

# NAU SAE



# TOOLBOX

**Derek Griffith:** Prototype Engineer

**Hailey Hein:** Project Manager, CAD Engineer, Financial Manager

**Haoran Li:** Test Engineer

**Yanbo Wang:** Manufacturing Engineer, Website Manager

**October 14th, 2025**

Engineering 218

# Client Requirements

60% Met

Table 1: Client Requirements Overview

	Part	Status	Notes	Presentation Shown	Built/Achieved
Required	Toolbox with tools	Acquired	Assembled and tested 5 Drawer toolbox with 238 tools	33%, 67%, 100%	Yes
	Storage for driver equipment	Upcoming Build	Manufactured-integrated cabinet space	33%, 100%	No
	Storage for 4 SAE car tires	Acquired	Top-mounted tire carrier tub made from aluminum sheet	33%, 67%, 100%	Yes
	Brake System	Acquired	Bicycle brake rotors and calipers mounted to the rear axle	67%	Yes
	Steering System	Acquired	Front wheel hub/tie rod system with base frame	33%, 100%	No
	Mounted vice	Acquired	Purchase vice, hard mounted to the top workspace	100%	Yes
	Built in shade	Upcoming Purchase	Rollout shade OR mounted umbrella	100%	No
	Power supply	Acquired	2500 W Inverter with power strip and extension cord	33%, 67%, 100%	Yes
	> 6in OD casters	Acquired	10 in casters provided with the sponsored base frame	100%	No
	Minimal trailer footprint	Upcoming Build	Dimensions 30"x60", to test by loading and unloading	100%	No
	Mounted fire extinguisher	Acquired	Hard mounted to the exterior of the cart for easy access	33%, 100%	Yes
	Drawer locking system	Acquired	Incorporated 3D printed locks in the purchased toolbox	67%, 100%	Yes
	Tie-down rings	Upcoming Purchase	To purchase or make from existing materials, undecided	100%	No
	NAU/Sponsor logos	Sponsored	Being coordinated with Northern Arizona Signs	67%, 100%	Yes
Bonus	Jacking push rod	Acquired	Assembled and tested on Formula SAE car, to mount next	33%, 67%, 100%	Yes
	Grinding wheel/Arbor press	Backburner	Budget allocation	Undecided	No
	Wheel stands for SAE cars	Backburner	^	Undecided	No
	Additional trailer tailgate	Backburner	^ Budget & product was backordered	Undecided	No
	Sound System	Backburner	^ Budget, waiting until all cart components are purchase	Undecided	No

