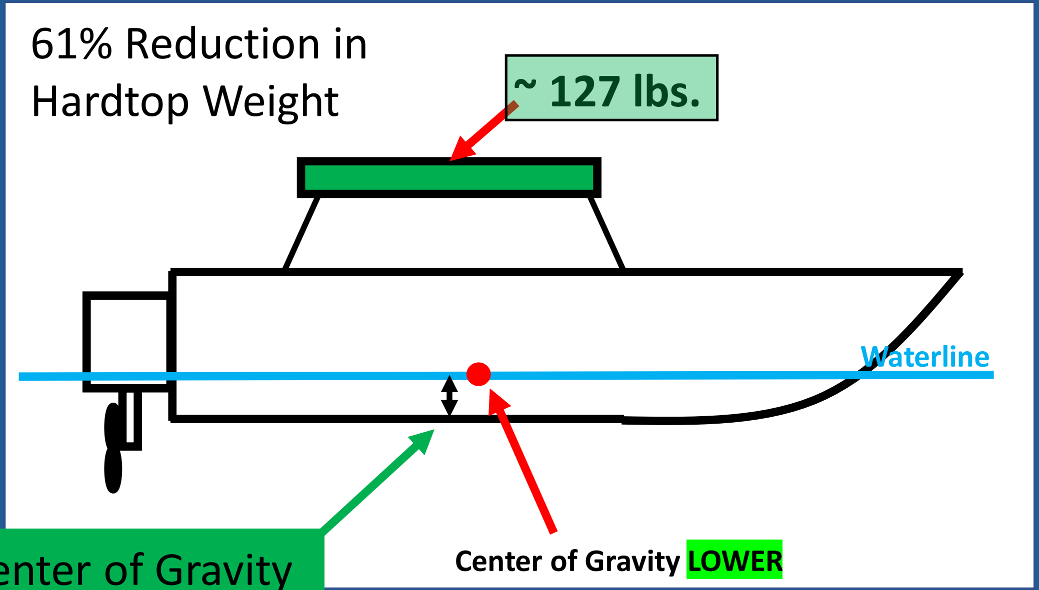
Juan Tapia

Key Goals

Improve fuel efficiency

Reducing hardtop weight reduces thrust required to travel a certain speed





Lower Center of Gravity
- Less thrust required
- More fuel efficient

Juan Tapia

Current Lamination Schedule

Changes can be made to the current lamination schedule for light-weighting

Current Lamination Schedule

Gelcoat

1 oz CSM

1208

¾” core

1” core

1208

1 oz CSM

Juan Tapia

Current Lamination Schedule

Changes can be made to the current lamination schedule for light-weighting

Current Lamination Schedule

Gelcoat

1 oz CSM

1208

¾” core

1” core

1208

1 oz CSM

Juan Tapia

Current Lamination Schedule

Changes can be made to the current lamination schedule for light-weighting

Current Lamination Schedule

Gelcoat

1 oz CSM

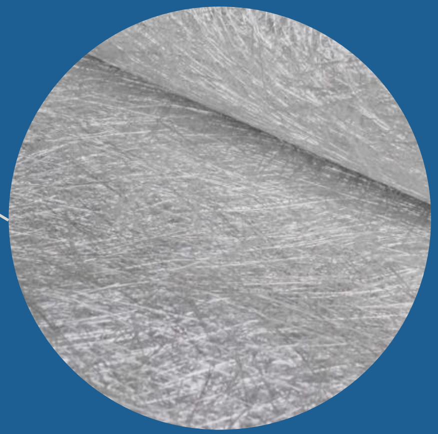
1208

¾” core

1” core

1208

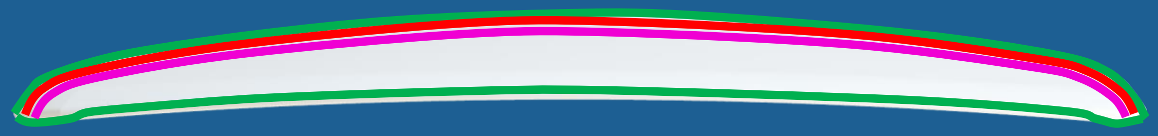
1 oz CSM



Juan Tapia

Current Lamination Schedule

Changes can be made to the current lamination schedule for light-weighting



Current Lamination Schedule

Gelcoat

1 oz CSM

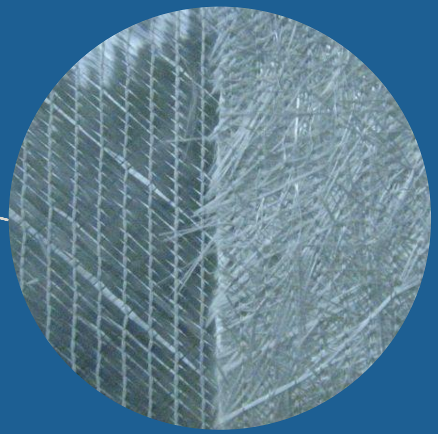
1208

¾" core

1" core

1208

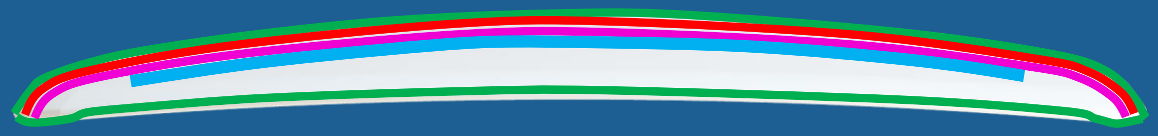
1 oz CSM



Juan Tapia

Current Lamination Schedule

Changes can be made to the current lamination schedule for light-weighting



Current Lamination Schedule

Gelcoat
1 oz CSM
1208
¾" core
1" core
1208
1 oz CSM

Juan Tapia

Current Lamination Schedule

Changes can be made to the current lamination schedule for light-weighting

Current Lamination Schedule

Gelcoat

1 oz CSM

1208

¾” core

1” core

1208

1 oz CSM

Juan Tapia

Current Lamination Schedule

Changes can be made to the current lamination schedule for light-weighting

Current Lamination Schedule

Gelcoat

1 oz CSM

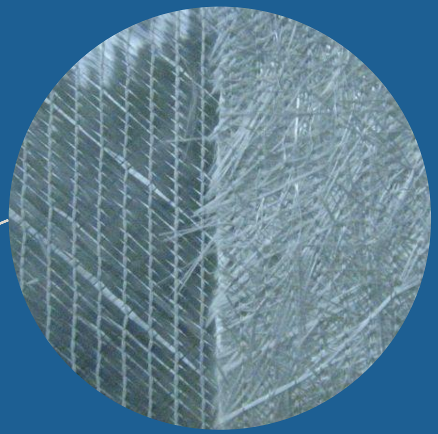
1208

¾” core

1” core

1208

1 oz CSM



Juan Tapia

Current Lamination Schedule

Changes can be made to the current lamination schedule for light-weighting

Current Lamination Schedule

Gelcoat

1 oz CSM

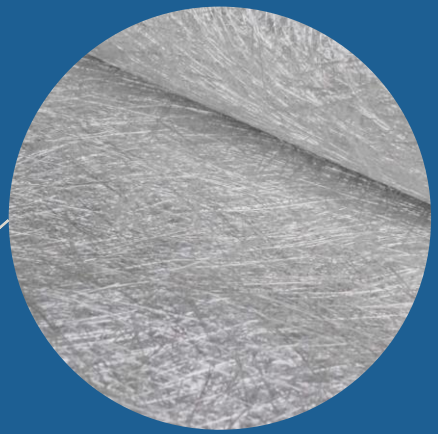
1208

¾” core

1” core

1208

1 oz CSM

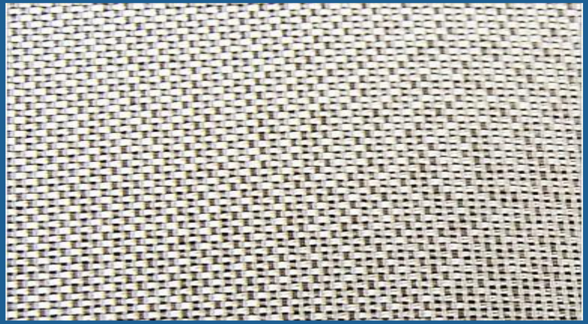


Juan Tapia

Fiberglass Change

<u>Changes can be made to the current lamination schedule for light-weighting</u>

S-2 Fiberglass



- Low Density
- Low Resin Absorption
- Very Thin Fiberglass Sheets
- Excellent Strength to Weight Ratio

Juan Tapia

Fiberglass Change

Changes can be made to the current lamination schedule for light-weighting

1208 Fiberglass → S-2 Fiberglass

18.3% Weight Reduction from Fiberglass Change

3.85% Cost Increase from Fiberglass Change

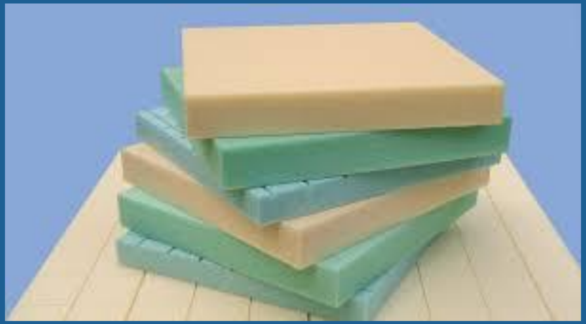
59.9 lbs. saved!

Juan Tapia

Foam Core Change

Changes can be made to the current lamination schedule for light-weighting

Divinycell H-35



- Low Density
- High Stiffness to Weight Ratio
- Low Water Absorption
- Low Resin Absorption
- Excellent Strength to Weight Ratio
- Lightweight Foam Core Used for Marine Applications

Juan Tapia

Foam Core Change

Changes can be made to the current lamination schedule for light-weighting

Aircell T-100 → Divinycell H-35

42.7% Weight Reduction from Foam Core Change

7.70% Cost Decrease from Foam Core Change

140 lbs. saved!

