KS8 VD + Suspension

Tuesday, June 18, 2024 12:01 AM

OneNote documenting the work and research for the Suspension and Vehicle Dynamics team for the KS8E/C

KS8 VD + Suspension Goals

Monday, August 12, 2024 1:17 AM

The team wide goals document can be found HERE for the KS8E/C and the presentation for the Suspension can be found HERE
For the KS8 season the VD and Suspension team had these main goals for both cars

KS8C: Testing – 200 Miles + Investing in Testing Documentation

- Dynamic characterization of tire selection
  - Toe
  - Normal Load
  - Camber
- Improve repeatability of suspension alignment
  - Jigs to align car in toe
  - Platform to align the ride height and corner balance

The team is currently not limited in testing space but limited in design tools, emphasizing suspension tuning and efficiency aids both cars performance and helps meet its testing timeline of January.
In design, a lot of carryover is likely but looking at the performance of the KS6C vs. the KS7C, greater testing time and opportunities to tune the car will yield more dynamic event points.

KS8E: Characterization – Kinematics and Suspension

- Increase System Understanding for Kinematic Targets
  - Static testing of the car's kinematic behaviors
  - Increase modeling capabilities for grip balance and kinematic behaviors
- Support Aerodynamic Platform of Car
  - Set stiffness targets for roll and pitch for the suspension
  - Using those get Damping Ratio targets for the car

Previously, the suspension subgroup since the KS5 has struggled with understanding target kinematic behaviors. The outboard kinematics model, csaps tire model, and data acquisition advancements enhance suspension performance possibilities. These goals are essential for the subgroup's progress in Design and Testing.

VD + Suspension Fall 24 Debrief

Monday, December 2, 2024 5:26 PM

Design

- A lot of post design beyond the deadline
- Unclear progress across all projects to the team
- More guidance with the design proposals or an example design document
- Can be more aggressive about poking for progress on other projects

Testing/ Events

- Testing for the electric car before Pitt was very good
- Did not carry through to other events, could be design and school
- Characterization of car was weak at the start of testing
- Did not fully utilize time in the summer to get testing
- New Members enjoyed going to the events and seeing in real time
- Put things into context for new members
- Think of more tasks for members to do during the event
- Benchmark for how much to run the car before an event

New Member Training

- Nearly 4x the amount of new members for VD/ Suspension
- Weekly meetings were good to get a reliable time to meet with everyone
- Not enough projects to do for members who had some training
- More time to sit down and work through
- Presentations and Classes were helpful for new members
- Just working on general projects and learning as it went was helpful
- Tasks on car was super helpful - teching the car and inspection
- More resources for stuff and making it more available
- At the beginning give a broad overview of the car

VD Simulation

Friday, August 16, 2024 1:33 AM

Focuses primarily on pushing simulation possibilities of the car. Lead determines what behaviors or variables are required to evaluate in both input and output and simulation engineer focuses on creating the possibility for those simulations. This person will be instrumental in helping better understand kinematic behaviors on the car and pushing better understanding and more exact testing.

KS8 Tire Modeling

Sunday, August 18, 2024 11:49 PM

Previous Edition: Created plots that would isolate different sweeps of variables which could visualize specific performance characteristics for each tire. Was very bulky and could not handle processing any data that was after Round 5 of the TTC Data.

Current Edition: Builds off previous edition making data sorting more compact and allows it to process rounds of tire data.

GITHUB REP W/ ALL TIRE MODELS

INTRO TO TIRE MODELING PRESENTATION

Project Requirements for future editions:

- Needs to generate predictive values for Fy, Fz, and Mz for conditions of slip, load, and camber using either CSAPS or Pacejka Coefficients
- This function/ model can then be used for different modeling solutions like lap time simulation and basic handling models for design
- Exploring heat generation characteristics by analyzing the step steer input test against itself is also a necessary development tool and justifies the potential thermal mass gain/ loss across different tire dimensions
- For immediate iterations I'd keep it on Matlab but moving to a different platform like python could be of good value

*7 DOF Vehicle Model

Monday, August 19, 2024 12:20 PM

Assigned: Leyth Alhendy

The main architecture for a lot of the kinematic design decisions are going to be the tire model and this 7 DOF Vehicle Model.

Necessary Outputs for the Model:

- Yaw Velocity
- Side Slip Velocity
- Longitudinal Acceleration
- Front/ Rear Roll
- Ride Height
- Pitch Angle

With these parameters, effective aerodynamic-suspension stiffness design can be made with handling characteristics in mind. With the complexity of mechanical grip suspension stiffnesses can be accounted for total roll and pitch motions but not any direct effect into mechanical grip. Ideally this simulator can be added onto over time with steer-camber effects. This foundation for a vehicle model can then be put into a GGV diagram and into a lap time simulator.

Camber Curve Kinematics

Monday, August 19, 2024 11:29 AM

In the competition spec sheet you need to submit your camber change variables as deg/m in both bump and roll. A simulation or investigation into different ranges of camber change characteristics during comp events like autocross and endurance will be helpful to provide sensitivities for different design targets.

The approach to this can be both simulation but also from logged data. Can use an existing lap time simulator to get roll and bump data for a given track and with a tire model, analyze the camber angle per wheel but also the lateral force generated.

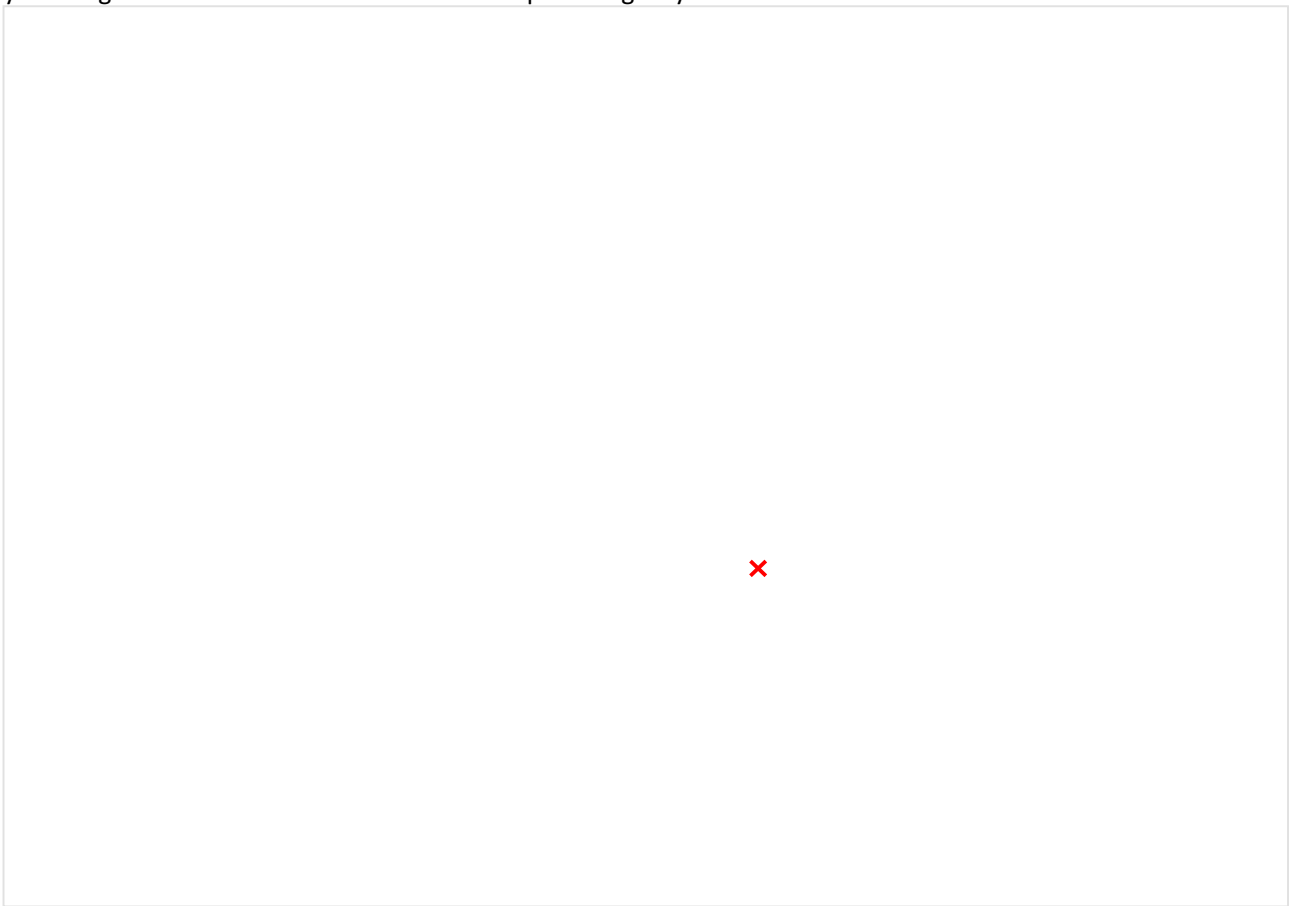
With logged data, we have the autocross and endurance data for both the KS7C and KS7E. Can use the gyro and accelerometer data from the Vectornav to approximate the camber per wheel and plugging in a basic model and analyze the camber per wheel.

Throughout this investigation it needs to be remembered that you are not looking for a specific value of camber change per roll or bump. These design decision live in sensitivities and knowing ranges of performance rather than specific values make design compromises easier to understand and make.

Requirements for this Projects:

- Tire Model/ Function that generates Fy and Fx with Load, Slip, and Camber
- Lap Time Simulator / Logged Data from Competition providing Gyro and Accelerometer Data.

Ideally with simulation data you can generate a curve like this which will give you a good idea of camber change and static camber setup and the resultant competition score. A really good way of understanding how this is generated through simulation is if you know in Skidpad that your slip angle, roll angle, and load per wheel will be consistent with itself you have a single value for these functions you can get lateral acceleration which for Skidpad can give you the time and resultant score.



Source for the photos HERE

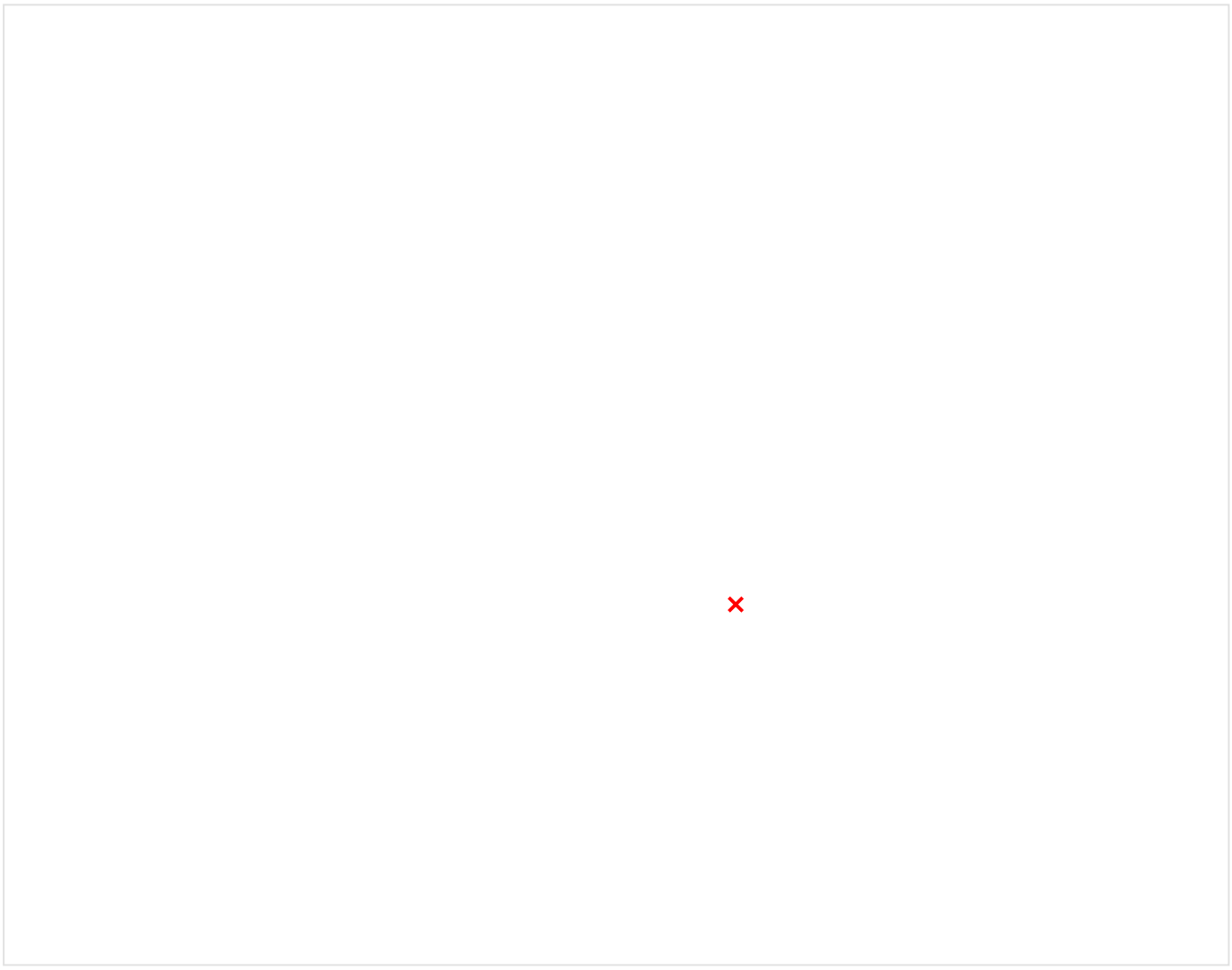
Components

Friday, August 16, 2024 1:34 AM

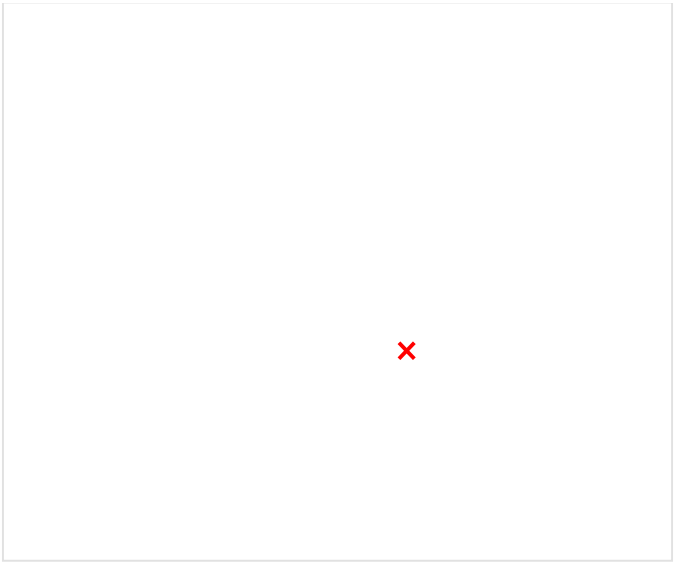
Works on the component level side of trying to get the kinematic points into the physical components that are machined and finished on the car. For development they are looking to make components lighter and stiffer while also increasing our simulation understanding through FMEA and understanding of our load cases.

*Jacking Bar

Wednesday, November 6, 2024 11:50 PM

1. 

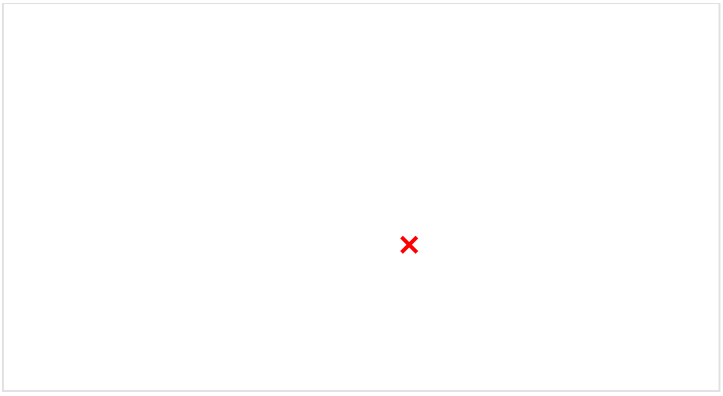
2. Jacking bar tube analysis for tube thickness & strength
    a. Using steel, no aluminum
    b. Helpful resources:
        i. https://www.quora.com/How-do-I- calculate-the-bending-stress-of-a-hollow-circular-steel-rod-pipe
        ii. https://skyciv.com/docs/tutorials/beam-tutorials/how-to-draw-bending-moment-diagrams/
        iii. https://www.teachengineering.org/lessons/view/wpi_lesson_1#:~:text=The%20five%20types%20of%20loads,%2C%20shear%2C%20bending%20and%20torsion.
        iv. Desmos | Graphing Calculator

c. 

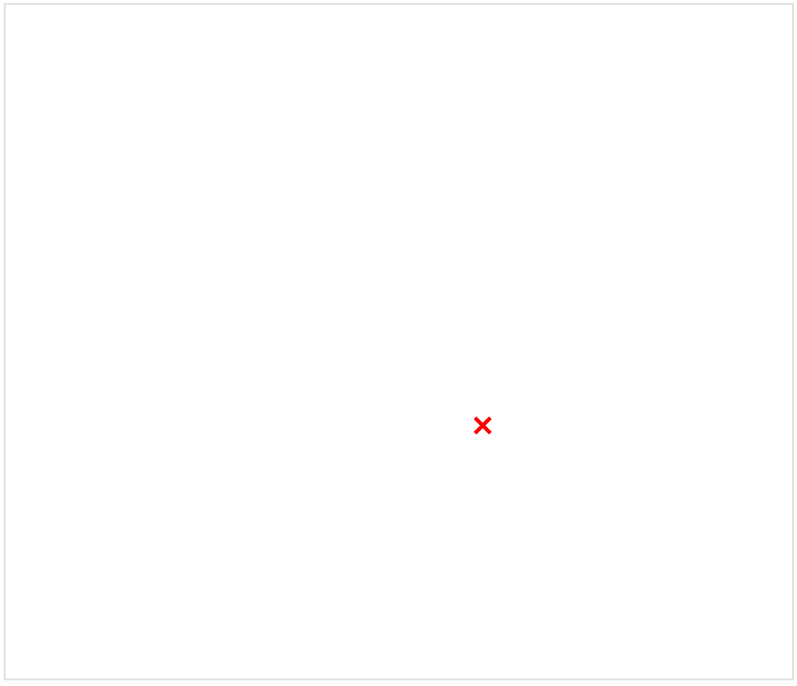
d. While bending stresses may not come close to 70,000 PSI yield strength of 4130 alloy steel round tubes, walls of tube may buckle under stress or warp during welding.
e. Table copied from Vehicle Dynamics > Excels > KS8E Jacking Bar Optimization Old.xlsx

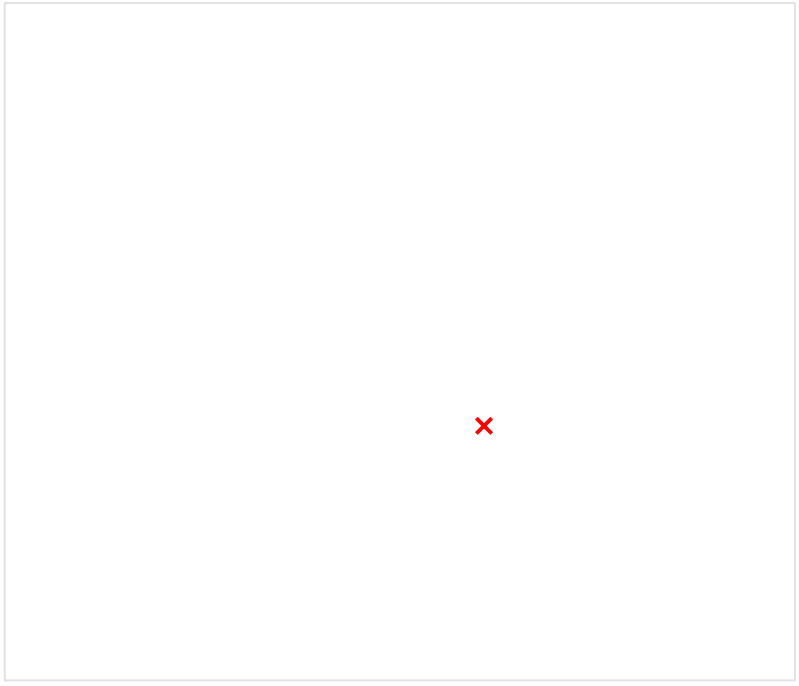
Material	Mass of Ecar w/ Driver (kg)	Outer Diameter (m) [in]	Wall Thickness (in)	Bending Stress (psi)	Volume for 12 ft (in^3)	Mass for 12 ft (lb)
Easy-to-Weld 4130 Alloy Steel Round Tubes	95.2544	0.0254 [1]	0.028	31179.3225	1.026	0.291384
			0.035	25477.8529	1.2733	0.3616172
			0.049	18988.6754	1.7567	0.4989028
			0.058	16487.6871	2.0597	0.5849548
			0.065	15029.4028	2.2912	0.6507008
			0.083	12435.2399	2.8693	0.8148812
			0.095	11270.8064	3.2412	0.9205008
			0.12	9632.8083	3.981	1.130604
			0.188	7566.2391	5.755	1.63442
			0.25	6847.0334	7.0686	2.0074824

3. erm every option highkey sucks ass
4. What we're doing is bolting tabs to the yoke plate and welding tubes on them to come out and then weld to a perpendicular tube which will be the actual jacking bar. NEW DESIGN! 2b.iv - 2e NOT RELEVANT TO ACTUAL DESIGN ASIDE FROM LEARNING EXPERIENCE!
    a. Desmos | Graphing Calculator - Lil desmos I cooked up for rod calculations

b. 