# Design Description

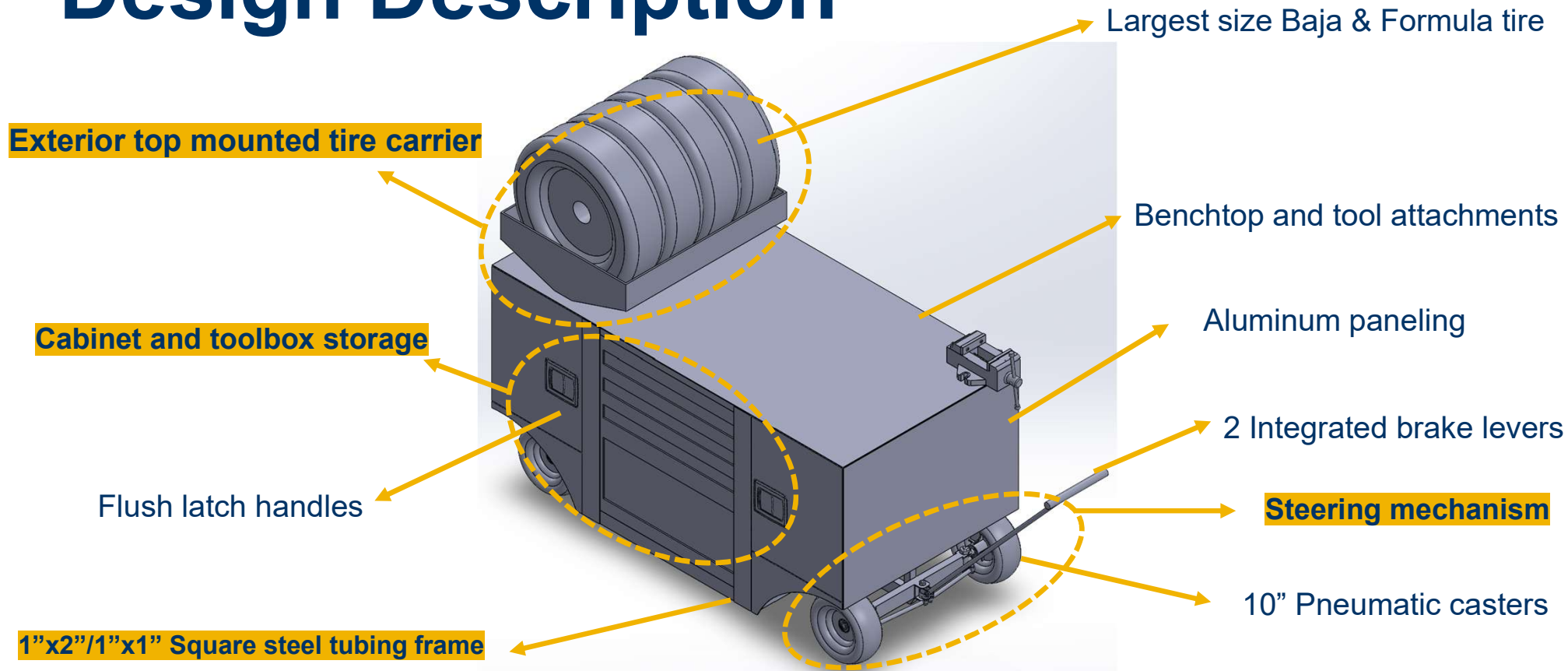


Figure 1: Top Model View

Derek Griffith, SAE Toolbox

# Progress Chart

\*Complete\*



Figure 2: Raw Frame CAD

Initial:  
Completed CAD  
Completed calculations  
Completed BOM

\*In Transit\*



Figure 3: Miller Custom Fab Sponsored Frame

33% Build:  
Parts 70% Ordered  
**Base frame constructed**  
Attached wheels  
Attached handle

\*Projected\*



Figure 4: Benchmarked Frame Construction

67% Build:  
Parts 85% Ordered  
~~Working brakes~~  
~~Integrated toolbox~~  
~~4x1" Framing around toolbox~~

\*Projected\*



Figure 5: Benchmarked Completed Pit-cart

100% Build:  
Full aluminum siding  
Tools/equipment in place  
Completed assembly manual  
Tests in progress  
Full vinyl wrap installed

# Sponsored Frame Update

**Chase Miller**

to me ▼

Jul 22, 2025 1:05 PM



Hailey,

Hope you are having a good week so far. I have one in stock that is close to your dimensions. I need to finish a few things on it. Give me a week or so and I will get it done and shipped out to you.

**Chase Miller**

to me ▼

Sep 30, 2025 8:07 PM (6 days ago)



It should ship by next Tuesday. The boys got the frame in the jig and the back axle tacked. Had to put a paying job in front of it but should have it welded Friday. Spindle kit and wheels are ready to go. We normally ship these assembled but I want you all to learn and put it together. More info to come end of this week.

