Maritime Drone Launcher (MDL)

Brody Baker - Connor Barrett - Richard Garcia - Alex Moeller

"Launching Into A Safer Tomorrow"

Team Members

- **Brody Baker:**
  Senior Mechanical Engineering student at Florida State University Panama City. Experienced in 3-D modeling and design conceptualization. Brody has the role of Team Leader for the Maritime Drone Launcher Team.
- **Connor Barrett:**
  Senior Mechanical Engineering student at Florida State University Panama City. Areas of interest include materials, robotics, and 3-D CAD. Connor will act as the systems engineer on the project.
- **Richard Garcia:**
  Senior Mechanical Engineering student at Florida State University Panama City. Newest addition to the class with experience in creativity. The role in the project is to make sure all of the mathematics line up and double checking the values.
- **Alex Moeller:**
  Senior Mechanical Engineering student at Florida State University Panama City. Alex has the role of logistics and prototyping pertaining to cost analysis and data acquisition.

Recap From DR1

[2] Pensacola News Journal


[3] CBS News

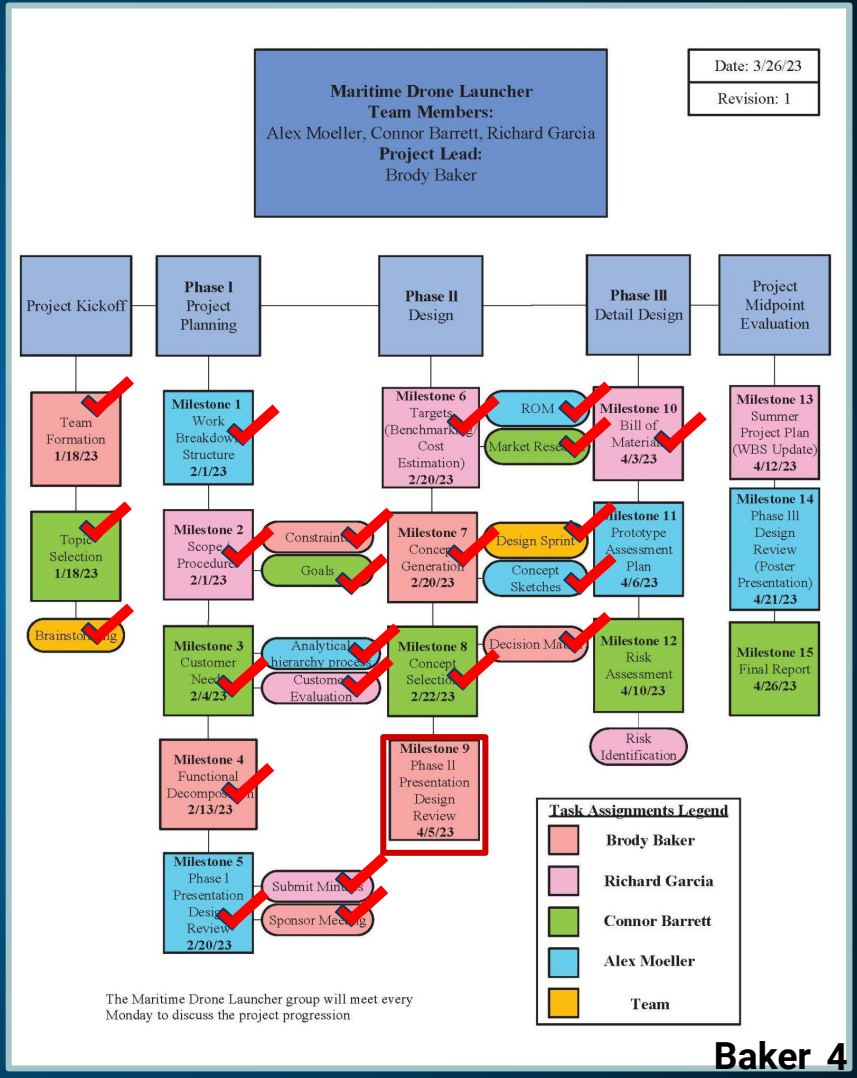
- **Need statement:**
  There is a large gap in technology between the military and commercial market when it comes to mid sized, long distance drone launchers. There is currently no drone launcher designed for use on small vessels.