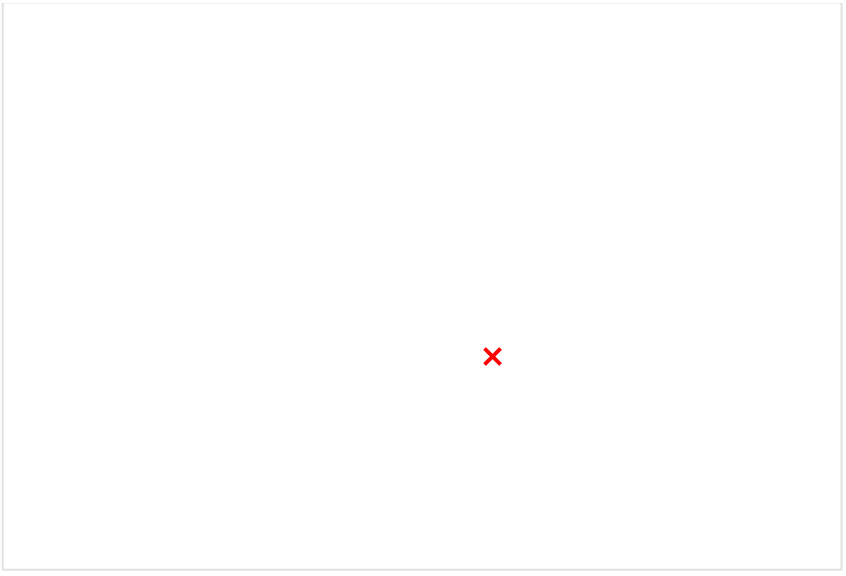
c. Primarily concerned about rods coming out of yoke plate stress-wise, see sub-points

i. 

ii. 

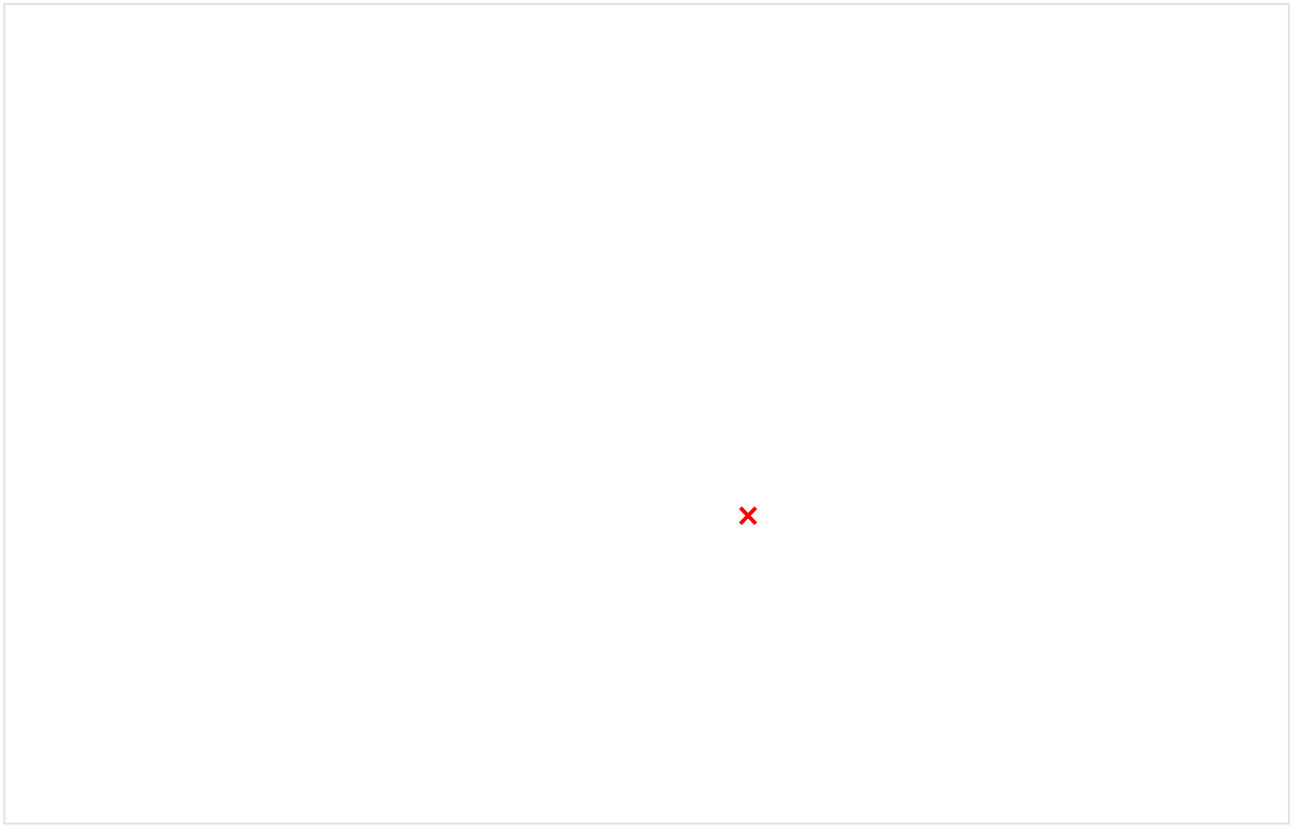
d. Not concerned about jacking bar itself

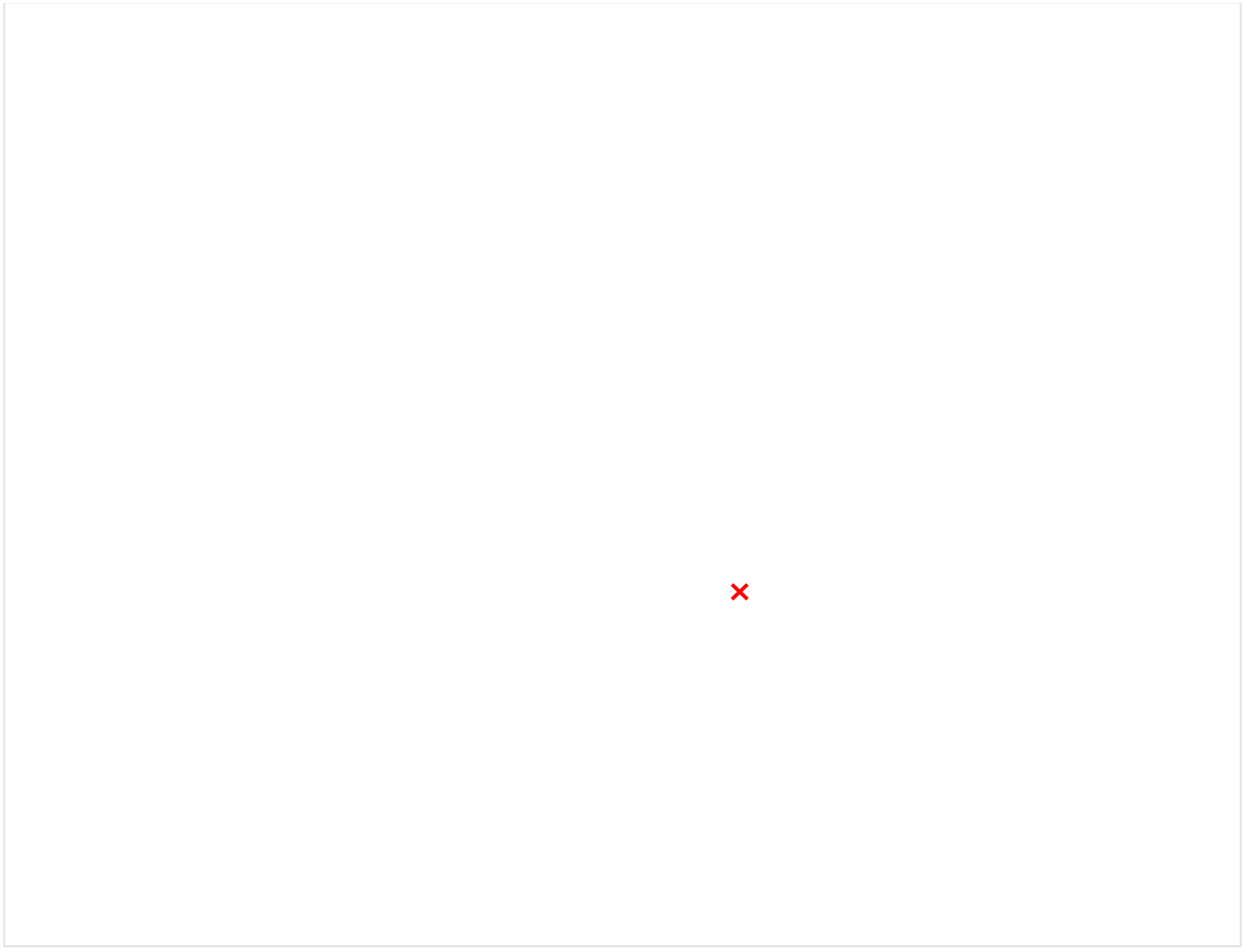
i.

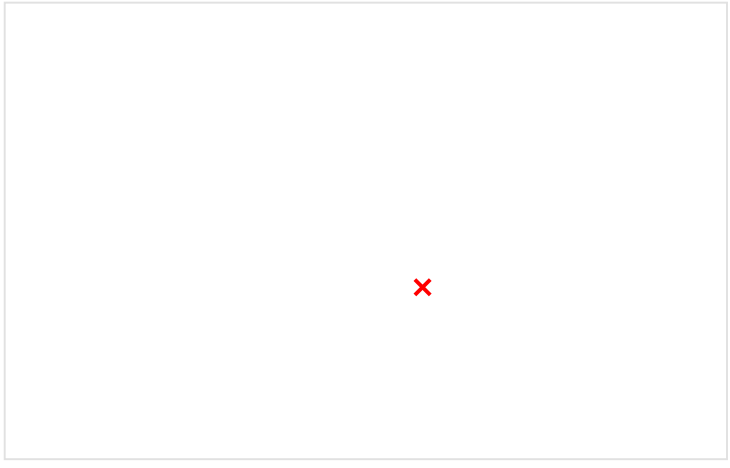


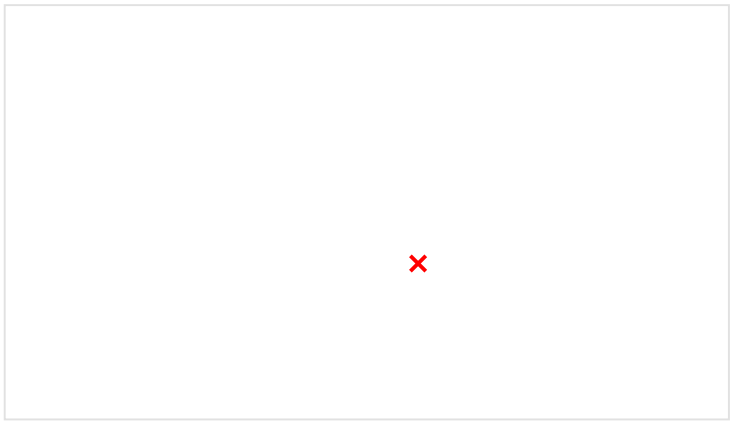
Shit to change after getting roasted (design review post mortem)

- Remove middle tube
    - Have to fulfill rule of unobstructed 180 degrees for uninterrupted 280 mm
- Offset bolt holes - can compensate
    - Thread into yoke plate
- Thickness of mounting plate
- Chain guard check





- ~~This design ONLY works with AR500 Steel which Mihai has said we should avoid because it's very hard and prone to cracking. Switching to design with square tubes connected to top and bottom of yoke plate.~~
- ~~Stock for CNC'ed tabs:~~
    - ~~Block 1: 4 x 2.25 x 1.375~~
    - ~~Block 2: 5 x 2.25 x 1.375~~
- ~~Square Tubing:~~ ~~https://www.mcmaster.com/6582K28/~~
- Going forward with this design because actually it does work with other materials. Need to look at two things:
    - Steel waterjet part + steel tube (1008, A36 / Mild Steel waterjet, 4130 tube)
        - 3.512 lbs
        - Min FOS = 2.1
        - 

    - Aluminum waterjet part + aluminum tube (6061 T6)
        - 1.208 lbs
        - Min FOS = 2.5
        - 
    - A third, more sinister option
- We're going to ball w/ the all aluminum option

See design review for all final design choices

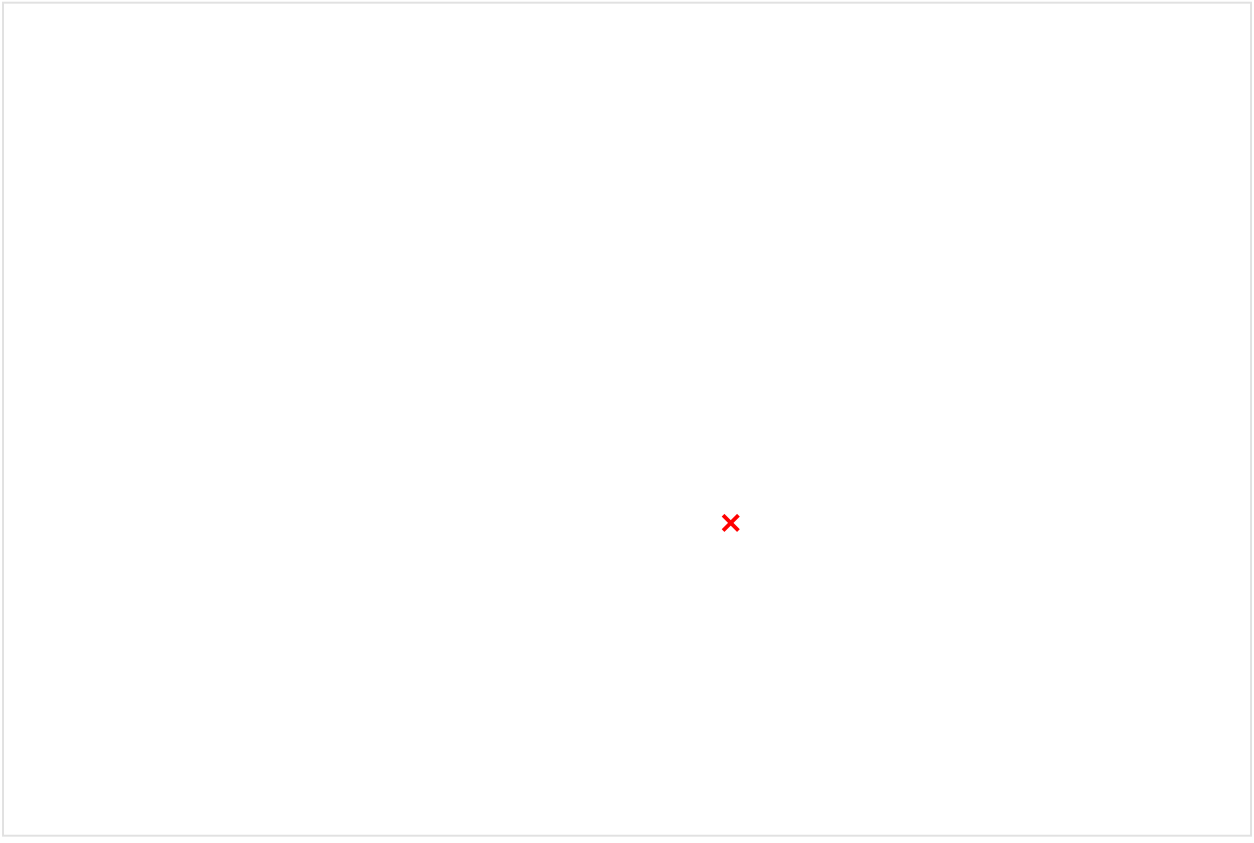
*Suspension Toe Alignment Frame

Monday, August 19, 2024 1:50 PM

Assigned: Adi Turlapati

In previous years, toe of the suspension could not be aligned consistently and quickly. Previously plates would lay on the side of each wheel and two tape measures would be used to align the wheels by loosening the toe rod ends and twisting until they were aligned with each other (the tape measures read the same length). This was inconsistent and would often lead to the wheels be pointing in one direction statically because although both front and rear lengths would be the same.

