Miniature Modular Rack Launcher Combo

Senior Design Group 3

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Overview

- Problem Statement
- Product Specifications
  - Tigershark UAV Platform
  - Constraints
- Concept Generation
  - Latch System
  - Mechanical Safety System
  - Sway Brace
  - Ejector Mechanism
- Conclusion/Next Steps

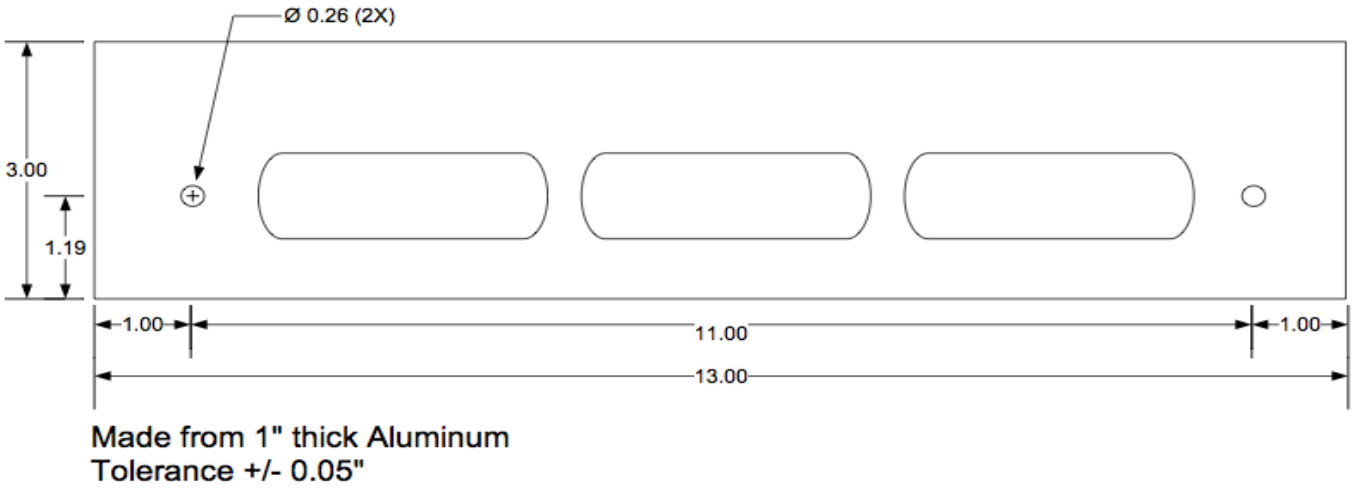
Problem Statement

- Design and develop a Bomb Rack Unit (BRU) that is attached to the Tigershark UAV capable of housing and launching a cylindrical payload.
- BRU must contain an electrical interface that allows the user to go through a safety sequence before the payload is released
- Provide budget analysis for MMRLC
- Prototype and fit check

Tigershark UAV Platform

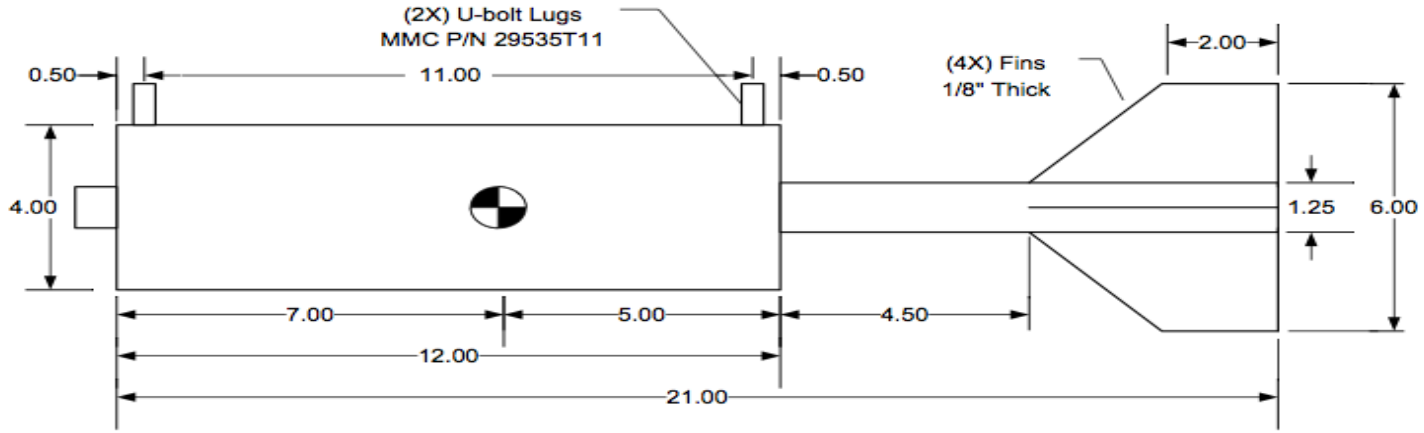
Specifications:

- Wing span 21 feet
- Propulsion - 372cc two stroke
- 20 gallon fuel tank
- Empty airframe weight - 150 lbs.
- Gross take off weight - 300 lbs.
- Payload capacity – 50 lbs.
- One hard-point location per wing for launcher attachment



Constraints

- BRU must not exceed 5 lbs.
- Capable of holding a payload that is 10lbs
- Operation in temperature range -20 to 60 degrees C and during rain exposure
- Retain payload during aircraft maneuvers up to 2GS lateral load and 1G landing shock.

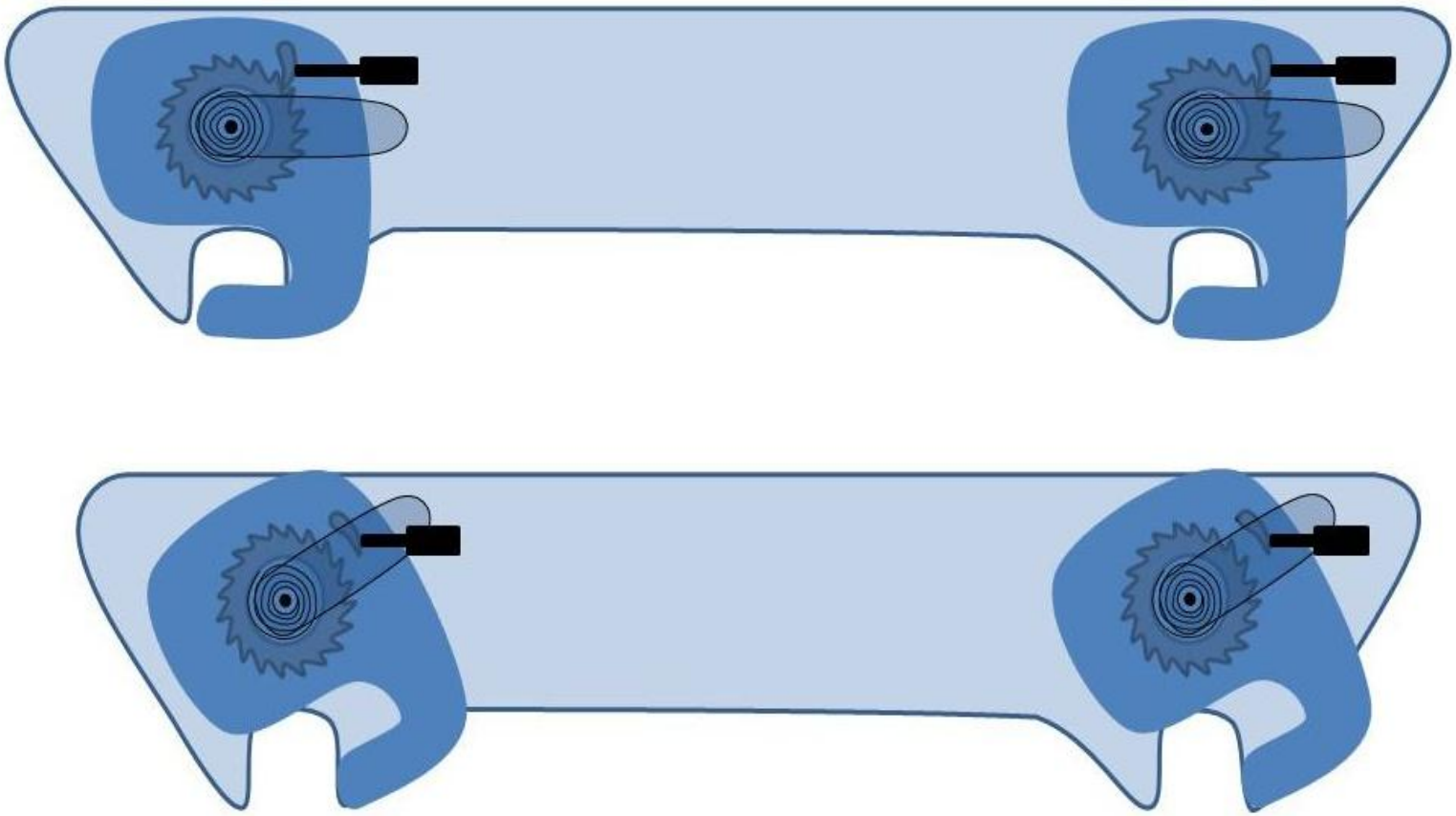


Weight = 10lbs
Tolerance +/- 0.125"

Latch System

- Hold payload in place during aircraft maneuvers
  - 2Gs lateral load
  - 1G Landing shock
- Integrated with safety system that prevents hooks from opening before “ARM” signal is received.
- Integrated into electrical interface allowing the hooks to swing away during the “RELEASE” command

Design #1



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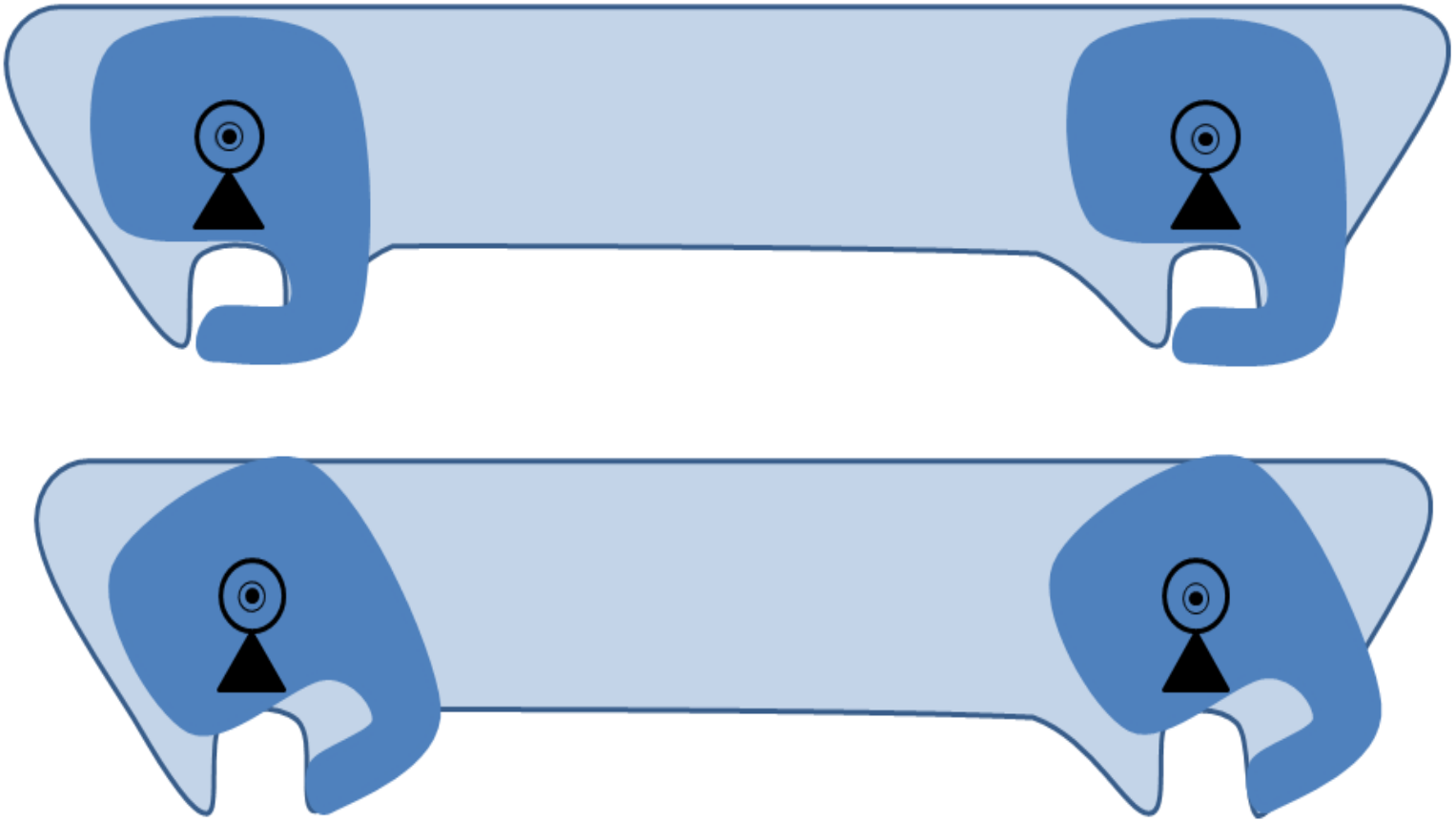