- **Significance:**
  - Provides increased range for search and rescue operations.
  - Provides larger payload capability for delivering supplies to remote locations.
  - Increases flight time for longer surveillance operations.

- **Objective:**
  The objective of our project is to design a drone launching system capable of interfacing with various small watercraft used by the Florida Fish and Wildlife Conservation Commission (FWC) and other law enforcement organizations.

Schedule Update

2 (16 Jan)	Team Topic / Members confirmed/ Project Manager Selected Project Manager confirms Team Members & Topic via email by 1/18
3 (23 Jan)	STEM FAIR & Danfoss Plant Tour: Tallahassee (Tuesday 24, 2023) Milestone 1 (WBS) preliminary on-paper submittal due 1/25, Electronic upload by 2/1 Guest Speaker from NSWC: Mr. LJ Earnest Trane Plant Visit Friday 1/27
4 (30 Jan)	Milestone 2 (Scope/Procedures) submittal due 2/1 Advisor / Sponsor Selection Process: Pre-Advisor/Sponsor Meeting- Submit Agenda Eastern Shipbuilding Visit Friday 2/3
5 (6 Feb)	Note: Lecture Class moved to Wednesday 2/8 with Guest Sponsors: Mr. & Mrs. J. Dafoe Individual Homework Assignment: Professional Communication (e.g. Letter of Submittal) due 2/8 Milestone 4 (Functional Decomposition) submittal due ~~2/6~~ 2/13
6 (13 Feb)	Meeting 1 (minimum of 3 meetings Advisor or 2 meetings Sponsor during the semester) with Advisor/Sponsor Meeting- Submit Minutes Milestone 5: Design Review Presentation 1 (~~2/15~~ 2/20)
7 (20 Feb)	Milestone 8: Concept Selection submittal due 2/22
8 (27 Feb)	Submittal due for Student Research Symposium https://pc.fsu.edu/student-research/symposium ~~Milestone 9: Design Review (Conclusion of Preliminary Design with Concept Selection): 3/1~~ Presentation by Dr. Keith Aliberti, Head Science and Technology at NSWC-PC (in HOL301, Dean's Conference Room)
9 (6 March)	"Embodiment Design Phase" in work Peer Evaluation 1 due 3/8, FSU-PC STEM Career Fair
**********	Spring Break (March 13-17, 2023) **********
10 (20 Mar)	"Embodiment Design Phase / Detail Design Phase" in work Advisor / Sponsor Meeting- Submit Minutes Reading Assignment: Ethics due 3/22
11 (27 Mar)	Individual Homework Assignment: Biographical Sketch "Detail Design Phase" in work Milestone 10 (Bill of Materials) due 4/3
12 (3 Apr)	Individual Homework Assignment: Linked In setup ~~Milestone 12 Risk Assessment due 4/5~~ Milestone 9: Design Review 4/5 ENGINEERING DAY - Tallahassee (Thursday April 6)
13 (10Apr)	Milestone 12 Risk Assessment due 4/10 Milestone 13 (Summer Project Plan) due 4/12



Collaboration Update

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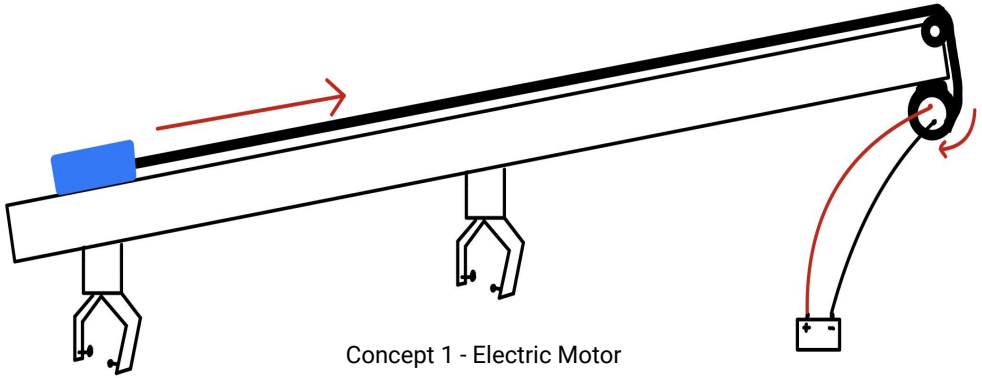
Florida Fish and Wildlife Conservation Commision:

