University of New Hampshire

PROJECT PEDICAB

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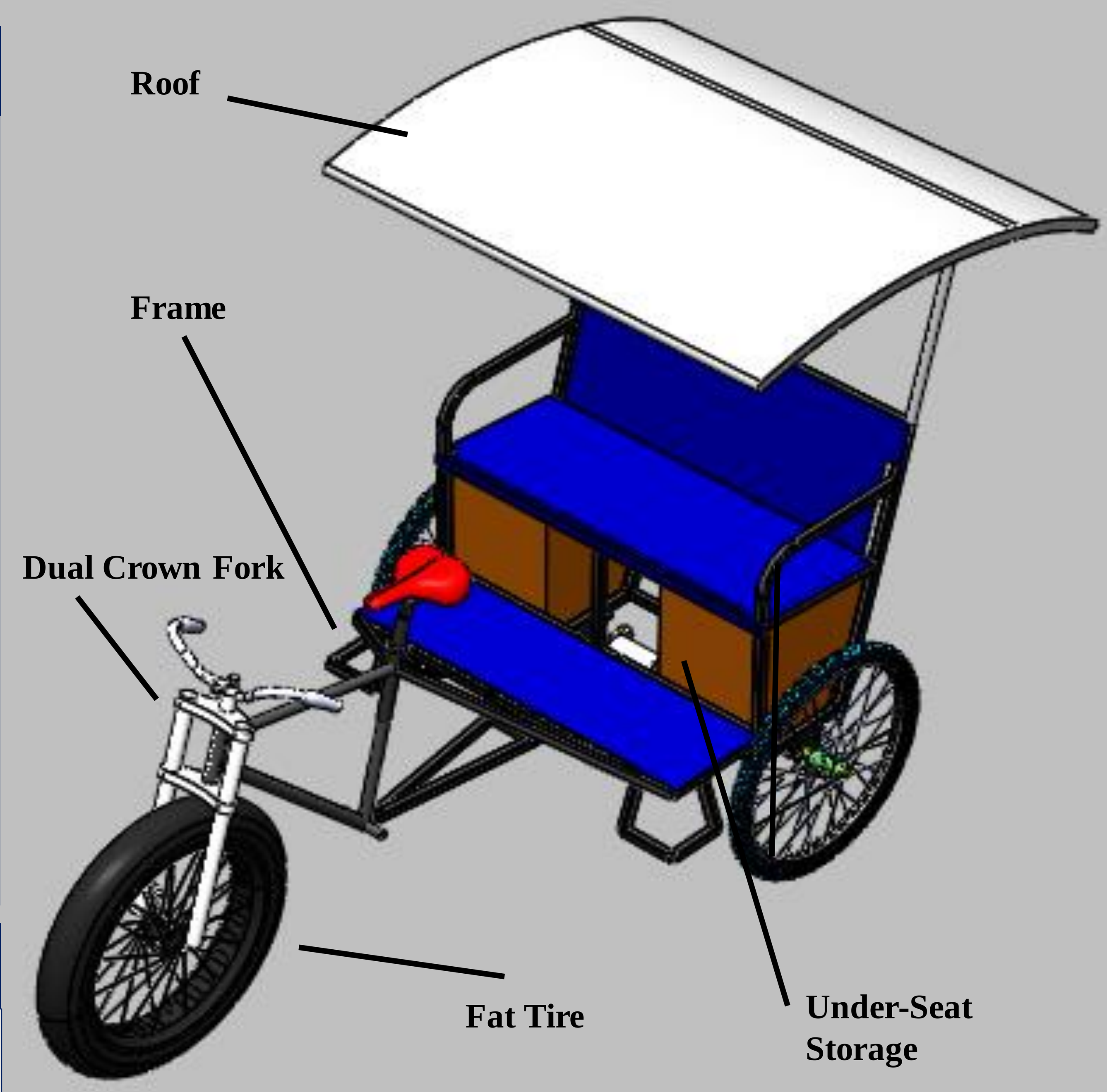
PROJECT OVERVIEW