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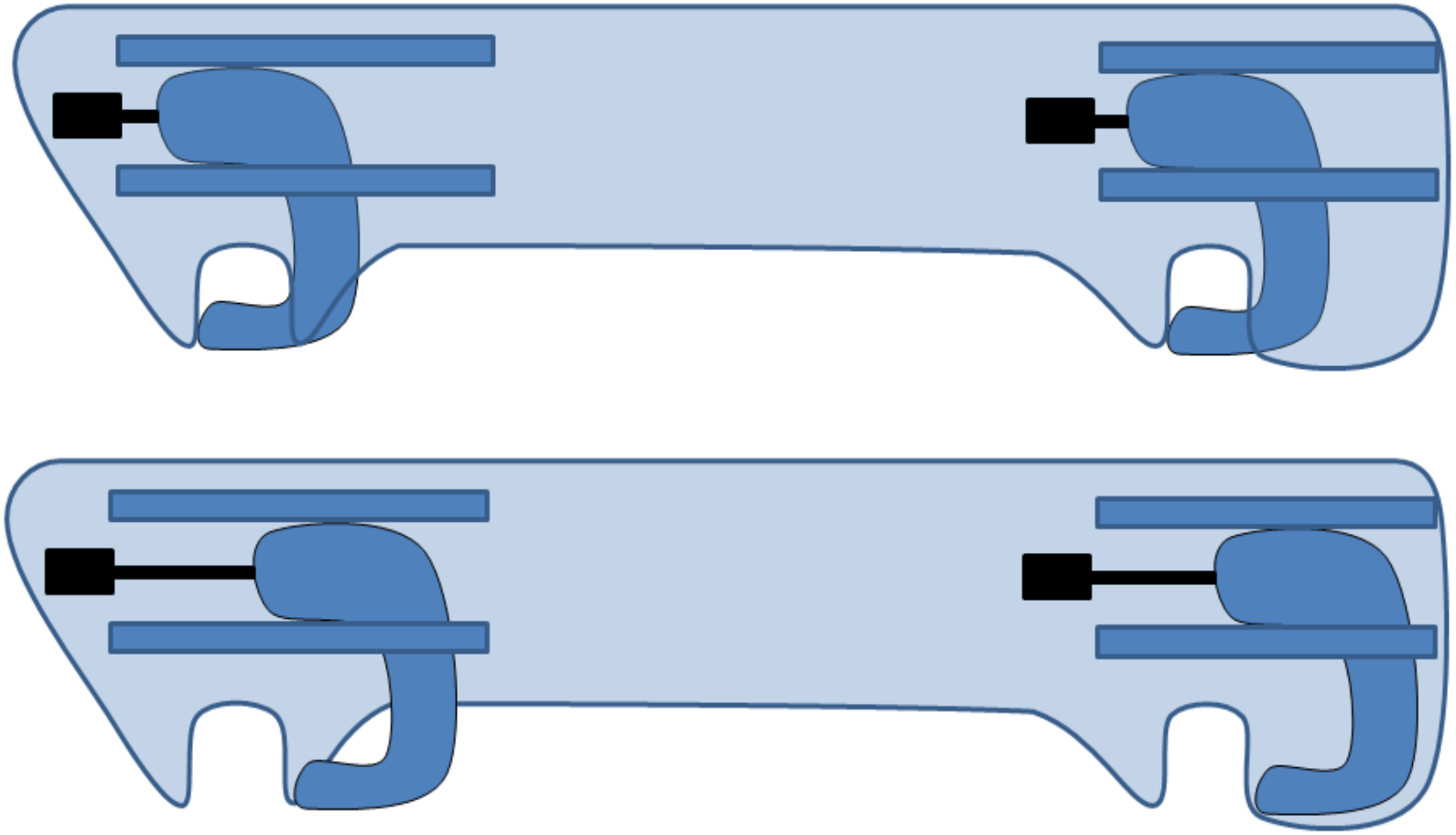

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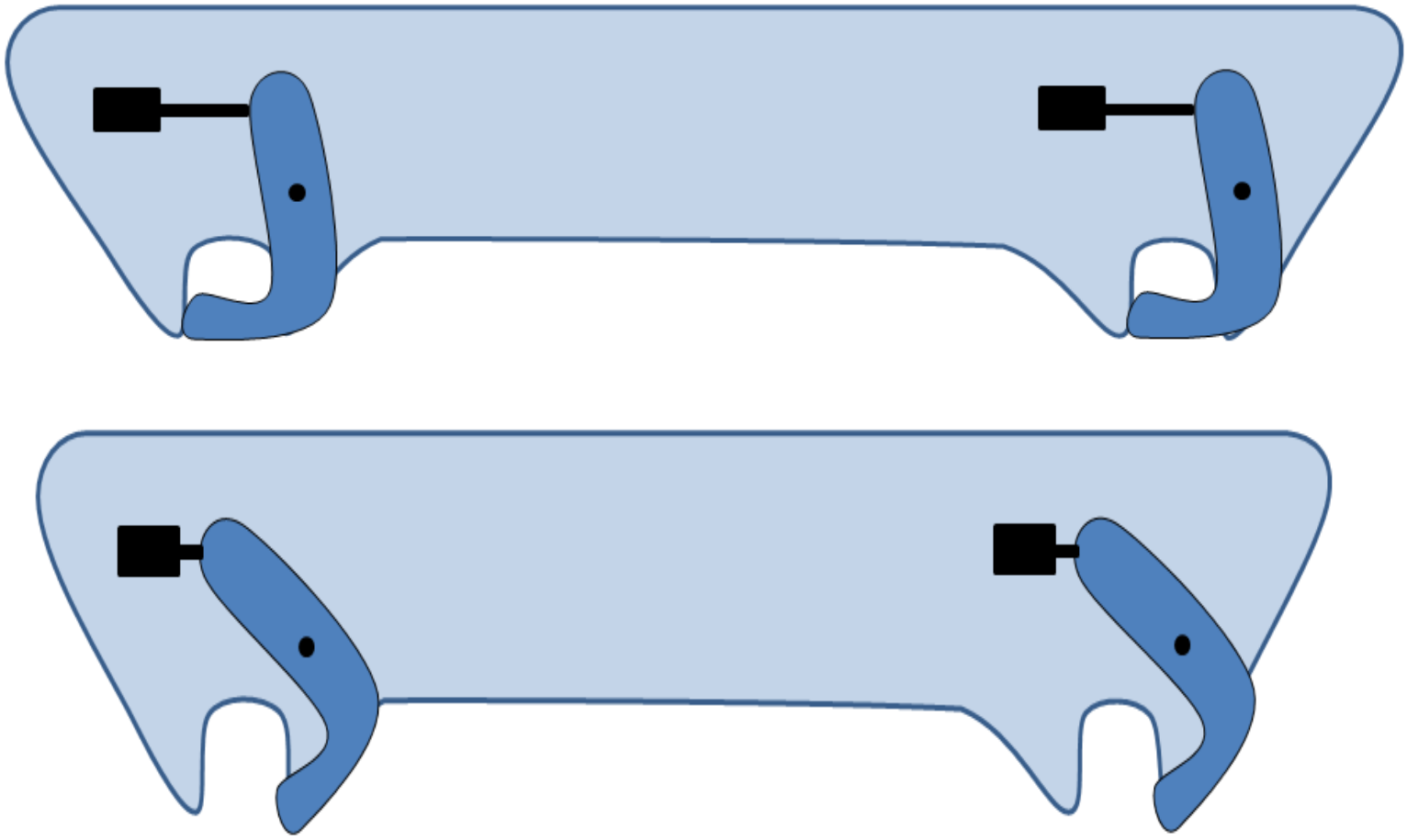
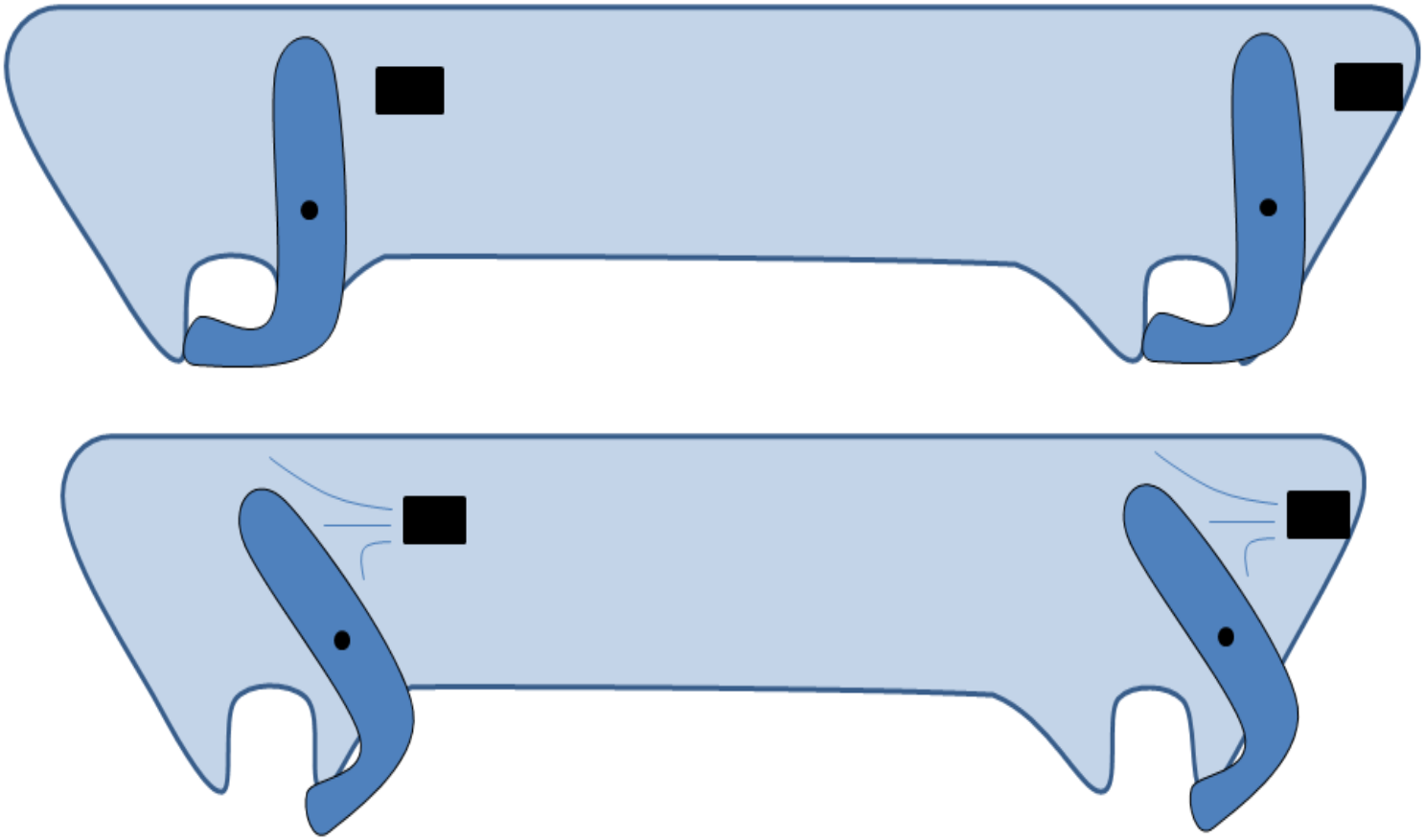