The Maritime Drone Launcher team contacted Captain Clements from the Florida Fish and Wildlife Conservation Commision (FWC). A meeting was arranged to allow us to tour the FWC office at the NSWC in Panama City on March 22nd. This meeting allowed us to discuss the project with Captain Clements and get his feedback on possible improvements. We were also able to measure a variety of FWC patrol boats to allow for a better adapted design.

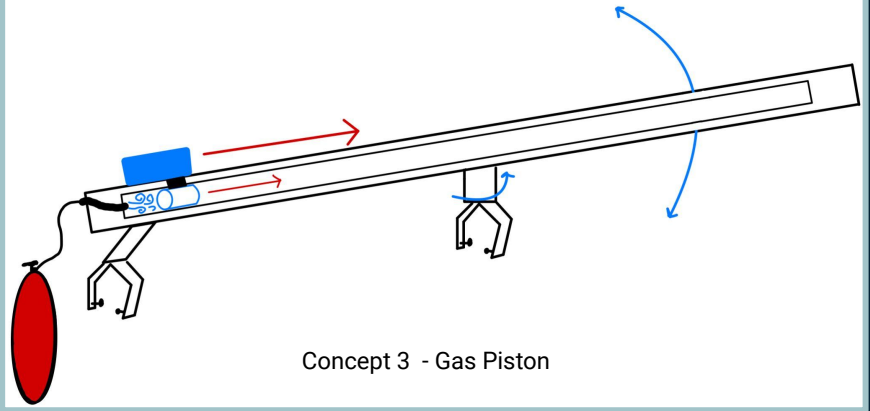
FWC Drone Program:

Capitan Clements has informed us that there is a new drone program for the FWC. He is currently working on providing us with a point of contact with the FWC drone program for possible collaboration. The ability to design our launcher around the drones used by the FWC drone program would allow for a more efficient design.