Juan Tapia

Total Weight Reduction

Changes can be made to the current lamination schedule for light-weighting

327 lbs. → 127 lbs.

61% Weight Reduction Overall

3.7% Cost Decrease Overall

200 lbs. saved between fiberglass and core changes!

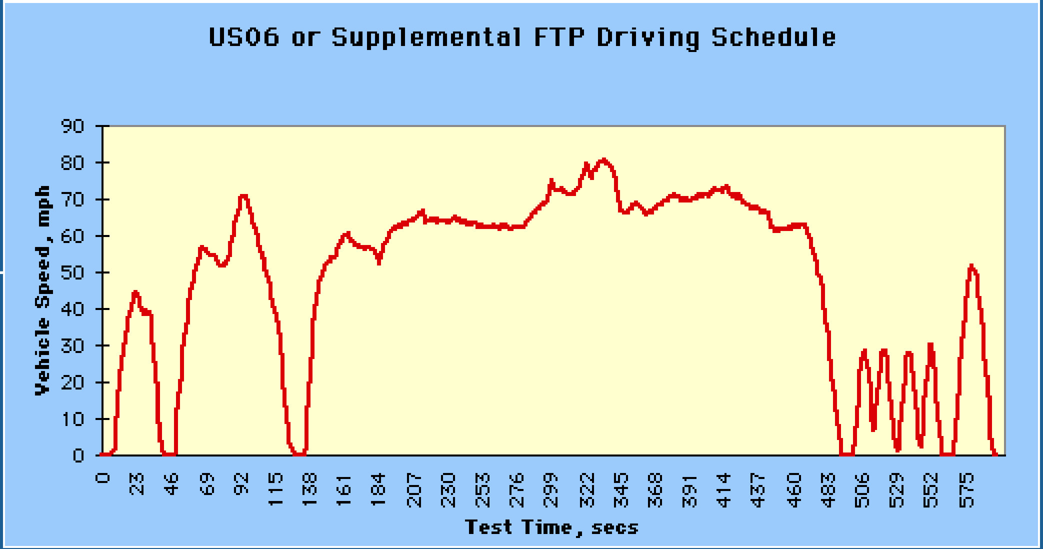
1% decrease in overall vessel weight

Juan Tapia

System Modeling - Simulink

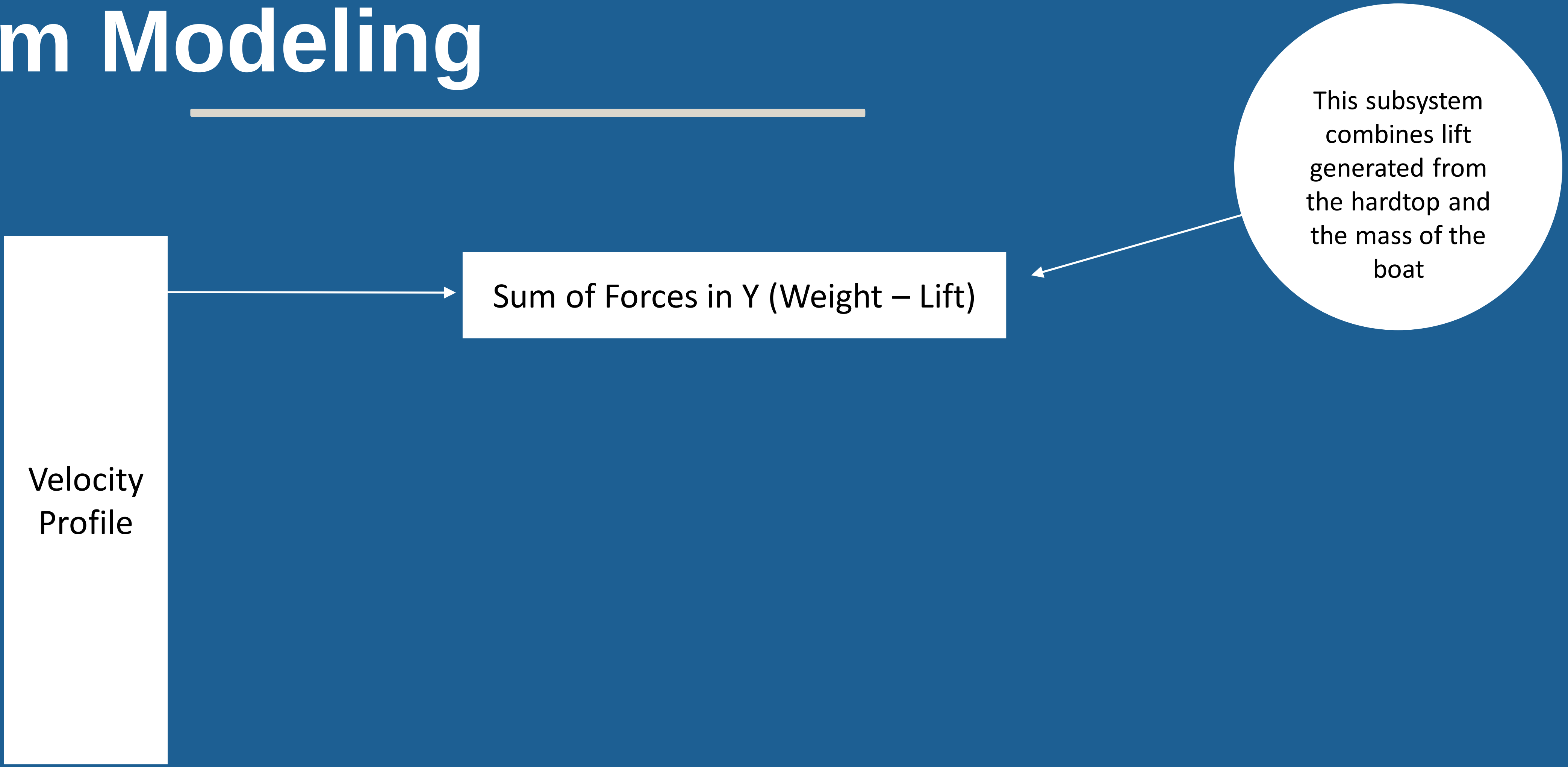
Velocity profile taken from the EPA Dynamometer Drive Schedules and scaled to suit our system