- **Lead by Mechanical Engineering** Students: Driven by a student-led initiative, Project Pedicab aims to design and manufacture a pedicab.
- **Inspired by Reciprocity:** Rooted in the theory of "reciprocity," our project aligns with the United Nations Sustainable Goals, fostering a community where mutual support thrives.
- **Positive Community Engagement:** Operators provide free rides, creating positive experiences and encouraging the community to pay it forward to generate a ripple effect of kindness.
- **Innovative Design:** Our goal is to design a pedicab with innovative and practical features tailored for the Portsmouth, NH area, ensuring efficiency and comfort for riders.
- **Promoting a Positive Attitude:** Through the pedicab initiative, we aim to instill a positive attitude within the community, fostering a culture of kindness and cooperation.



OBJECTIVES

- **Passenger Capacity:** Design dimensions should comfortably accommodate two passengers along with their items. At least 19” width per passenger.
- **Durability:** Must withstand regular usage without risk of falling apart, breaking, or bending.
- **Weather Protection:** Roof structure must provide adequate coverage to shield passengers from variable weather conditions while not creating a large drag force.
- **Onboard Storage:** Must have storage compartments to allow passengers to store their belongings during their ride.
- **Tire Versatility:** Tires should offer mobility across different terrains, ensuring smooth operation on different surfaces.
- **Single-Person Pedaling:** Ensure ease of pedaling, allowing the pedicab to be operated by a single individual efficiently.

CONTROL IMPROVEMENTS

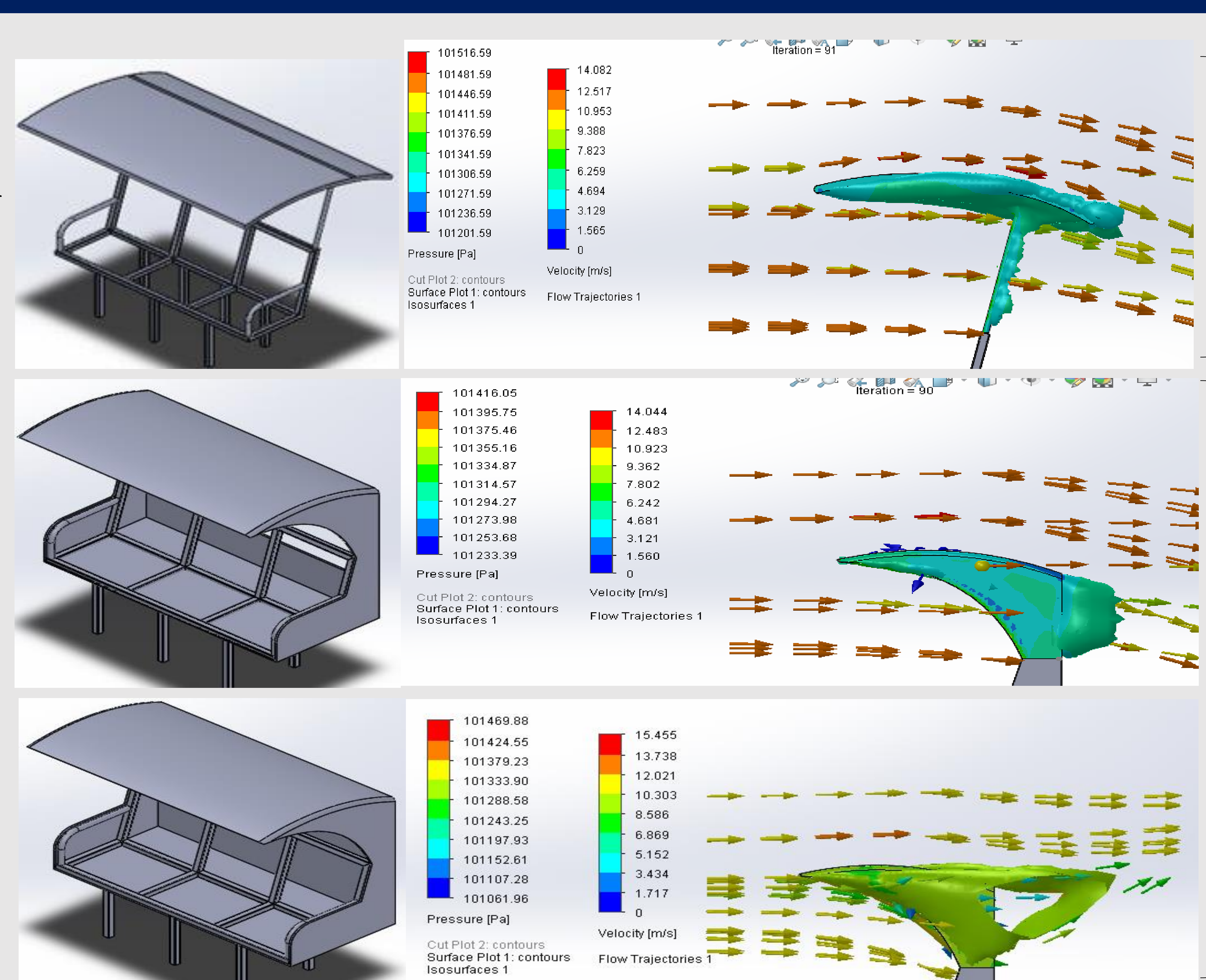
- **Heavy Duty Dual Crown Fork:** The increased diameter and dual crowns reduce the maximum stress in the fork legs by about 40%. This increases safety and allows for more confident steering due to less flex in fork.
- **Shimano MT200 Hydraulic Disc Brake:** Provides improved power over rim brake. Maintenance is easy due to use of mineral oil.
- **Fat Tire:** The 26x4.0 in. fat tire can be run at a lower tire pressure than standard tires for a smoother ride and improved grip across varying terrain.
- **Storage:** Provides separate compartments for each passenger, allowing them to store small backpacks or other personal items securely under their seat during their ride.