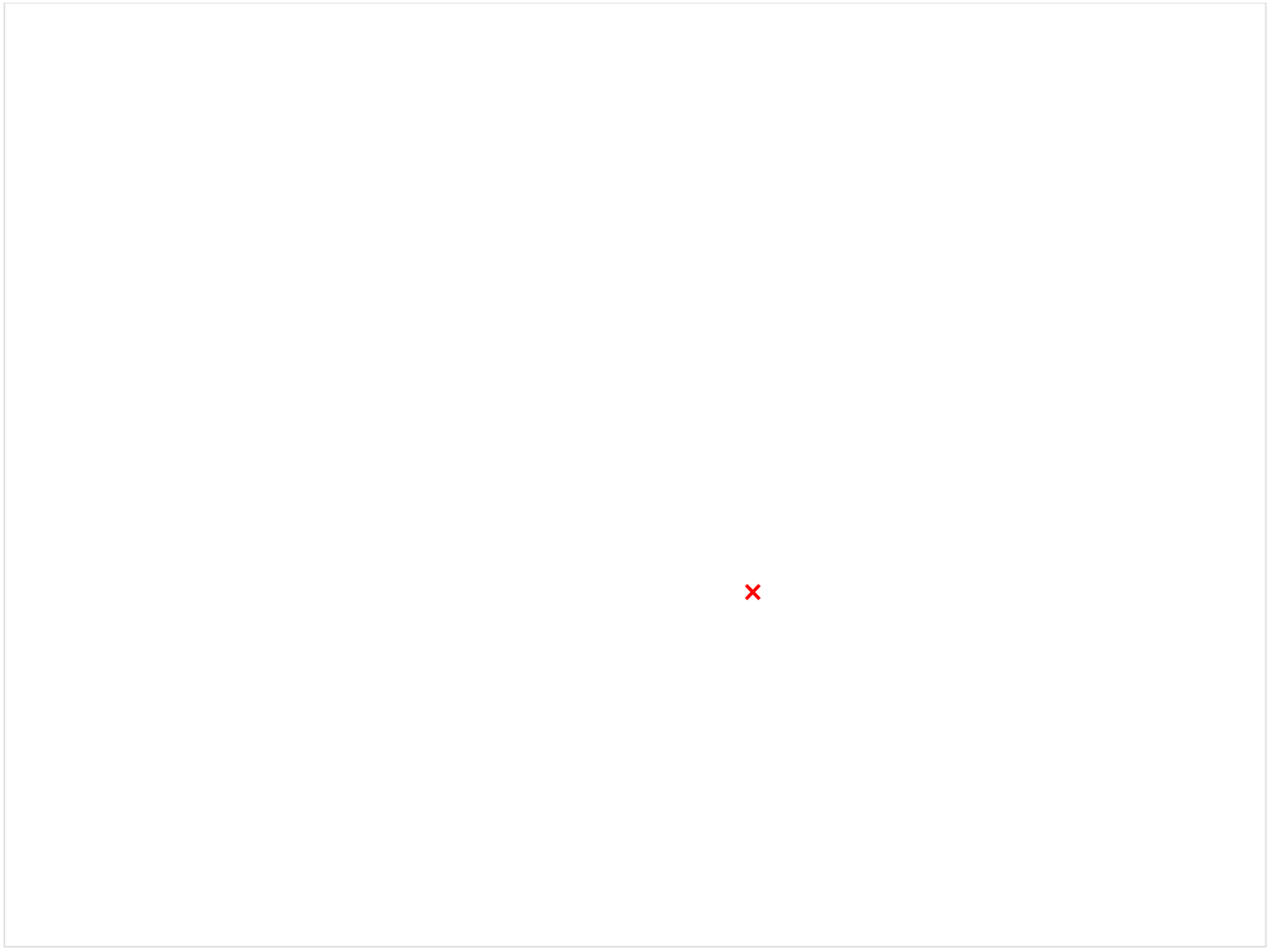
A possible solution is having an external jack and on that jack a frame with a wooden bar or tube that attaches both front and rear. With that we can then use string ties on front and rear bars to measure the side of the wheel from itself to measure toe length.



With the above design, the frame attaches to a jack at the front of the car and with this frame you can attach string to it and measure the end of the string to a part of the wheel to get direction of the wheel.

Last year I tried to create a frame like this where a wooden dowel could just go across and for the front it was fairly simple but there was difficulty when it came to the rear for finding a strong alignment point to attach some sort of disconnect frame or link.

As the team is looking for a definitive way of putting on undertray (making new jack for it) we can quickly have this In mind for its design. Can have the jack go onto the jacking bar and a frame over it to attach or bolt onto the jack to ensure it's aligned.



*Camber Gauge Tool

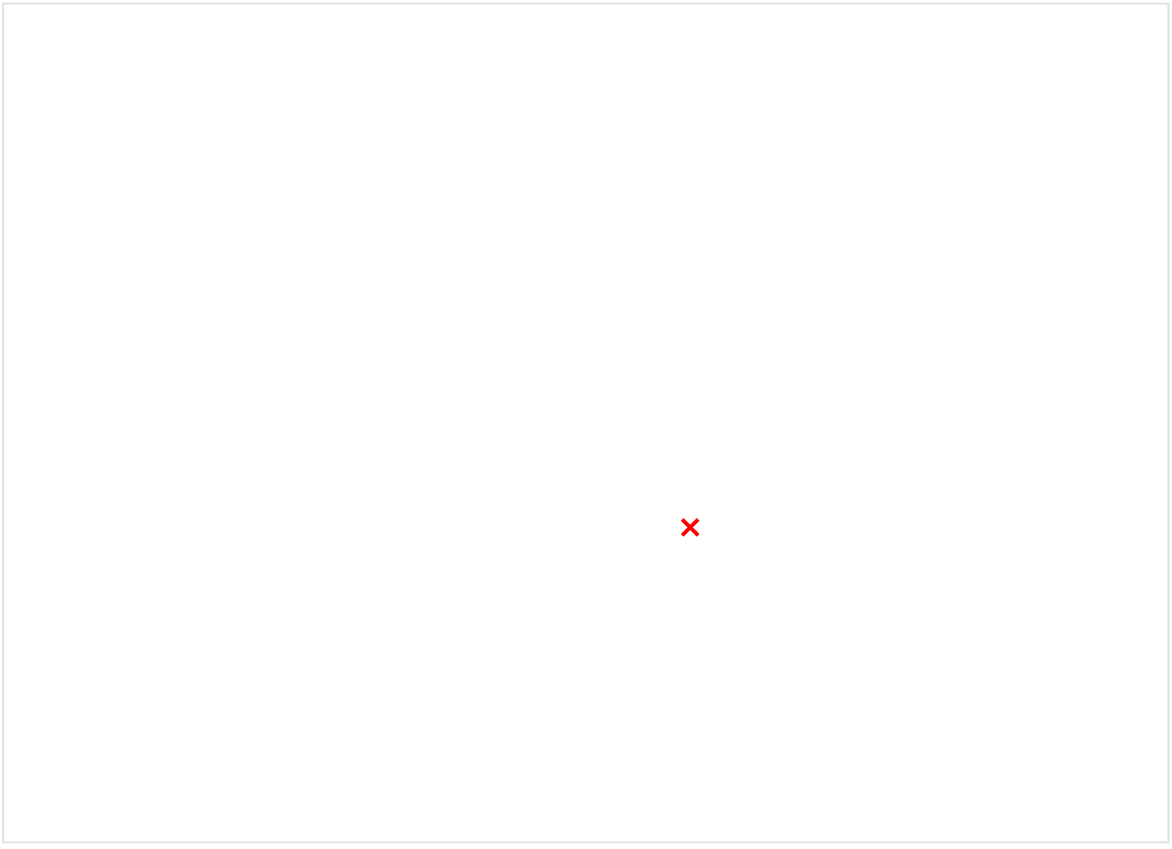
Monday, August 19, 2024 2:19 PM

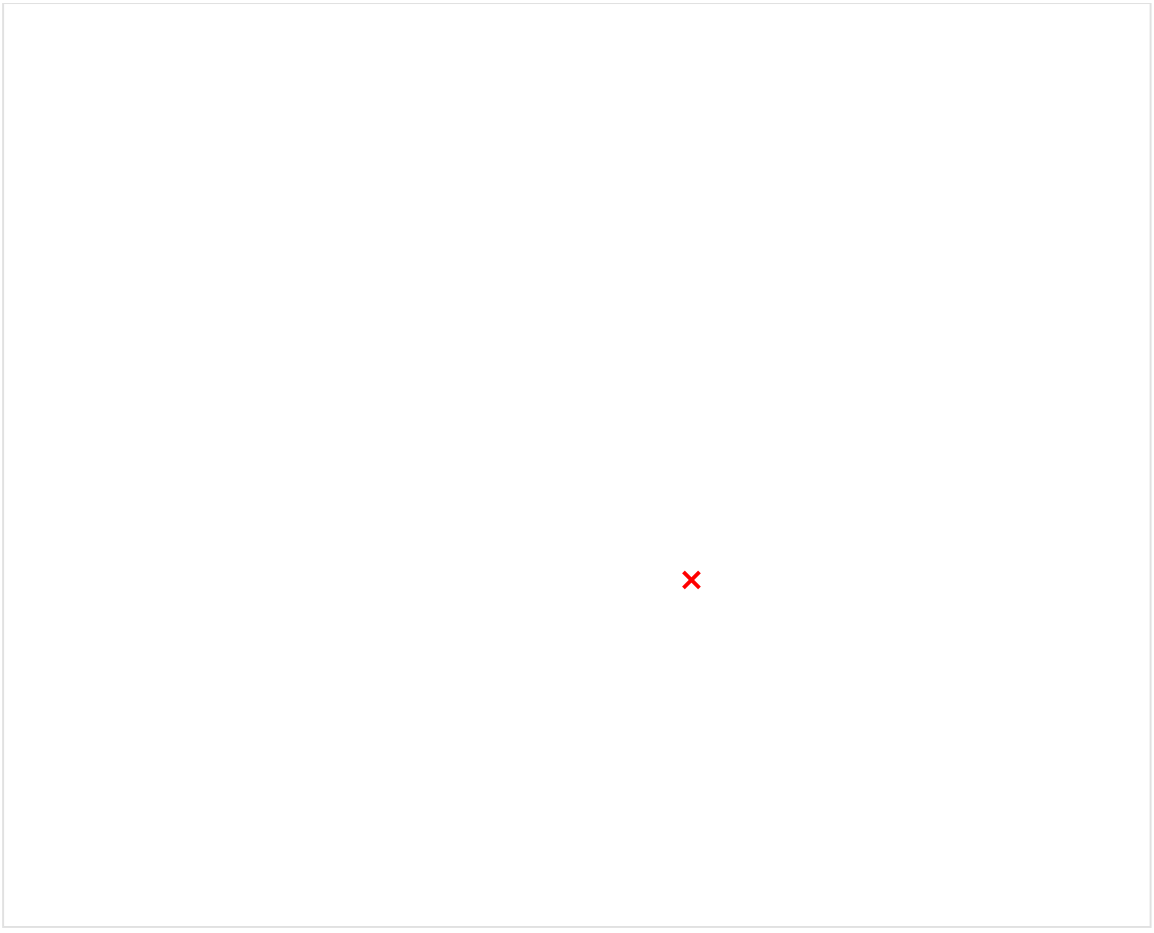
Assigned: Preston Coutinho

Team has a camber gauge and currently the way it measures is it has a cylinder bolted to the bottom made of steel and that fits into the hole in the center of the wheel hub. It was fine but over time the center of the hub wore and so did the cylinder and overtime this will continue to ware. A tool to bolts onto the hub directly and connects to the gauge would be ideal for measure camber and making sure it is repeatable.

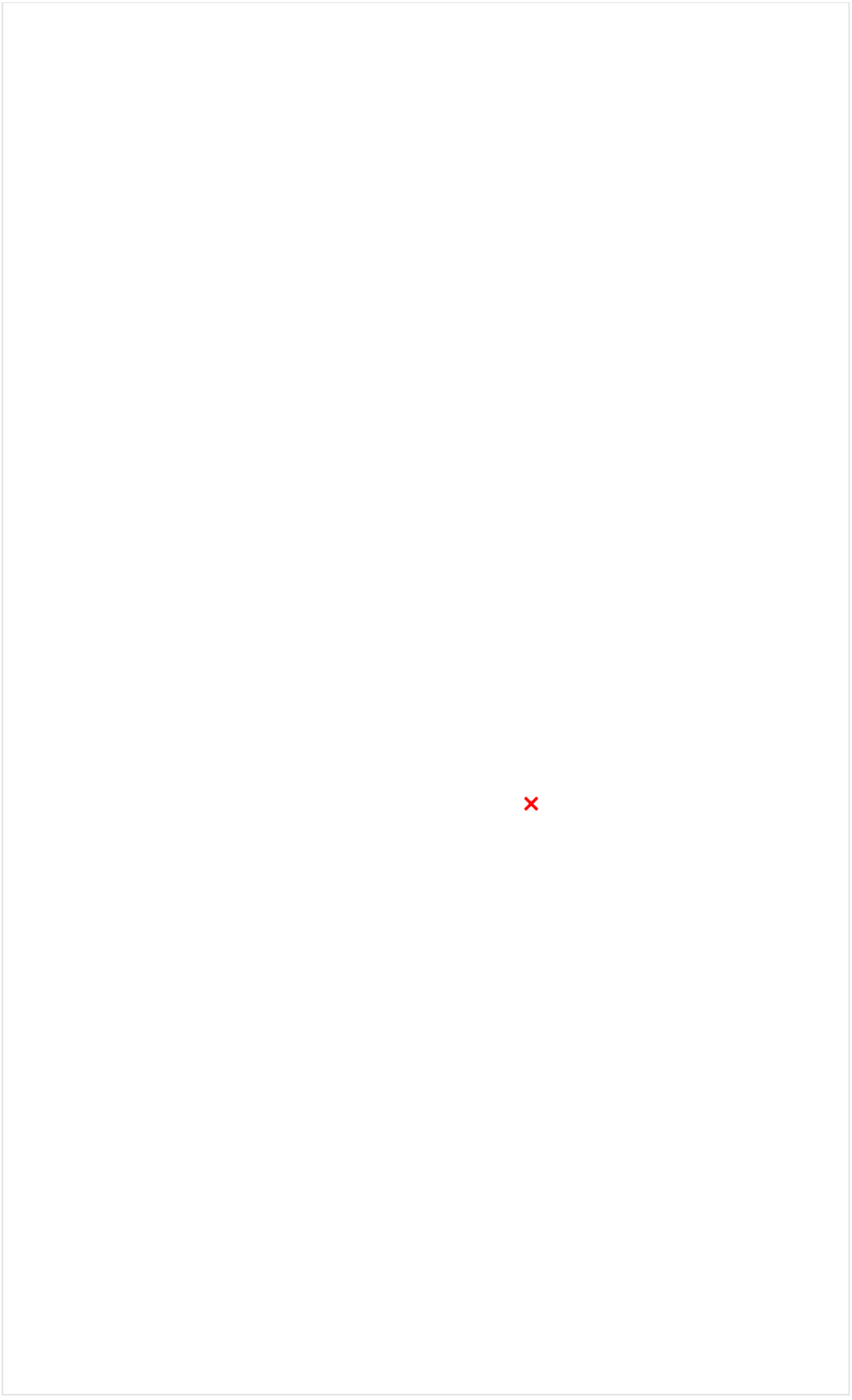
The specific part for the camber gauge can be found here

Below are some designs are started working on last year for one. It is super long because I thought about potentially integrating as a toe measurement tool as well but would quickly become impractical for manufacturing. I would like to maintain the mating feature on the hub for it.



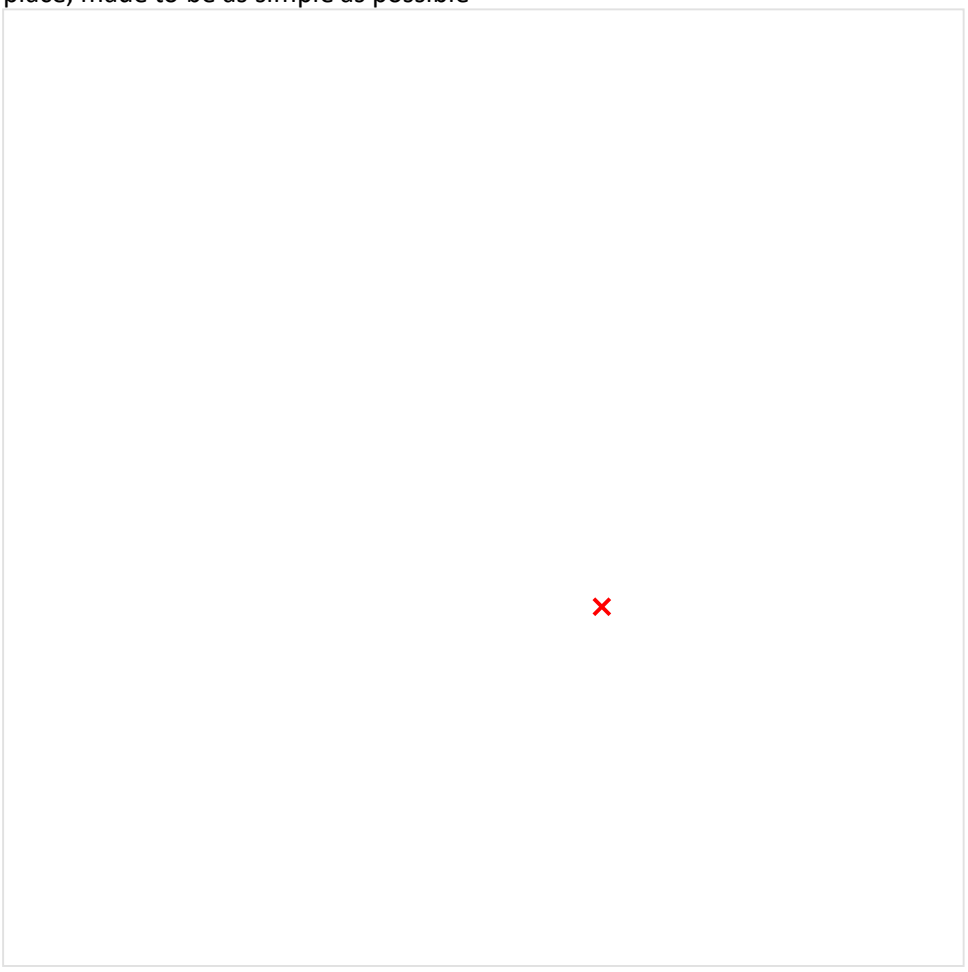


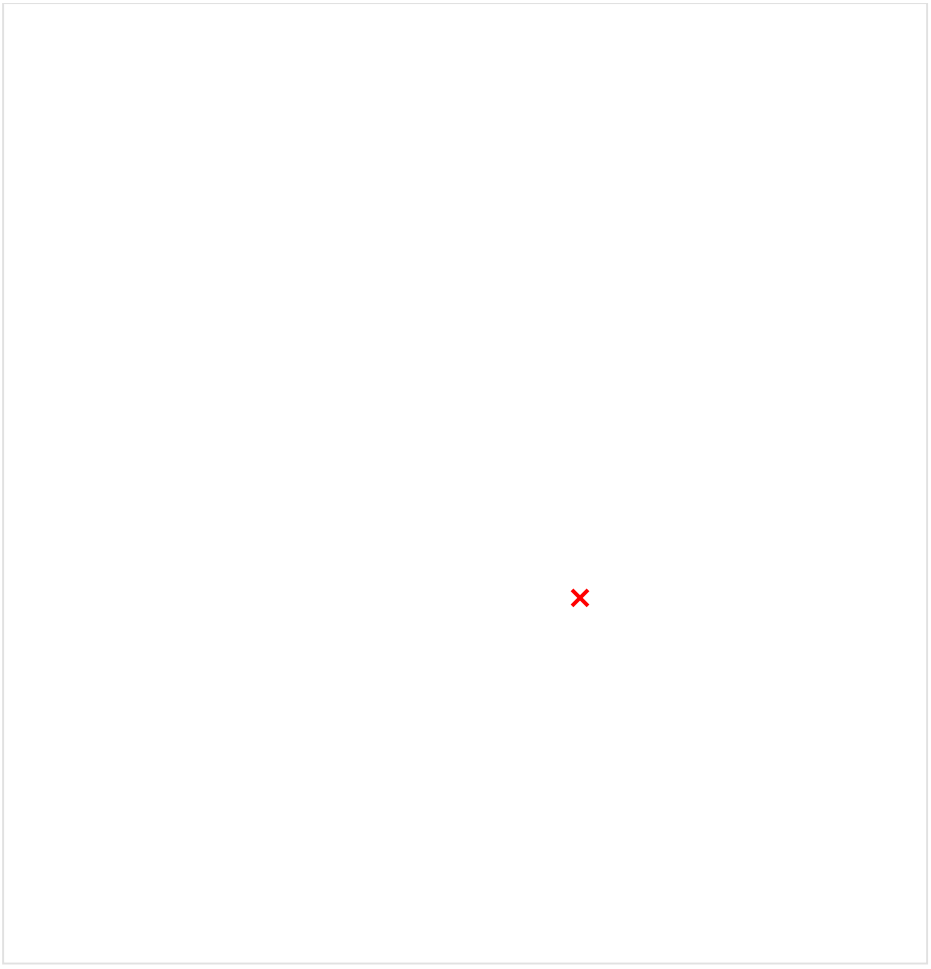
8/20/2024 Preston + Sam Meeting
First concept for the base, needs alignment feature on the face of the tool to make sure that the gauge is fully seated into the plate. The part can be made of Aluminum water jet materials but can also be 3D printed beforehand and can be kept if suitable.