# Design Efforts

100% Complete

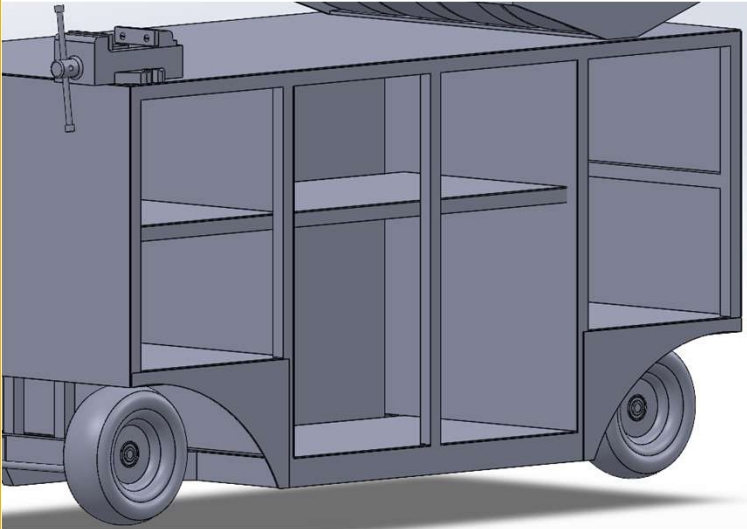


Figure 6: Modeled Cabinet Storage



Figure 7: Modeled Steering Mechanism

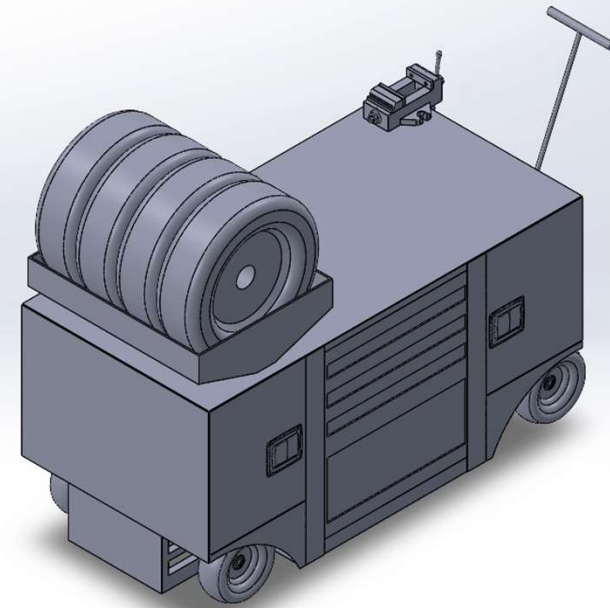


Figure 8: Tire Holder Schematic

# Design Changes



Figure 9: Original Sponsor Designed Front Brakes

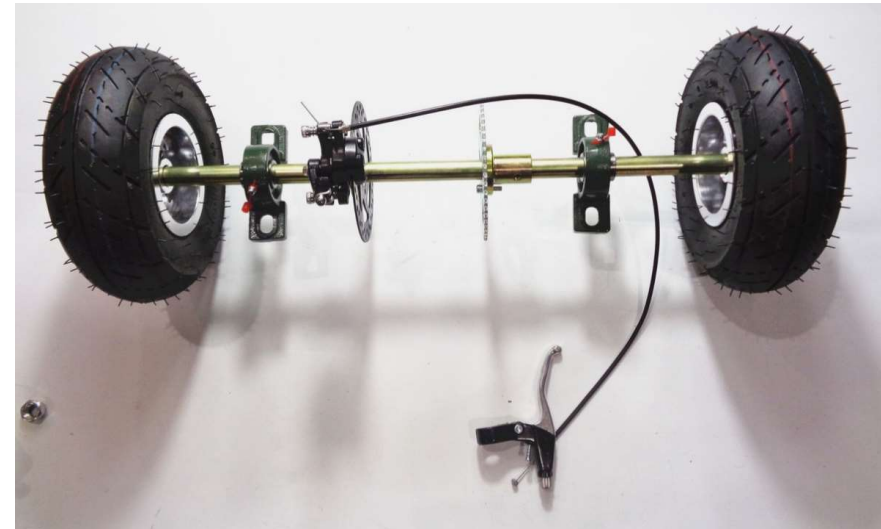


Figure 10: Example of New Rear Axle Brakes



# Brake Layout CAD

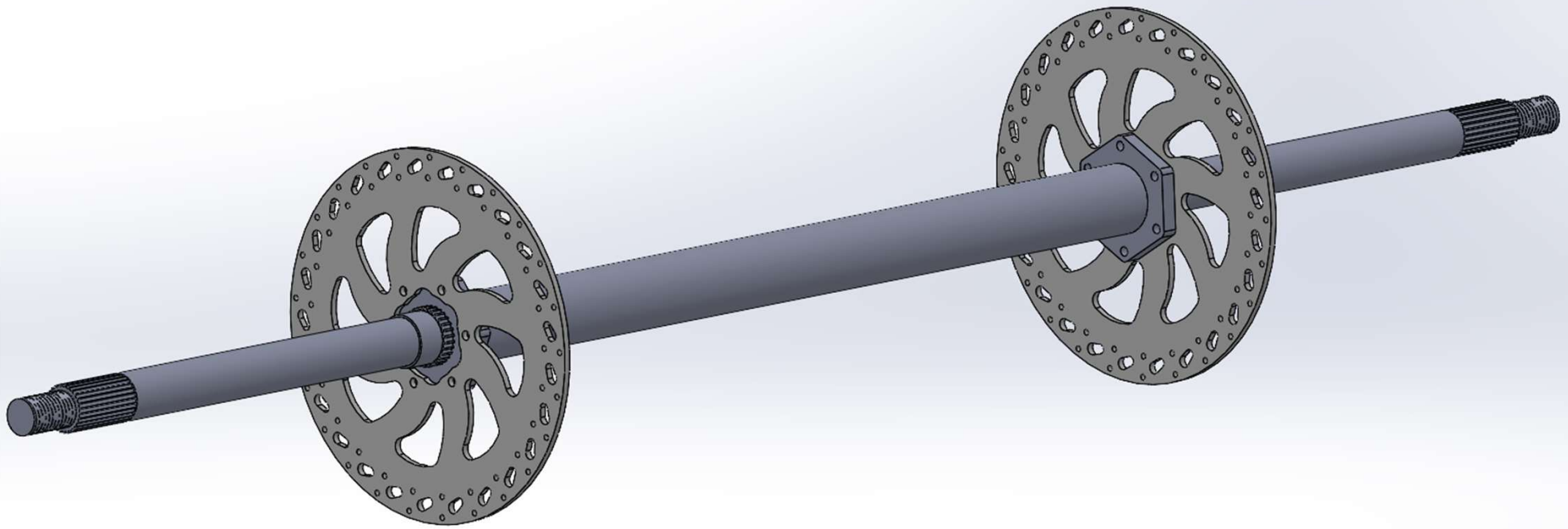


Figure 11: Two Rotor Brake Layout



# Brake Layout CAD

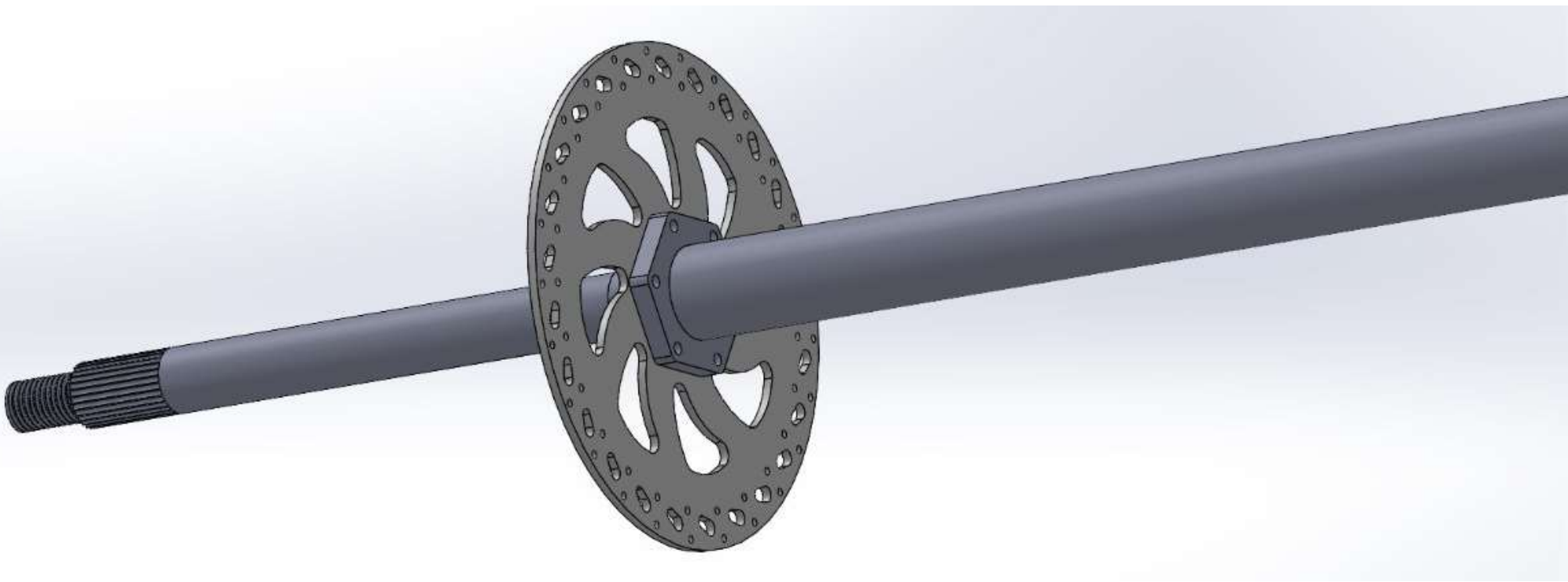


Figure 12: Closeup Brake Layout

# Purchasing Plan

- 86% Purchased
- 90% On Hand
- Staying under budget
- Adding new sponsors to reduce cost
- Waiting on major frame component
- All other components are ready to be installed

Table 2: In Progress Purchase Plan

Part	Price	Status
<b>Order Form 1:</b>		
13"Dx24.25"Wx29.33"H Box with 238 tools	\$ 284.39	Delivered
Fire extinguisher mount for 2.5lb extinguisher	\$ 8.85	Delivered
