



University of Idaho
College of Engineering

QUALITY TUGS DESIGN REVIEW

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PROBLEM DEFINITION



The goal is to create an airplane tug that can be used with a wide variety of tire sizes and types including those with wheel pants.



PRODUCT REQUIREMENTS



- Minimal user input
- Different size wheels
 - 8.00x6
 - 7.00x6
 - 6.00x6 (wheel pants)
 - 5.00x6
 - 4.00x4
- 4,000 lb. aircraft
- 500 lb. static vertical load
- 5,000 cycles of operation
- Carry load up 2% grade
- Handle variety of surface conditions

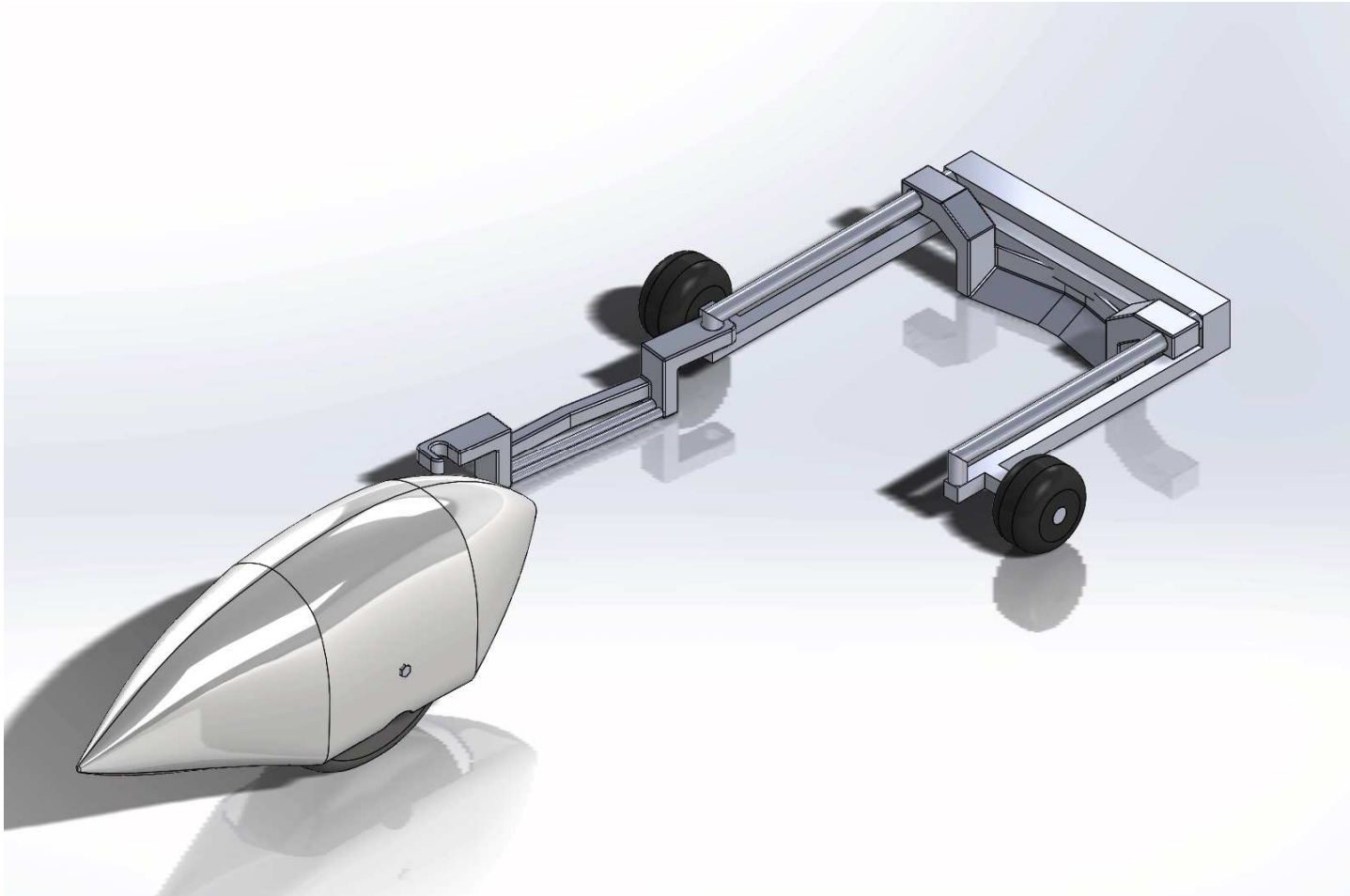


PALLET JACK

- Motorized drive and lift
- 840 lbs. empty weight
- Our device will be a prosthetic to the pallet jack to capture wheels
- Forks:
 - 47 ¼" in length
 - 7 ¼" wide
 - 3 ¼" off of ground
 - 12 ¼" between each fork