Design #5



Decision Matrix

		Designs									
		1		**2**		**3**		**4**		**5**	
Specifications	Weight	Score	Weight	Score	Weight	Score	Weight	Score	Weight	Score	Weight
Compactness	0.1	2	0.2	3	0.3	3	0.3	5	0.5	5	0.5
Weight	0.25	4	1	2	0.5	5	1.25	5	1.25	5	1.25
Strength	0.15	3	0.45	4	0.6	3	0.45	4	0.6	4	0.6
Durability	0.1	3	0.4	4	0.4	2	0.2	4	0.4	4	0.4
Operational Speed	0.4	5	2	3	1.2	2	0.8	3	1.2	5	2
Total		**4.05**		3		3		**3.95**		**4.75**	

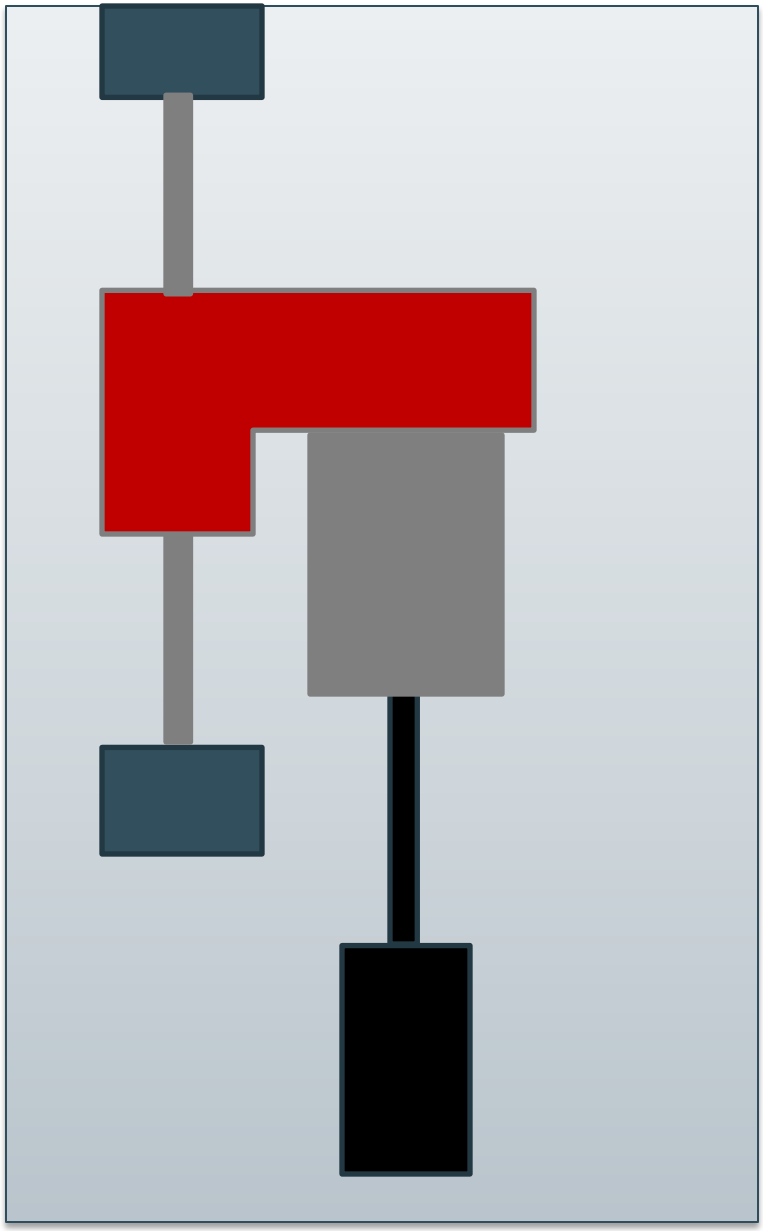
Mechanical Safety System

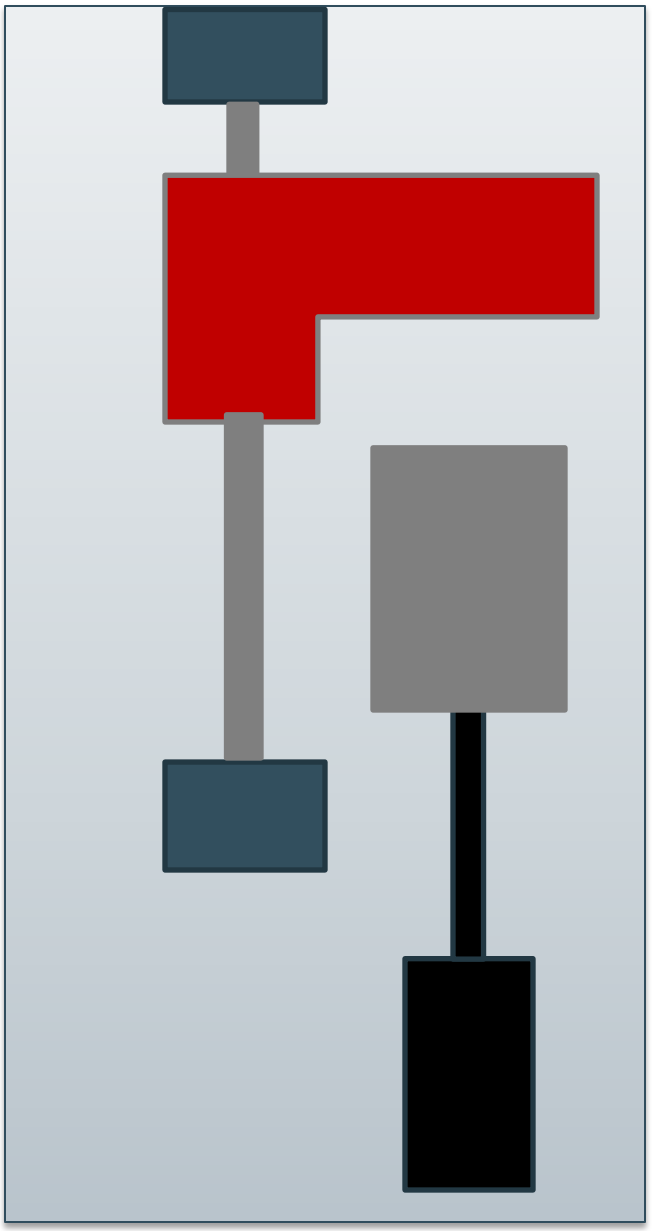
- Moves to allow the hook to open when the system is put in “Armed” mode
- Uses a servomotor to achieve this motion

Constraints:

- Safety pins that mechanically inhibit launching mechanisms during ground procedures
  - Pins labeled with red “Remove Before Flight” flags
- Safety feature that interrupts launch mechanism until “ARM” command is received from the aircraft.
- Launcher shall eject payload when “RELEASE” command is received from the aircraft