9" Safety wire plier kit	\$ 26.62	Delivered
Brake bleed kit	\$ 23.38	Delivered
2500W Inverter Generator	\$ 294.90	Delivered
120 V Power strip	\$ 31.87	Delivered
25 ft Extension cord	\$ 12.75	Delivered
Hinged aluminum trailer ramp extension		Canceled/Backordered
Formula rear swivel lift jack	\$ 290.84	Delivered
	\$ 973.60	
<b>Order Form 2:</b>		
0.065" 1x1 Square Tubing 6' Qty 18	\$ 306.90	Delivered
0.020" 36x96" Aluminum Paneling Qty 4	\$ 520.84	Delivered
Tax+Shipping	\$ 228.55	
	\$ 1,056.29	
<b>Order Form 3:</b>		
Door hinges/handles/latches, brakes	\$ 117.56	Delivered
<b>In Person (Harbor Freight):</b>		
6" Vice, Super glue, tie-wire, bungee cords	\$ 77.59	Delivered
<b>Upcoming:</b>		
Rivets		
Tie-down Anchors		
Umbrella	\$ 39.99	Undecided
<b>Donated/Sponsored:</b>		
Formula Tire Holder	\$ 100.00	Delivered
Miller Fab Base Frame	\$ 1,150.00	In Transit
Monetary	\$ 501.00	Deposited
	\$ 1,751.00	
<b>Total Spent:</b>	\$ 2,225.04	\$2000 NAU SAE Starting Budget
<b>Total Left:</b>	\$ 275.96	