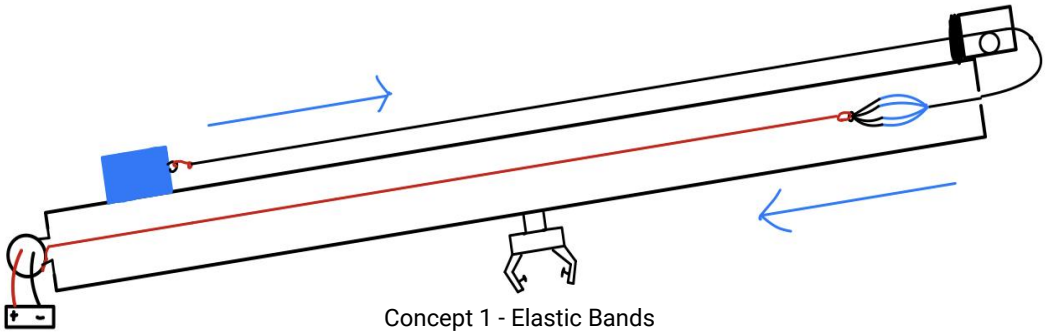
Concepts



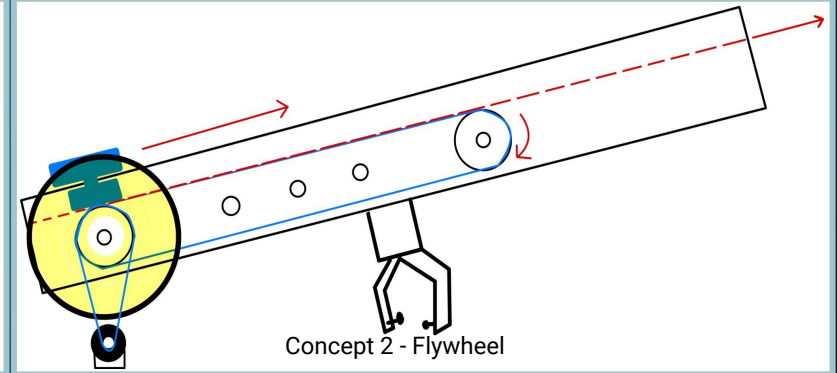
Concept 1 - Electric Motor



Concept 3 - Gas Piston



Concept 1 - Elastic Bands

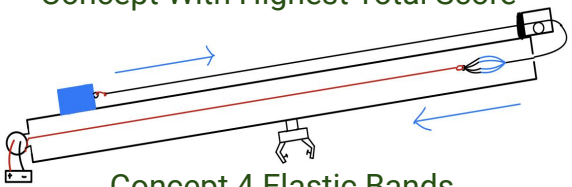


Concept 2 - Flywheel

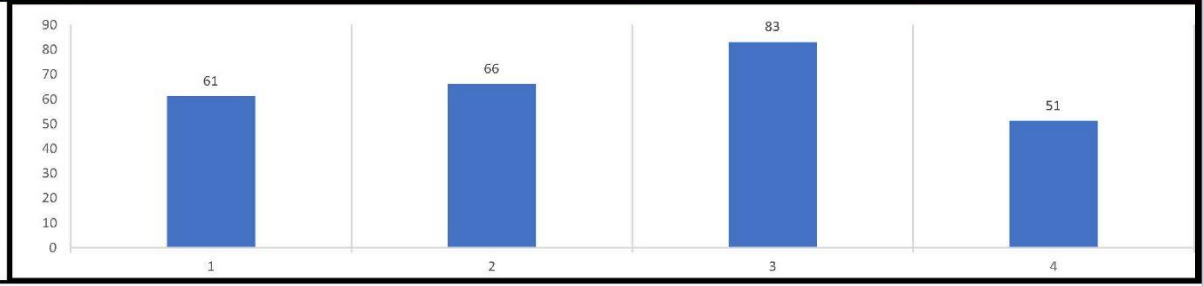
Concept Decision Matrix

		Ratings			
Criterion	Weight	Gas Piston	Electric Motor	Elastic Bands	Fly Wheel
Ease of Use	20	4	4	5	2
Durability	10	1	4	3	2
Ease of Manufacturing	10	1	5	5	4
Load Capacity	10	3	5	3	3
Safety	20	2	4	3	2
Weight	10	5	1	5	1
Power Consumption	5	5	1	4	3
Cost	15	4	1	5	4
Total	100	61	66	83	51

Concept With Highest Total Score



Concept 4 Elastic Bands



Concept Selection

The elastic bands concept showed the most promise by scoring the highest overall rating compared to the other concepts on the decision matrix. Below are some of the key factors which support the choice of this concept.

- **Man powered loading mechanism.**
  - No external power source required, reducing the power consumption, weight, and cost.
  - Increased ease of use due to the lack of complex digital controls.
  - Increased resistance to wet environments due to lack of electrical components.