Design # 1





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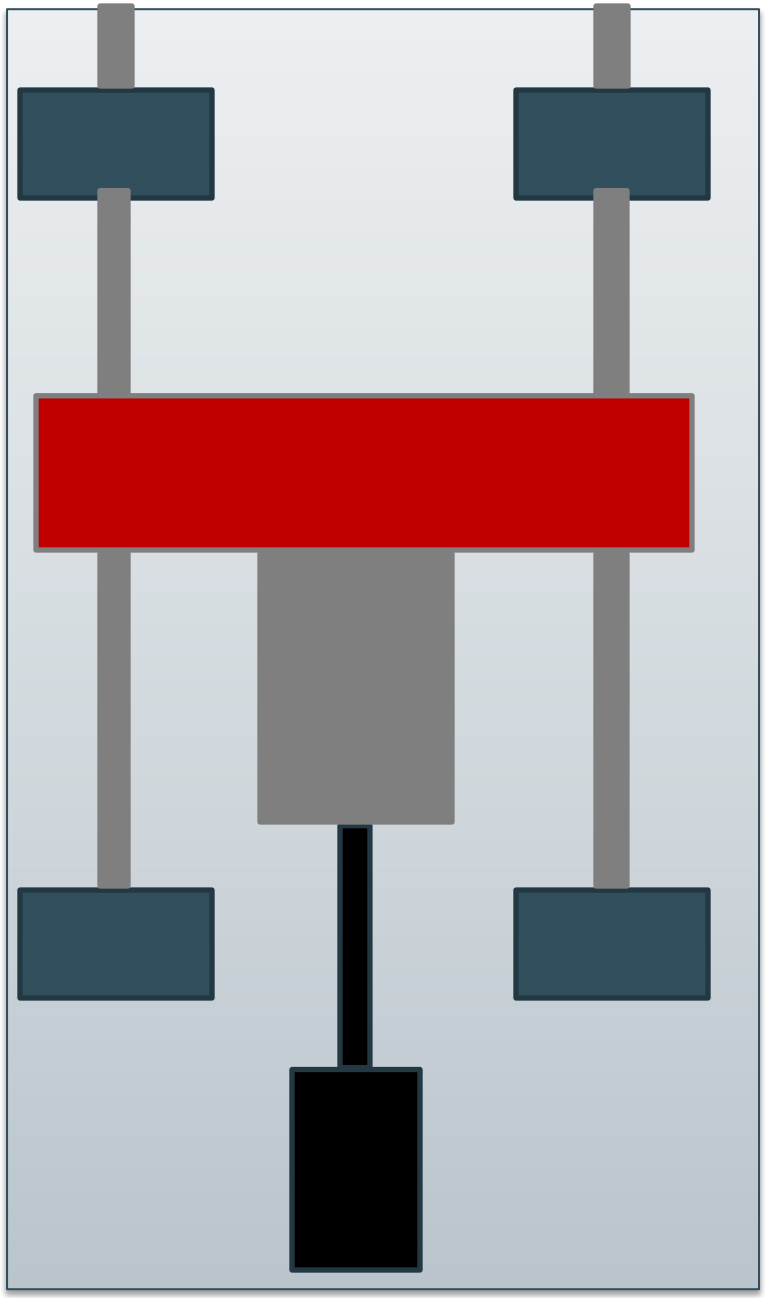
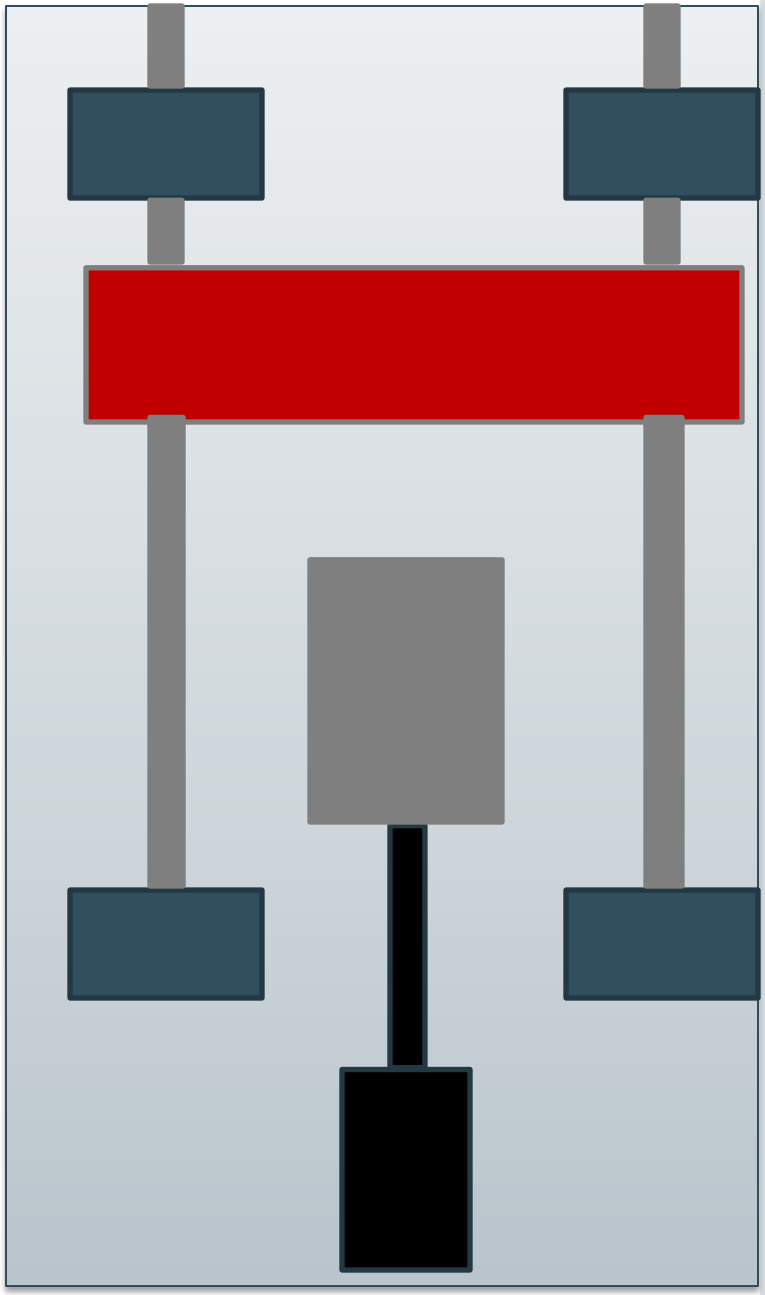
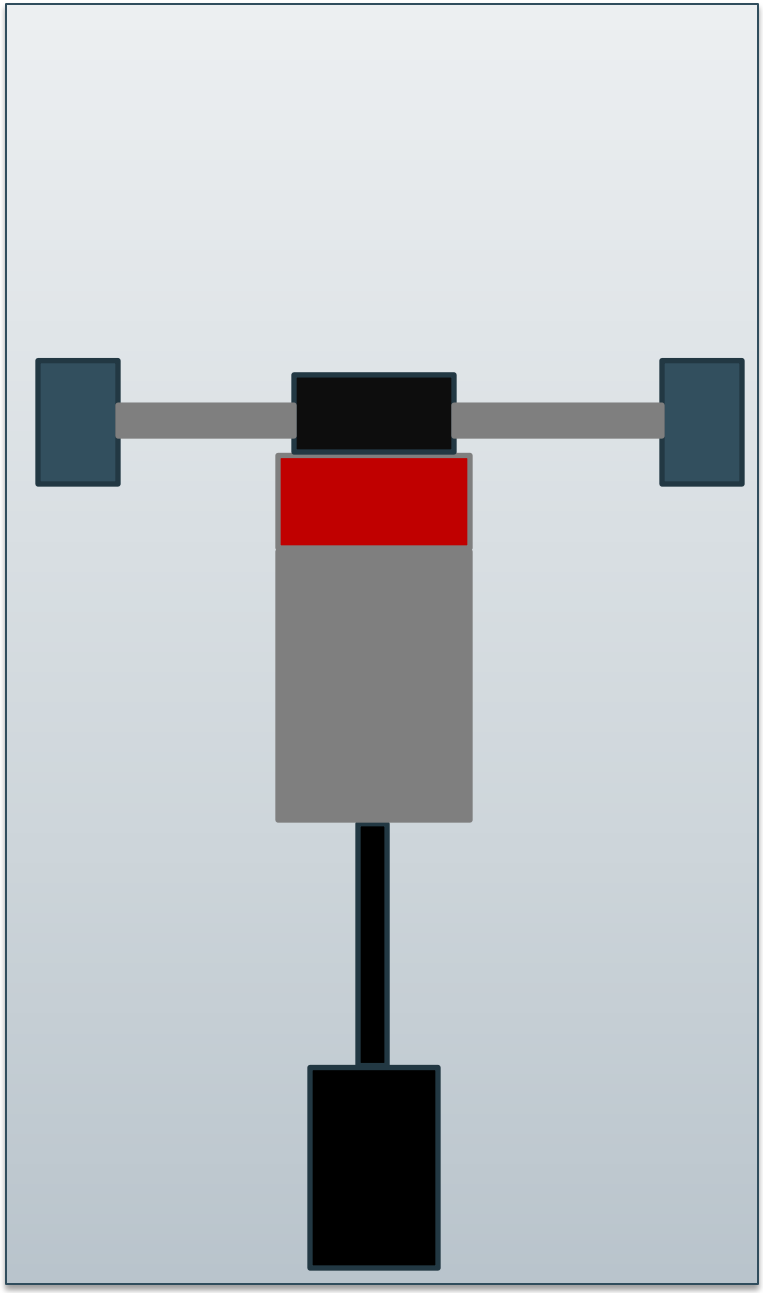
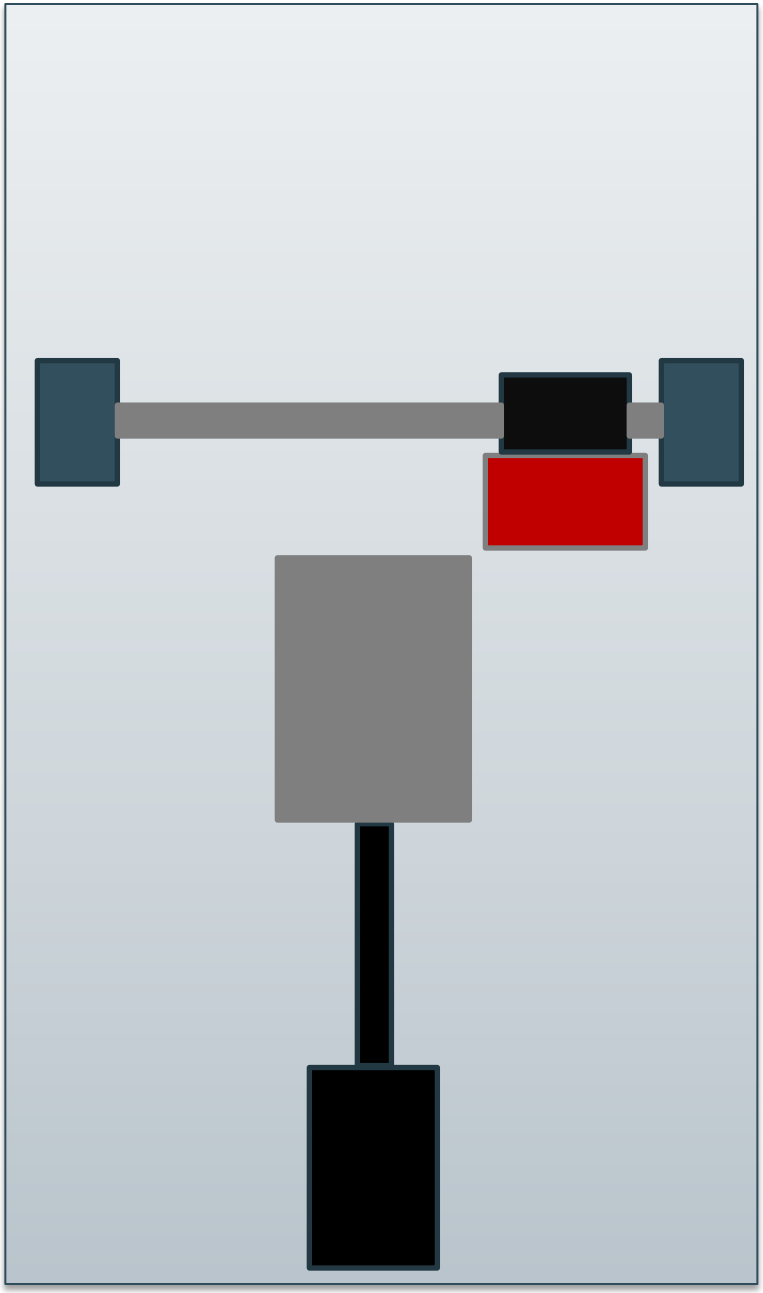