ROOF DESIGN

A

B

C



Our Design

Pre-existing Designs

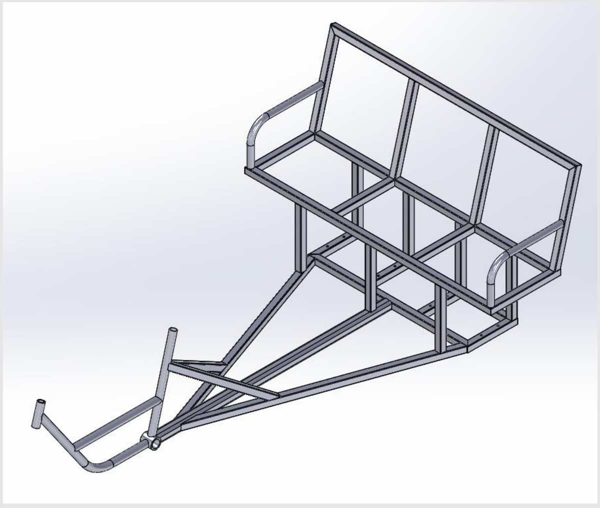
- **Flow Simulation Analysis:** The passenger seating area was taken as a constant and the roof was designed around it to keep similar dimensions for testing.
- **Goals:** Minimize drag force and drag coefficient for a wind speed of 25 mph (max allowed speed of Pedicab)