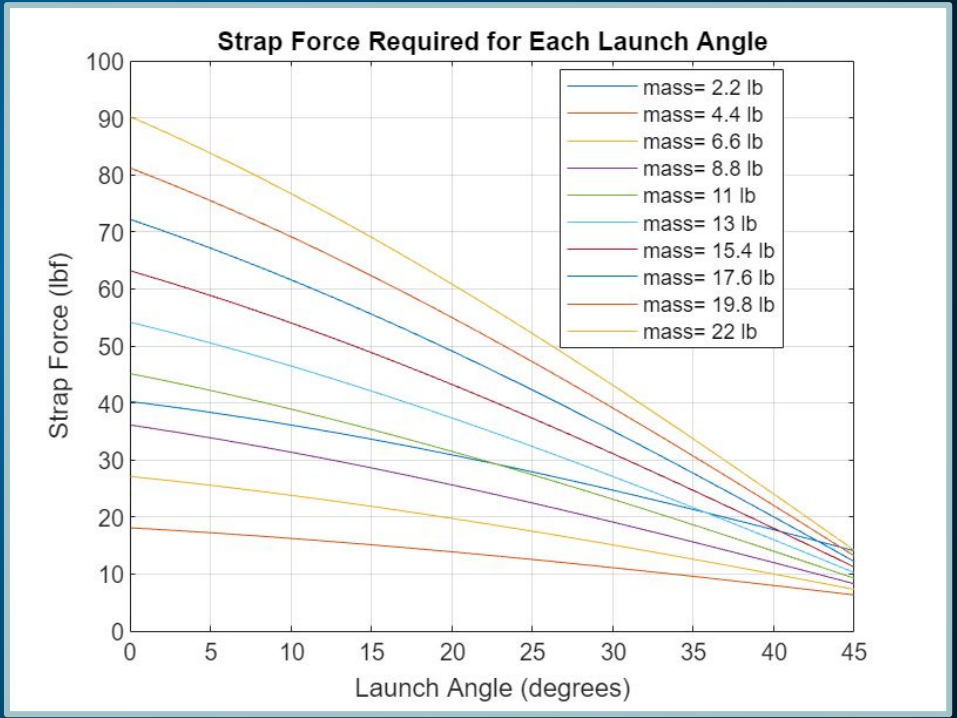
- **Elastic band propulsion mechanism.**
  - The use of elastic bands allows for a simplistic yet powerful launcher design. The bands are also highly resistant to harsh maritime conditions as they are designed for marine use.

- **Use of “off the shelf” components.**
  - Very little custom fabrication will be needed to construct this design. This reduces the cost, manufacturing complexity, and maintenance difficulty of the launcher system.

Initial Calculations

Calculated Values for the Launcher

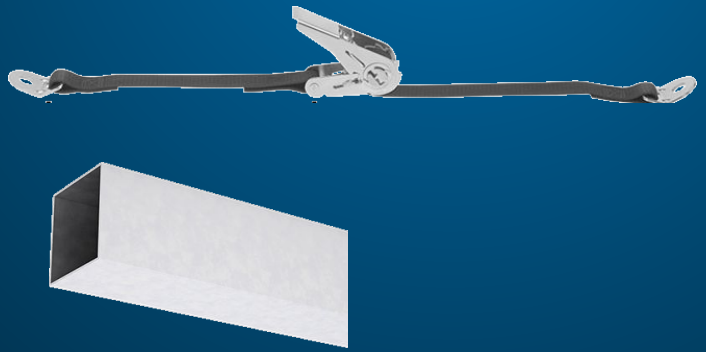
- Dynamic force Acting upon Launcher = **729N (163.88 lbs).**
- Compressive stress experienced by the launcher frame = **0.38 MPa (55.11 psi).**
- Spring constant (K) for the elastic bands required to launch the drone = **400N/m (2.28 lb/in)**.
- Elastic deformation of the elastic bands required to launch the drone = **1.82m (6 ft).**
- Total frictional force required to keep the launcher stationary is equal to the dynamic force on the launcher = **729N (163.88 lbs).**
- Strap force required to maintain stability is shown on graph to right for different drone weights.

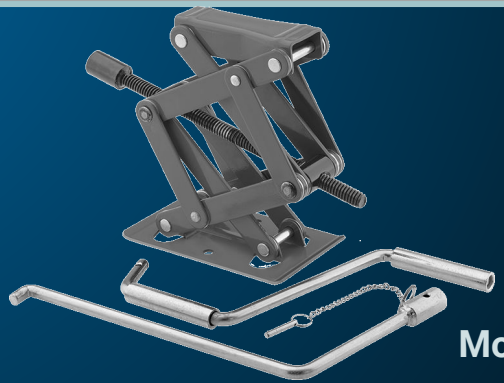


*Calculations for the Dynamic force and Compressive Stress were analyzed using a drone weight of 22lbs.
*Detailed calculations are available upon request