# Manufacturing Plan

Table 3: In Progress Manufacturing Plan

Part	Manufacture Status	Location	Comment	Projected Time to Build	Percentage Complete
Base Frame	Built?	Sponsor Shop	In Transit?	Apparently 4 months?	100%?
Frame shell	Upcoming Build	98C Machine Shop	Requires Base Frame	18 hours	0%
Aluminum Panels	Upcoming Build	98C Machine Shop	Requires Base Frame	8 hours	0%
Aluminum Tire Holder	Built	Sponsor Shop	Tested with tires	3.5 hours	100%
Brake System	Upcoming Build	98C Machine Shop	Designed in CAD	4 hours	30%
Formula Push-Rod	Built	98C Machine Shop	Testing stage	2 hours	100%
Toolbox Latches	3D Printed	Engineering	Installed	3 hours	100%
Steering Handle	Built	Sponsor Shop	In Transit?	1 hour	100%?
Extinguisher mounting	Upcoming Install	98C Machine Shop	Requires Base Frame	0.5 hours	75%

# Hardware Demonstration



Figure 13: Toolbox and Tools Hardware



Figure 14, 15: Additional Parts Hardware



Figure 16: Material Hardware



# Toolbox Latch Testing Demonstration



Figure 17: Tilted Toolbox Without the Latching System

10/14/2025



Figure 18: 3D Printed Latch Design

Derek Griffith, SAE Toolbox