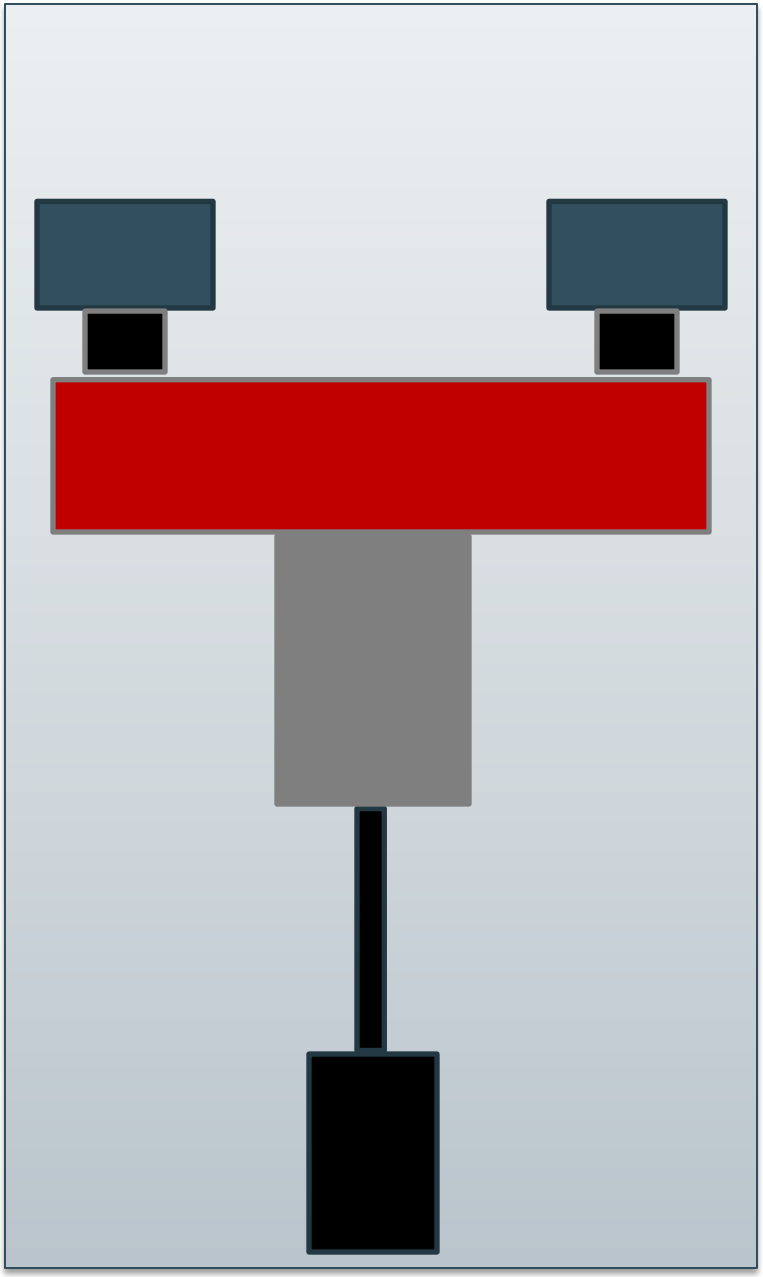


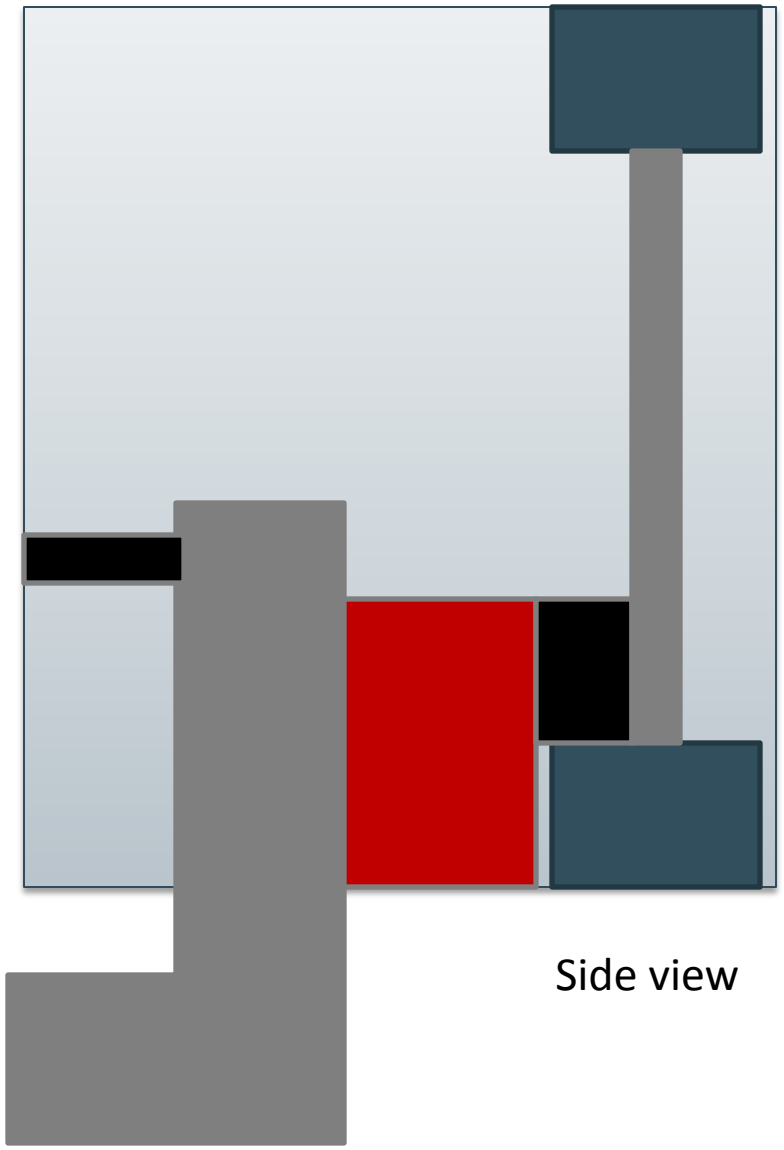
Design #3





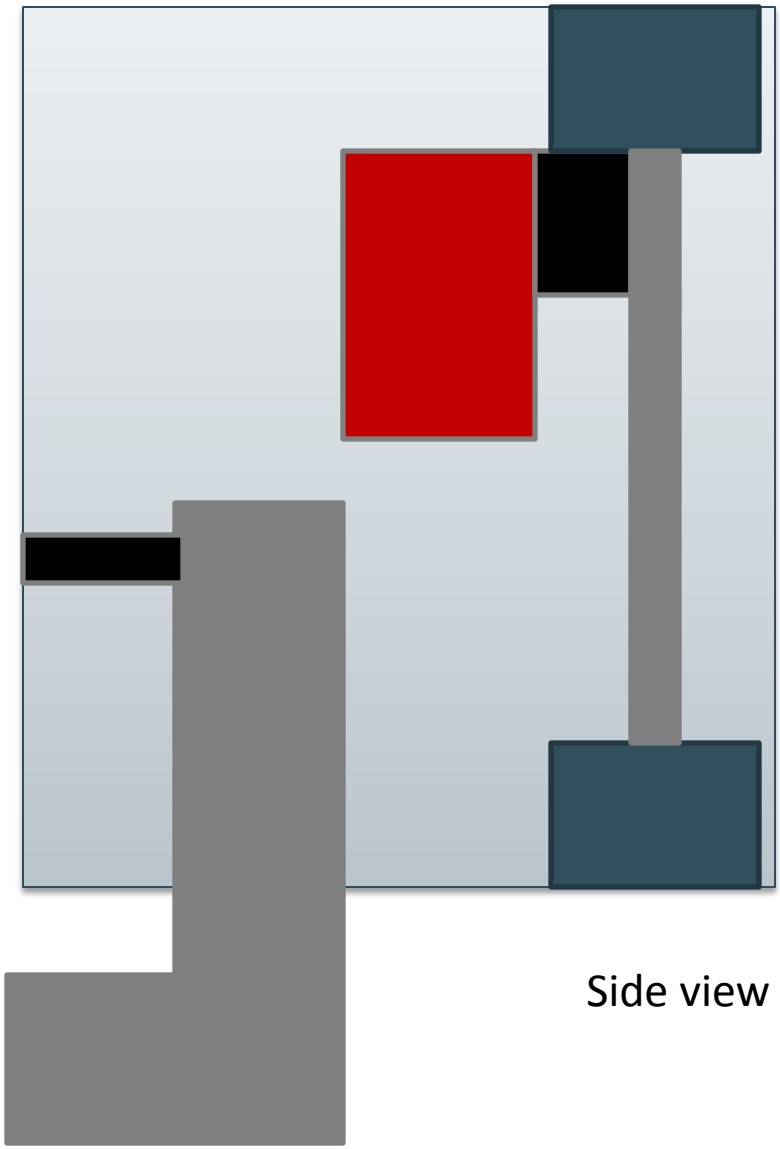
Design #4





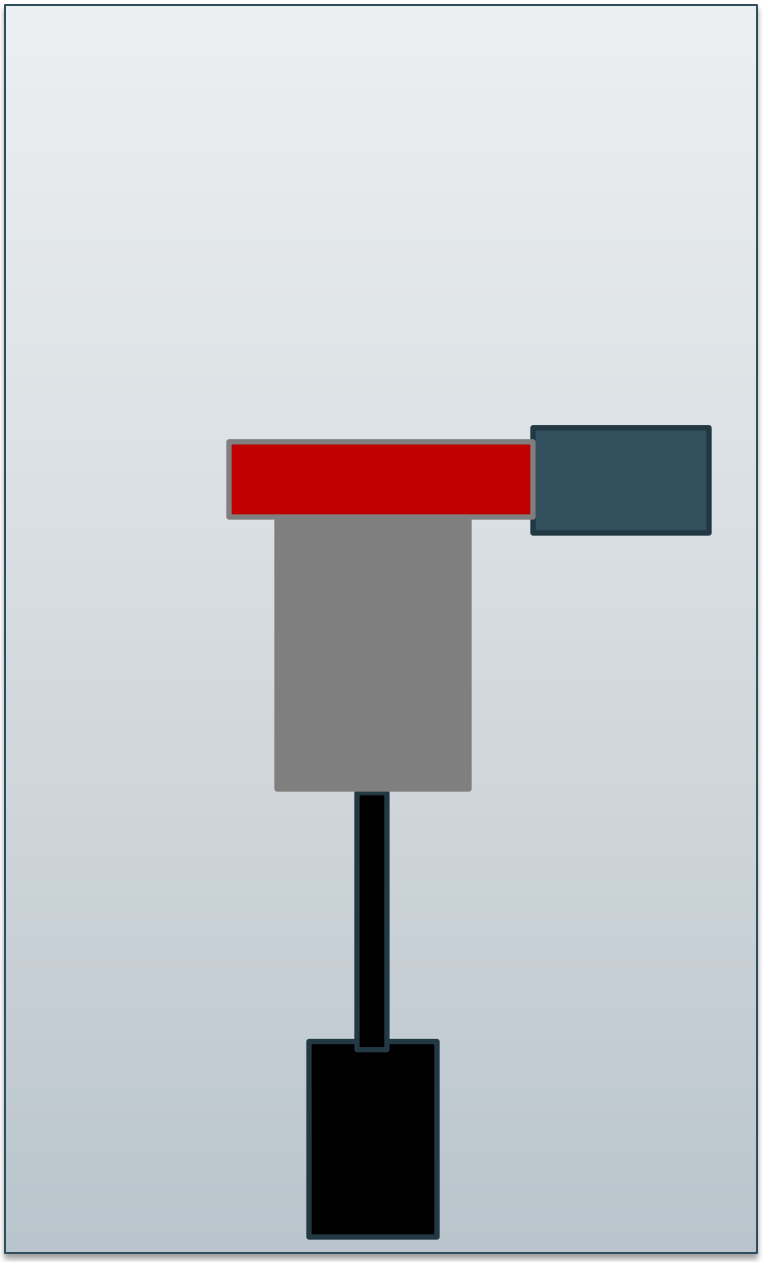
Side view

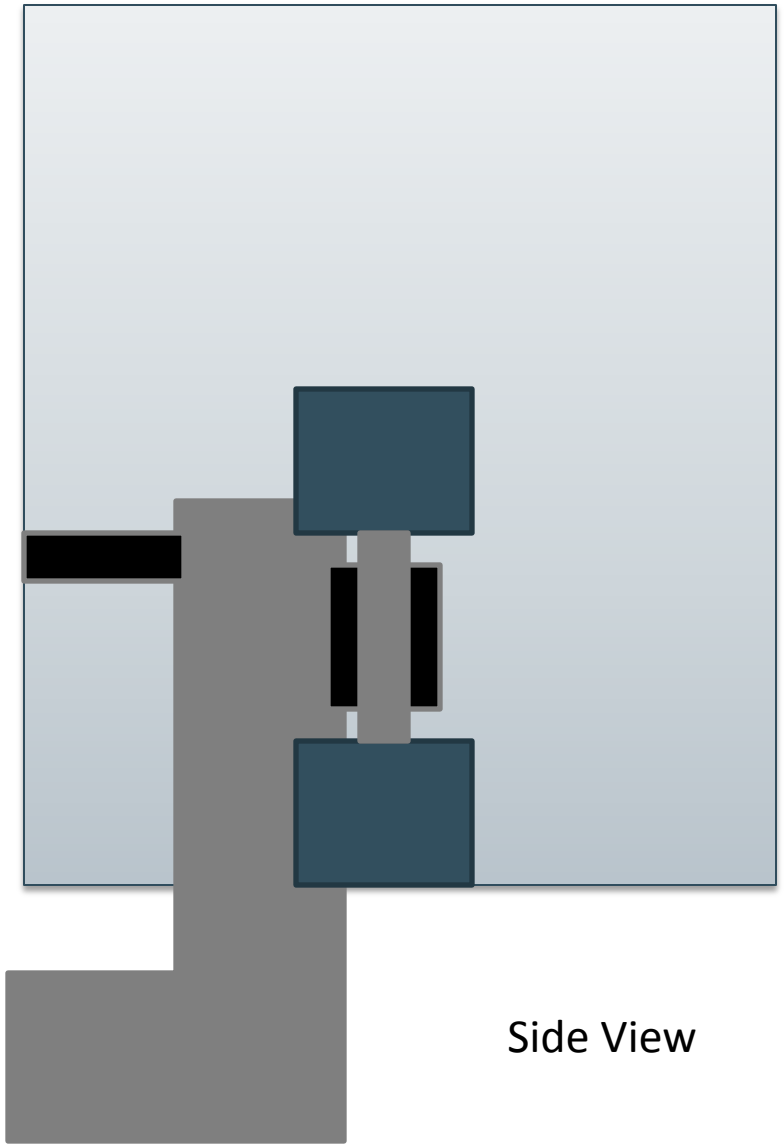
Design #4 in “Armed” mode



Side view

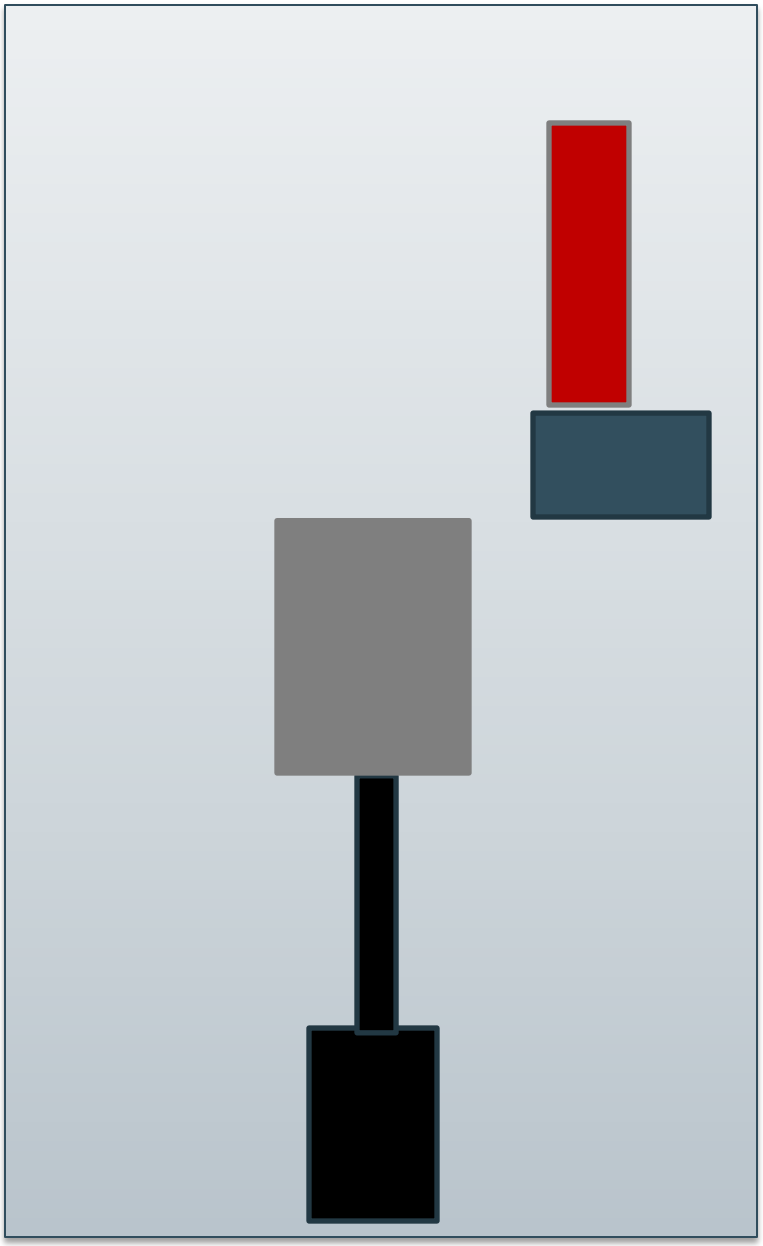
Design #5



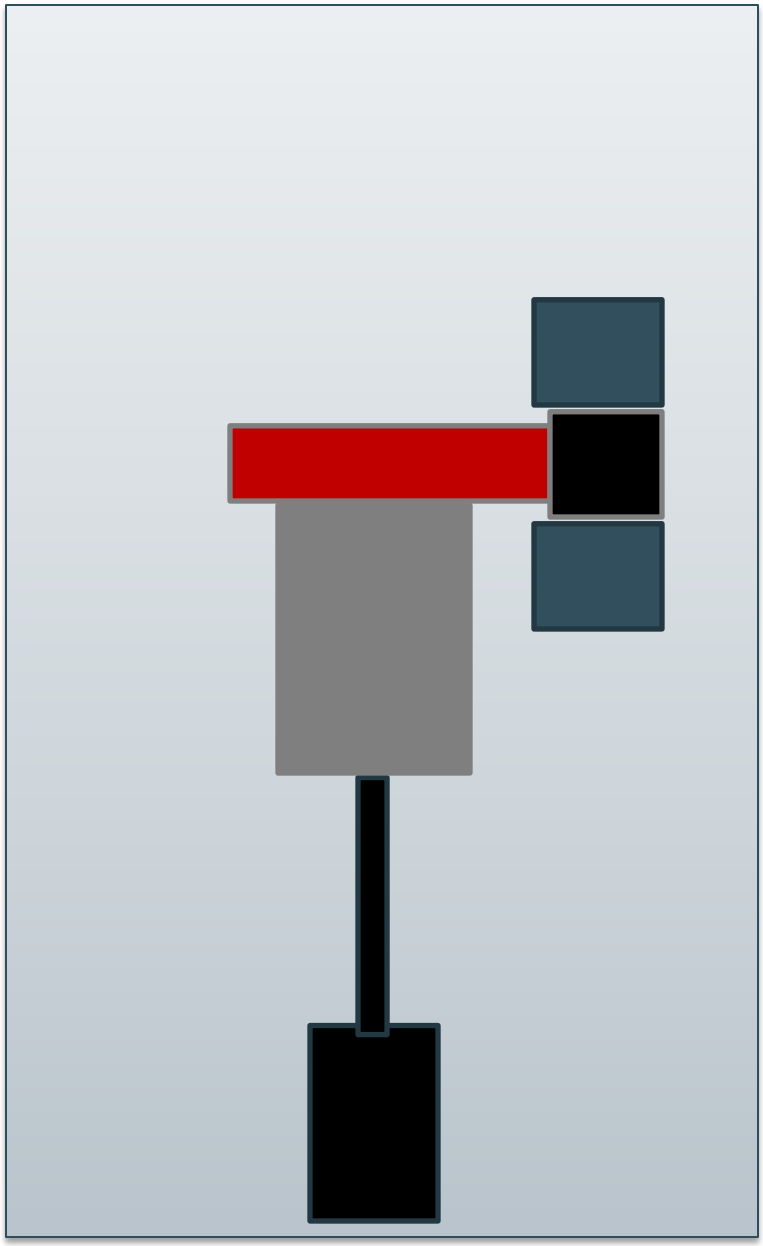


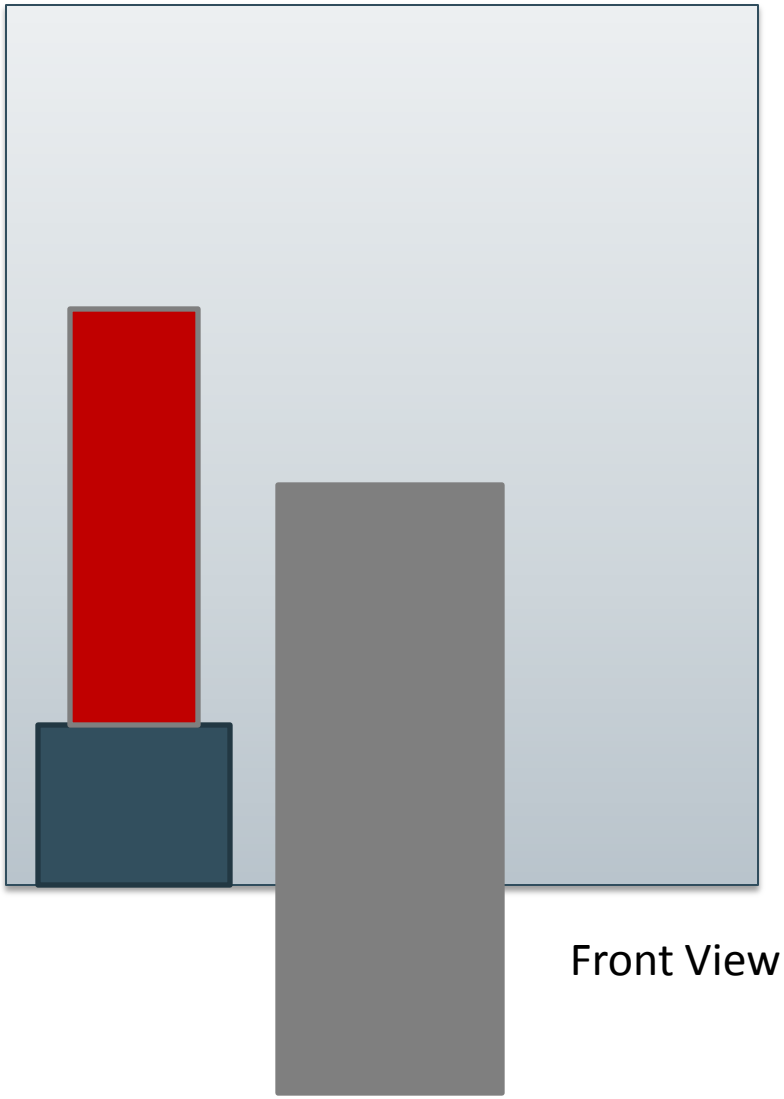
Side View

Design #5 in “Armed” mode



Design #6





Front View