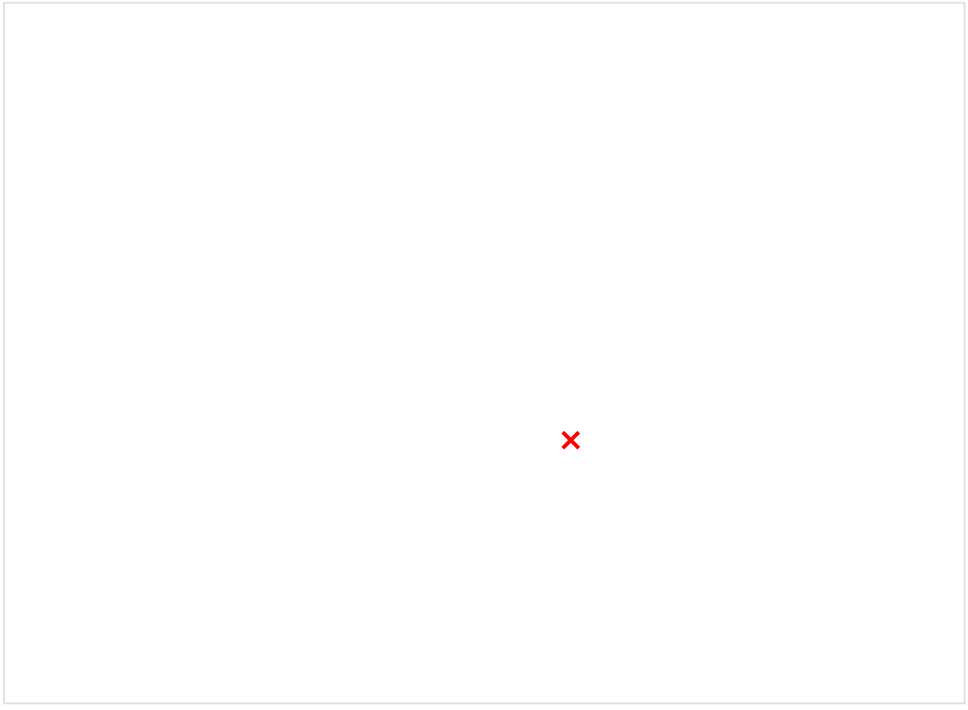
Preston:
-originally the tool above had the hole for the head of the screw in the wrong place, now it's in the right

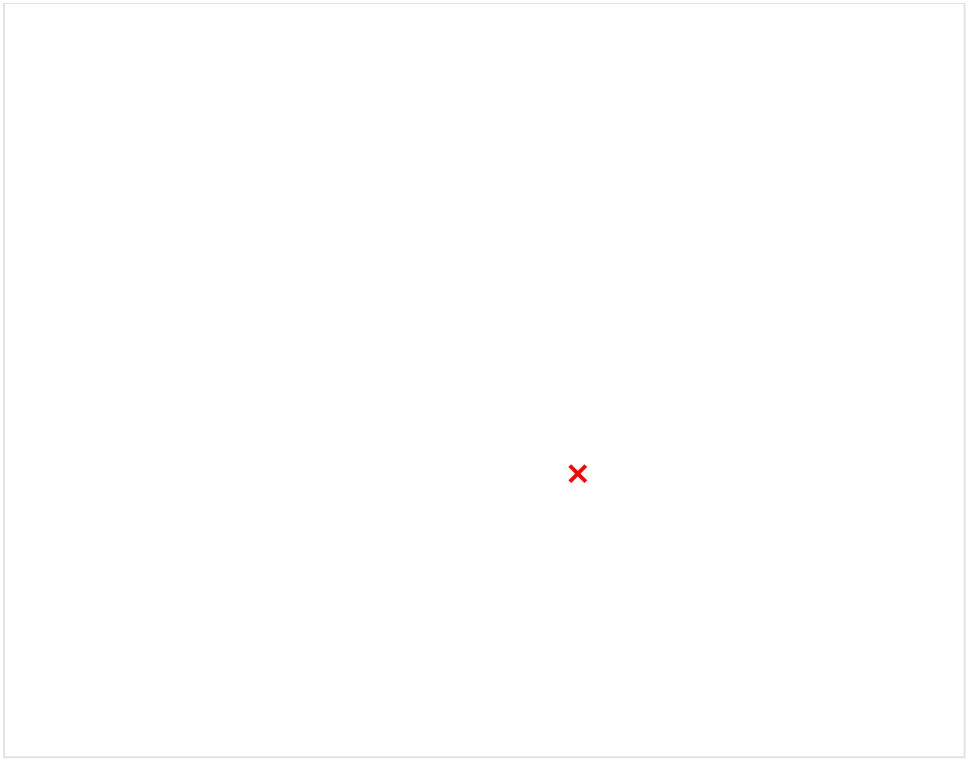
place, made to be as simple as possible





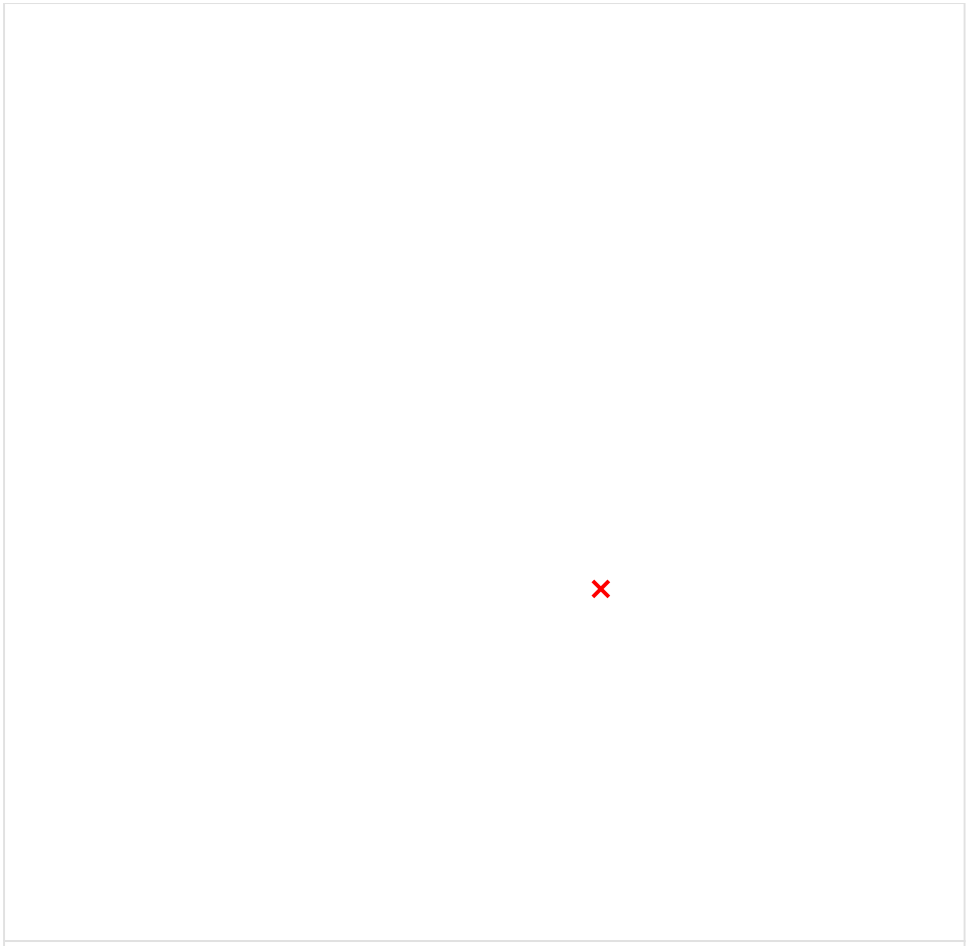
THE STUDS INTERACT WITH THE CAMBER TOOL ON THIS ONE

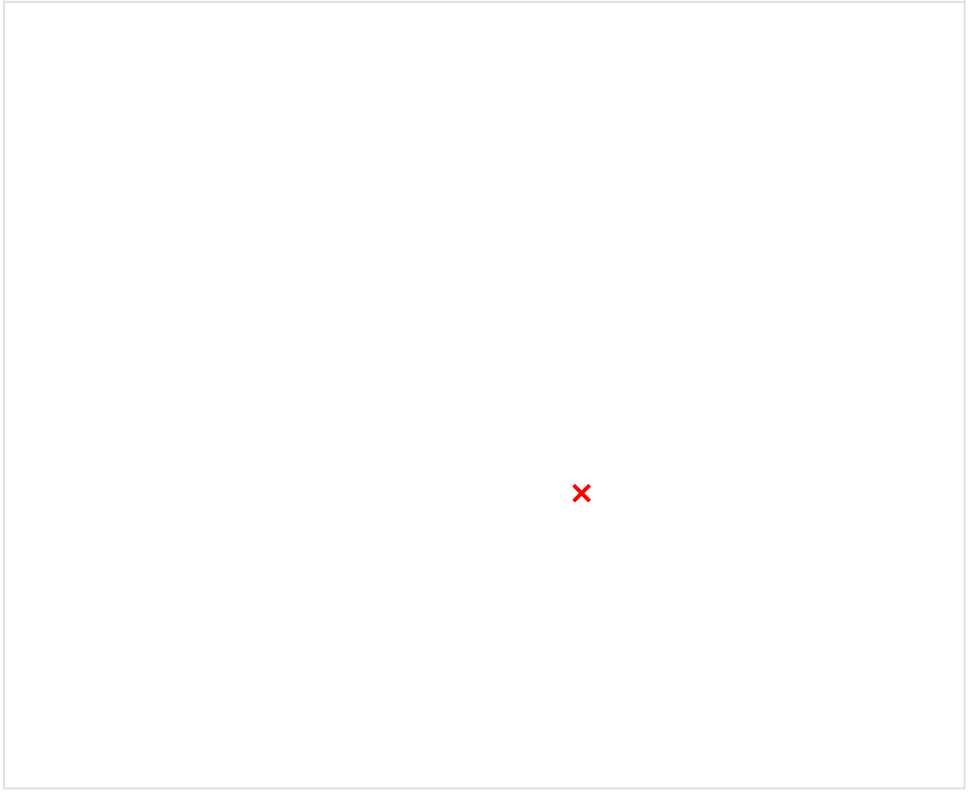




THE STUDS WILL NOT INTERACT WITH THE CAMBER TOOL ON THIS ONE
Will have 2 purposes:
-utilizing the camber Guage by allowing to attach the tool directly to the hub
-able to measure bump steer while in the jig(which is what the 2 circular parts on the side are, bearings will go on that part most likely, if not, bushings)

Decreasing amount of filament used with extra holes and decreasing the side part's length:





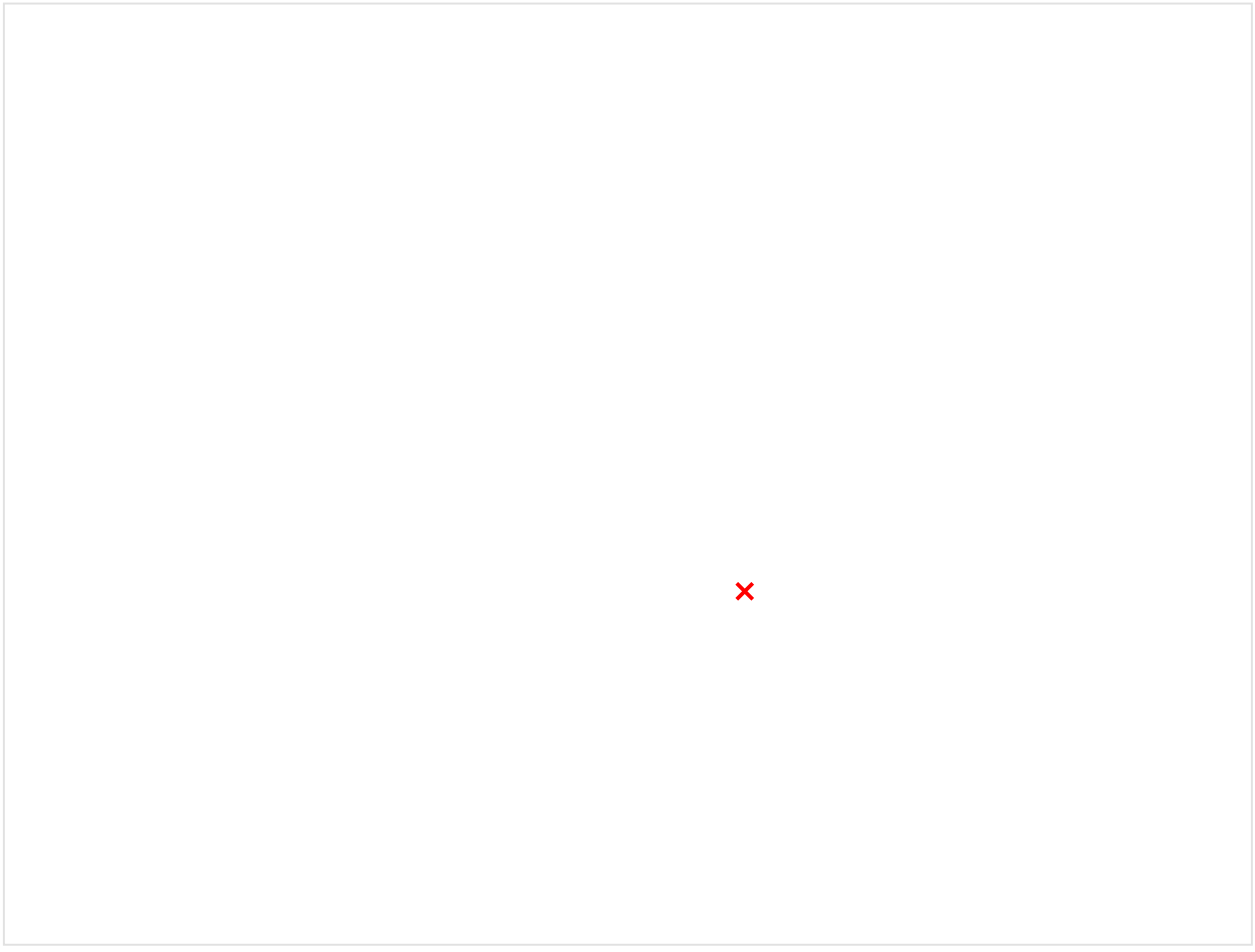
*Dummy Damper

Monday, August 19, 2024 2:38 PM

Assigned: Wasim Alam

When corner balancing the car you want to make sure your body isn't compressing at all. A dummy damper would just be a tube with bolt holes that would make sure the length stays extended in its proper position when corner balancing and ensuring ride heights are at appropriate length.

Get some of this and some rod ends and it should be fine, just needs to be done in CAD and needs to get manufactured.