Initial Component Selection

Bill of Materials					
Name	Seller	Link	Model #	Quantity	Cost
Pully	McMaster Carr	https://www.mcmaster.com/59475K64/	59475K64	1	22.5
Hand Winch	McMaster Carr	https://www.mcmaster.com/3196T55/	3196T55	1	77.65
Linear Rails and Bearings	Amazon	https://www.amazon.com/gp/product/B08NDDHSD8/ref=ox_sc_act_title_2?smid=A2OGTDVD3DU8MA&psc=1	SBR16	1 (pack of two)	79.99
Scissor Jack	McMaster Carr	https://www.mcmaster.com/3196T55/scissor-jacks-5/	2952T51	1	89.29
Aluminum Square Tube	McMaster Carr	https://www.mcmaster.com/88875K39-88875K396/	88875K39	1 (6 feet)	220.23
Aluminum Sheet Metal	MCMaster Carr	https://www.mcmaster.com/89015K88/	89015K88	1 (48"X48"X.125")	384.47
High Strength Rope	MCMaster Carr	https://www.mcmaster.com/36965T15/	36965T15	25"	40.75
Elastic Bands	Amazon	Q&pf_rd_p=c8697a08-4071-4b95-a6c6-18057bcdb898&pf_rd_r=TNBQE50DCENSPRN6YV1S&qid=1680066069&sbo=	-	10" X 5/8 OD	33.54
Rubber Pad	McMaster Carr	https://www.mcmaster.com/1296N58/	1296N58	1 (1"X2"X36")	99.48
Ratchet Straps	McMaster Carr	https://www.mcmaster.com/8834T341/	8834T341	3 (1"X12")	87.87
				Total Cost	1135.77





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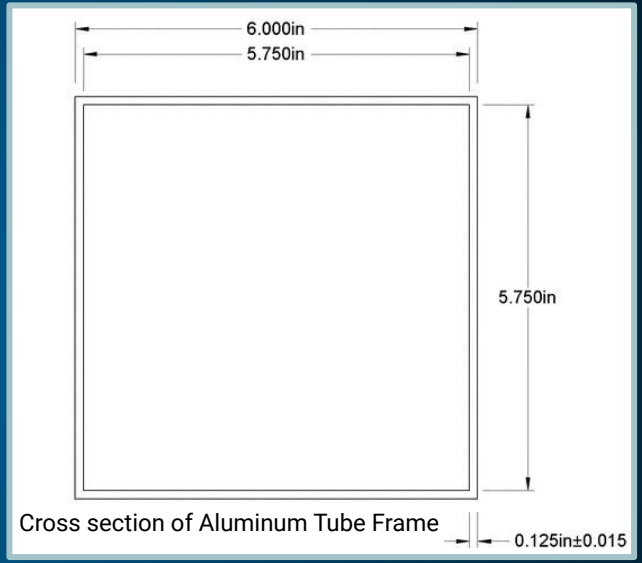
Justifications of Components

The components were selected based on the values found in the initial load calculations.

- Square metal tubing was chosen to serve as the main frame of the launcher because of its strength and flat surfaces for mounting other components.
- 6063 T5 aluminum was chosen as the material for the launcher frame due to its corrosion resistant and lightweight properties.
- ⅝ Diameter elastic speargun bands were chosen to provide propulsion. The bands were chosen due to their elastic coefficient and low cost.
- A small scissor jack was selected to provide launch angle adjustability.
- A hand crank winch was chosen to provide tension to the elastic bands. The crank allows for the adjustability of launch force for different sized drones.