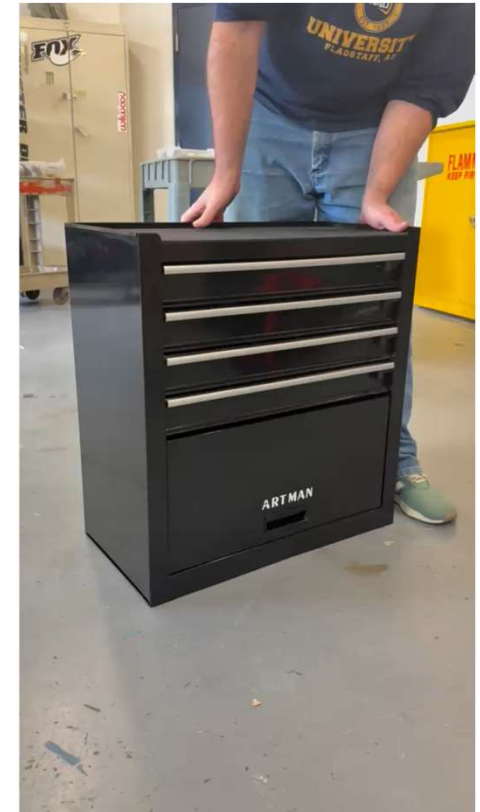


Figure 19: Tilted Toolbox With 3D Printed Latching System and Magnet Catch

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# Tire Carrier Construction

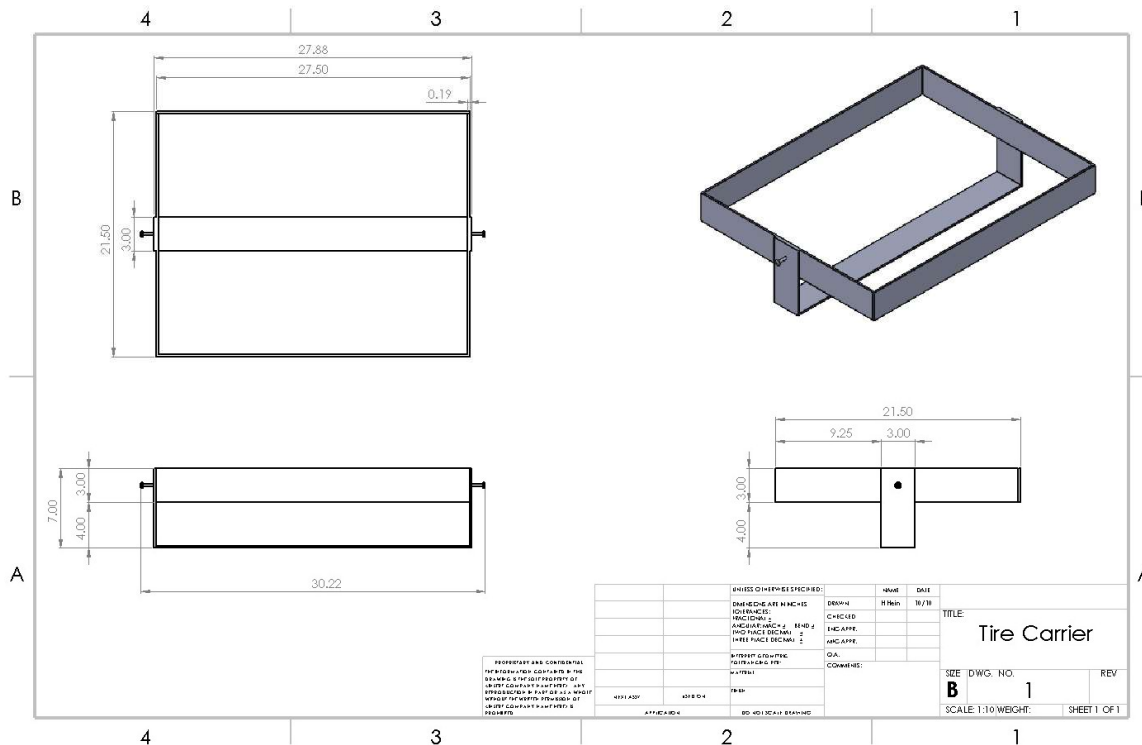


Figure 21: Physical Tire Carrier With Formula Tire

# Formula Jack Test Demonstration

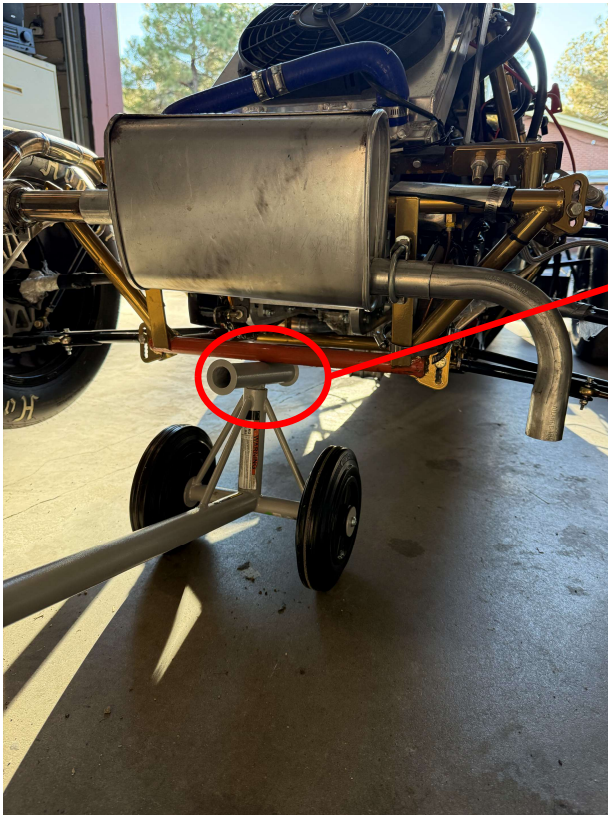


Figure 22: Push-jack Under the Formula SAE



Figure 23: Need for Design Change



Figure 24: Completed Design Change Test



# Inverter Load Test Demonstration



Figure 25: 10W-30 Oil Fill

Prepped the inverter by filling with:

- 10W-30 Oil
- E87 Pump gas

Took the inverter outside and plugged in different devices to check all systems

- Noticeably quiet noise level (69dB)
- 11 hour run time @ 25% load
- 5.5 hour run time @ 50% load
- 39.7 lbs total weight



Figure 26: All-Systems Inverter Check

# Vinyl Wrap Projection

## Northern Arizona Signs

- Partnership for a **fully sponsored** vinyl wrap; design and install
- Display of sponsor' and NAU logos
- Removes the need for spray paint purchasing
- Achieves client requirements