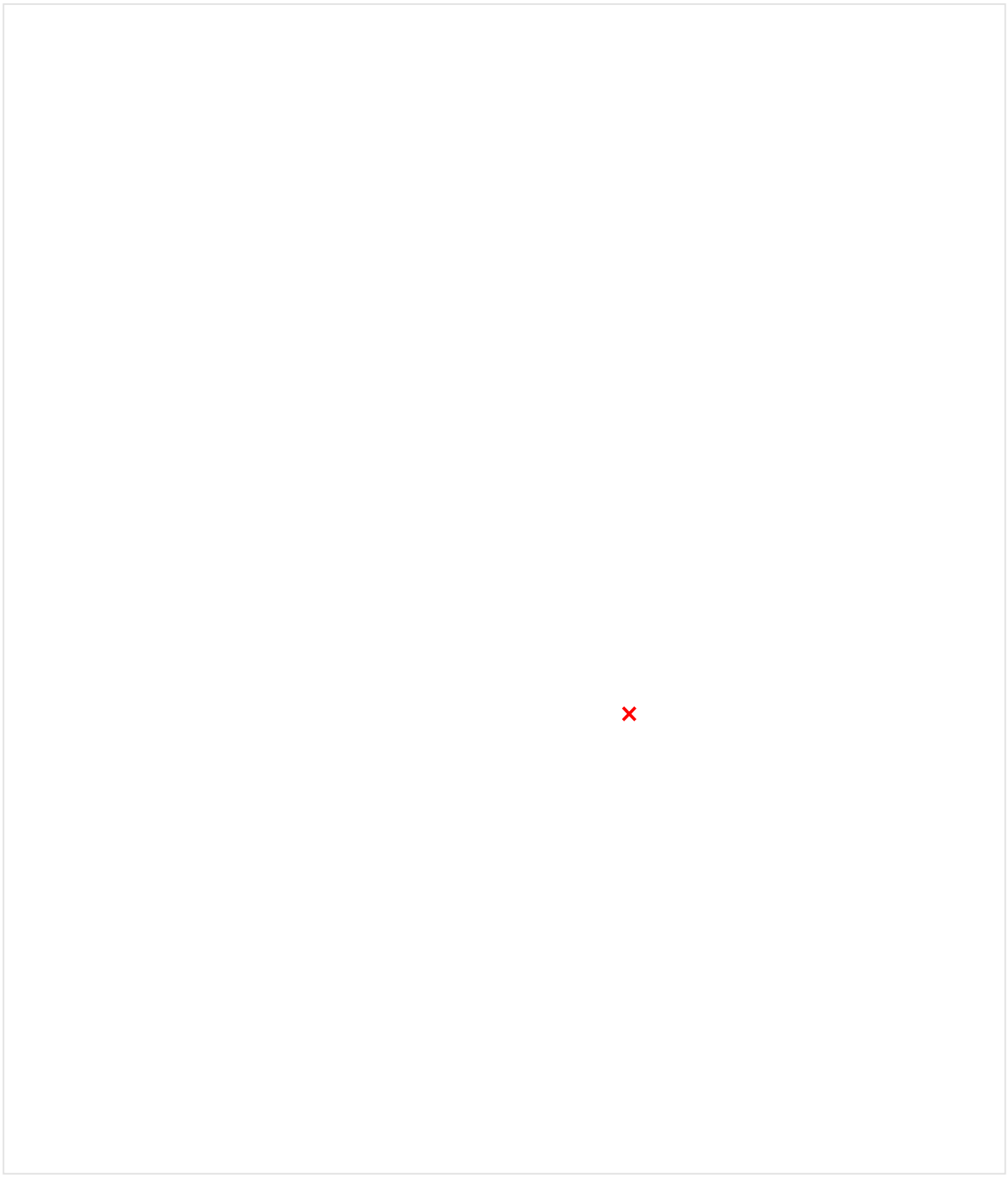
Wheel Gasket

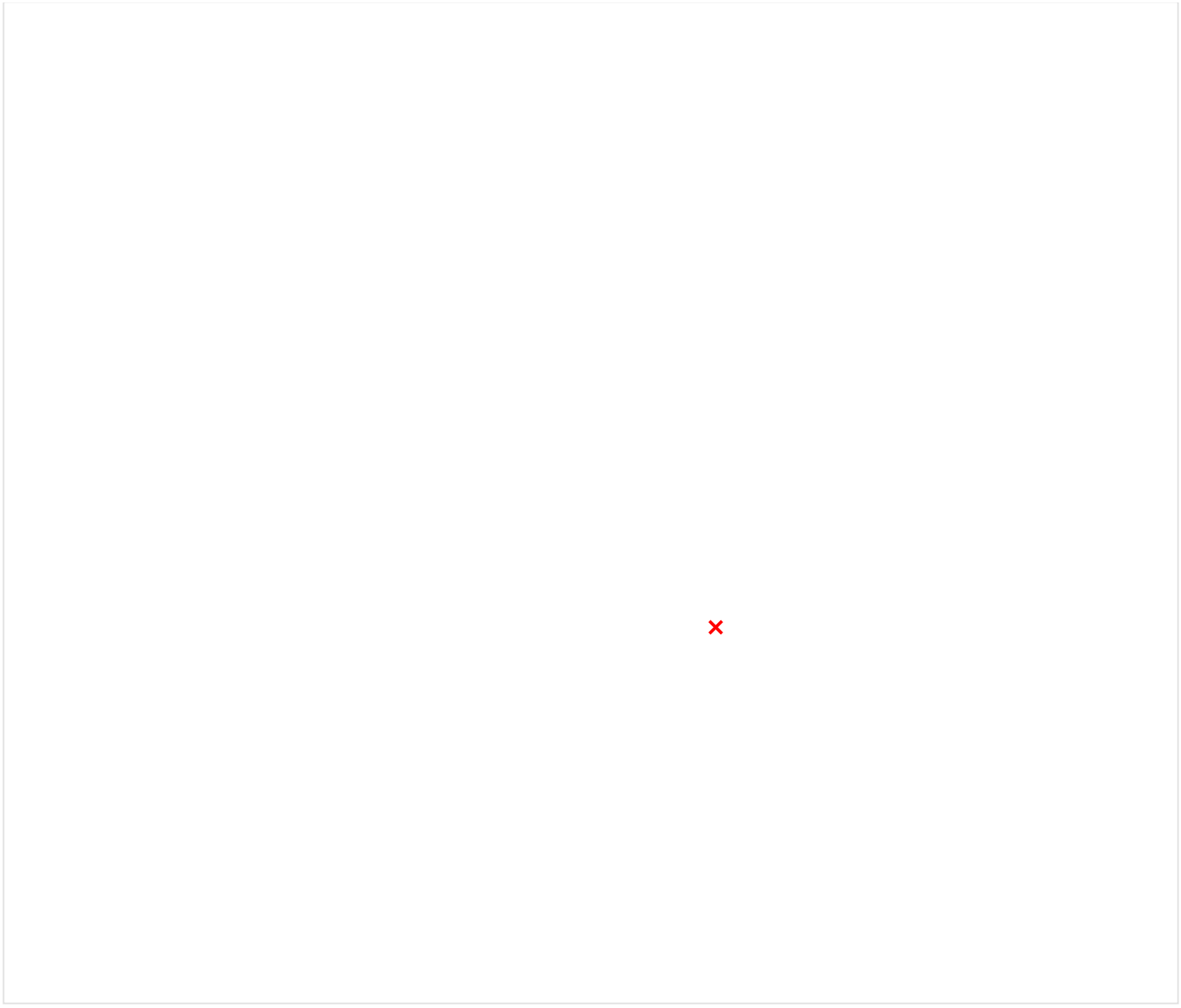
Tuesday, August 20, 2024 2:37 PM

Find the proper material for the wheel gasket, like the specific rubber for sealing the aluminum surfaces of the wheels and CAD the pattern to get them cut on the OXOS laser cutter.

Best way to find proper sealing material (gasket material) is searching for some aluminum air sealing rubber material on McMaster-Carr.

Could also email/ call Keizer (Wheel Manufacturer). The space for the gasket can be shown below.





Gasket should fit the profile of the blue on the wheel in the photo above

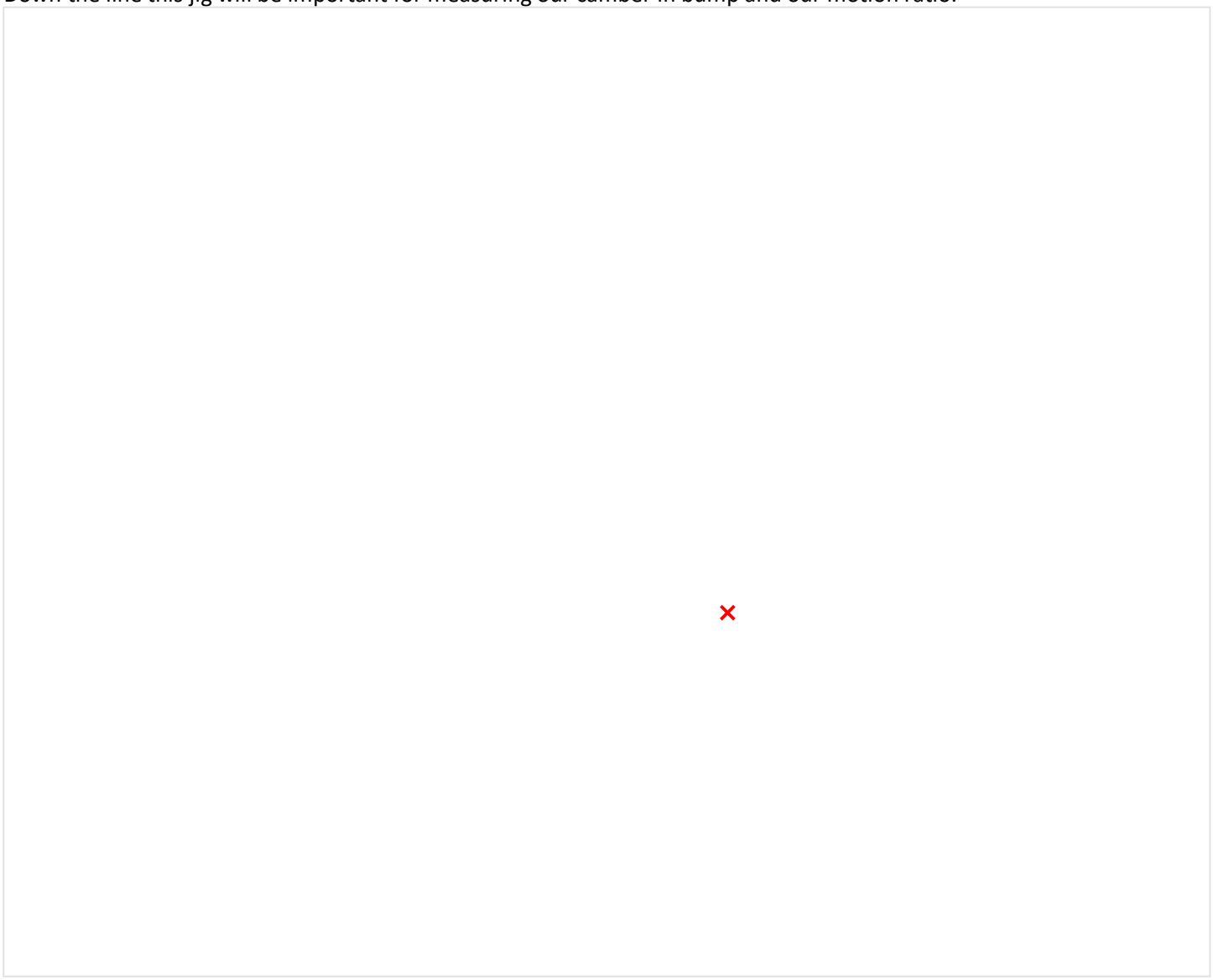
*Wheel Bump Jig

Tuesday, August 20, 2024 6:49 PM

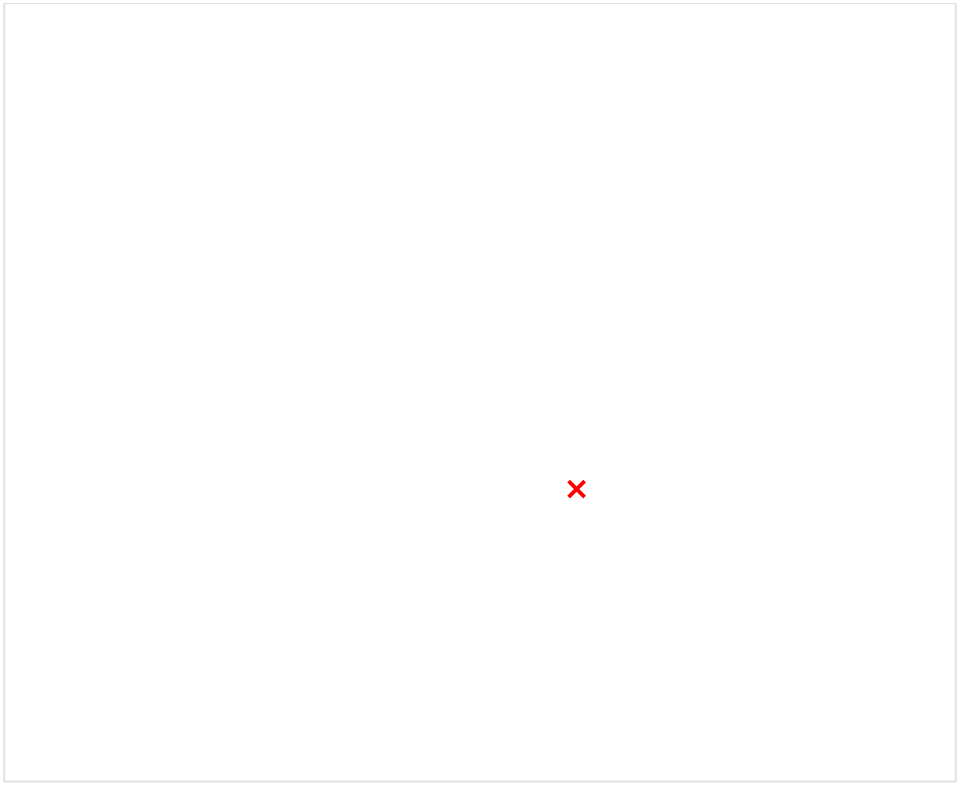
Assigned: Preston Coutinho

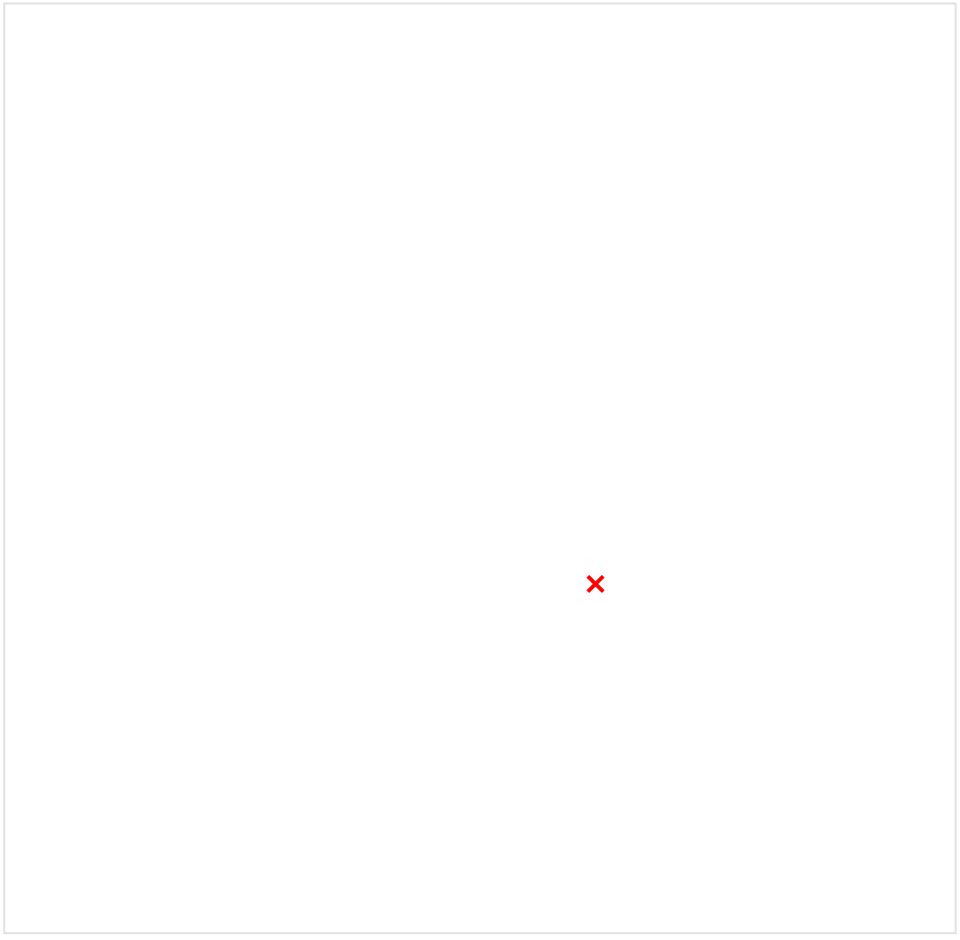
Need something or a method to where we can raise the height and control the drop length of the hub and suspension per corner. You can do a shim stack or something with a set screw. Preferably this would attach to the hub itself and go up and down.

Down the line this jig will be important for measuring our camber in bump and our motion ratio.



Above is not a very good photo but a frame that would mount to the hub and can be shifted up and down at a measured length and hold the wheel at that position. Can be done with multiple mounting holes up and down the tower that can be at specific lengths.





Will have 2 purposes:
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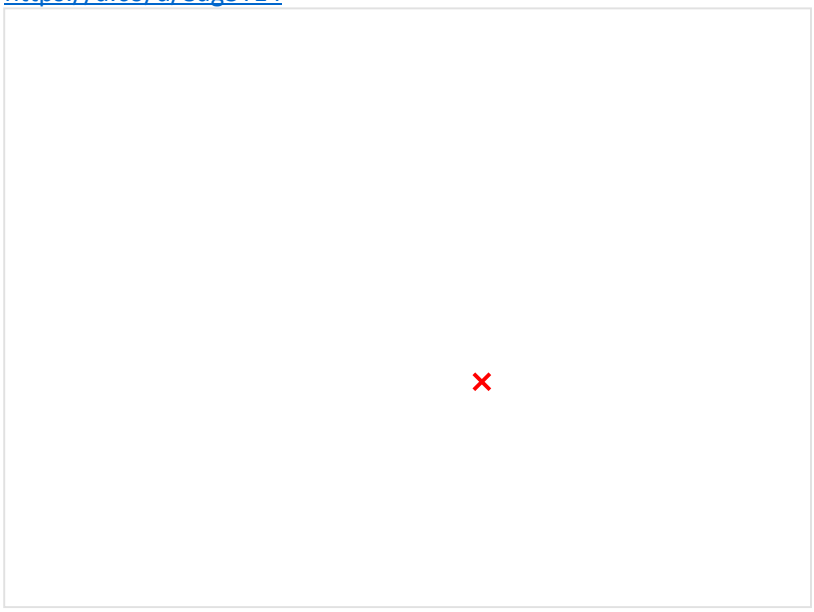
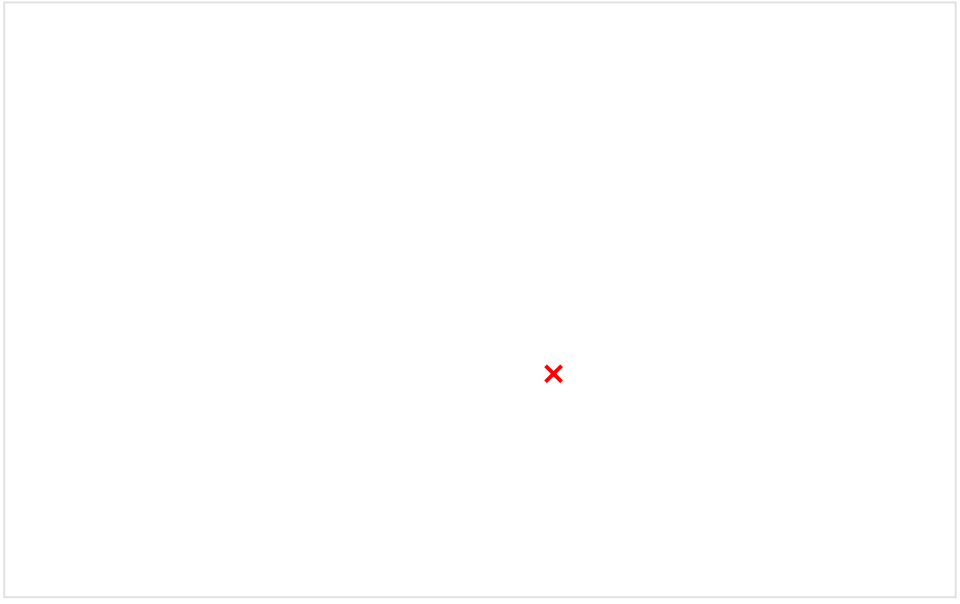
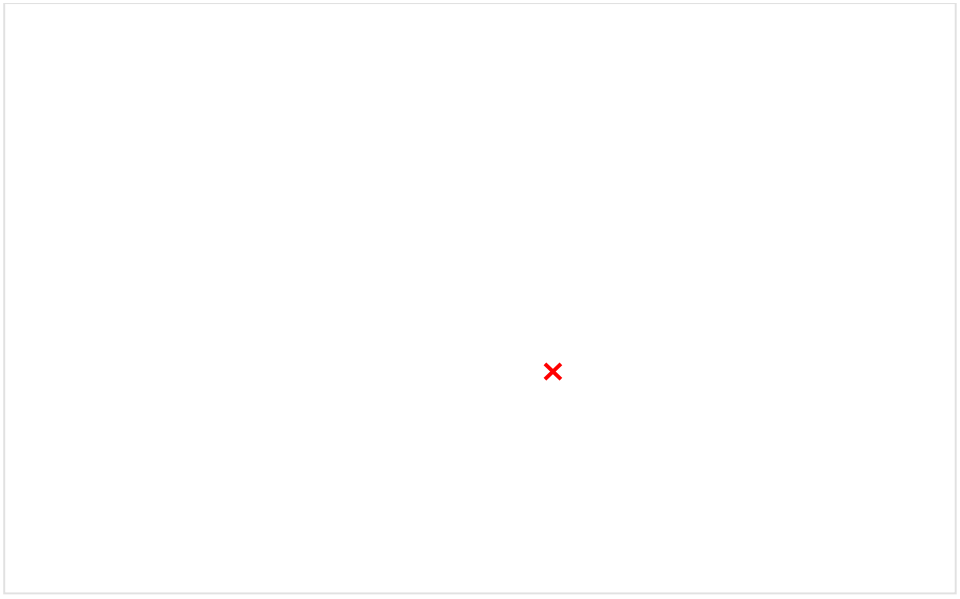
will go on that part most likely, if not, bushings)
Bearings:
https://a.co/d/8ag3TE4