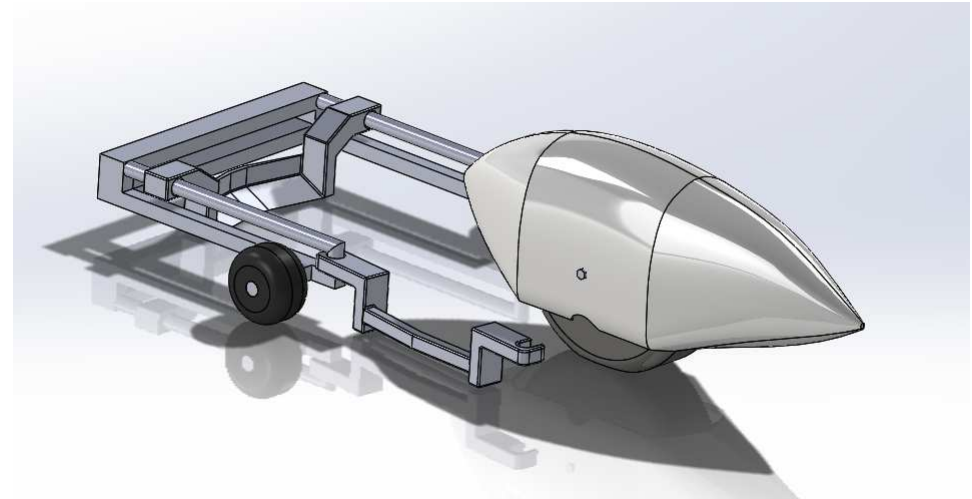
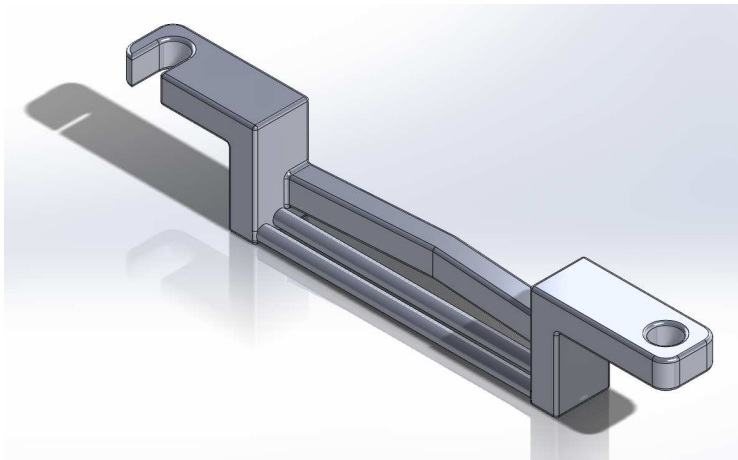