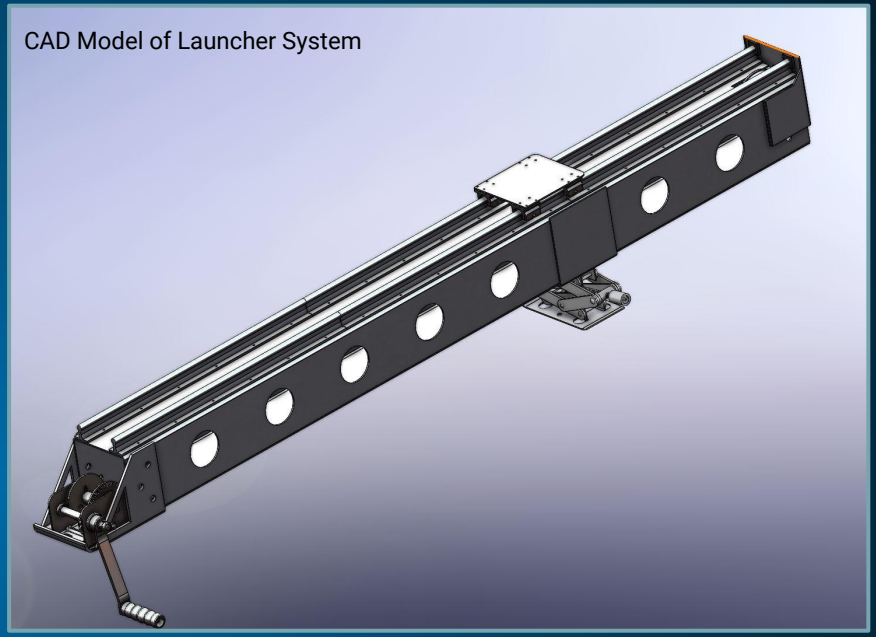
Cross section of Aluminum Tube Frame

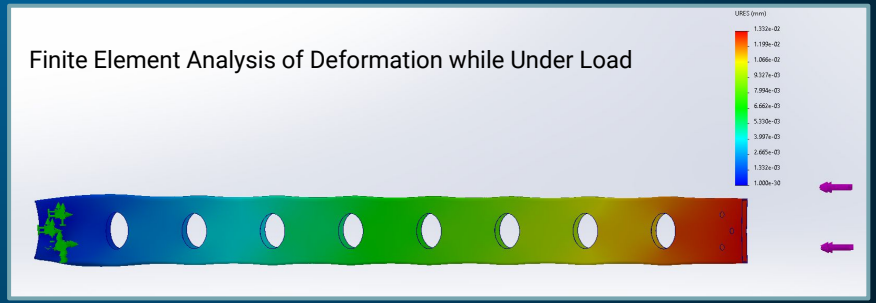

[6]

Elastic Speargun Bands

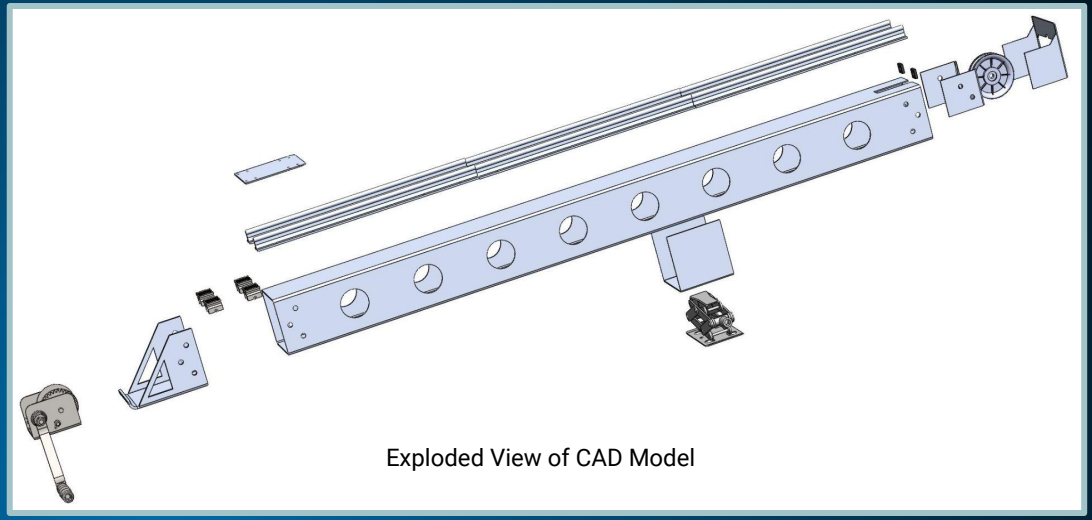
CAD Design

- CAD Model
  - The selected components were modeled in SolidWorks and assembled into the configuration shown.
  - All components were assigned their respective material properties.
- **Initial Finite Element Analysis:**
  - A deformation analysis was conducted on the frame of the launcher body using the highest force value from our initial calculations.
  - The results of the analysis show a maximum deformation of ~ 1.3 X10^-2 mm which has been deemed an acceptable value by our team.
  - More detailed load simulations will be conducted in the detail design phase.