Decision Matrix

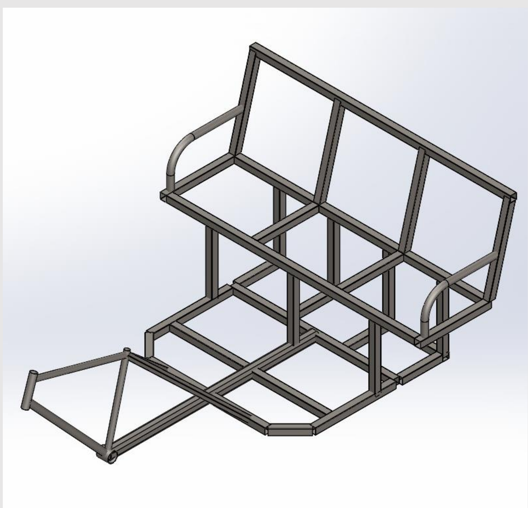
	A	B	C
Building	3	2	1
Drag Coefficient	3	2	1
Drag Force	3	2	1
Time/Cost	3	2	1
Looks	2	3	1
Total	14	11	5

FRAME DESIGN

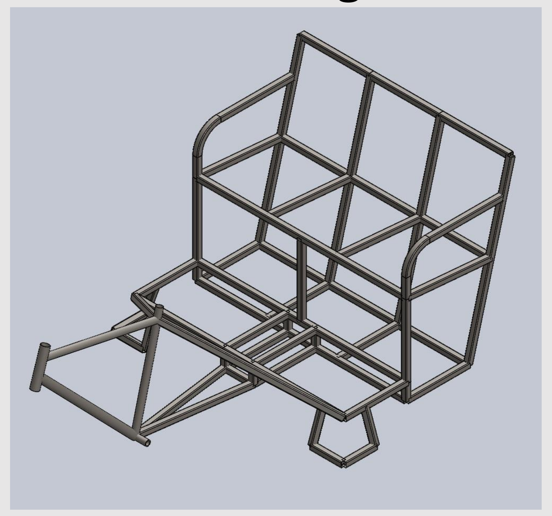
Last Year’s Design



First Redesign



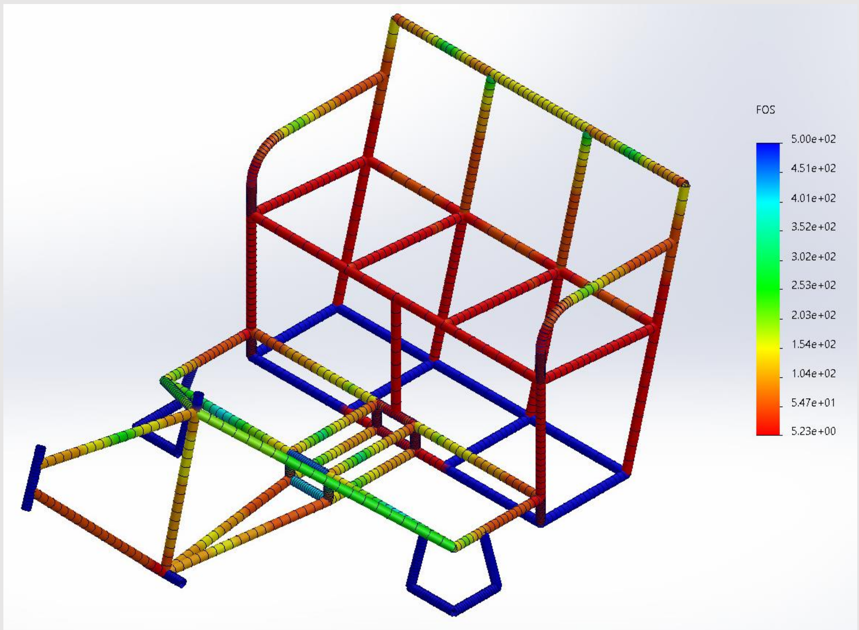
Final Design



- **Weight Reduction:** In our first redesign, we remodeled the front of the frame and were able to reduce the weight from 178 lbs. to 104 lbs. We then did a full redesign of the frame and further reduced the weight to only 59 lbs. This was a 67% weight reduction.
- **Additional Features:** In our final design, we added additional features to make the pedicab safer and more comfortable for the passengers. These features were: the addition of steps to help passengers step onto the platform, a seat with an inclined bench to make the passenger feel more secure, and the relocation of the drivetrain mounting location to under the passenger platform.
- **Material:** The final frame was designed using 4130 Alloy Steel with a yield strength of 70,000 psi due to its strength and ease of welding. The rear of the frame uses 1” square tubing while the front uses 1-1/8” and 1-3/8” round tubing.