DESIGN IDEA 1



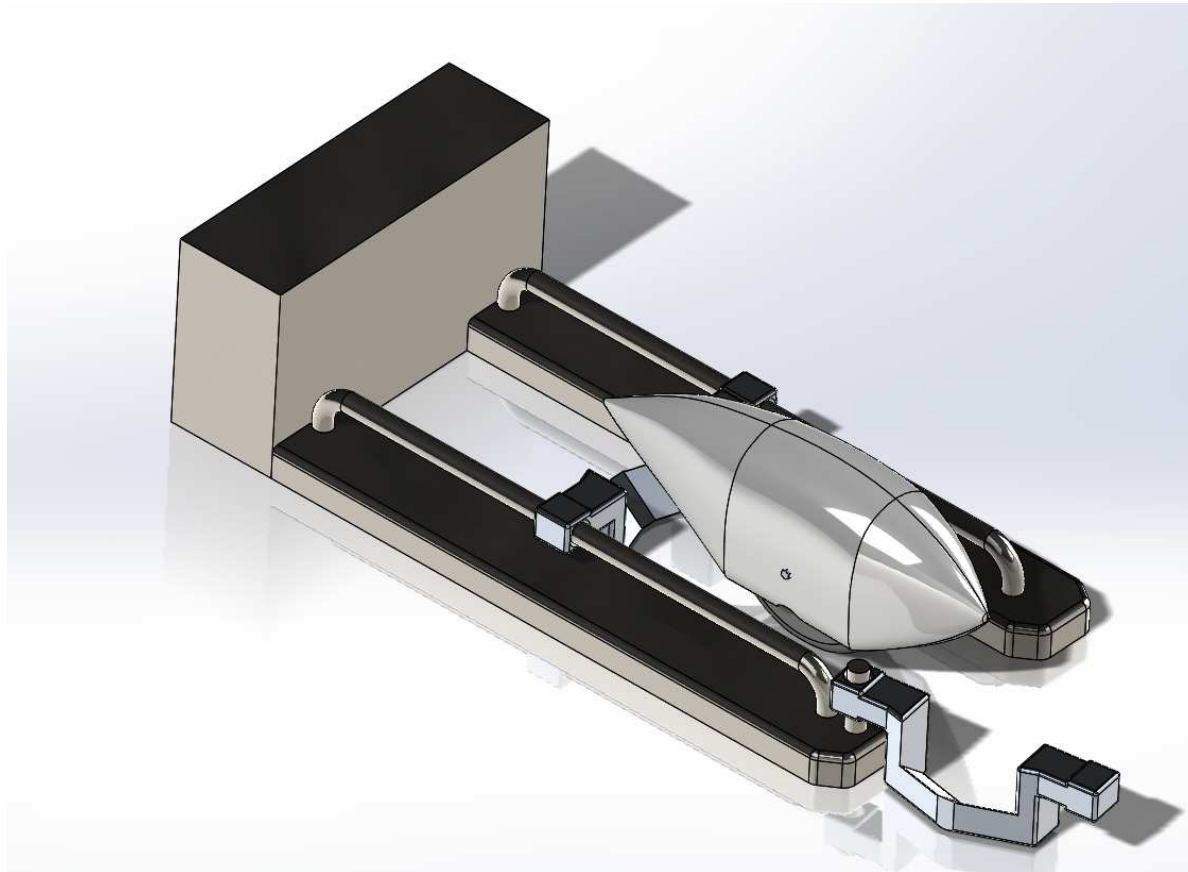
DESIGN IDEA 1

- Gate is closed by the operator once tug is in place (pull cord).
- Linear actuator pushes wheel against gate.
- Sliding mechanism uses UHMW plastic to reduce friction and part count (as opposed to bearings).