Velocity Profile



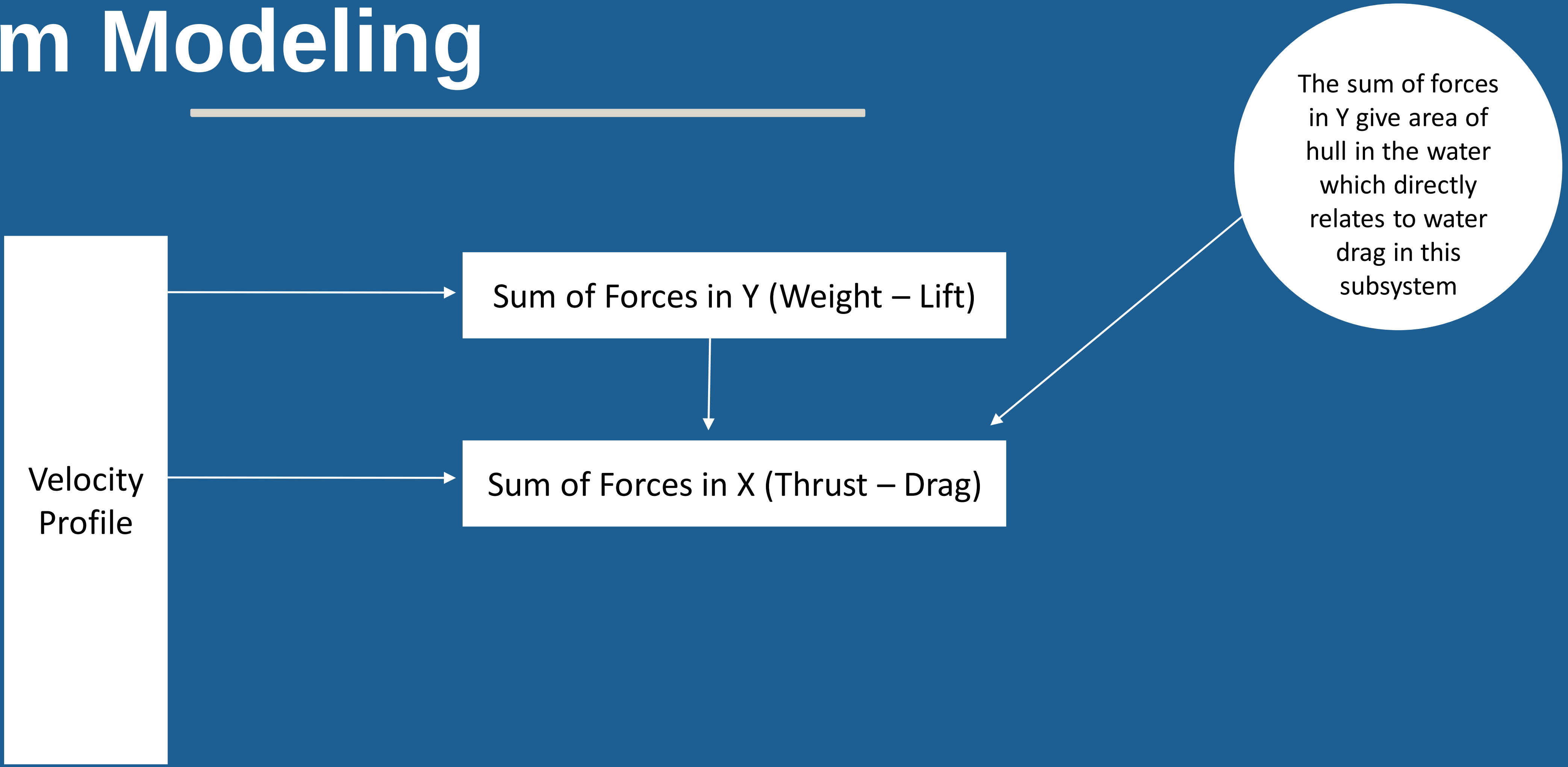
Juan Tapia

System Modeling



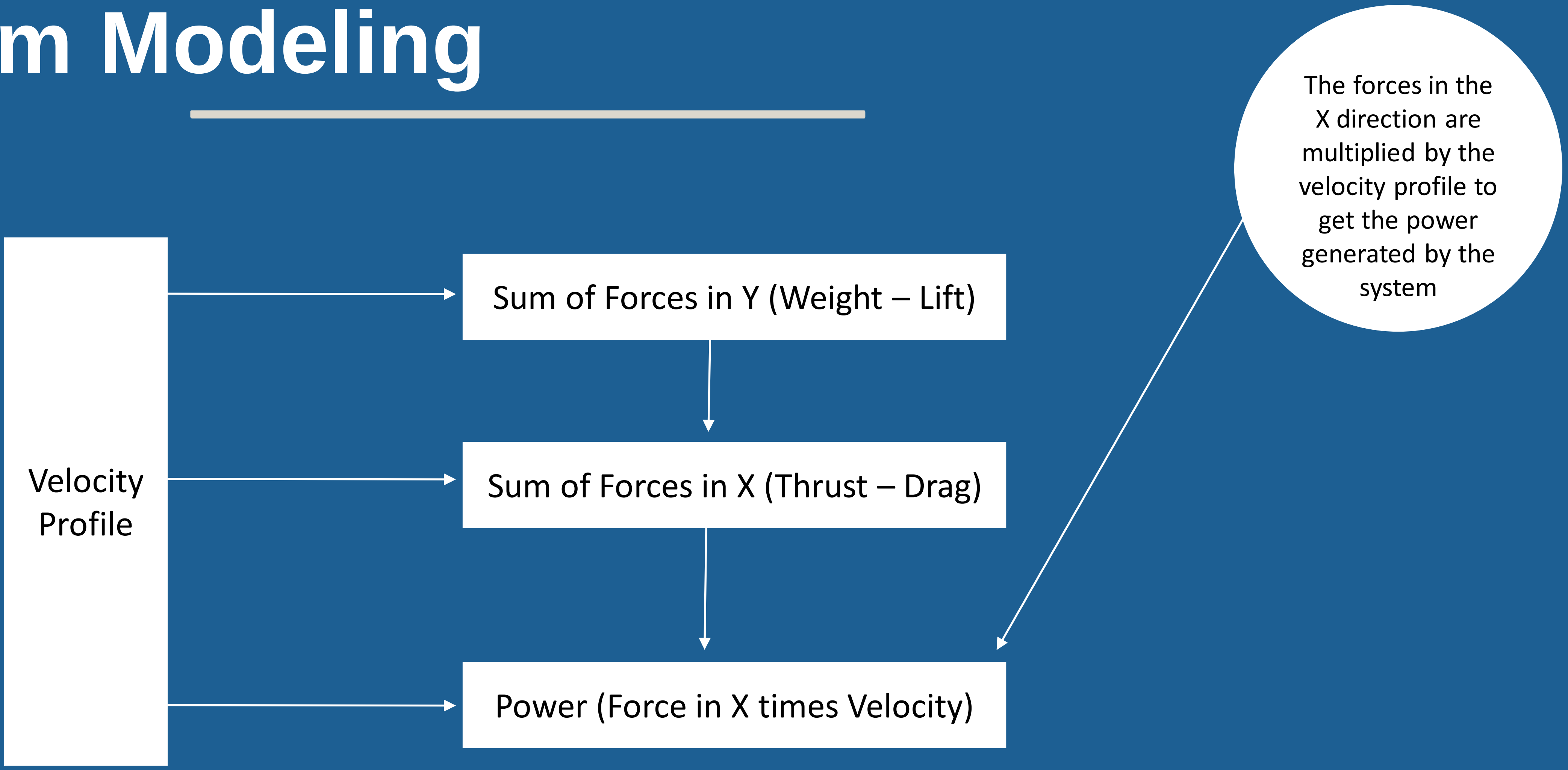
Juan Tapia

System Modeling



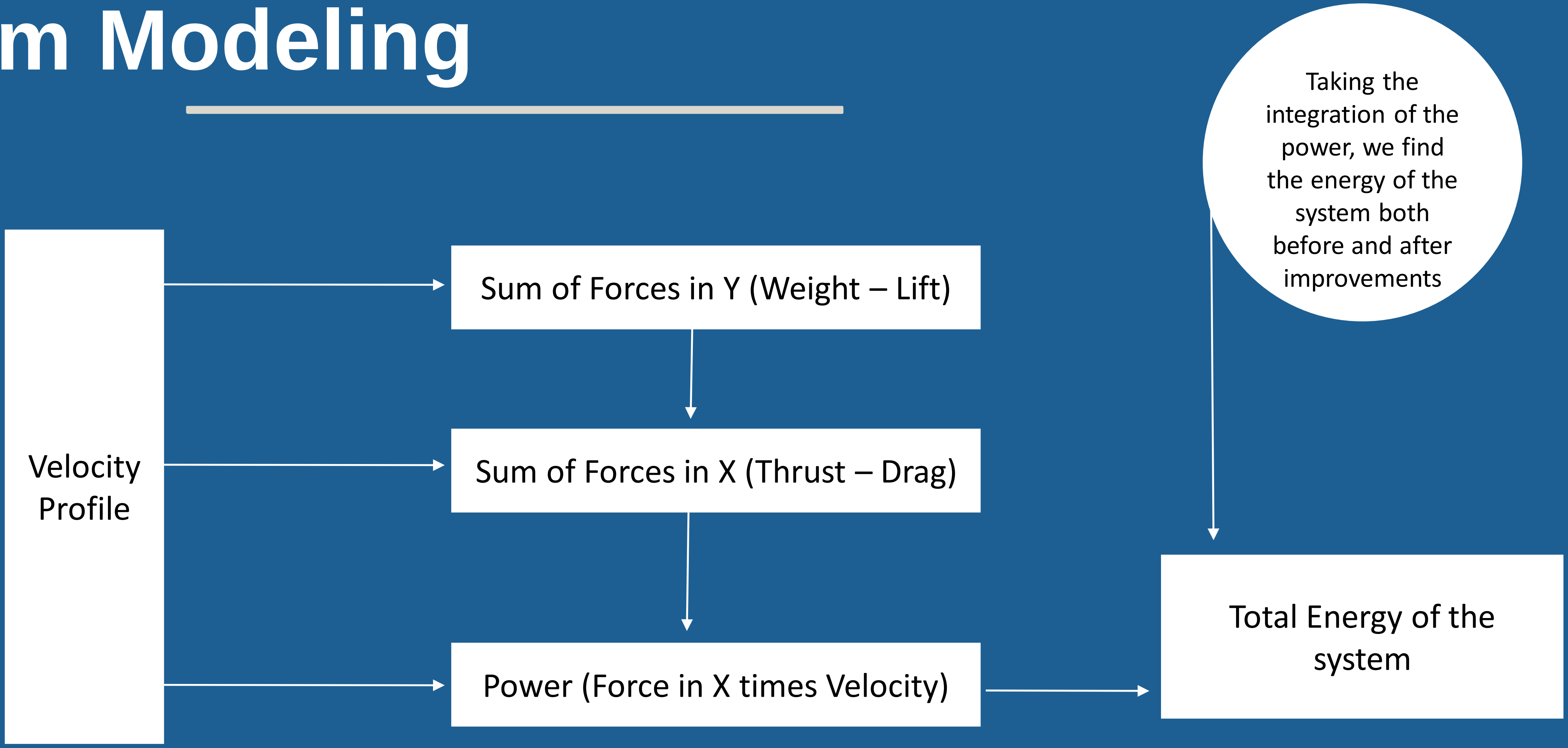
Juan Tapia

System Modeling



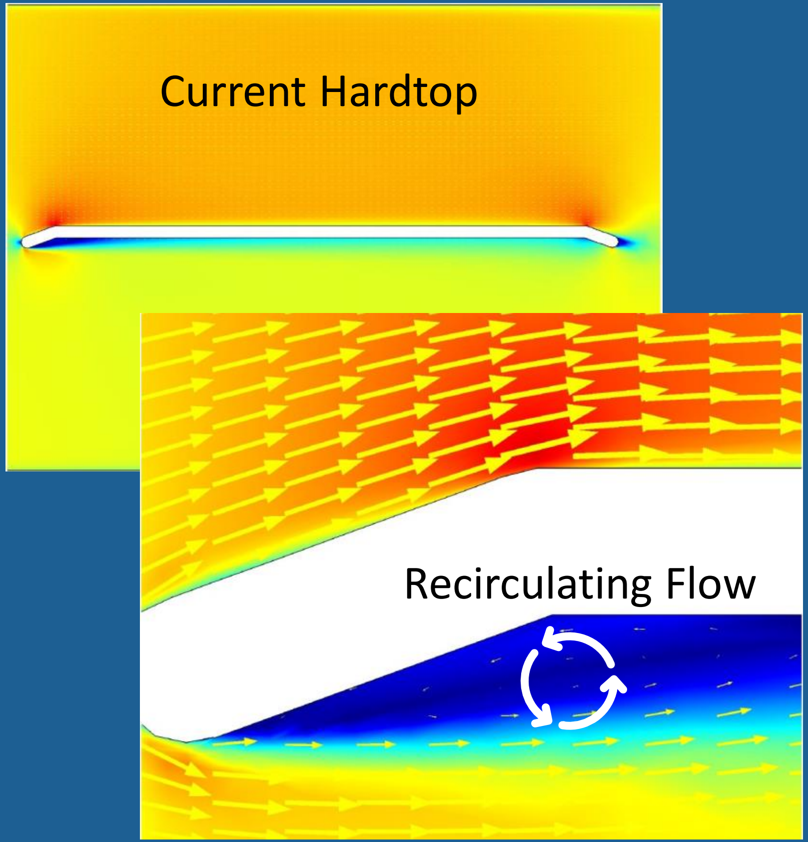
Juan Tapia

System Modeling



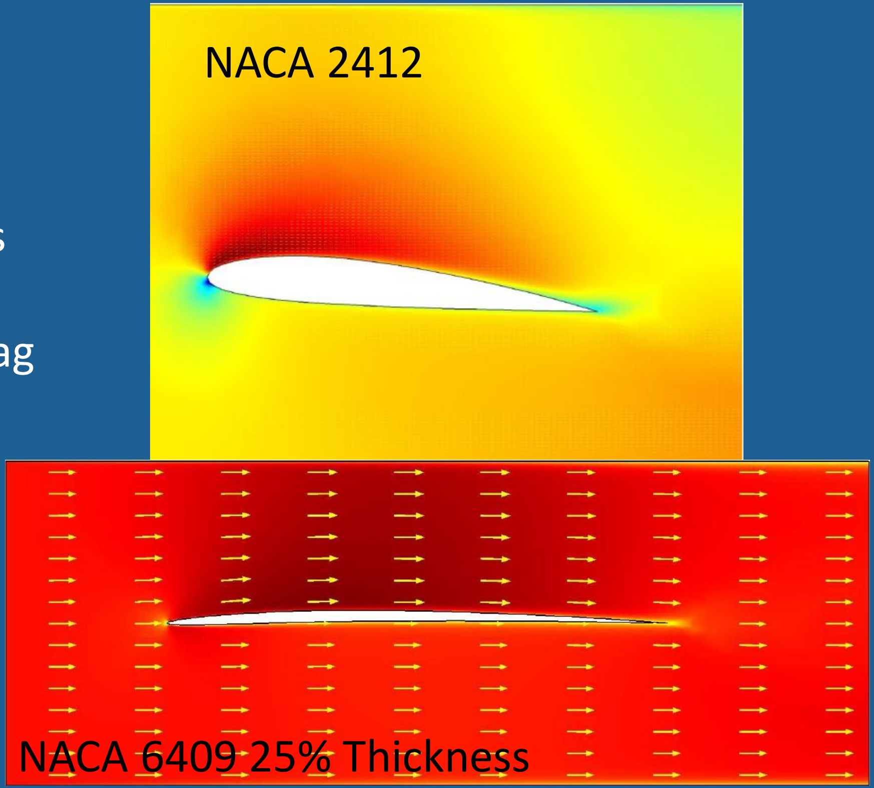
Juan Tapia

System Modeling - COMSOL



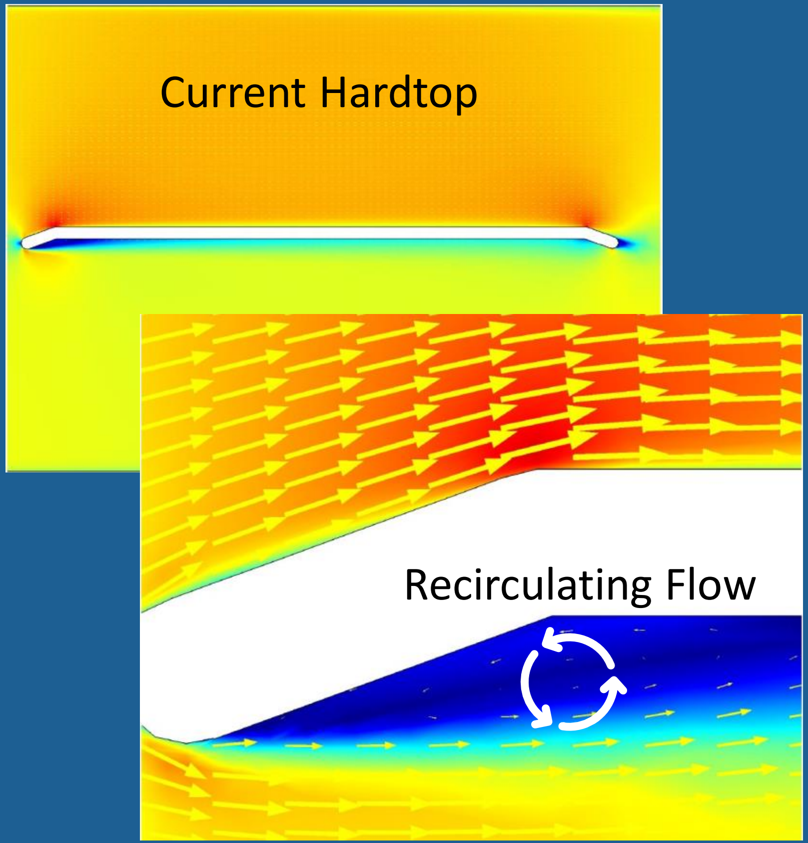
Changing geometry eliminates

flow separation and reduces drag



Juan Tapia

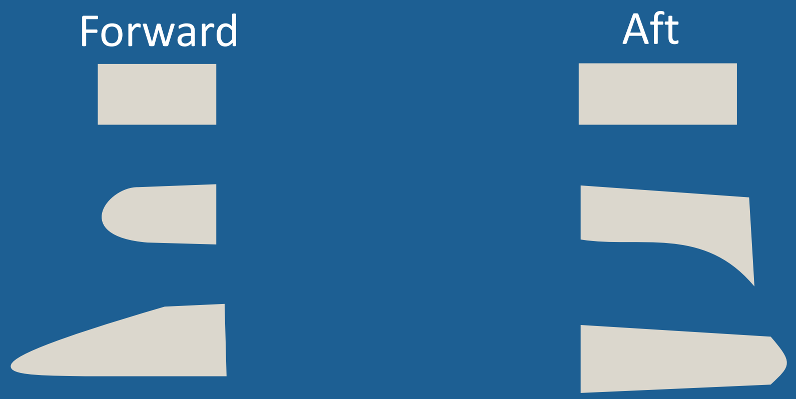
Future Work- Recommendations



Changing geometry eliminates

flow separation and reduces drag

Airfoil geometry gives insight as to how hardtop can be manipulated



- Full geometry changes yield marginal changes in performance and efficiency and increase material usage and weight
- Manipulate edges to reduce C_D and increase C_L

Juan Tapia

Future Work- Recommendations

- Recommend shape changes to forward and aft edges
  - Small changes in edge geometry
    - Reduce C_D and Increase C_L

Juan Tapia

FAMU-FSU College of Engineering

Department of Mechanical Engineering

Erika Craft,
Undergraduate Student,
Materials Track