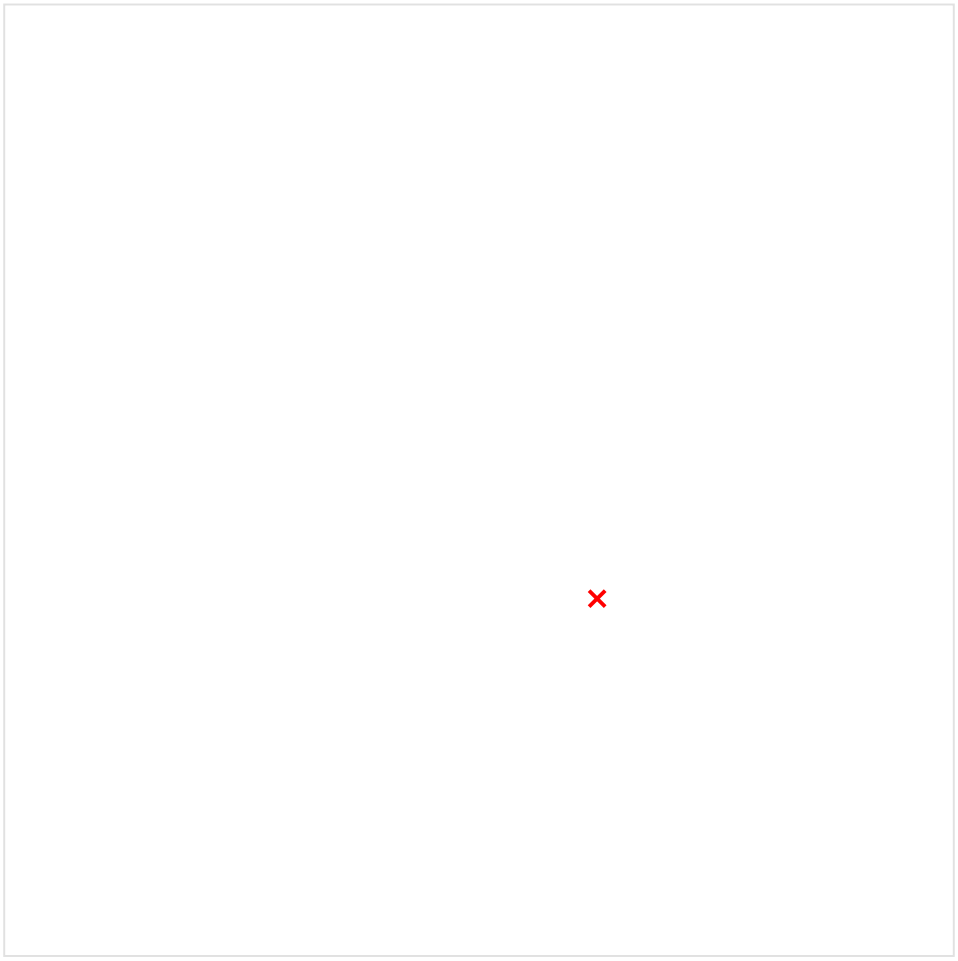


Slots for extra material to fit it on the car jack

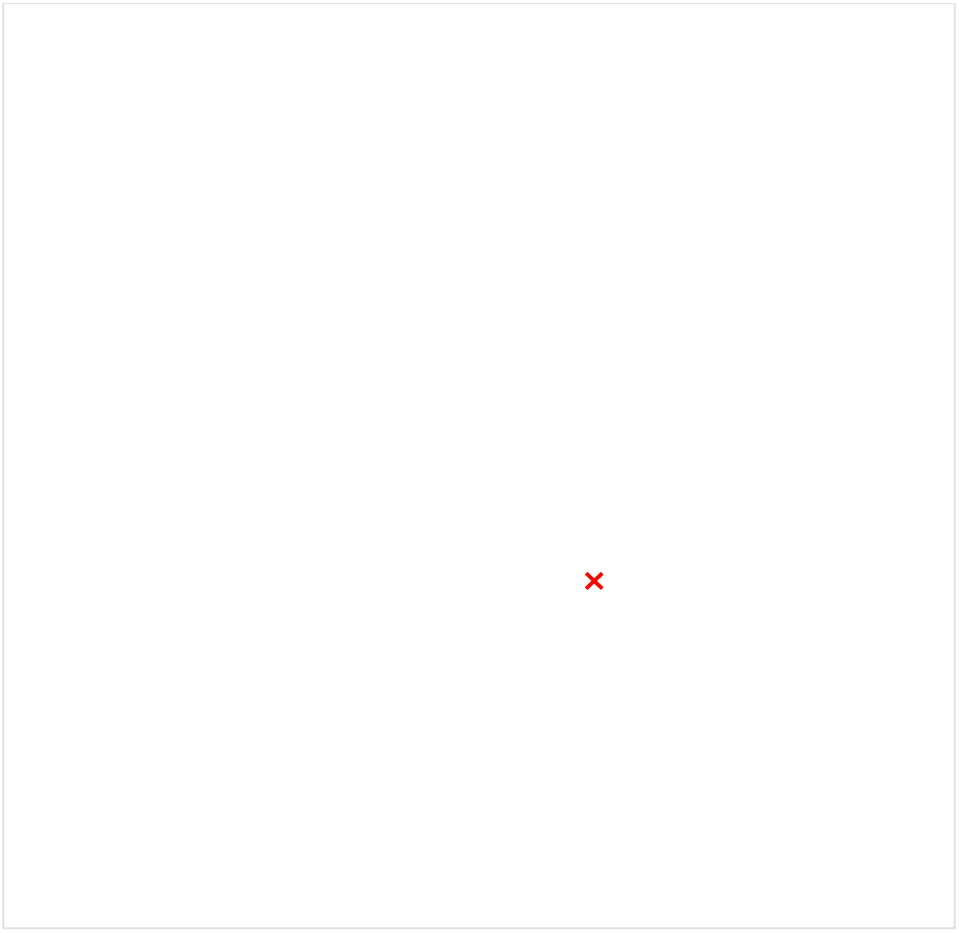




Clearance with the caliper



Fork part which will need 2 bearings in it on the sides and then 2 bearings on the bottom part



What will hold the fork part with 2 bearings

*Wheel Hub

Thursday, September 5, 2024 8:15 PM

Wheel Hub on the KS5-KS7 is fine. With all the other interactions this part has, don't want to make huge amounts of change to the part. Rule of thumb is everything behind the hub face should not change.

Requirements:

- +/- 10% of current weight of component
    - Could be lighter - Could be Stiffer

Pedal Box

Thursday, September 5, 2024 8:22 PM

Current Issues with KS6+KS7 Pedal Box:

- APPS Potentiometer (TPS BPS) Mounting
    - Sits on the pedal box with two pins with threaded studs, has stack up with waterjet parts that adjust the throw of the throttle pedal. Tolerance stack up for that assembly is not great
- Brake Pedal Slop is Excessive
    - Only way to add
    - About 5-10% of Slop (Shown in Potentiometer Data). Is still excessive even when adjusting master cylinder set screw
- Changing Position Servicing isn't Good
    - Convoluted zip tie and cut process for the cover
    - Changing seating position of pedal box also takes long and hard to get to
- Brake Pressure Sensor for Tail Light
    - Positioning makes it easy to break
- The Banjo Bolts are very close
    - Hard to take off the master cylinders without taking the whole pedal box assembly off
- When taking out the entire pedal box requires taking out the reservoirs
- A lot of post manufacturing items, leads to it being very weak and hard to work with and make adjustments
    - Brake reservoir mounting
    - Brake overtravel switch
- Chassis of the pedal box is rusted

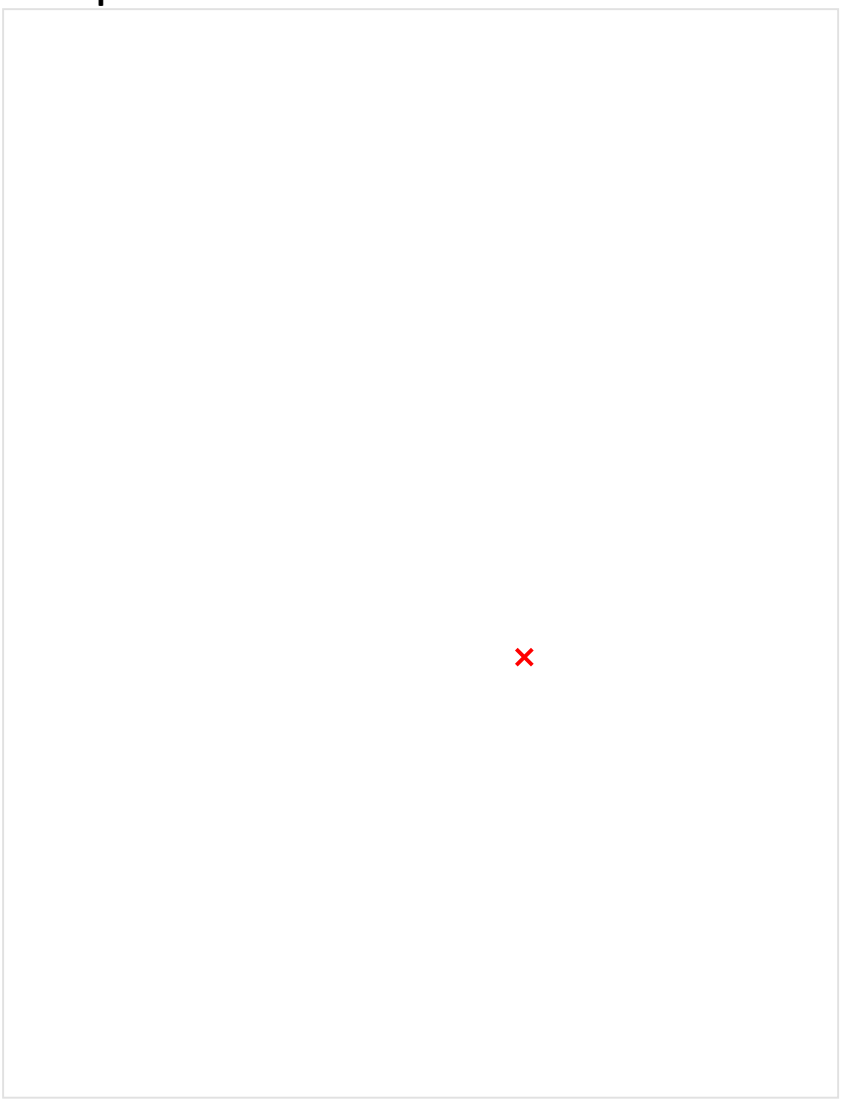
*Load Cell Push/ Pull Rod

Monday, September 23, 2024 12:56 AM

Component Brief:

Got new load cells for the KS7. Wanted to integrate on the KS7 after competition to trial them before officially implementing onto the KS8E. Wanted to retain the push + pull rod lengths while doing so even though we had a previous issue with aero bottoming during dynamic events. This would make it easier if we ever had to go back to the previous design and any possible issue where it won't fit could be avoided if we know these lengths are fine for the rods

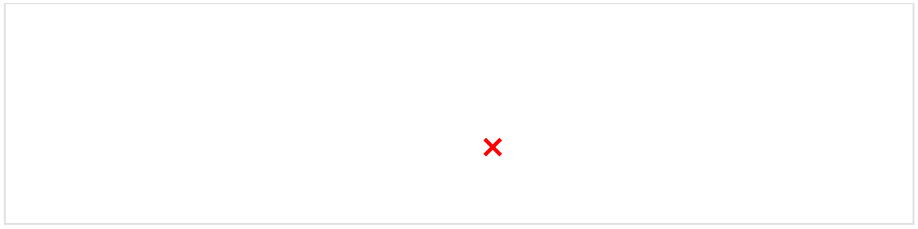
Concepts:



Component Info:

- The part number and information for the load cells HERE
- For ease of implementation going to use the same rod end sides and probably just have threaded inserts for the rod ends and load cell attachment then a welded insert for the other side to mount to tube and load cell.

-



*Direct Acting Suspension

Friday, October 4, 2024 6:45 PM

Assigned: Wasim Alam

1. Figure out what motion ratio is
    a. Effects on handling, mechanical grip
    b. Calculate Weight Gain possible from removing bell crank/ rocker and tabs

Component	Unit weight	QTY	Total weight
Bellcrank assembly	0.17	4	0.68
Bellcrank tabs	.0023	8	0.0184
Hardware	.02	12	.24
TOTAL	N/A	1	0.9384

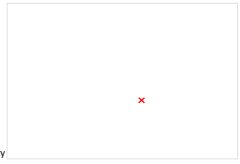
2. Figure out mounting to the Damper itself
    a. Thread into the damper
3. CAD into assembly- Check Motion Ratio
    a. Sam help
4. Motion Ratio Analysis
    a. Direct Acting Suspension - Spreadsheet

We're sorry, we couldn't make a preview image.

Right-click and pick Refresh and we'll try again

*Test Rocker

Tuesday, January 14, 2025 4:14 PM



Wheel rate= motion ratio * spring rate

Lmp cars have very little shock movement
Because wheel going up and down has to be very
Small because it impacts aerodynamics
(ground effect)

Shock length: 200mm

Naming Scheme
P: Position
MR: Motion Ratio
B: Bump
D: Droop
D after bump or droop: derivative
A, B, C, D, E After First B or D: the mounting hole on rocker, A being the one closest to the body of the car and E being the farthest
S: Shock
Bottom Row: The D after bump and droop means derivative

BumpA	DroopA	BumpB	DroopB	BumpC	DroopC	BumpD	DroopD	BumpE	DroopE
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
1	1	1	1	1	1	1	1	1	1
1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
2	2	2	2	2	2	2	2	2	2
2.5		2.5		2.5		2.5		2.5	
3		3		3		3		3	
BumpSA	DroopSA	BumpSB	DroopSB	BumpSC	DroopSC	BumpSD	DroopSD	BumpSE	DroopSE
0.578	0.606	0.498	0.513	0.441	0.45	0.399	0.404	0.366	0.369
1.121	1.239	0.975	1.04	0.869	0.907	0.789	0.812	0.725	0.74
1.617	1.903	1.424	1.578	1.278	1.369	1.166	1.222	1.076	1.112
2.05	2.612	1.832	2.13	1.661	1.837	1.524	1.634	1.412	1.483
2.395		2.186		2.006		1.856		1.73	
2.622		2.464		2.3		2.151		2.02	
BumpDA	DroopDA	BumpDB	DroopDB	BumpDC	DroopDC	BumpDD	DroopDD	BumpDE	DroopDE
0.920810313	0.787889	1.048218	0.948767	1.168224	1.094091 9	1.282051 28	1.22549	1.392757 66	1.347709
1.008064516	0.753012	1.113586	0.929368	1.222494	1.082251 1	1.326259 95	1.219512	1.424501 42	1.344086
1.154734411	0.705219	1.22549	0.905797	1.305483	1.068376 1	1.396648 04	1.213592	1.488095 24	1.347709
1.449275362		1.412429		1.449275		1.506024 1		1.572327 04	
2.202643172		1.798561		1.70068		1.694915 25		1.724137 93	

-5 positions for pushrod
-c position is original position as before
-vertical line beneath lower control arm is for measuring bump/droop

*Anti Roll Bar

Thursday, January 23, 2025 9:35 PM

Team has thought about using ARB in the past, but generally lacked simulation or good proof for one. During testing the front wing of the KS7E would scrape under roll. Goal is to put ARB on KS8E before competition.