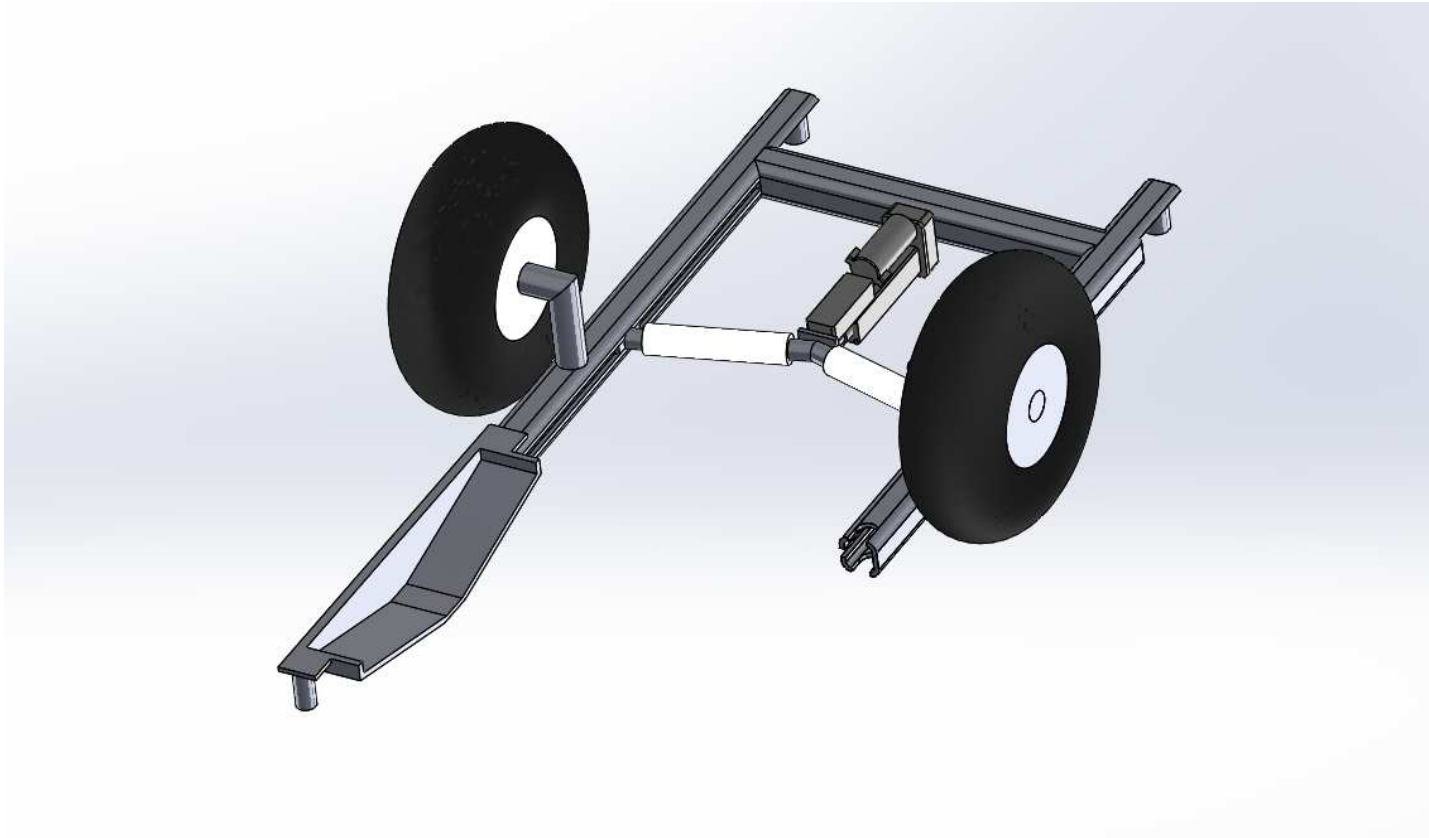


- Roller bearings are used to “lift” wheel when clamped.
- V shape helps stabilize tires of different widths.

DESIGN IDEA 1 ON PALLET JACK



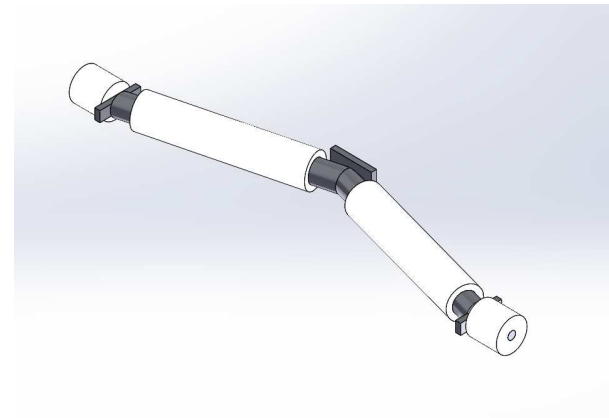
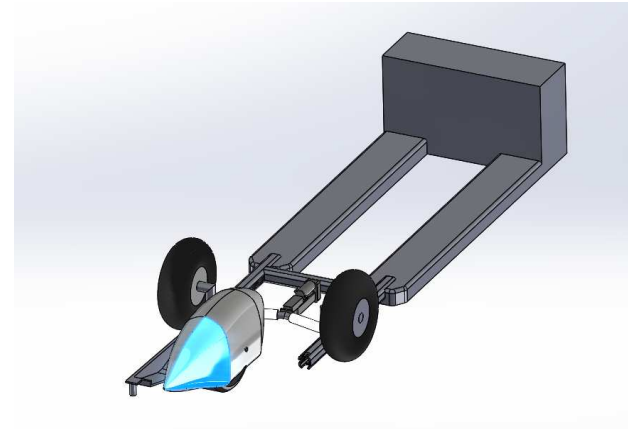
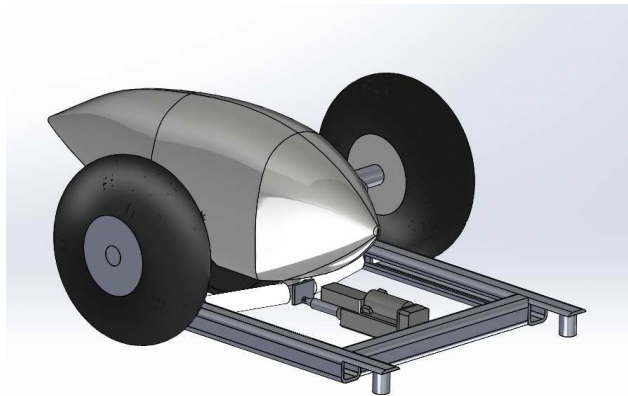
DESIGN IDEA 2



DESIGN IDEA 2



- Very Similar to Design 1
- Uses square tubing instead of steel rod.
- UHMW rollers and sliders
- Can be removed from pallet jack