P: 561-227-9849

E: epc16@my.fsu.edu

FAMU-FSU College of Engineering

Department of Mechanical Engineering

John Karamitsanis,
Undergraduate Student,
Thermal Fluids Track

P: 813-992-0152

E: jhk16c@my.fsu.edu

FAMU-FSU College of Engineering

Department of Mechanical Engineering

Cory Stanley,
Undergraduate Student,
Aeronautics Track

P: 850-566-4472

E: cps18u@my.fsu.edu

FAMU-FSU College of Engineering

Department of Mechanical Engineering

Juan Diego Tapia,
Undergraduate Student,
Materials Track

P: 850-273-3139

E: jdt16b@my.fsu.edu

Backup Slides

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

Tweedie, Dingo (2021, January 15). Retrieved from Savitsky Power Prediction | Page 6 | Boat Design Net

Knit, 1208 Biax (fiberglassflorida.com)

Chopped Strand Mat (fibreglast.com)

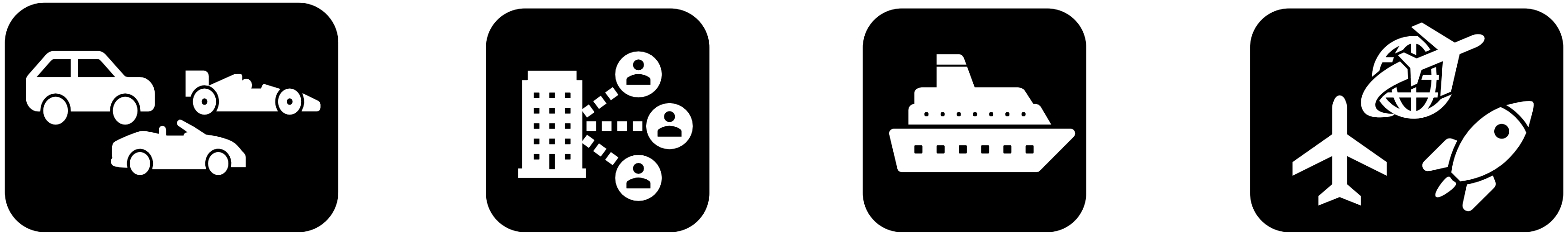
Gelcoat Product – Grainger Industrial Supply (grainger.com)

Foam Core Board, Uline Board (uline.com)

Project Scope Assumptions

- The changes to the hardtop will still use current mounting points.
- Our changes will only be applied to the hardtop and no other parts of the vessel.
- We are assuming we will not be physically producing the hardtop