Decision Matrix

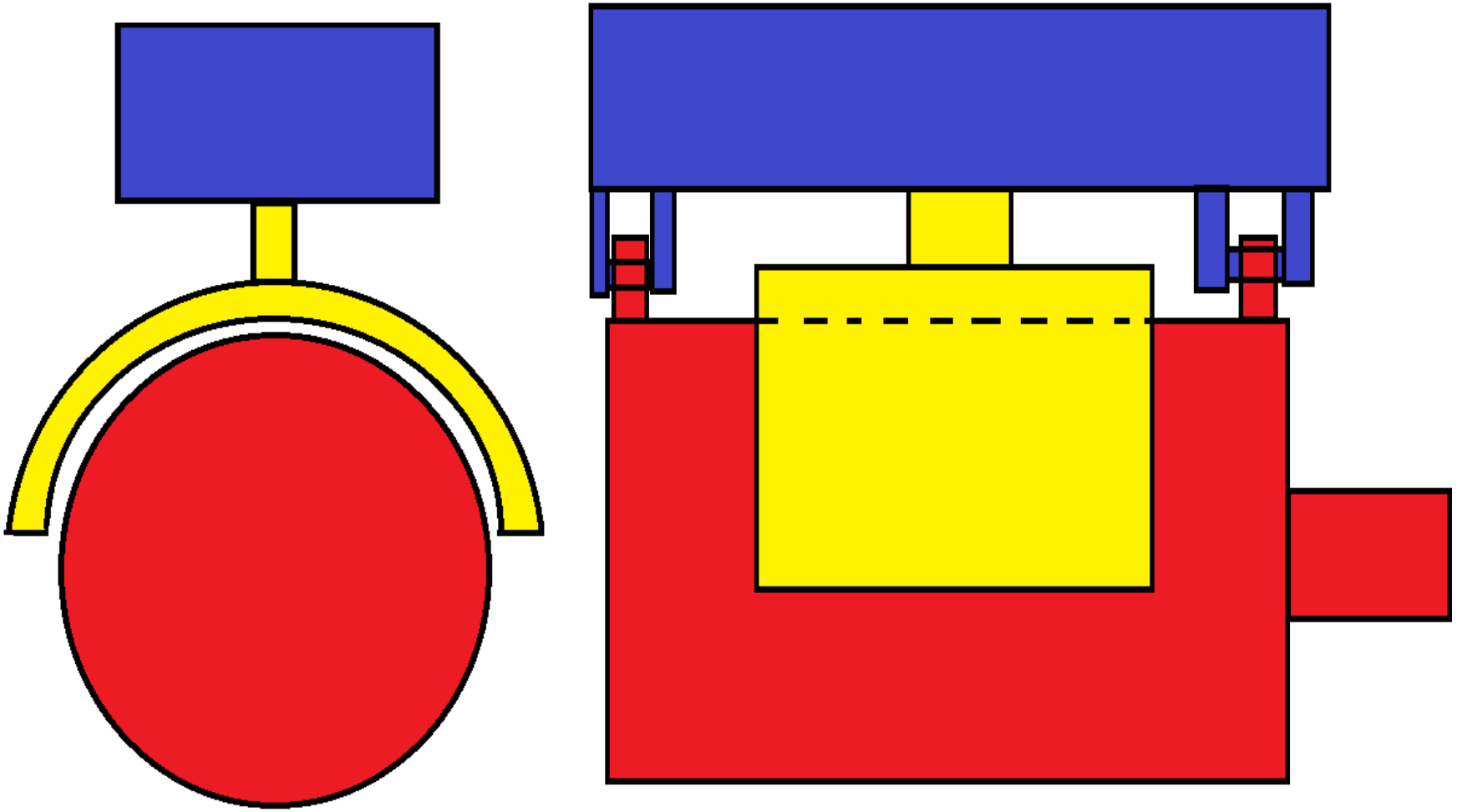
		Designs											
		1		2		3		4		5		6	
Specifications	Weight	Score	Weight	Score	Weight	Score	Weight	Score	Weight	Score	Weight	Score	Weight
Compactness	0.2	3	0.6	2	0.4	3	0.6	2	0.4	4	0.8	5	1
Weight	0.2	3	0.6	2	0.4	4	0.8	2	0.4	5	1	5	1
Strength	0.3	3	0.9	5	1.5	4	1.2	5	1.5	4	1.2	4	1.2
Durability	0.2	3	0,6	5	1	2	0.4	3	0.6	4	0.8	3	0.6
Operational Speed	0.1	4	0.4	5	0.5	2	0.4	3	0.3	5	0.5	4	0.4
Total		3.1		**3.8**		3.4		3.2		**4.3**		**4.2**	