DESIGN IDEA 2

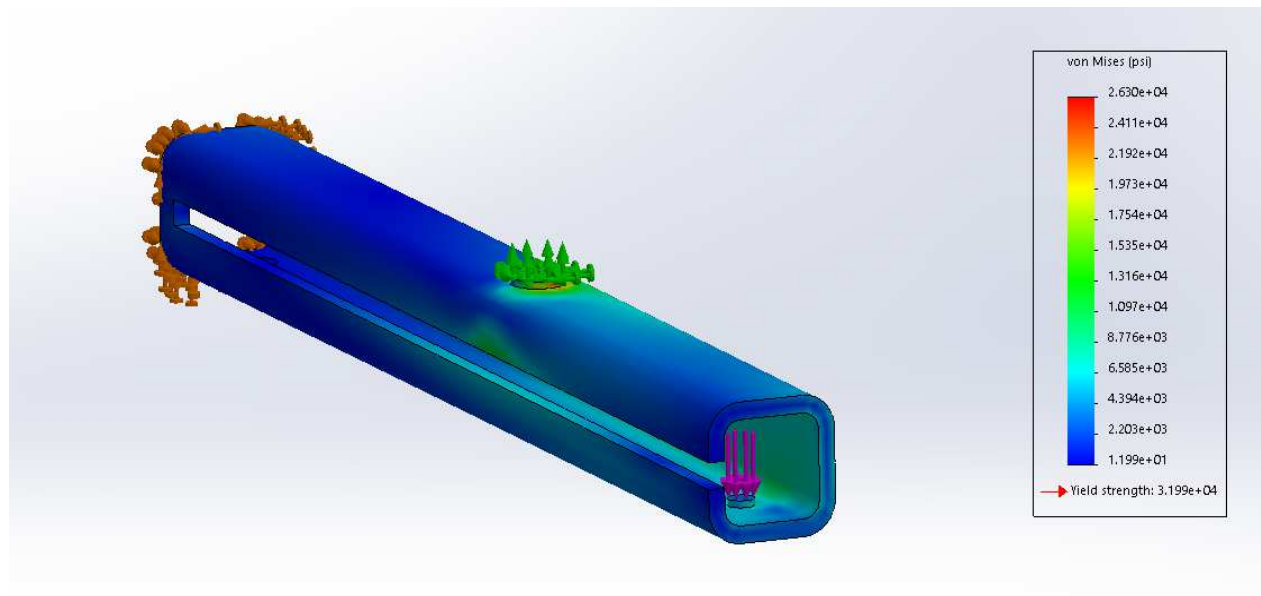


Pros:

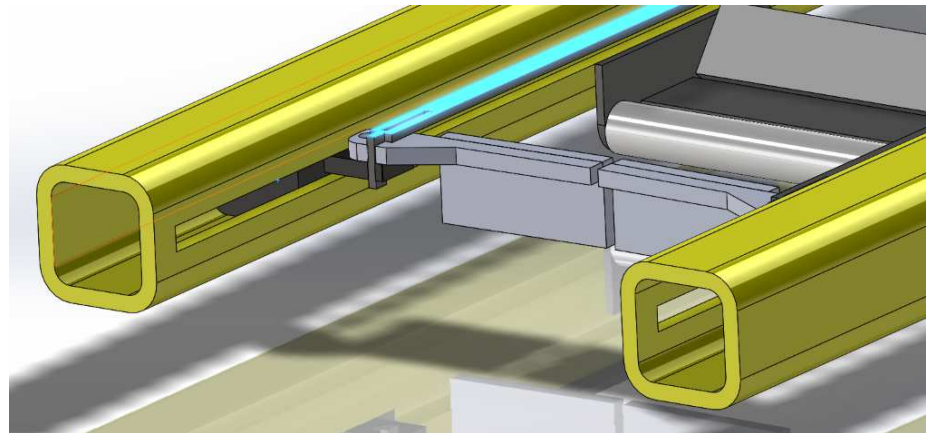
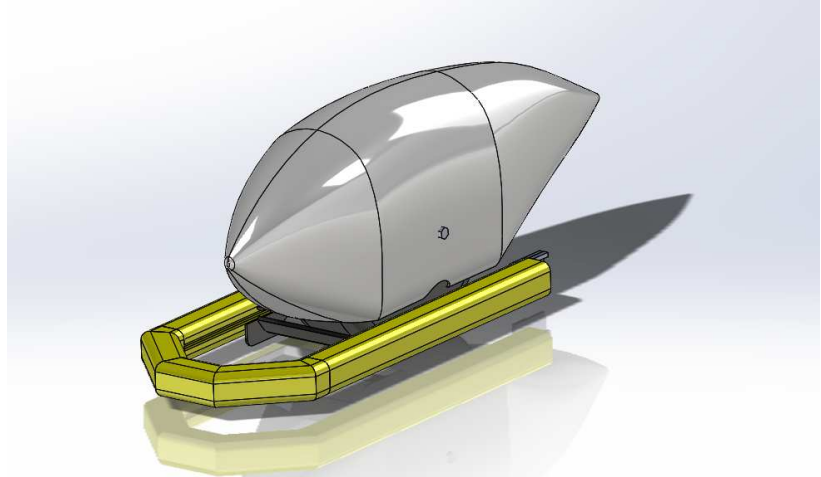
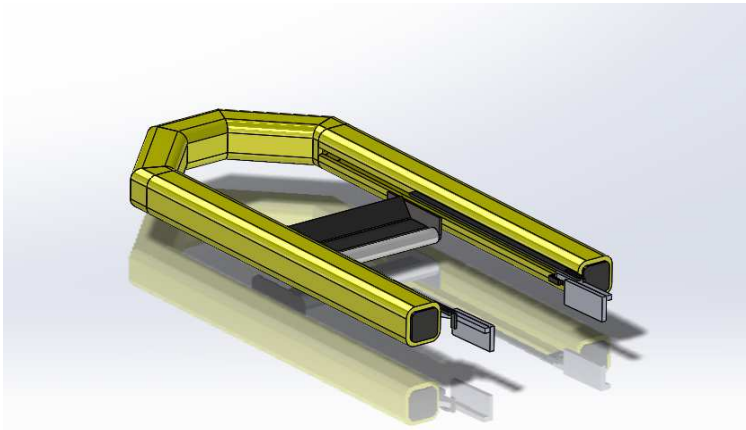
- Extremely Strong
- Cheap
- Closed System