Project Scope Markets

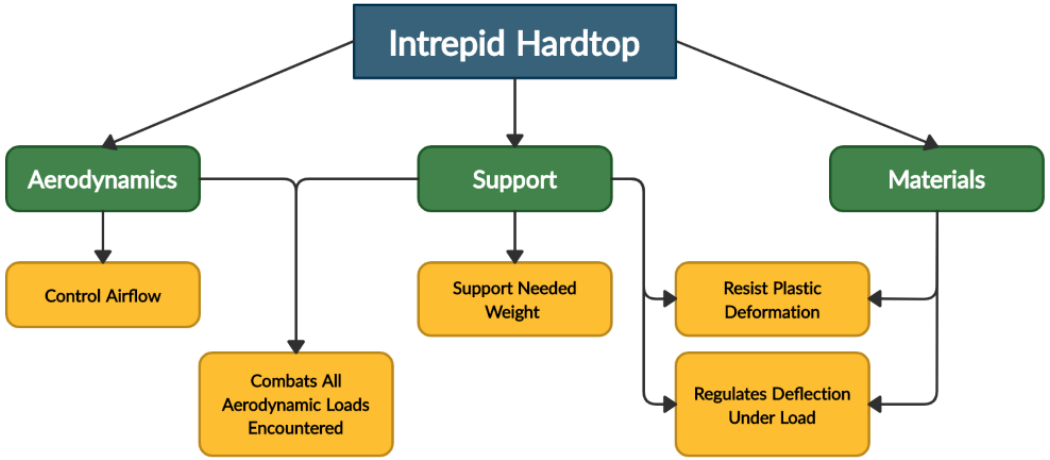


Customer Needs

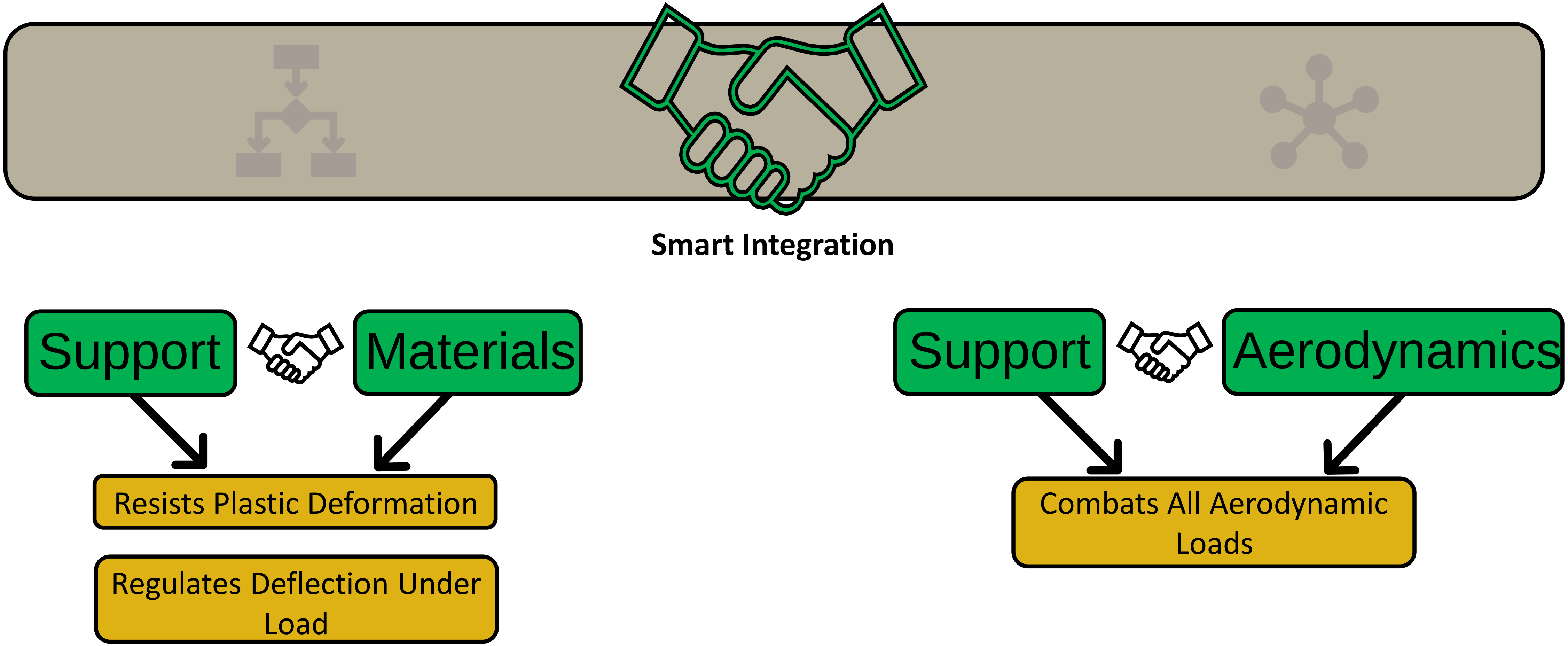
Question		Interpreted Need
What materials need to be considered?	→	Incorporate materials used within Intrepid
Parameters of the current hardtop?	→	Similar dimensions retained
Can we alter wire/chase tube layout?	→	Exit points must stay the same
Is there a certain weight the hardtop needs to withstand?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

Functional Decomposition

Flow Chart

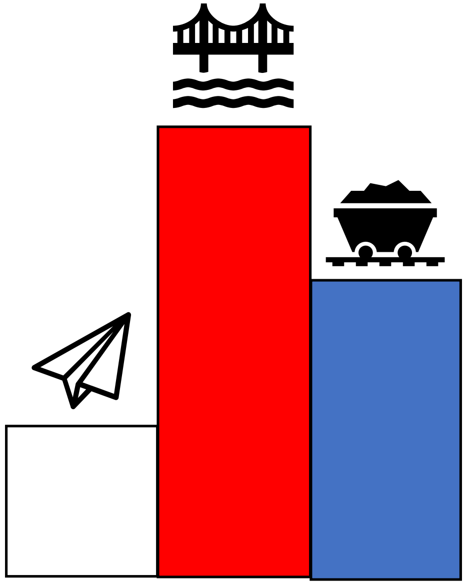


Functional Decomposition



Functional Decomposition

Connection to Systems



Highest number of functions
Highest number of cross system functions

Most shared functions with support system

Least shared functions across systems

Fiberglass Change

Changes can be made to the current lamination schedule for light-weighting

1208 Fiberglass → S-2 Fiberglass

Density -> 97.2 $\frac{lbs}{ft^3}$

Density -> 66.6 $\frac{lbs}{ft^3}$

Juan Tapia

Fiberglass Change

Changes can be made to the current lamination schedule for light-weighting

1208 Fiberglass → S-2 Fiberglass

1208 Fiberglass

Density -> 97.2 $\frac{lbs}{ft^3}$

Thickness -> 0.04 in.

S-2 Fiberglass

Density -> 66.6 $\frac{lbs}{ft^3}$

Thickness -> 0.008 in.

Juan Tapia

Fiberglass Change

Changes can be made to the current lamination schedule for light-weighting

1208 Fiberglass → S-2 Fiberglass

1208 Fiberglass

Density -> 97.2 $\frac{lbs}{ft^3}$

Thickness -> 0.04 in.

Total Weight -> 81.5 lbs.

S-2 Fiberglass

Density -> 66.6 $\frac{lbs}{ft^3}$

Thickness -> 0.008 in.

Total Weight -> 21.6 lbs.

Juan Tapia

Fiberglass Change

Changes can be made to the current lamination schedule for light-weighting

1208 Fiberglass → S-2 Fiberglass

1208 Fiberglass

Density -> 97.2 $\frac{lbs}{ft^3}$

Thickness -> 0.04 in.

Total Weight -> 81.5 lbs.

Total Cost -> $221

S-2 Fiberglass

Density -> 66.6 $\frac{lbs}{ft^3}$

Thickness -> 0.008 in.

Total Weight -> 21.6 lbs.

Total Cost -> $393

Juan Tapia

Fiberglass Engineering Characteristics

1208 Fiberglass

Tensile Strength(ksi)-> 23.8

Compressive Strength(ksi)--> 33.2

Shear Stress(ksi)--> 18.4

Flex. Ult. Strength(ksi)--> 35.6

S-2 Fiberglass

Tensile Strength(ksi)-> 681.7

Compressive Strength(ksi)-> 580.2

Shear Stress(ksi)-> 507.0

Flex. Ult. Strength(ksi)-> 94.1

John Karamitsanis

Foam Core Change

Changes can be made to the current lamination schedule for light-weighting

Aircell T-100 → Divinycell H-35

Density -> 9.98 $\frac{lbs}{ft^3}$

Density -> 2.40 $\frac{lbs}{ft^3}$

Juan Tapia

Foam Core Change

Changes can be made to the current lamination schedule for light-weighting

Aircell T-100 → Divinycell H-35

Density -> 9.98 $\frac{lbs}{ft^3}$

Total Weight -> 183 lbs.

Density -> 2.40 $\frac{lbs}{ft^3}$

Total Weight -> 45.2 lbs.

John Karamitsanis

Foam Core Change

Changes can be made to the current lamination schedule for light-weighting

Aircell T-100	→	Divinycell H-35
Density -> 9.98 $\frac{lbs}{ft^3}$		**Density -> 2.40** $\frac{lbs}{ft^3}$
Total Weight -> 183 lbs.		**Total Weight -> 45.2 lbs.**
Total Cost -> $1154.96		**Total Cost -> $825.64**