Designs 2, 5, 6 will be used for the interim design process

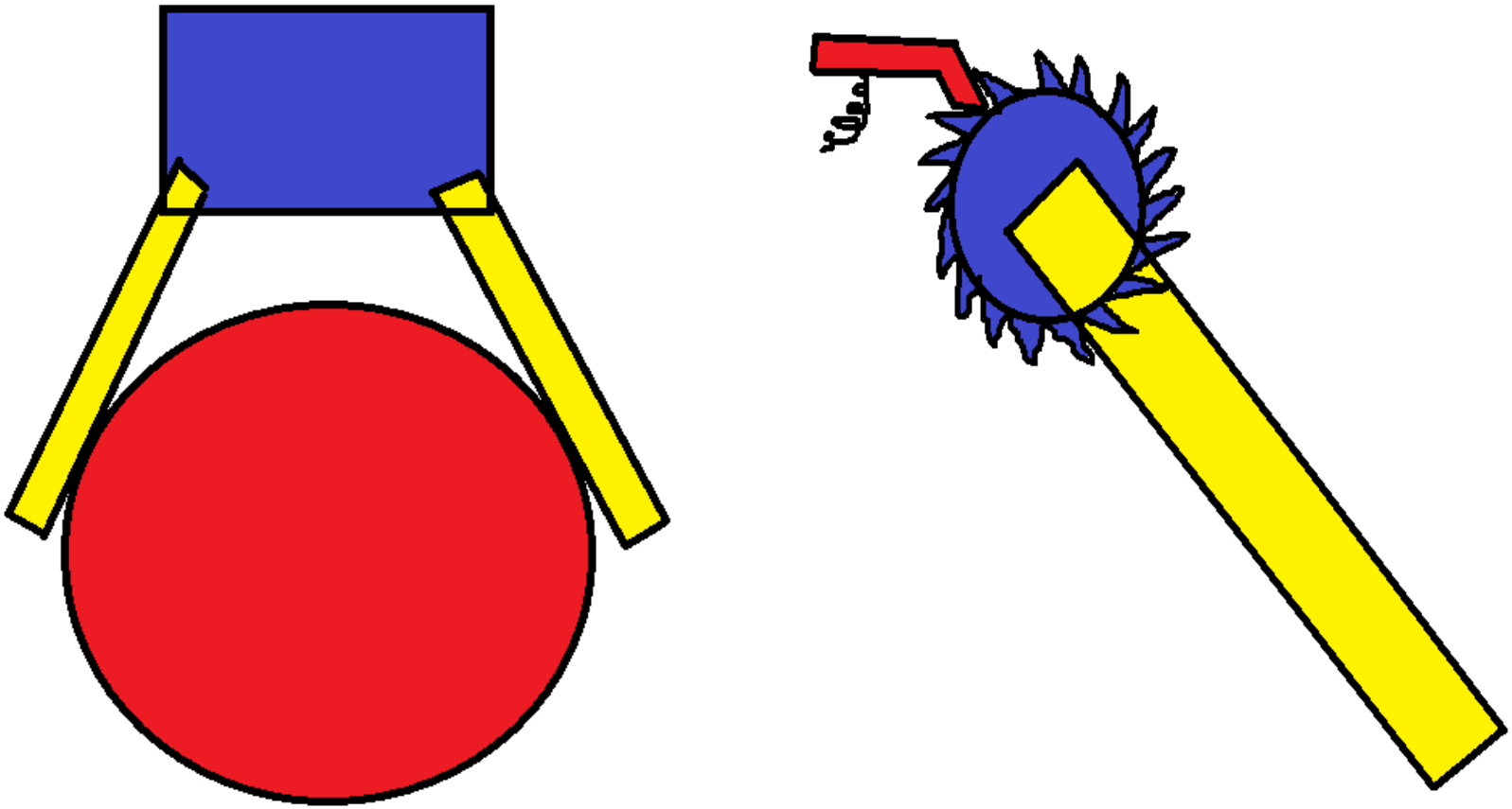
Sway Brace

- Designed to keep payload stable during air operations
- Must be able to withstand aircraft maneuvers up to 2GS lateral load and 1G landing shock
- Sway brace may be able to adjust depending on the size/shape of payload
- Brace must be easy to use allowing the ground crew easily add and remove payloads.

Design #1



Design #2



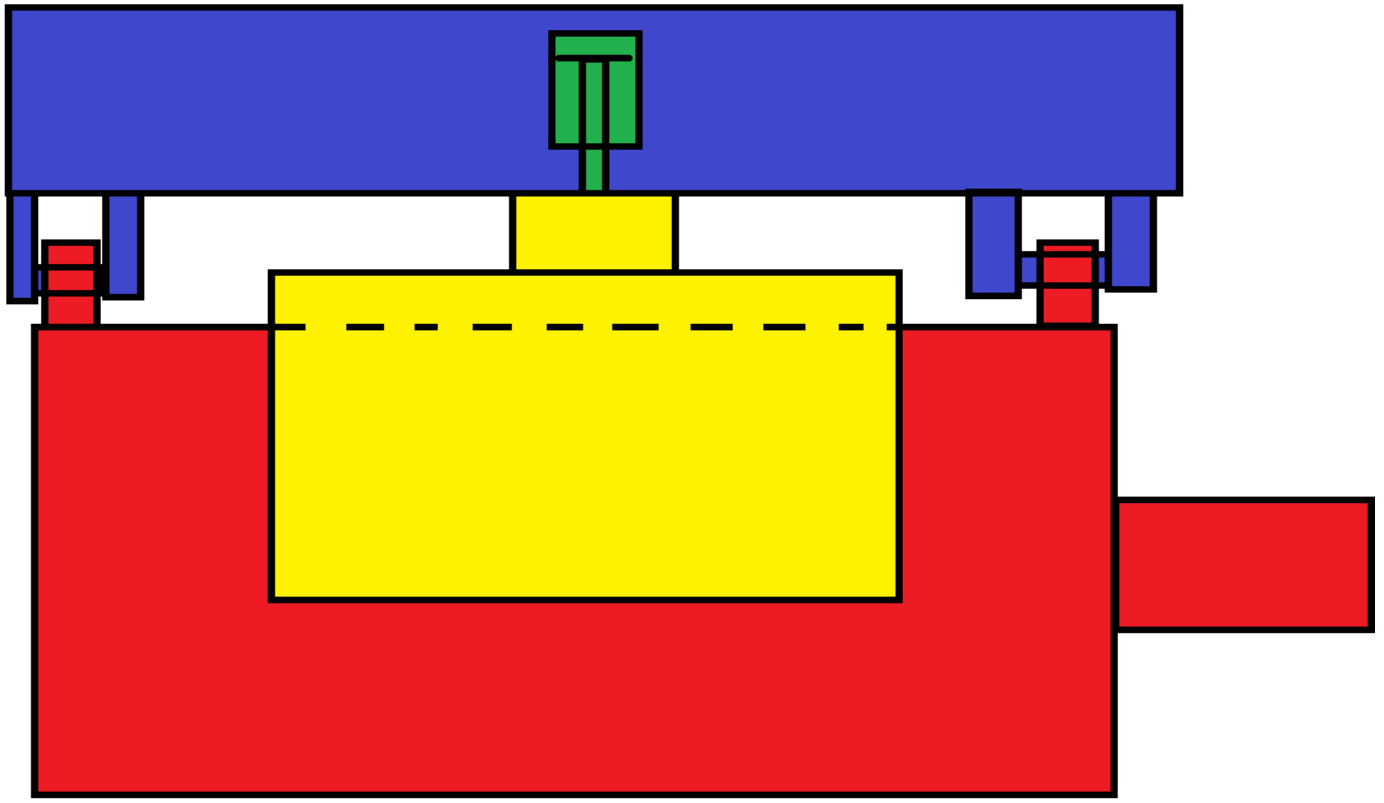
Decision Matrix

		Sway Brace Concepts			
		1		2	
Specifications	Weight	Score	Weight	Score	Weight
Weight	0.3	2	0.6	4	1.2
Load carrying	0.3	5	1.5	3	0.9
Store Size Flexibility	0.15	1	0.15	5	0.75
Durability	0.1	4	0.4	2	0.2
Ease of Use	0.1	5	0.5	4	0.4
Simplicity	0.05	5	0.25	2	0.1
Total		3.4		3.55	