Cons:

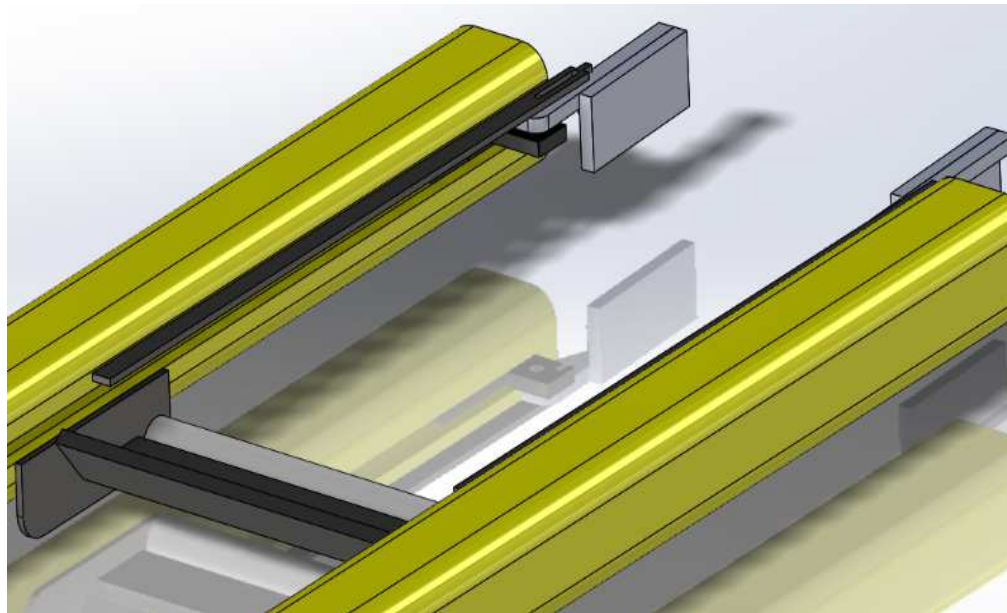
- Must be machined
- Gate system may be complicated
- Extends the pallet jack