Juan Tapia

Core Engineering Characteristics

Aircell T-100 Core

Tensile Strength(ksi)-> 1017

Compressive Strength(ksi)--> 1017

Shear Stress(ksi)--> 968.8

Flex. Ult. Strength(ksi)--> 966.2

Divinycell H-35

Tensile Strength(ksi)-> 1017

Compressive Strength(ksi)-> 1017

Shear Stress(ksi)-> 600

Flex. Ult. Strength(ksi)-> 966.2

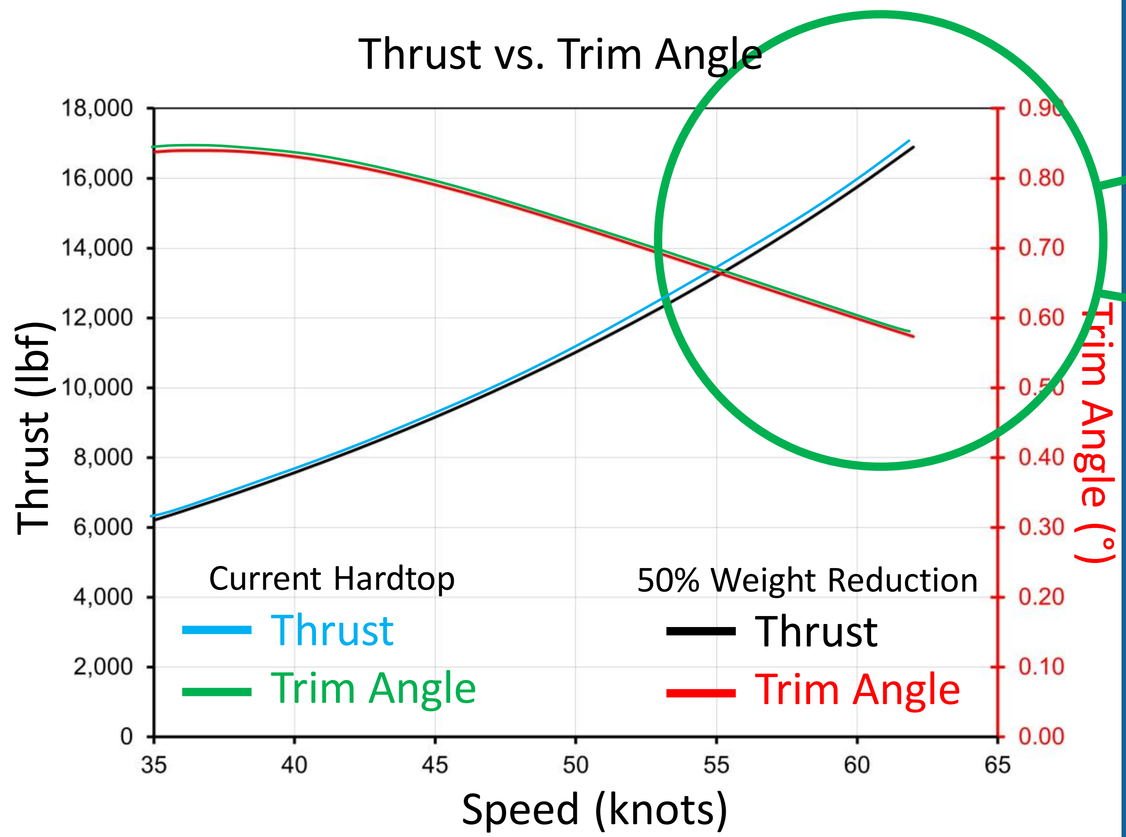
John Karamitsanis

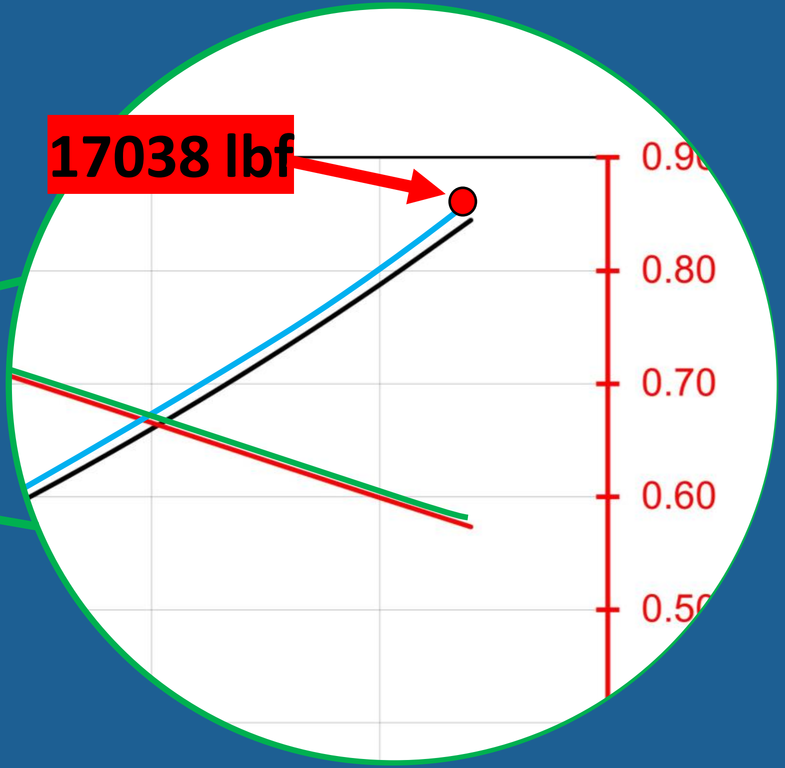
Aerodynamic Calculations

	A	B	C	D	E	F	G	H	I	J	K	L
1										cL	@ 0 deg	@ 5 deg
2	LIFT		Flat Plate	2412	NACA 6409	EPPLER 58				Flat Plate	0	0.7
3	0 deg	35	0	408 N	1135 N	1536 N				NACA 2412	0.2442	0.8089
4	0 deg	70	0	1632 N	4540 N	6146 N				NACA 6409	0.679	1.1928
5	5 deg	35	1170 N	1352 N	1994 N	2239 N				EPPLER 58	0.9192	1.3395
6	5 deg	70	4680 N	5409 N	7975 N	8956 N						
7												
8	DRAG		Flat Plate	2412	NACA 6409	EPPLER 58						
9	0 deg	35	0	9.5 N	12 N	10 N						
10	0 deg	70	0	38 N	47 N	40 N		A = 11.148 m^2		cD	@ 0 deg	@ 5 deg
11	5 deg	35	84 N	13 N	13 N	24 N		V = 15.6464 m/s		Flat Plate	~0	0.05
12	5 deg	70	334 N	54 N	54 N	96 N		V = 31.2928 m/s		NACA 2412	0.00568	0.00804
13								rho = 1.225 kg/m^3		NACA 6409	0.007	0.0079
14	We are using L = (1/2)*(cL)*rho * V * V * A							rho is STP		EPPLER 58	0.0059	0.01428
15	We are using D = (1/2)*(cD)*rho * V * V * A											

Improve fuel efficiency

Key Goals



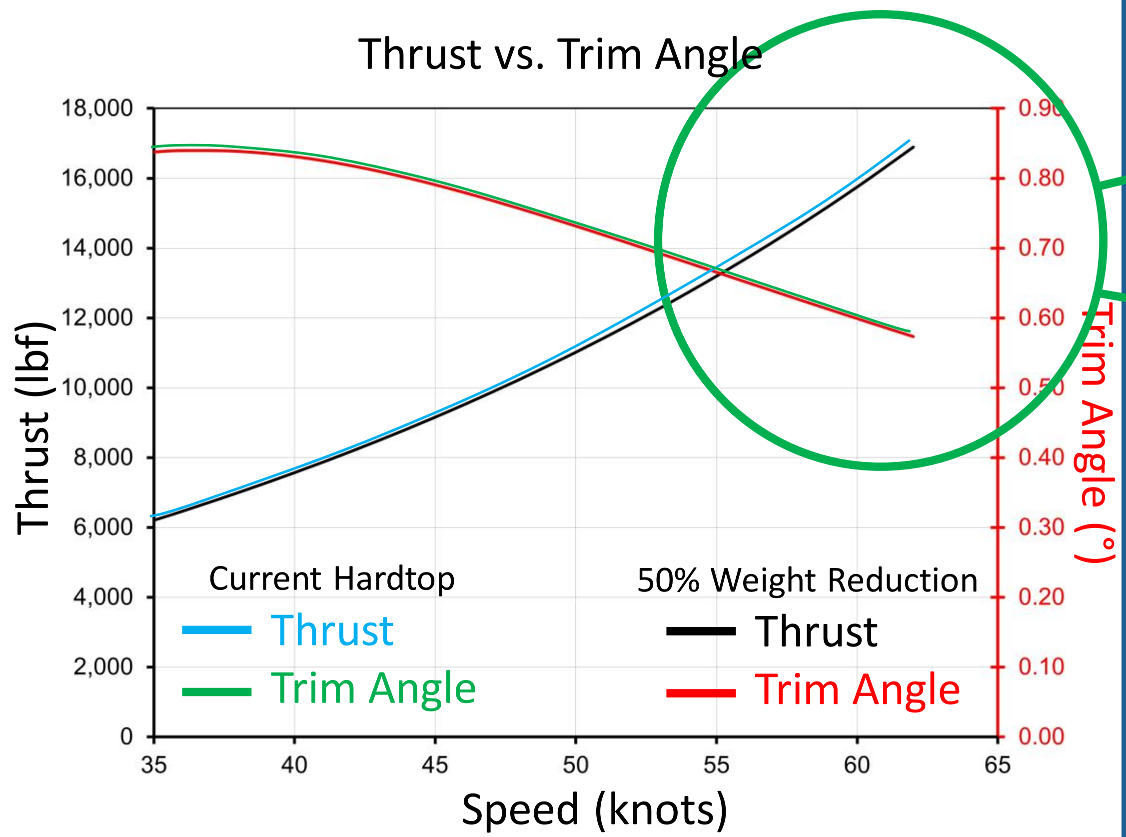


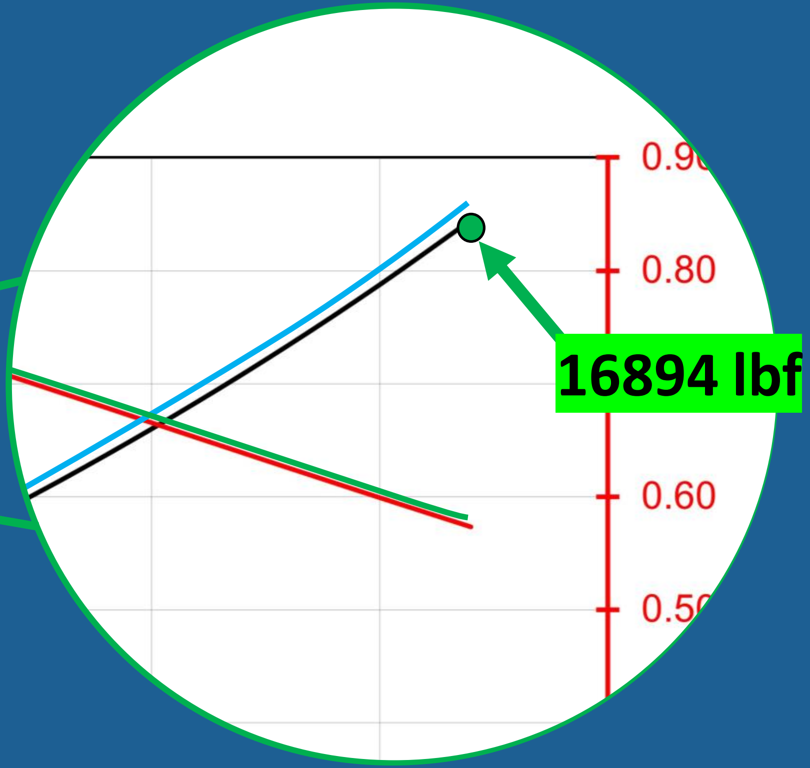
Thrust required is higher throughout powerband with current hardtop