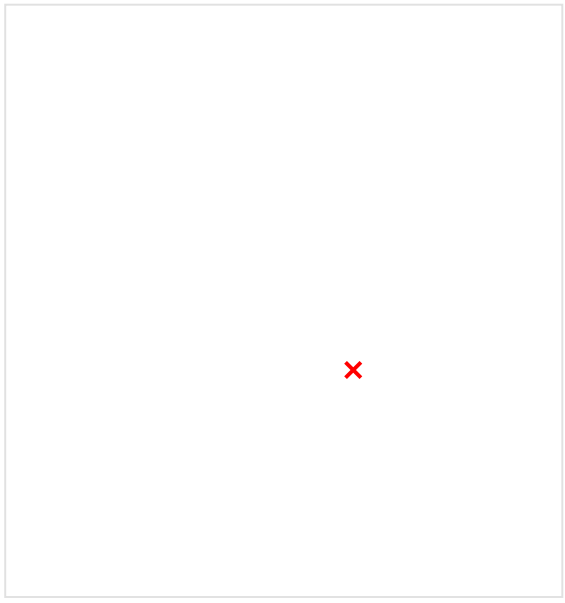
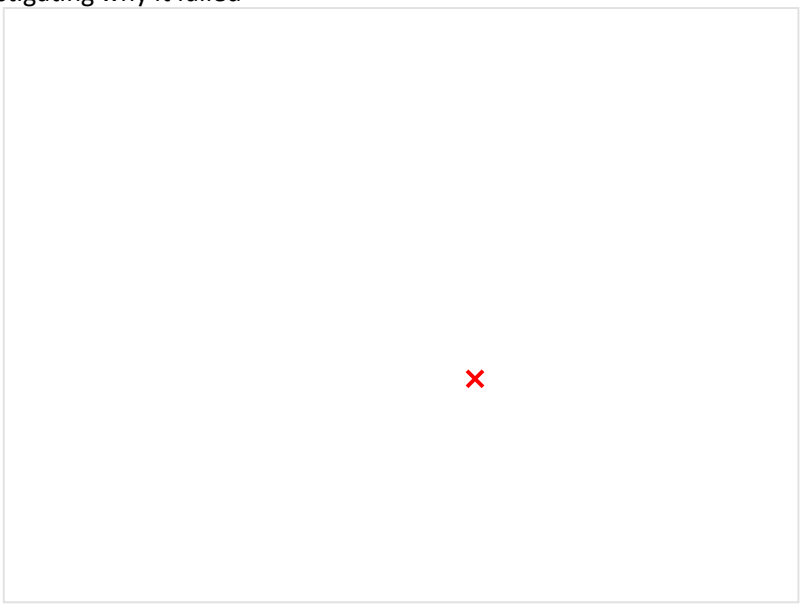
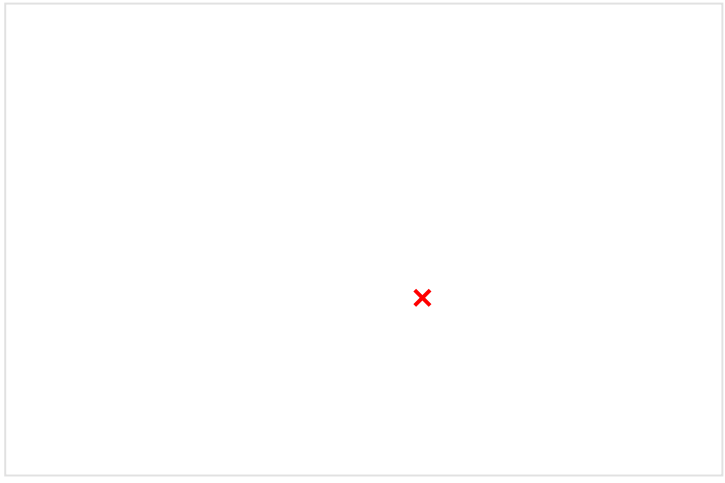
Throughout investigate

- Roll stiffness of the current car without an ARB
- Roll stiffness of car with a hypothetical ARB

KS7E Front Upright Failure Report

Friday, November 15, 2024 7:22 PM

Overview:

- During 2024 Barnesville event, the KS7E has a front upright failure at the steering mount
- This will be the notes and documentation for investigating why it failed
- 

- 

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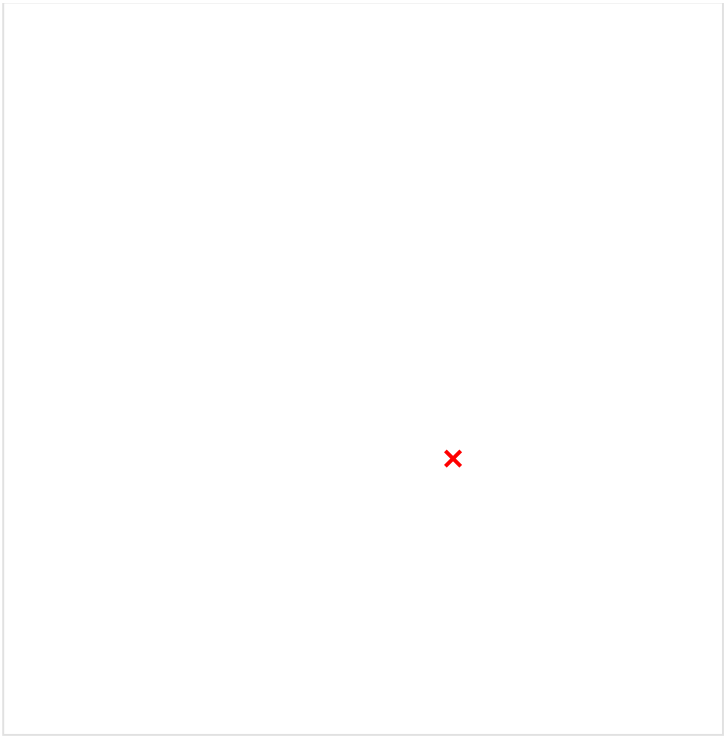
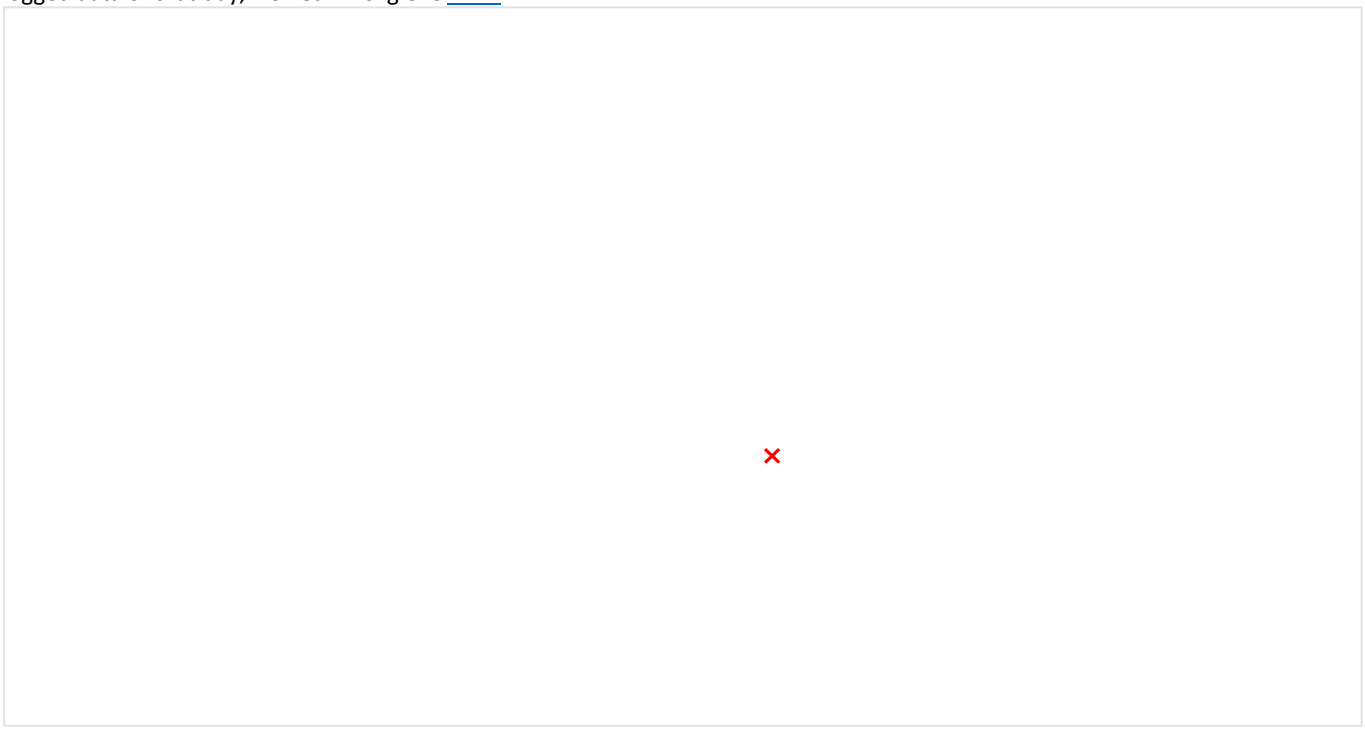
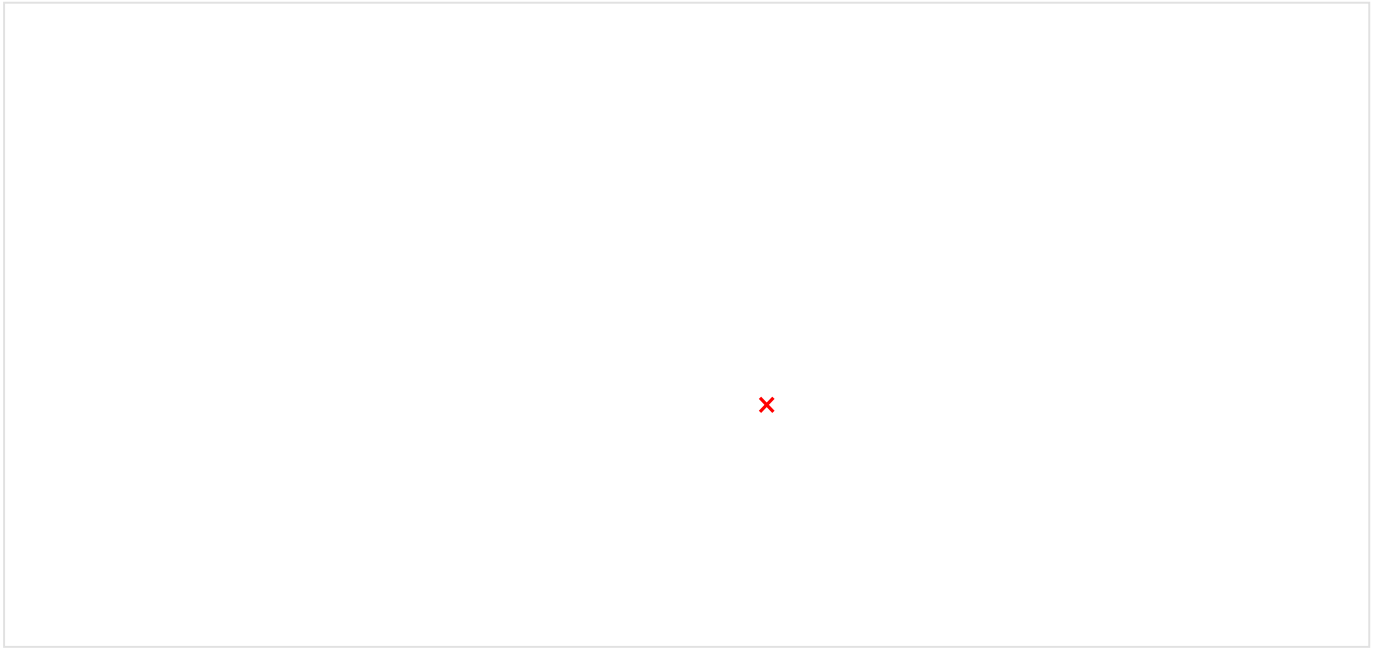


Logged Data

Friday, November 15, 2024 7:23 PM

From logged data of that day, viewed in foxglove HERE

- 
- Vectornav Signals dropped right at that point where the car seemed to have broken it's uprights
- To recreate the load case, want to derive approx. acceleration values to get tire forces
- Need to get corner load, corner slip angle, and camber

- 

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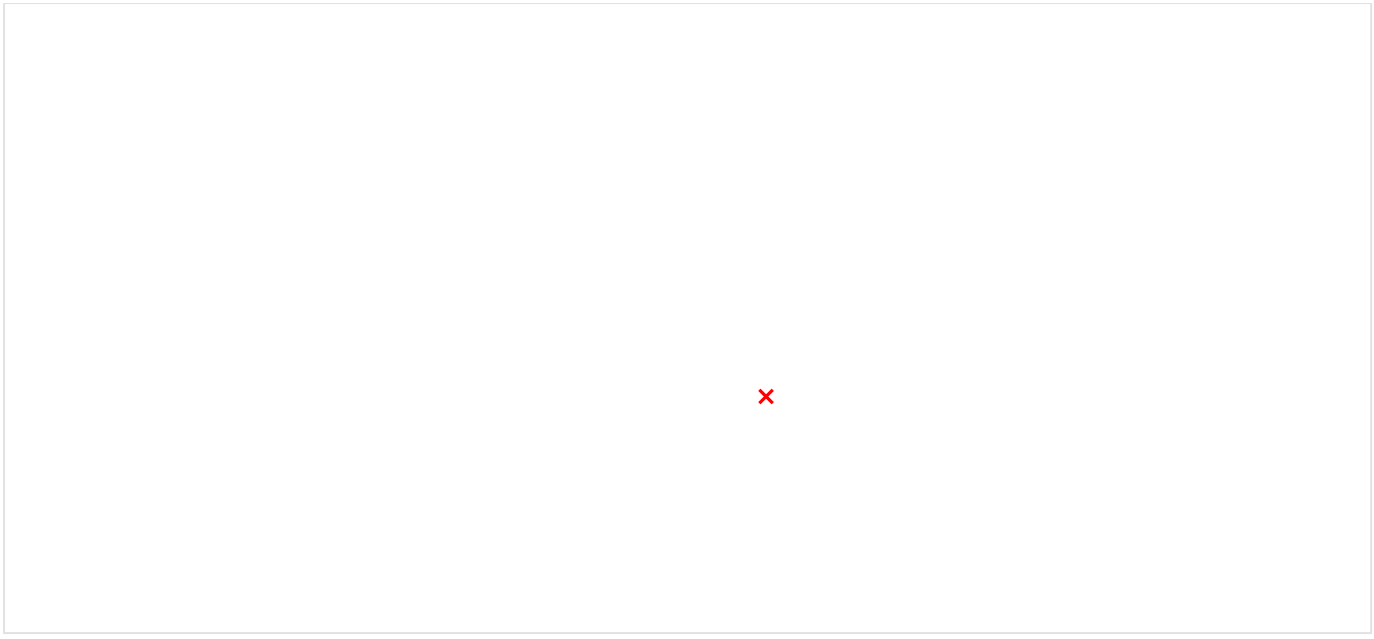
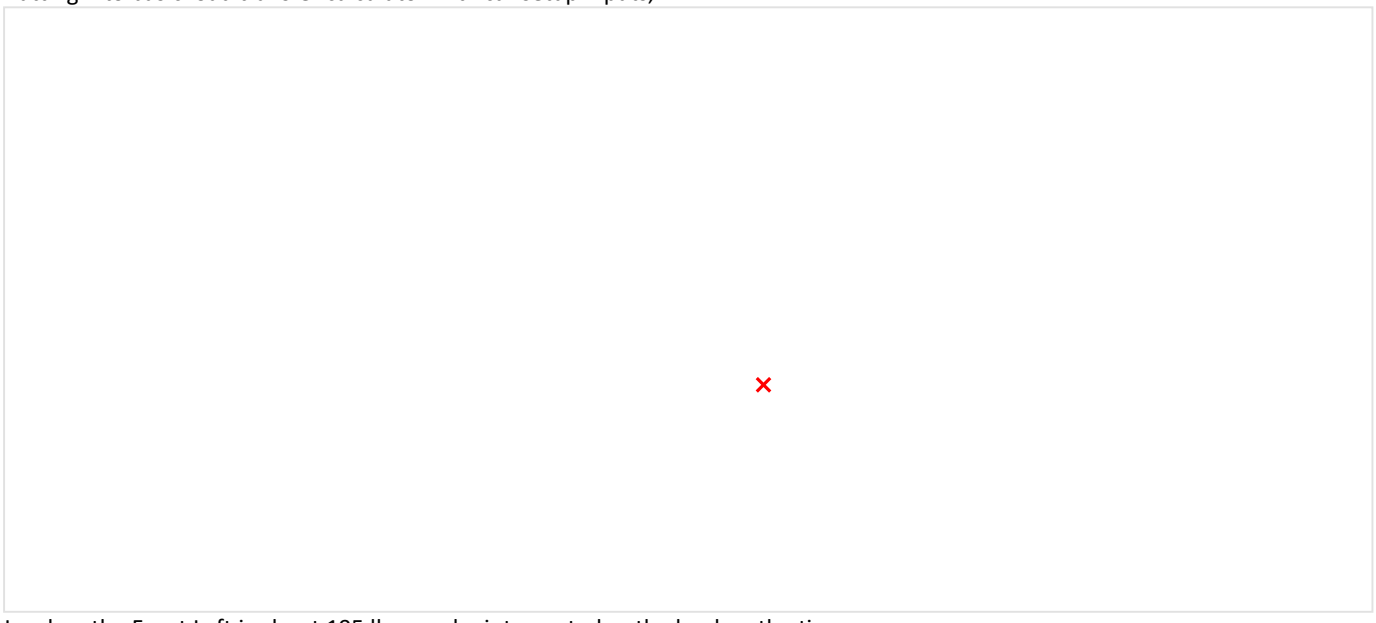


- From Shock Pot data, was able to knock out that it was some huge bump curb in the track, there was no significant spike in the data to make it seem that way
- Values of lateral acceleration seem to be about -10 to -14 m/s^2 with a peak of -16 right before the signals dropped. This equals about -1.02 to -1.43 G's with a peak of 1.63
- For load estimation will use 1.63 Lateral G for worst case
- Values of longitudinal acceleration around 7 to 10 m/s^2 with a value of 9.76 before signal cuts out
- 0.71 to 1.02 G's with a peak of 0.997 G's peak

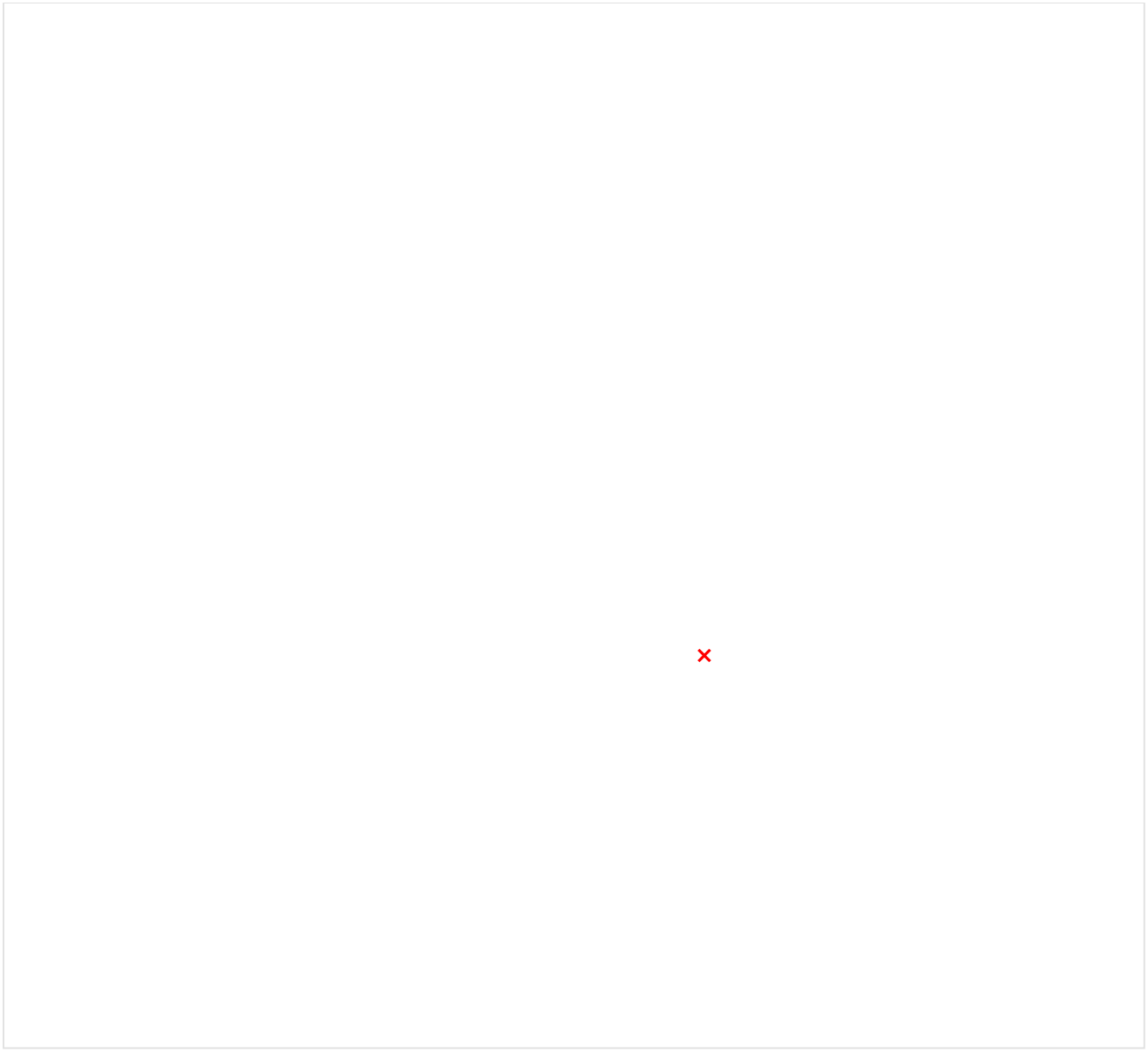
- Putting into basic load transfer calculator with car setup inputs,