DESIGN IDEA 3

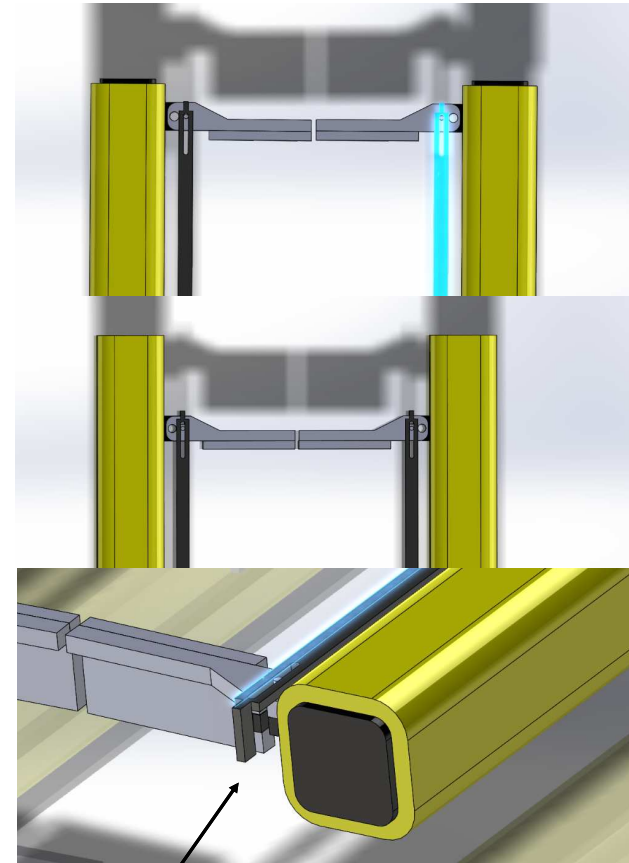
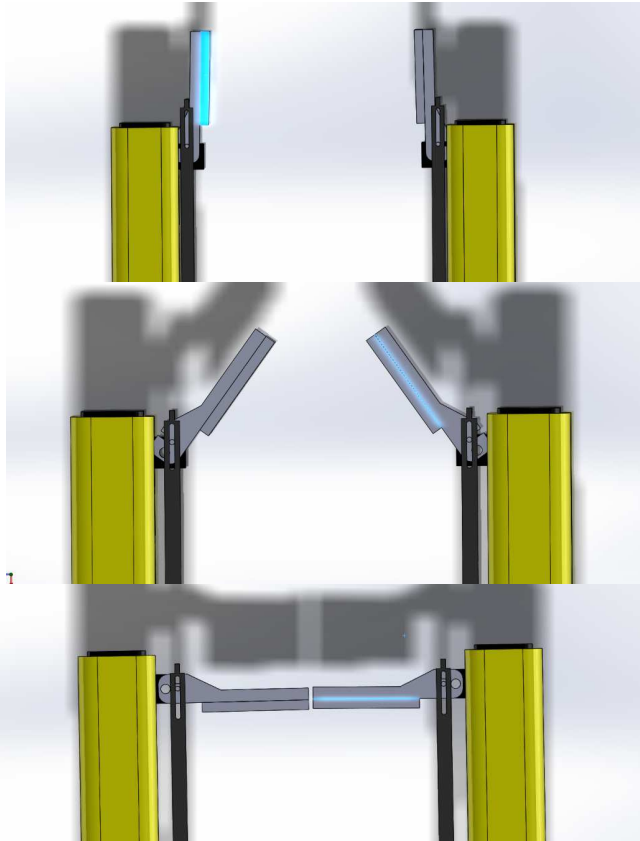


DESIGN IDEA 3



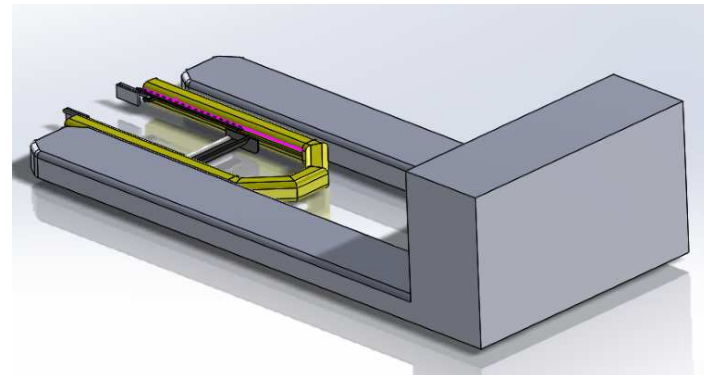
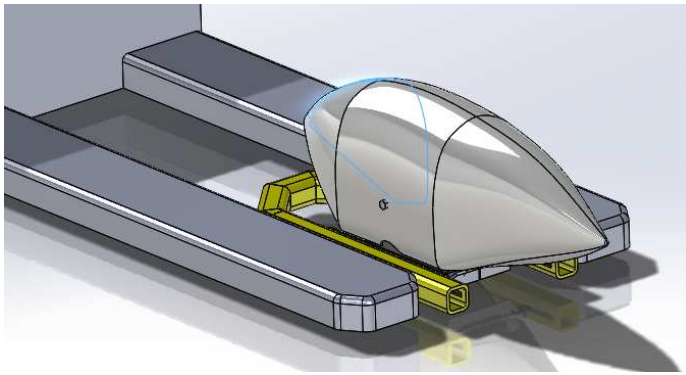
- Slot and pin allow to hold gate shut and then open at end of stroke
- Achieves shutting the gate and pulling the tire with one linear motion
- Linear actuator moves arm
- Roller bearing and backing plate for tire to rest on
- Compact enough to fit inside pallet jack forks
- UHMW on sliders

DESIGN IDEA 3



Locking Pin

DESIGN IDEA 3 ON PALLET JACK



Pros

- Compact
- Easy to use(one motion)
- Fits on pallet jack

Cons

- Some complicated parts
- Requires some machined parts
- Clearance on 8.00x6" tire is very tight

Future Ideas

- Improve the hinge to allow for more clearance
- Make the tube frame smaller
- Make the locking pin round and provide a better path for it to travel
- Improve design of components to provide more strength.