John Karamitsanis

Improve fuel efficiency

Key Goals





Thrust required is lower throughout powerband with lighter hardtop i.e. Fuel is saved

John Karamitsanis

Thrust Calculations – 4 ft CoG

INPUT

This spreadsheet was written by Dingo Tweedie, October 2004.
Dit rekenblad werd deur Dingo Tweedie, oktober 2004, geschreven.
Versie 1.2.1

Hull	Length of Waterline	L_{WL}	40.00	feet	=	12.192	metres	
	Beam	B	11.08	feet	=	3.378	metres	
	VCG	VCG	4.00	feet	=	1.219	metres	
	Displacement	Δ	20,000	lbf	=	9,072	kg	
	Deadrise @ Transom	β_T	10.00	°				
	Deadrise @ Amidships	$\beta_{)0(}$	10.00	°				
	Distance to Amidships	$L_{)0(}$	20.000	feet	=	6.096	metres	
		θ	0.000	°				
	Angle of Thrust Line	ε	0.00	°				
		f	0.00	feet	=	0.000	metres	
	Minimum Speed	V_{min}	6.7	kn	=	11.3	feet/s	This is the minimum speed valid for this analysis
	Maximum Speed	V_{max}	145.4	kn	=	245.5	feet/s	This is the maximum speed valid for this analysis
S/Str.	Length Overall	LOA	40.00	feet	=	12.192	metres	
	Maximum Beam	B_{max}	11.08	feet	=	3.378	metres	
	Moulded Depth of Hull	Z	11.67	feet	=	3.556	metres	
	Height of House	H_{SS}	0.00	feet	=	0.000	metres	
	Breadth of House	B_{SS}	0.00	feet	=	0.000	metres	
	Frontal Area of House	A_{SS}	0.00	$feet^2$	=	0.000	m^2	
Number	Number of Propellers	N	3					
Trim Tab	Chord	c_F	1	feet	=	0.305	metres	
	Span Ratio	σ	0.333	(<= 1)				
	Deflection Angle	δ	2	°				
Rudder	Chord	c_{rudder}	0.00	feet	=	0.000	metres	
	Thickness	t	0.00	feet	=	0.000	metres	
	Area	A_{rudder}	0.00	$feet^2$	=	0.000	m^2	
	Centrepoint	x_c	0.00	feet from transom	=	0.000	metres	(+ve fwd)
		y_c	0.00	feet from baseline	=	0.000	metres	(+ve up)
Shaft	Diameter of Shaft	Φ_{shaft}	0.00	feet	=	0.000	metres	
	Length of Shaft & Hub	l	0.00	feet	=	0.000	metres	
	Centrepoint	x_c	0.00	feet from transom	=	0.000	metres	(+ve fwd)
		y_c	0.00	feet from baseline	=	0.000	metres	(+ve up)

Strut	Chord	c_{strut}	0.00	feet	=	0.000	metres	
	Thickness	t	0.00	feet	=	0.000	metres	
	Area	A_{strut}	0.00	$feet^2$	=	0.000	m^2	****
	Centrepoint	x_c	0.00	feet from transom	=	0.000	metres	(+ve fwd)
		y_c	0.00	feet from baseline	=	0.000	metres	(+ve up)

OUTPUT

Go

V	LCG		τ	D		T		$P_{effective}$		h		τ_{cr}		Comments	λ
[kn]	[ft]	[metres]	[°]	[lbf]	[kN]	[lbf]	[kN]	[ehp]	[ekW]	[ft]	[metres]	Lew.[°]	Angeli [°]		
35	29	8.839	0.84	6,201	27.6	6,202	27.6	666	497	1.19	0.363	3.23	2.12	Note: not planing	5.6630
36	29	8.839	0.84	6,459	28.7	6,459	28.7	714	533	1.19	0.363	3.08	2.04	Note: not planing	5.5945
38	29	8.839	0.84	6,996	31.1	6,997	31.1	816	609	1.16	0.354	2.83	1.90	Note: not planing	5.4736
40	29	8.839	0.83	7,566	33.7	7,567	33.7	929	693	1.14	0.347	2.60	1.77	Note: not planing	5.3743
42	29	8.839	0.82	8,172	36.4	8,173	36.4	1,053	786	1.12	0.341	2.41	1.66	Note: not planing	5.2951
44	29	8.839	0.80	8,818	39.2	8,818	39.2	1,191	889	1.09	0.332	2.24	1.56	Note: not planing	5.2351
46	29	8.839	0.78	9,505	42.3	9,506	42.3	1,342	1,001	1.06	0.323	2.09	1.47	Note: not planing	5.1925
48	29	8.839	0.76	10,237	45.6	10,238	45.6	1,508	1,125	1.03	0.314	1.95	1.39	Note: not planing	5.1658
50	29	8.839	0.73	11,017	49.0	11,017	49.0	1,691	1,262	1.01	0.308	1.83	1.32	Note: not planing	5.1537
52	29	8.839	0.71	11,847	52.7	11,848	52.7	1,891	1,411	0.98	0.299	1.72	1.25	Note: not planing	5.1552
54	29	8.839	0.68	12,732	56.7	12,733	56.7	2,110	1,575	0.96	0.293	1.62	1.19	Note: not planing	5.1689
56	29	8.839	0.65	13,675	60.9	13,676	60.9	2,350	1,754	0.93	0.283	1.53	1.14	Note: not planing	5.1946
58	29	8.839	0.63	14,679	65.3	14,680	65.3	2,613	1,950	0.91	0.277	1.45	1.09	Note: not planing	5.2312
60	29	8.839	0.60	15,750	70.1	15,750	70.1	2,900	2,164	0.89	0.271	1.38	1.04	Note: not planing	5.2792
62	29	8.839	0.57	16,894	75.2	16,895	75.2	3,215	2,399	0.87	0.265	1.31	1.00	Note: not planing	5.3390

Thrust Calculations – 4.25 ft CoG

INPUT

This spreadsheet was written by Dingo Tweedie, October 2004.
Dit rekenblad werd deur Dingo Tweedie, oktober 2004, geschreven.
Versie 1.2.1

Hull	Length of Waterline	L_{WL}	40.00	feet	=	12.192	metres	
	Beam	B	11.08	feet	=	3.378	metres	
	VCG	VCG	4.25	feet	=	1.295	metres	
	Displacement	Δ	20,000	lbf	=	9,072	kg	
	Deadrise @ Transom	β_T	10.00	°				
	Deadrise @ Amidships	β)0(	10.00	°				
	Distance to Amidships	L)0(	20.000	feet	=	6.096	metres	
		θ	0.000	°				
	Angle of Thrust Line	ε	0.00	°				
		f	0.00	feet	=	0.000	metres	
	Minimum Speed	V_{min}	6.7	kn	=	11.3	feet/s	This is the minimum speed valid for this analysis
	Maximum Speed	V_{max}	145.4	kn	=	245.5	feet/s	This is the maximum speed valid for this analysis
S/Str.	Length Overall	LOA	40.00	feet	=	12.192	metres	
	Maximum Beam	B_{max}	11.08	feet	=	3.378	metres	
	Moulded Depth of Hull	Z	11.67	feet	=	3.556	metres	
	Height of House	H_{SS}	0.00	feet	=	0.000	metres	
	Breadth of House	B_{SS}	0.00	feet	=	0.000	metres	
	Frontal Area of House	A_{SS}	0.00	feet^2	=	0.000	m^2	
Number	Number of Propellers	N	3					
Trim Tab	Chord	c_F	1	feet	=	0.305	metres	
	Span Ratio	σ	0.333	(<= 1)				
	Deflection Angle	δ	2	°				
Rudder	Chord	c_{rudder}	0.00	feet	=	0.000	metres	
	Thickness	t	0.00	feet	=	0.000	metres	
	Area	A_{rudder}	0.00	feet^2	=	0.000	m^2	
	Centrepoint	x_c	0.00	feet from transom	=	0.000	metres	(+ve fwd)
		y_c	0.00	feet from baseline	=	0.000	metres	(+ve up)
Shaft	Diameter of Shaft	Φ_{shaft}	0.00	feet	=	0.000	metres	
	Length of Shaft & Hub	l	0.00	feet	=	0.000	metres	
	Centrepoint	x_c	0.00	feet from transom	=	0.000	metres	(+ve fwd)
		y_c	0.00	feet from baseline	=	0.000	metres	(+ve up)