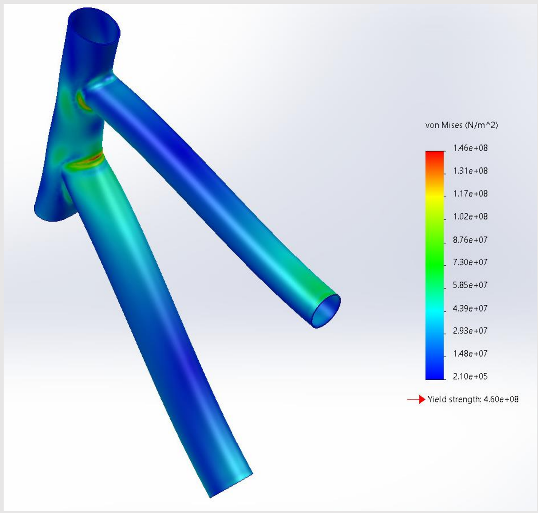
FRAME ANALYSIS

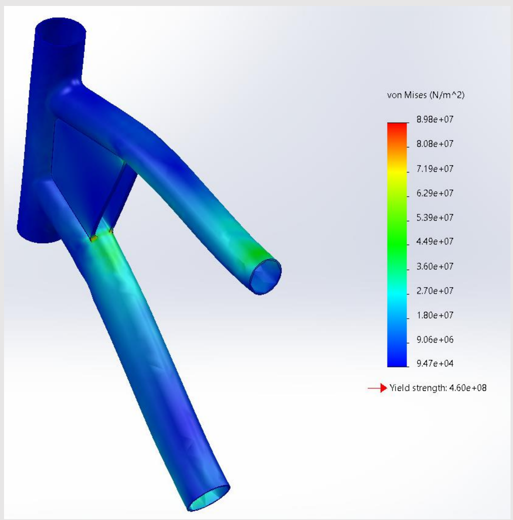
Factor of Safety (FOS)



- Using a SolidWorks static simulation, we found that the minimum FOS on our new frame design is 5.23. This is well above our goal of 3.00. The analysis was performed with fixed points where the rear axle and fork will be attached to the frame. A 400lb force was applied to the bench seat and a 200lb force was distributed between the seat post and BB where the operator will be. We wanted to maintain a buffer because this analysis did not account for impacts, fatigue, or weak spots around welds.

Head Tube Gusset





- One of the areas with the greatest stress concentration was on the head tube. To reduce this concentration, gusseting was added in the form of two 1/8” steel plates. This reduced the maximum stress in the area by 61.5%.

DRIVETRAIN

Internally Geared Hub

- We decided on the **Shimano SG-S7001-8 Alfine 8 Speed Hub** for our drivetrain. It features a 306% gear ratio and weighs 1670 g.
- **Increased Durability and Reduced Maintenance:** The use of an internally geared hub over a traditional derailleur allows for the utilization of a thicker single speed chain. This is expected to reduce the frequency of chain breaks and reduce the rate of wear on the chain. The hub also doesn’t need to be cleaned and adjusted as frequently as a derailleur nor is it at risk of being bent from an impact.
- **In-Place Shifting:** The internally geared hub allows the operator to shift gears while in place. This is expected to decrease the risk of chain breaks and allows for easier starting on hills.

Chain Tensioning

- **Sliding Dropouts:** To tension the rear chain, the geared hub will be mounted on sliding dropouts, where it can be moved back and forth to apply proper tension to the chain.
- **Eccentric Bottom Bracket:** To tension the front chain the crankset will be mounted to the frame using an eccentric bottom bracket where the axle bearings are mounted eccentrically to the BB shell and can be rotated to chain the distance between the crankset and the hub.