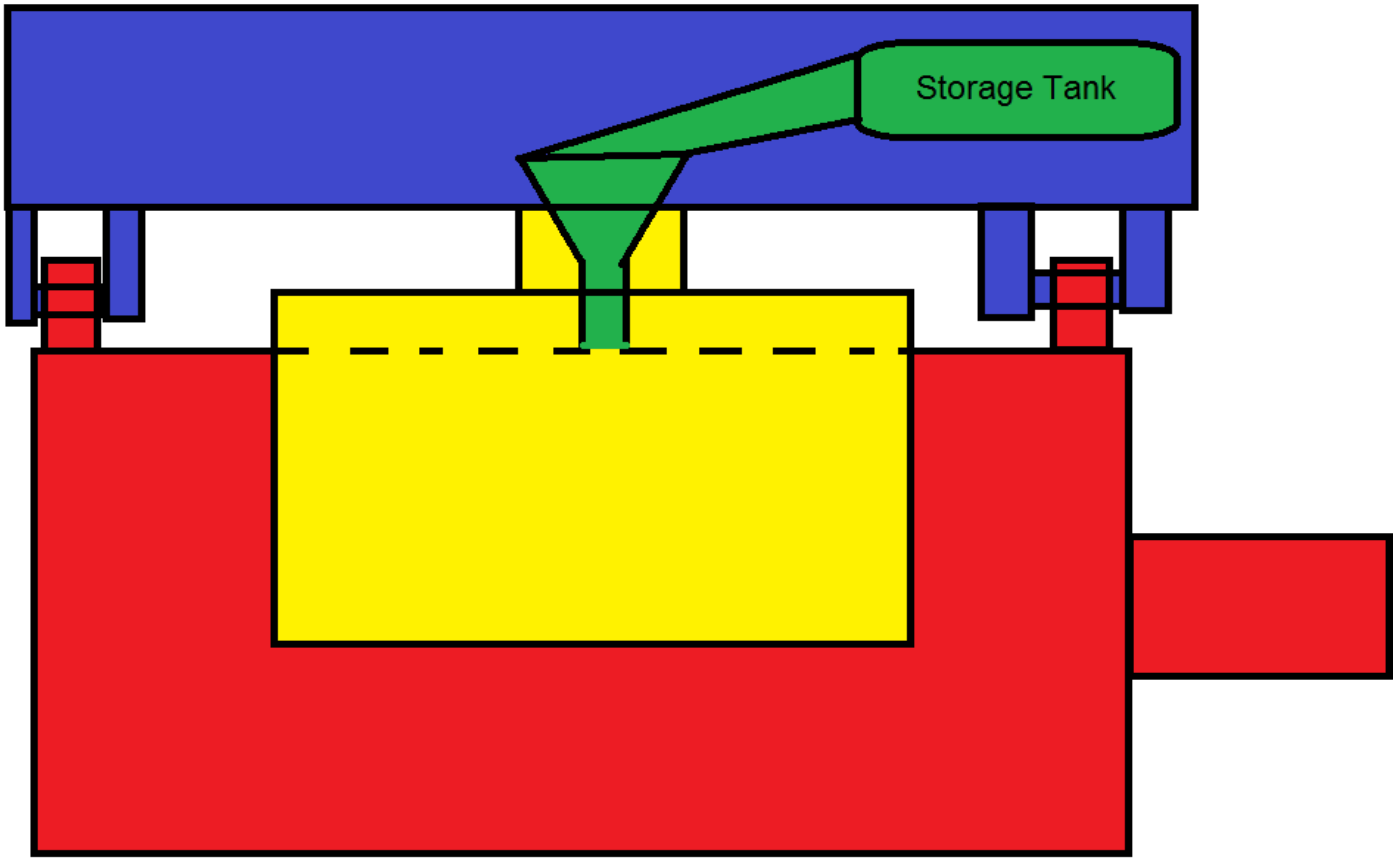
Ejector Mechanism

- Launcher will eject payload when “RELEASE” command is received from the aircraft.
- Free fall will not allow enough separation between the wing and payload
- Ejection velocity shall be a minimum of 10ft/s
- Net ejection energy of no more than 75 ft-lbs

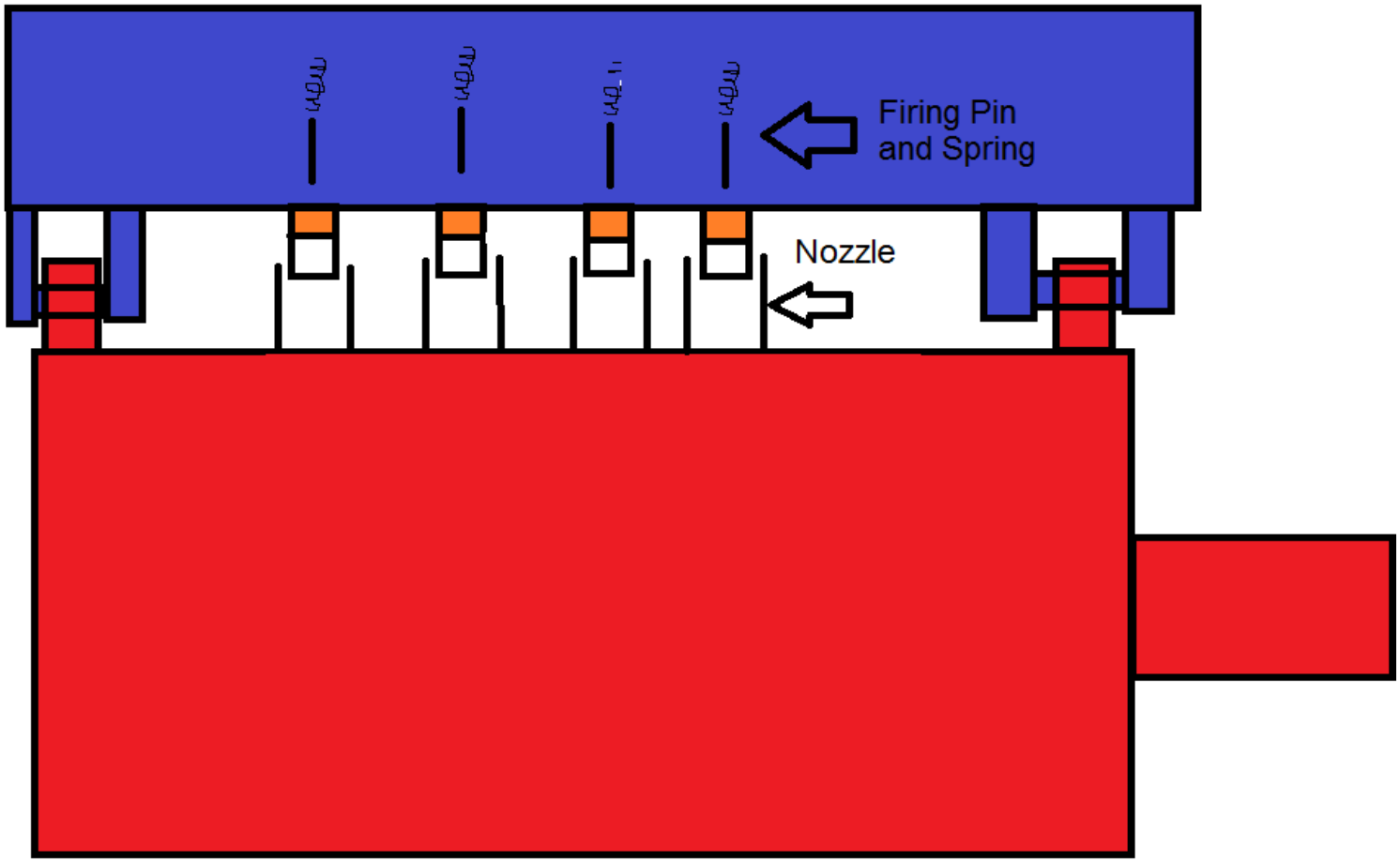
Design #1



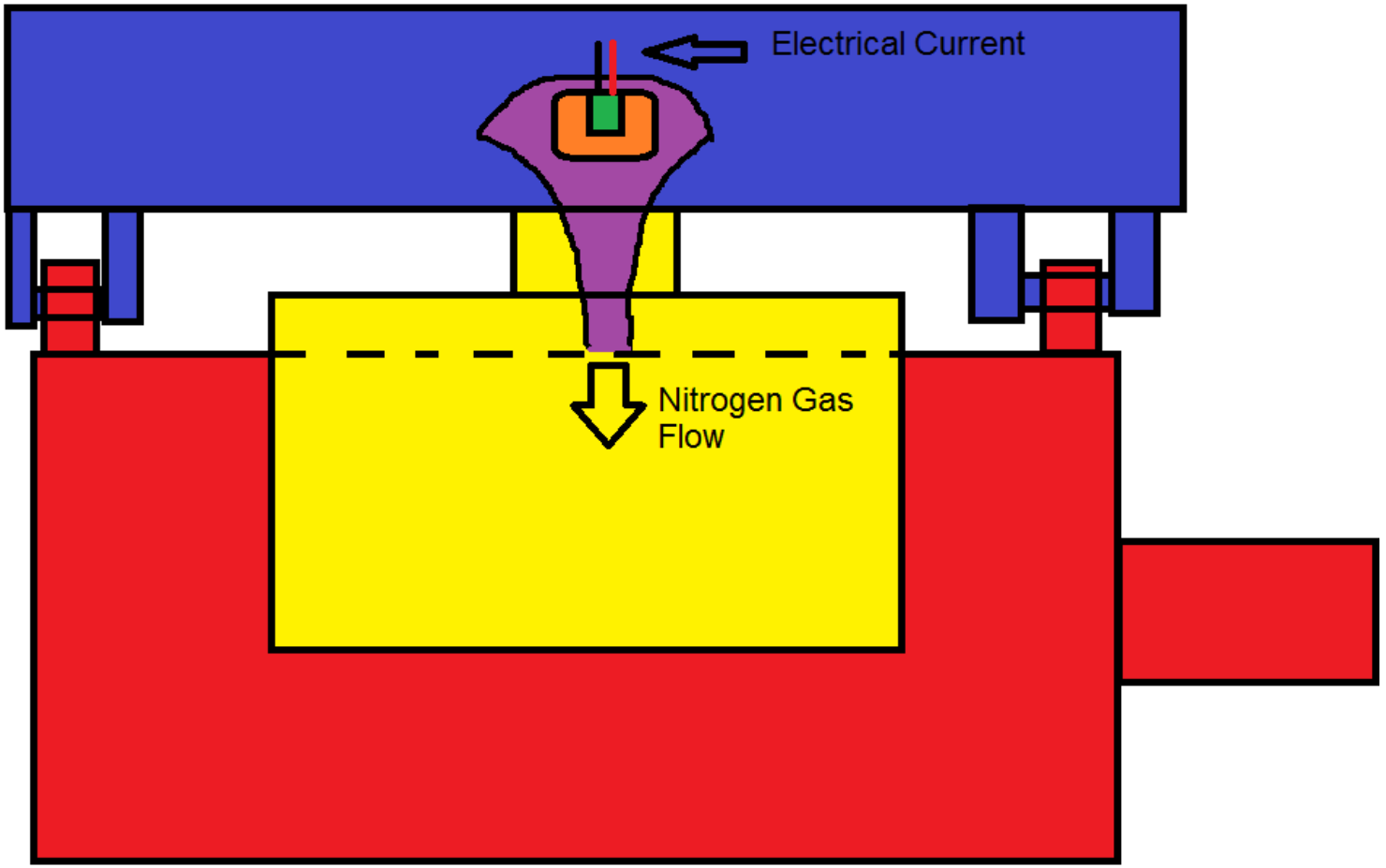
Design #2



Design #3



Design #4



Decision Matrix

		Ejector Designs							
		1		2		3		4	
Specifications	Weight	Score	Weight	Score	Weight	Score	Weight	Score	Weight
Weight	0.25	2	0.5	3.5	0.875	5	1.25	2.5	0.625
Size	0.15	3	0.45	4	0.6	5	0.75	2	0.3
Cost	0.1	2	0.2	3	0.3	4	0.4	2	0.2
Safety	0.2	4.5	0.9	4	0.8	1	0.2	2	0.4
Ease of Use	0.2	3	0.6	3	0.6	4	0.8	3	0.6
Simplicity	0.1	3	0.3	3	0.3	2	0.2	4	0.4
Total		2.95		**3.475**		**3.6**		2.525	

Conclusion/Next Steps

- Integration of our components into one cohesive system
- Develop a mechatronic system integrated with an intervalometer to organize sequence of events for payload release
- Engineering analysis on each component taking into account given constraints
- Interim Design

Questions ????

References

Hawks, Chuck. ".22 Rimfire Cartridges." *CHUCKHAWKS.COM: Guns and Shooting Online; Motorcycles and Riding; Military History; Astronomy and Photography Online; Travel and Fishing Information Guide*. Web. 18 Oct. 2011. <http://www.chuckhawks.com/22_rimfire_cartridges.htm>.

"HowStuffWorks "Airbag Inflation"" *HowStuffWorks "Auto"* Web. 13 Oct. 2011. <http://auto.howstuffworks.com/car-driving-safety/safety-regulatory-devices/airbag1.htm>.