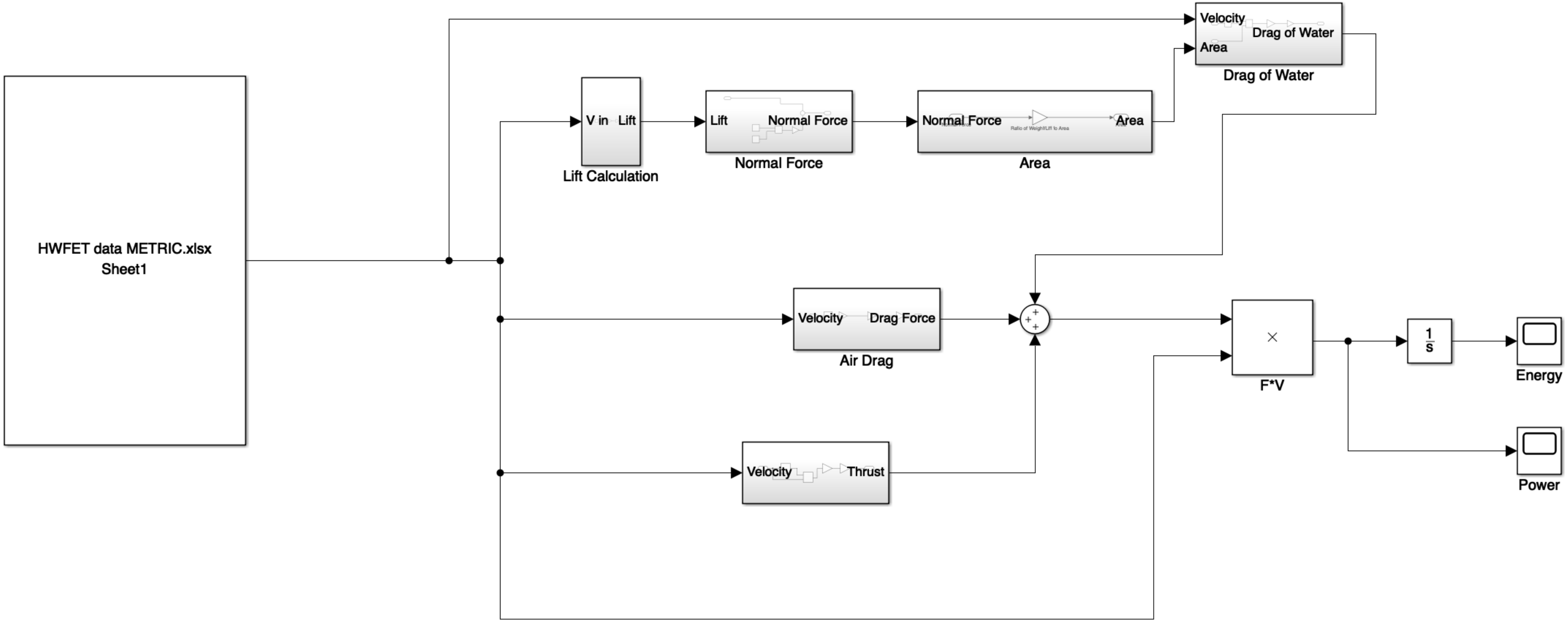
Strut	Chord	c_{strut}	0.00	feet	=	0.000	metres	
	Thickness	t	0.00	feet	=	0.000	metres	
	Area	A_{strut}	0.00	feet^2	=	0.000	m^2	****
	Centrepoint	x_c	0.00	feet from transom	=	0.000	metres	(+ve fwd)
		y_c	0.00	feet from baseline	=	0.000	metres	(+ve up)

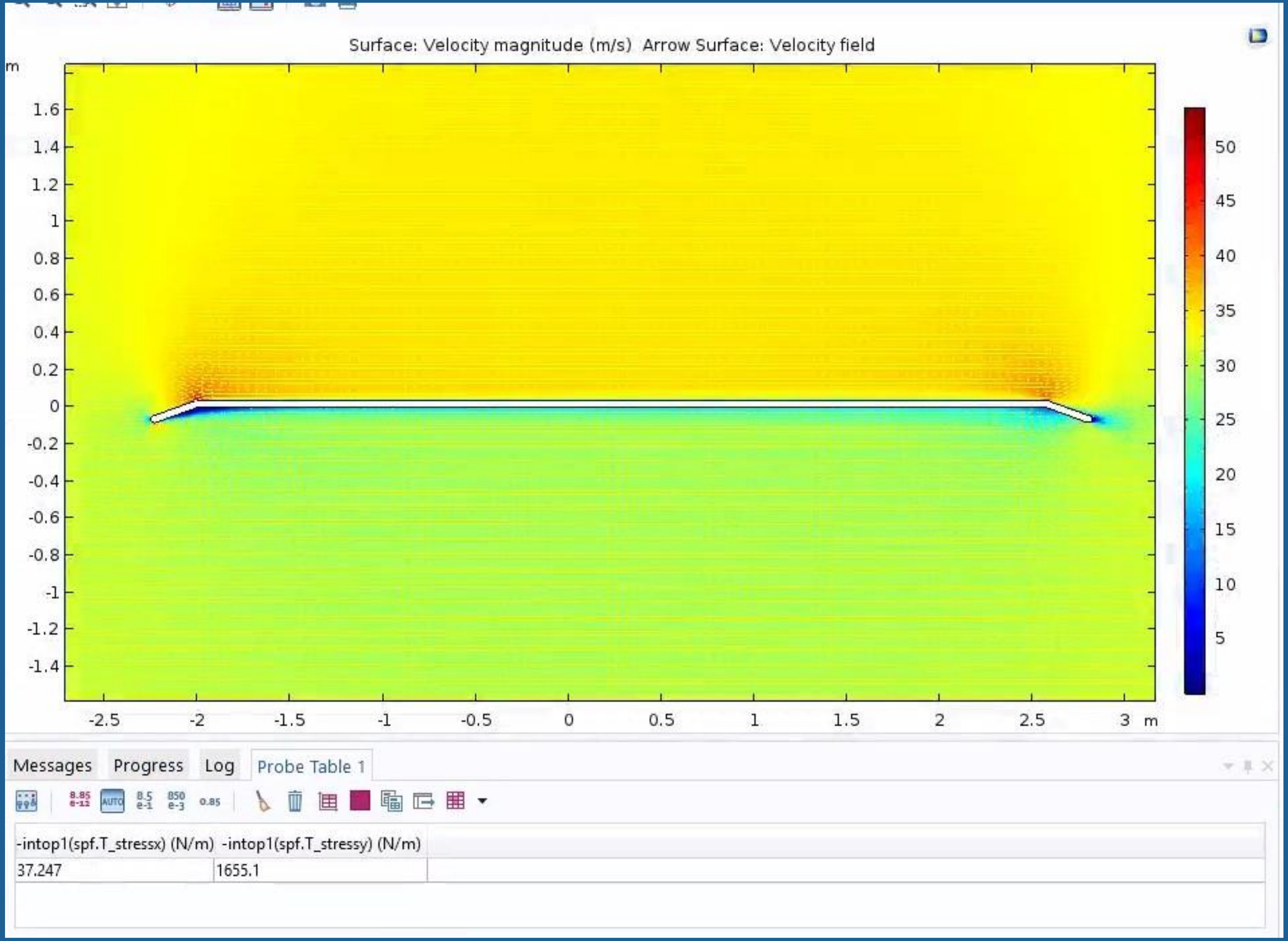
OUTPUT

Go

V	LCG		τ	D		T		$P_{effective}$		h		τ_{cr}		Comments	λ
[kn]	[ft]	[metres]	[°]	[lbf]	[kN]	[lbf]	[kN]	[ehp]	[ekW]	[ft]	[metres]	Lew.[°]	Angeli [°]		
35	29	8.839	0.83	6,221	27.7	6,221	27.7	668	499	1.19	0.363	3.23	2.12	Note: not planing	5.6885
36	29	8.839	0.83	6,480	28.8	6,480	28.8	716	534	1.18	0.360	3.08	2.04	Note: not planing	5.6207
38	29	8.839	0.83	7,021	31.2	7,022	31.2	819	611	1.16	0.354	2.83	1.90	Note: not planing	5.5018
40	29	8.839	0.82	7,596	33.8	7,597	33.8	932	696	1.14	0.347	2.60	1.77	Note: not planing	5.4039
42	29	8.839	0.81	8,207	36.5	8,208	36.5	1,058	789	1.11	0.338	2.41	1.66	Note: not planing	5.3265
44	29	8.839	0.79	8,858	39.4	8,859	39.4	1,196	893	1.09	0.332	2.24	1.56	Note: not planing	5.2683
46	29	8.839	0.77	9,552	42.5	9,553	42.5	1,348	1,006	1.06	0.323	2.09	1.47	Note: not planing	5.2276
48	29	8.839	0.75	10,291	45.8	10,292	45.8	1,516	1,131	1.03	0.314	1.95	1.39	Note: not planing	5.2031
50	29	8.839	0.73	11,079	49.3	11,080	49.3	1,700	1,269	1.01	0.308	1.83	1.32	Note: not planing	5.1933
52	29	8.839	0.70	11,919	53.0	11,920	53.0	1,902	1,420	0.98	0.299	1.72	1.25	Note: not planing	5.1969
54	29	8.839	0.67	12,815	57.0	12,816	57.0	2,124	1,585	0.96	0.293	1.62	1.19	Note: not planing	5.2135
56	29	8.839	0.65	13,769	61.3	13,769	61.3	2,366	1,766	0.93	0.283	1.53	1.14	Note: not planing	5.2417
58	29	8.839	0.62	14,788	65.8	14,789	65.8	2,632	1,964	0.91	0.277	1.45	1.09	Note: not planing	5.2826
60	29	8.839	0.59	15,875	70.6	15,876	70.6	2,923	2,182	0.89	0.271	1.38	1.04	Note: not planing	5.3343
62	29	8.839	0.57	17,038	75.8	17,038	75.8	3,242	2,419	0.87	0.265	1.31	1.00	Note: not planing	5.3983

Simulink Model




Surface: Velocity magnitude (m/s) Arrow Surface: Velocity field
Messages
Progress
Log
Probe Table 1
-intop1(spf.T_stressx) (N/m)
-intop1(spf.T_stressy) (N/m)
37.247
1655.1