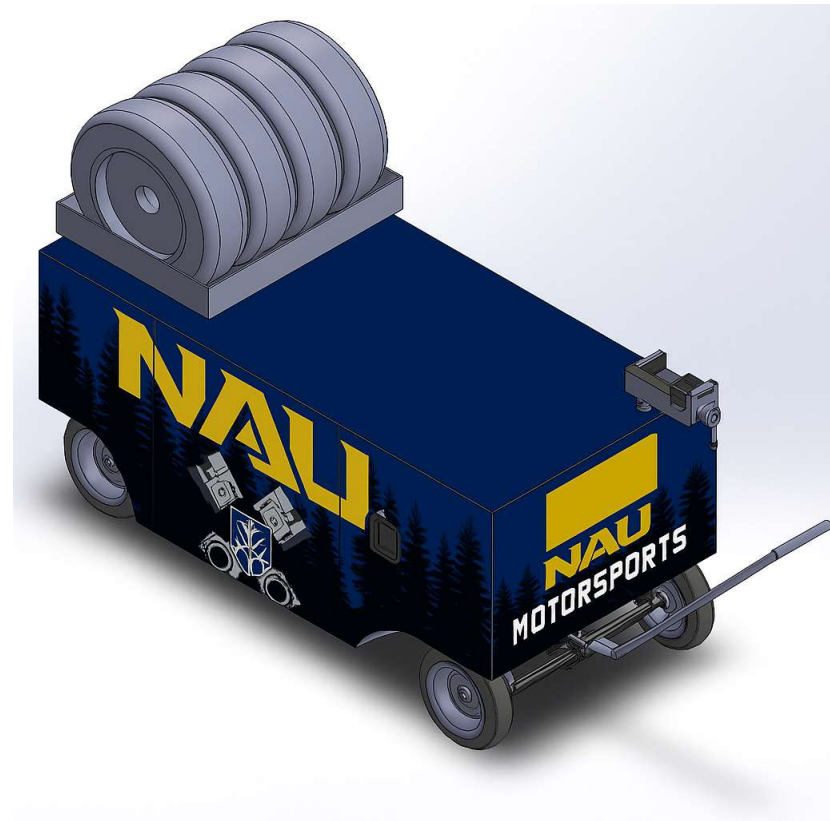


Figure 27: Rough AI Generated Wrap Concept

Table 4: SAE Toolbox Fall 2025 Gantt Chart Update

Owner	ACTIVITY	PLAN START	PLAN DURATION	DUE DATE	ACTUAL DURATION	PERCENT COMPLETE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
All	486C Kickoff	26-Aug	2	26-Aug	3	100%	25-Aug	1-Sep	8-Sep	15-Sep	22-Sep	29-Sep	6-Oct	13-Oct	20-Oct	27-Oct	3-Nov	10-Nov	17-Nov	24-Nov	1-Dec	8-Dec
All	Academic Integrity	25-Aug	1	29-Aug	1	100%																
Hailey	Project Management	25-Aug	6	30-Aug	8	100%																
Hailey	Timecard Wk1	2-Sep	0.5	2-Sep	0.25	100%																
Hailey	Timecard Wk2	8-Sep	0.5	8-Sep	0.25	100%																
All	Engineering Calculation Summary	1-Sep	5	10-Sep	7	100%																
All	Individual Analysis	1-Sep	8	12-Sep	9	100%																
Hailey	Timecard Wk3	15-Sep	0.5	15-Sep	0.25	100%																
Hailey	Timecard Wk4	22-Sep	0.5	22-Sep	0.25	100%																
All	33% Presentation work	19-Sep	8	23-Sep	10	100%																
All	Machine shop workday	20-Sep	6	21-Sep	7	100%																
All	33+% Presentation Delivery	20-Sep	5	23-Sep	7	100%																
All	Peer Eval 1	26-Sep	1	26-Sep	1	100%																
Hailey	Timecard Wk5	29-Sep	0.5	29-Sep	1	100%																
Hailey	Timecard Wk6	6-Oct	0.5	6-Oct	1	100%																
Yanbo	Website Check #1	10-Oct	6	10-Oct	4	100%																
Hailey	Timecard Wk7	13-Oct	0.5	13-Oct	1	100%																
Haoran	Inverter Load Testing	6-Oct	6	14-Oct	5	100%																
Derek	Brake System CAD Building	6-Oct	7	14-Oct	8	100%																
Hailey	Sponsor frame tracking	29-Sep	1	14-Oct	2	100%																
Hailey	Tire carrier manufacturing and test	13-Oct	6	16-Oct	0	0%																
All	67% Presentation Work	1-Oct	5	14-Oct	13	100%																
All	67+% Build Delivery	1-Oct	5	14-Oct	3.5	100%																
Hailey	Timecard Wk8	20-Oct	0.5	20-Oct		0%																
Derek	UGRADs Registration	1-Oct	2	23-Oct		50%																
All	Peer Eval 2	24-Oct	1	24-Oct		0%																
Hailey	Timecard Wk9	27-Oct	0.5	27-Oct		0%																
All	Draft of Poster	15-Sep	8	30-Oct		0%																
Derek	Physical Testing	15-Sep	15	30-Oct		15%																
Haoran	Finalized Testing Plan	5-Oct	4	31-Oct		10%																
Hailey	Timecard Wk10	3-Nov	0.5	3-Nov		0%																
All	100% Presentation Work	20-Oct	6	6-Nov		10%																
All	100% Build Delivery	6-Nov	8	6-Nov		0%																
Hailey	Timecard Wk11	11-Nov	0.5	11-Nov		0%																
All	Peer Eval 3	14-Nov	1	14-Nov		0%																
All	DAC Meeting Extra Credit	14-Nov	2	14-Nov		0%																
All	Final Poster and PPT	15-Oct	6	16-Nov		0%																
Hailey	Timecard Wk12	17-Nov	0.5	17-Nov		0%																
Derek	Initial Testing Results	5-Nov	8	20-Nov		0%																
Hailey	Final CAD Packet	15-Nov	15	21-Nov		0%																
Hailey	Timecard Wk13	24-Nov	0.5	24-Nov		0%																
Derek	Final Testing Results	5-Nov	8	26-Nov		0%																
Hailey	Timecard Wk14	1-Dec	0.5	1-Dec		0%																
All	Final Report	10-Nov	20	2-Dec		0%																
Yanbo	Final Website Check	3-Dec	5	3-Dec		10%																
Haoran	Final Product Demo	4-Dec	8	4-Dec		0%																
Derek	Assembly Manual	17-Nov	6	4-Dec		0%																
All	Poster Results	5-Dec	3	5-Dec		0%																
All	Capstone Exit Survey	6-Dec	2	6-Dec		0%																
All	Course Eval Extra Credit	7-Dec	1	7-Dec		0%																
Hailey	Timecard Wk15	8-Dec	0.5	8-Dec		0%																
All	Client Handoff	1-Dec	4	10-Dec		0%																
All	(FINAL) Peer Eval 4	11-Dec	1	11-Dec		0%																