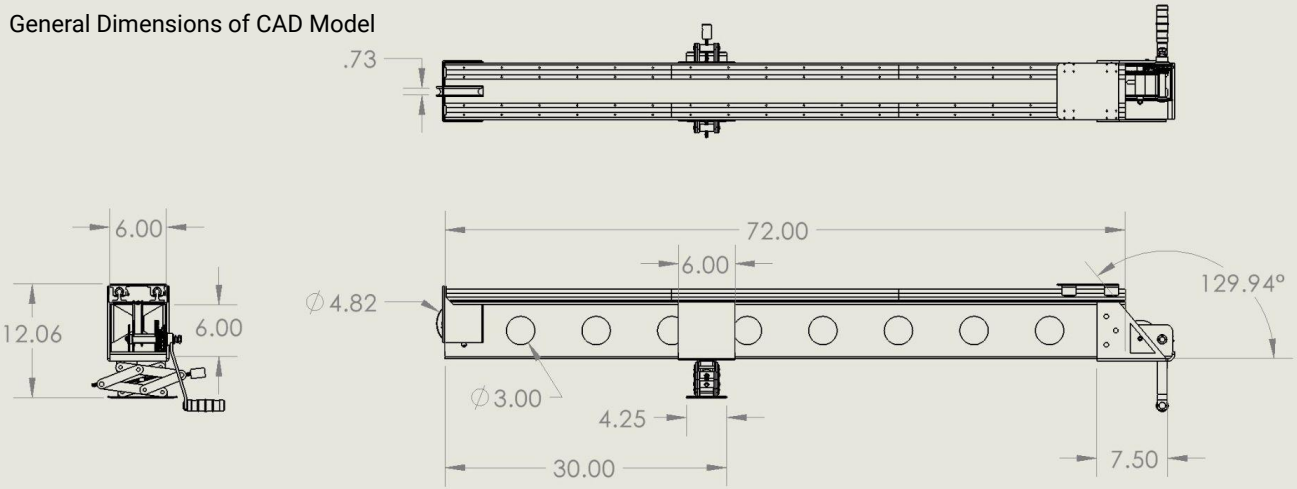


Model Dimensions and Characteristics



Exploded View of CAD Model

General Dimensions of CAD Model




```
Mass properties of Assembly
     Configuration: Default
     Coordinate system: -- default --

Mass = 62.04 pounds

Volume = 411.66 cubic inches

Surface area = 5691.25 square inches

Center of mass: ( inches )
        X = 32.76
        Y = 56.15
        Z = 82.34
```

The Next Steps

- Complete final CAD model with all components and their materials.
- Perform detailed finite element analysis of the launcher system under different loads.
- Perform calculations for Sea State limitations.
- Finalize the bill of materials.
- Update the project website with all the documents created in phase one.
- Meet with our technical advisor to get feedback on the final design.
- Prepare the final presentation for phase one of the project.
- Order materials in preparation for phase two of the project.

References

1. GrabCad.com, https://grabcad.com/library/midnight-express-power-boat-1
2. Pensacola News Journal, Body of missing boater located (pnj.com)
3. CBS News, https://cbsnews2.cbsistatic.com/hub/i/r/2013/07/10/9c674a1d-1c4f-11e3-9918-005056850598/thumbnail/1200x630/db9a013ecc87e3a11601f4c2ac716e85/navy_drone_AP293180821417.jpg
4. Florida Museum, https://www.floridamuseum.ufl.edu/earth-systems/blog/florida-fish-and-wildlife-conservation-commission-managing-our-fish-and-wildlife-resources/
5. McMaster-Carr, https://www.mcmaster.com/
6. Westside Dive and Tackle, https://store.westsidedive.com/product-p/ra-blapb17.htm

Questions?

Visit our website for more details!

https://web1.eng.famu.fsu.edu/me/senior_design/2023/team519pc/