LINEAR ACTUATORS



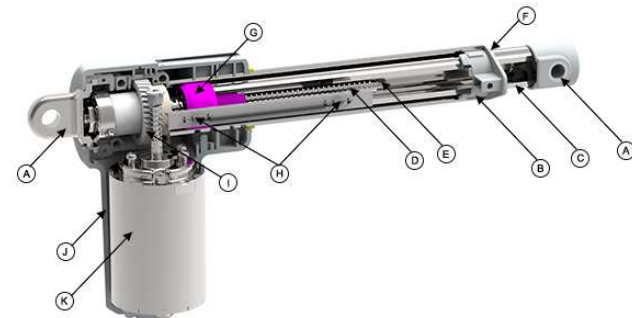
- Used to push wheel onto device
- Needed stroke length = 10"
- Could run off pallet jack battery or standalone power supply

Pros

- Long stroke length
- Light weight
- Small size

Cons

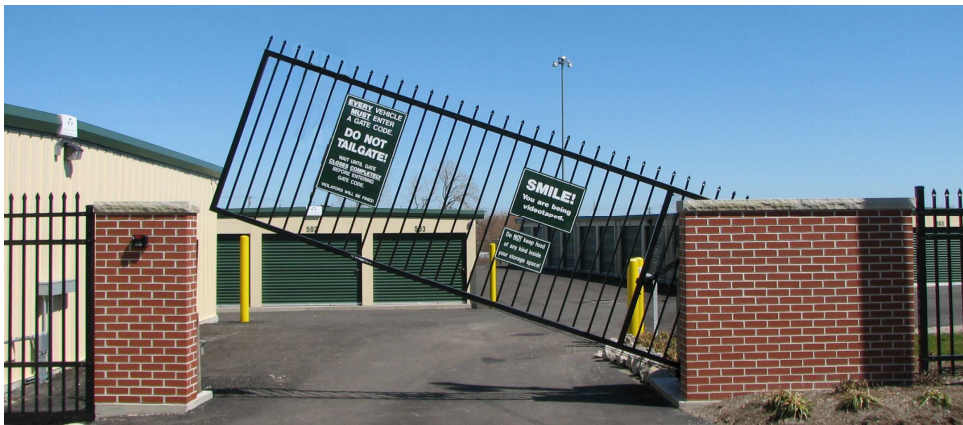
- Expensive
- Needs battery
- Requires Control System



LATCHING MECHANISMS



- May require more than one motion
- Possibly controlling the gate with another linear actuator
- Vertical instead of horizontal moving gate
- Automated latch with servo motor



RECOMMENDATIONS



- Linear Actuator
- Steel or Aluminum Tube Frame
- UHMW for low friction sliding and reduced part count



BUDGET



Capstone: Quality Tugs Budget												
Project: Electric Airplane Tug												
Last Updated: 11/30/2018												
Expense Items	Year								Item Total			
	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr				
Equipment/Tools:												
										\$ -		
Travel:												
Trip to CDA (09/20)	\$ 101.38									\$ 101		
Trip to CDA (March)							\$ 150			\$ 150		
Supplies / Parts / Services:												
Steel							\$ 30			\$ 30		
Linear Actuators							\$ 360			\$ 360		
Springs							\$ 30			\$ 30		
Latch							\$ 70			\$ 70		
3D Printing Filament				\$ 50						\$ 50		
UHMW							\$ 30			\$ 30		
8020							\$ 100			\$ 100		
Bearings							\$ 160			\$ 160		
Angle Plate							\$ 40			\$ 40		
Miscellaneous							\$ 100			\$ 100		
										\$ 1,221	Subtotal	
Shop Usage (est. Hrs):												
										Hours		
Machining					15	15	10	5		45		
Welding					10	10	5	5		30		
										0		
										0		
										0		
										0		
Graduate Student Support										\$ 519	including fringe	
Shop Overhead										\$ 500		
University Overhead										\$ 112	5% of all expenses	
Totals										\$ 2,352	\$ 2,500	\$ 148
										Budget	Excess	

8020



QUESTIONS?