# Live Website

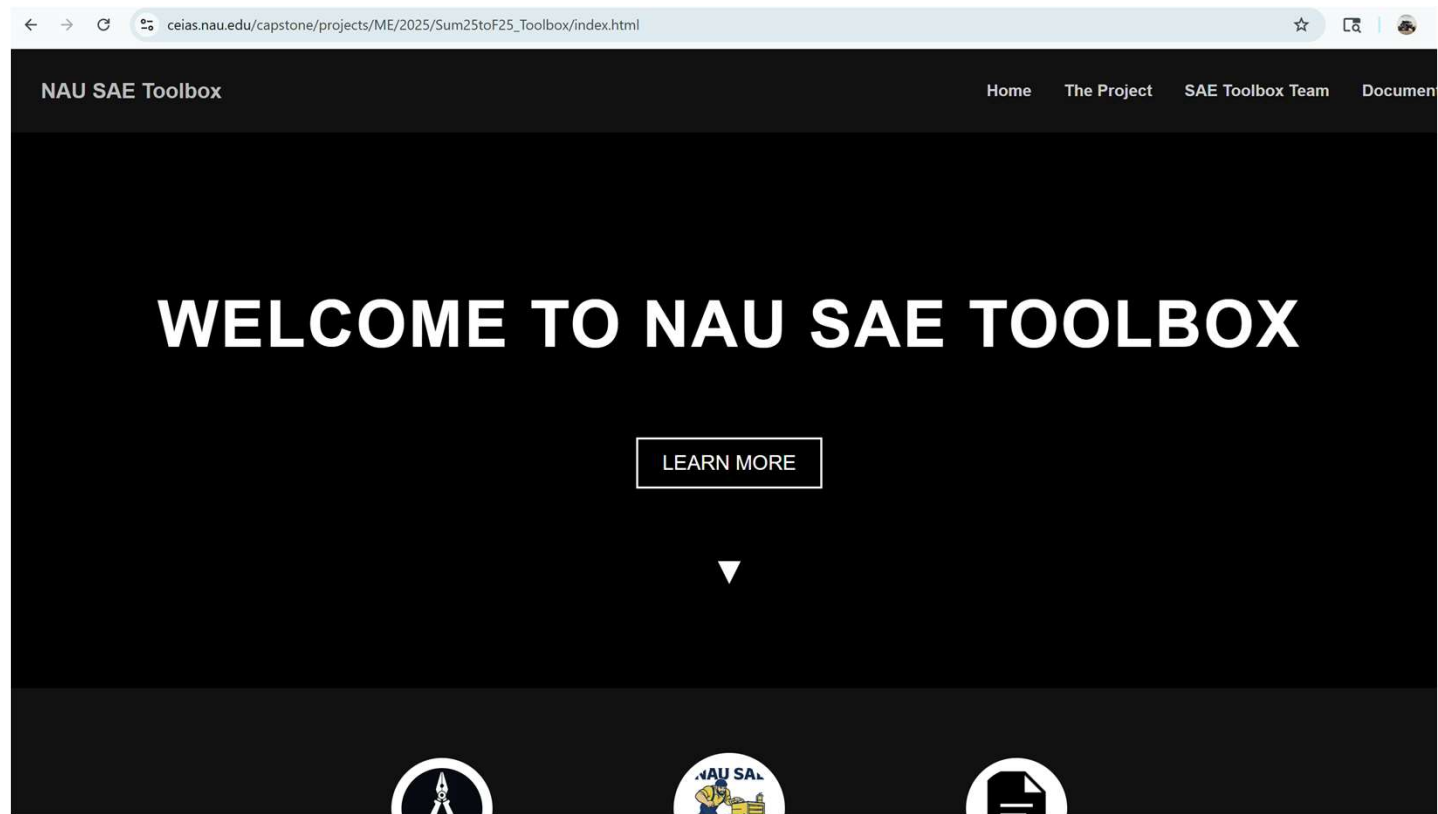


Figure 28: Website Walkthrough

Yanbo Wang, SAE Toolbox

# Moving Forward

## **100% Demo**

- Base frame construction!!
- Possible plan B design
- Full aluminum siding
- Tools/equipment in place
- Tests in progress
- Full vinyl wrap
- Working brakes

## **Next testing**

- Drawer latch operation
- Brake Operation
- Tipping/Stability
- Turning radius
- Trailer footprint
- Weight capacity
- Correct tooling

## **Timeframe**

- Poster draft (16 days)
- 100% Build (22 days)
- Final Testing Results (43 days)
- Client handoff (56 days)

**Thank You  
Questions?**