-


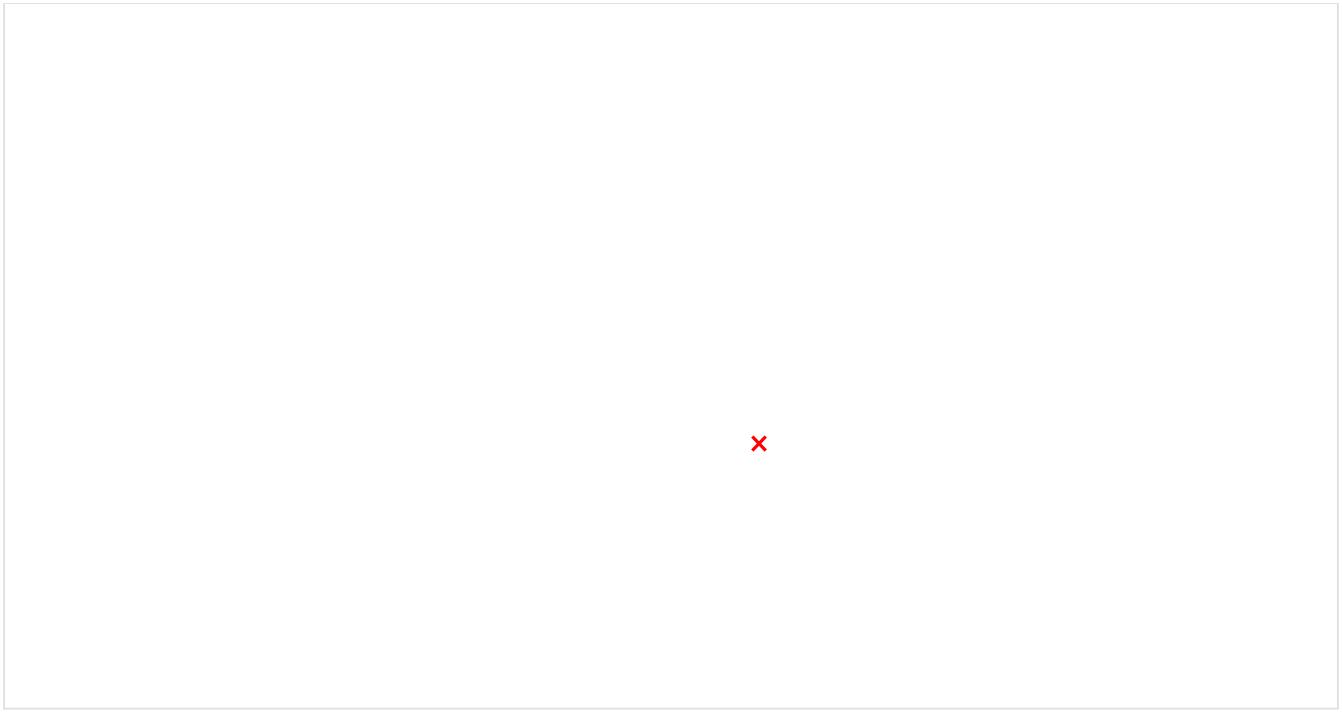
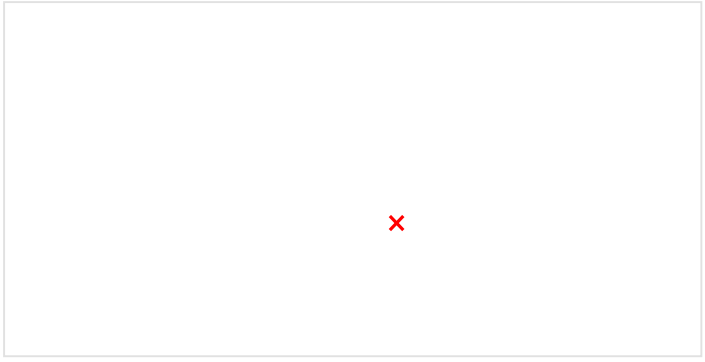
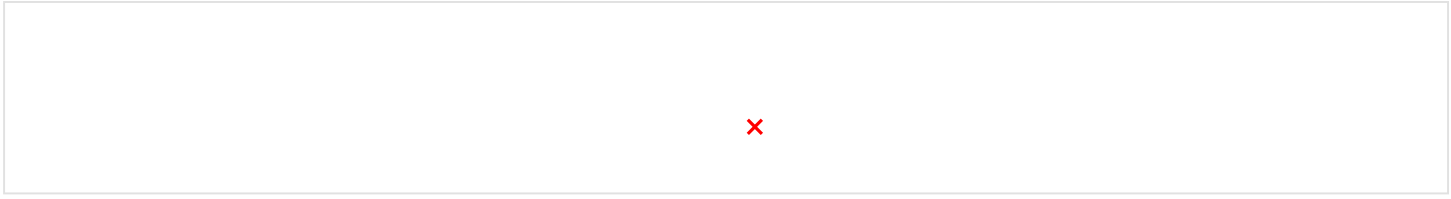
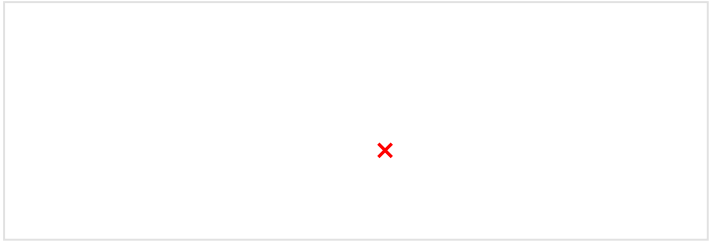
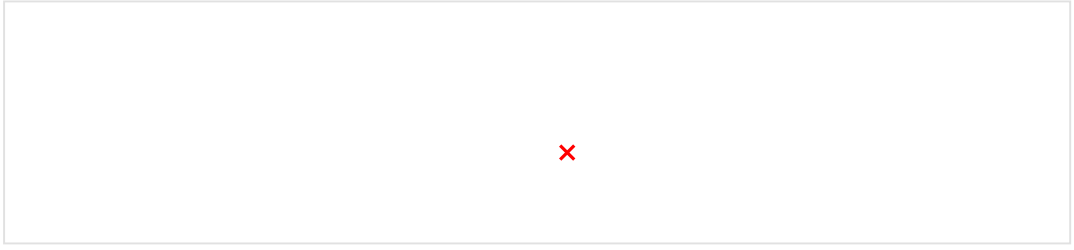
- Load on the Front Left is about 195 lbs. can be interpreted as the load on the tire

- For finding tire slip angle, the steering sensor had to be shut off on the car to move a CAN receiver (not 100% confident @Chance for full reason)
- Can still derive approx. tire steer angle using the GPS where we have the vehicle path

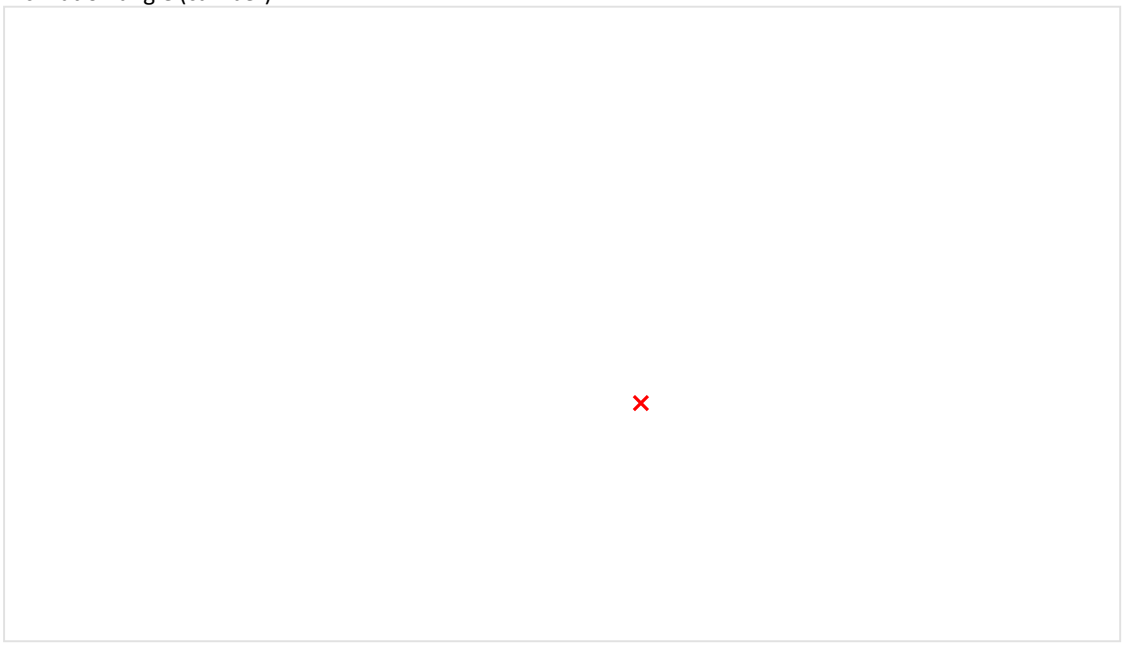
-

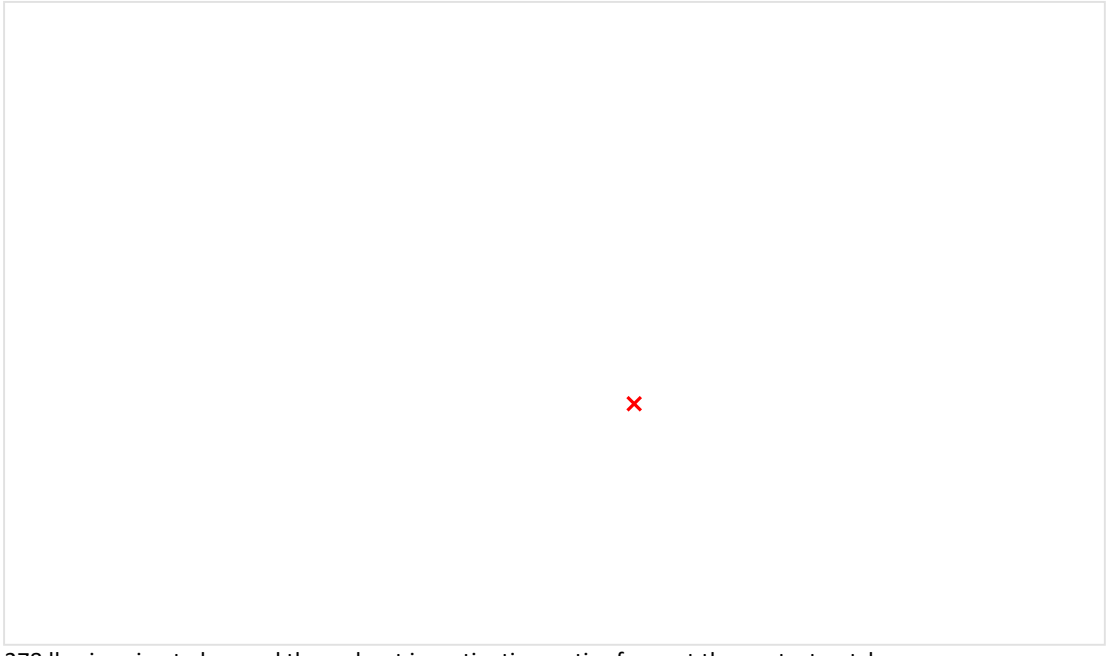


- This is the raw photo of the collected GPS data, I would not interpret the dots going off track as the car going off track. Depending on where the GPS satellite is in space could cause discrepancy or track map could not be as precise to that point in space

- 
- Putting into SolidWorks sketch, see that the radius of that curve is about 378.6in which is 31.5ft
- Geometric steer angle given the radius of turn, wheelbase, and track
- 
- 
- 
- RCVD equations defining the geometric steering angle and resulting steering angles
- 
- Above is an approximate slip angle, 4.15 degrees assumes front and rear are the same

- We know practically that makes no sense because likely your driver will be experiencing understeer or oversteer. Using Millikinnens approximate for understeer oversteer grip delta (4/3 slip vs 1/3 slip) we get about 5.5 degrees and 1.2 degrees.

- Camber is hard and has not a significant effect on our tires at that load and slip range
- It is hard because at that point of the corner we have so much uncertainty and camber is an additive value with roll, heave, and steer
- Looking at our tire graph, not much discrepancies of lateral tire force at different degrees of inclination angle (camber)
- 
- Keeping to predicting the worst case for our loading, 0 degrees of inclination was used to give the highest value

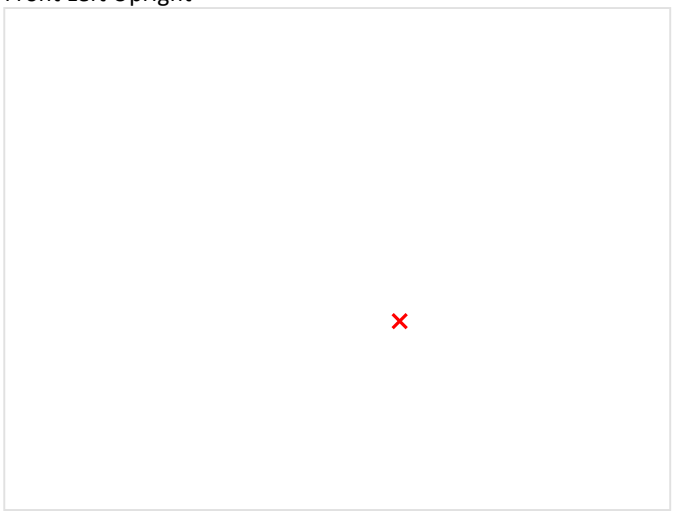
- At approximately 200 lbs., 5 degrees of slip angle, and 0 degrees of camber, the predicted tire forces at that point is 378 lbs.
- 
- 378 lbs. is going to be used throughout investigation as tire force at the contact patch

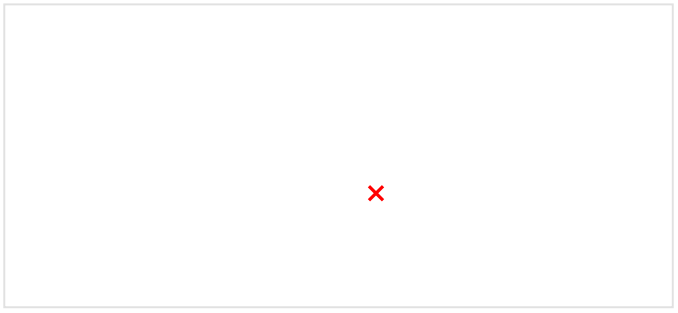
Dye Penetrate Testing

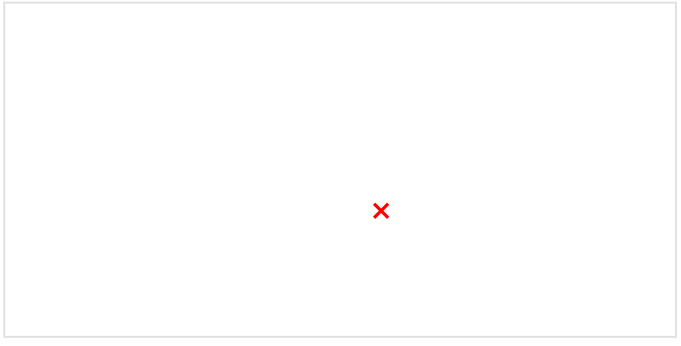
Friday, December 6, 2024 9:12 PM

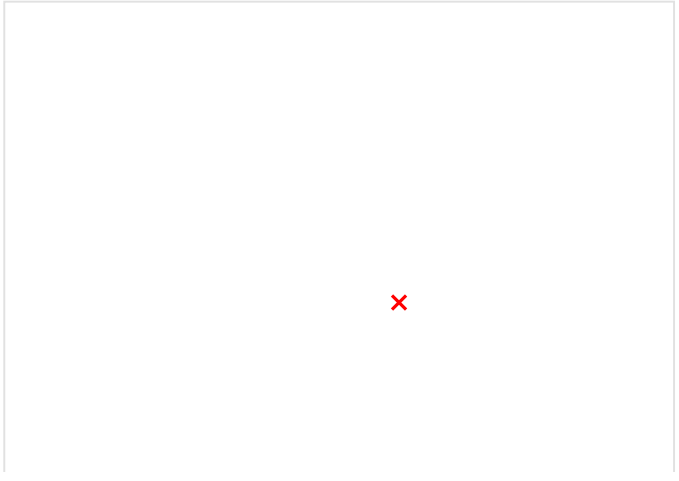
Photos from Dye Penetrate Testing at OXOS

- Front Left Upright



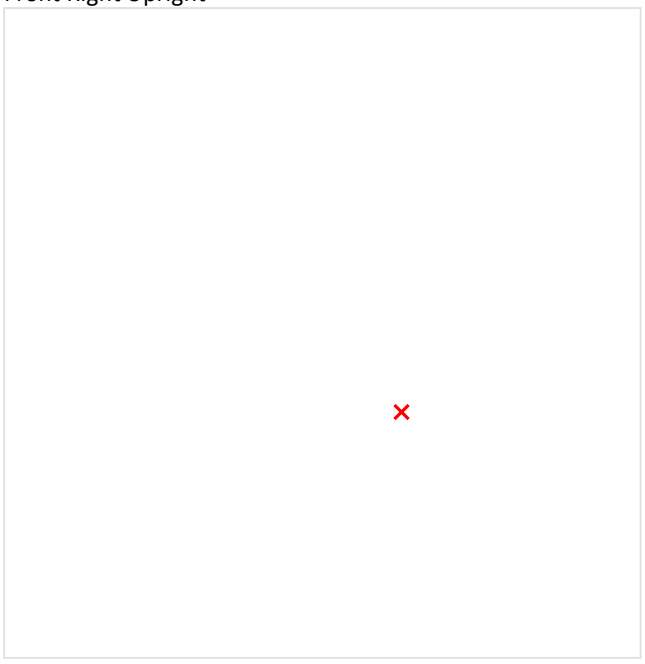


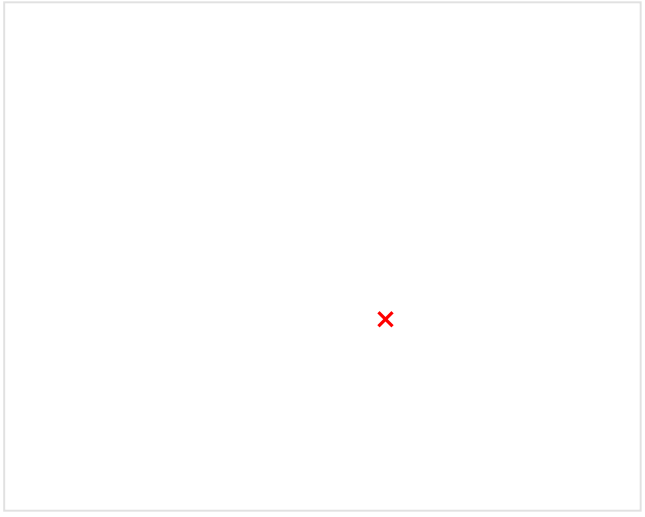


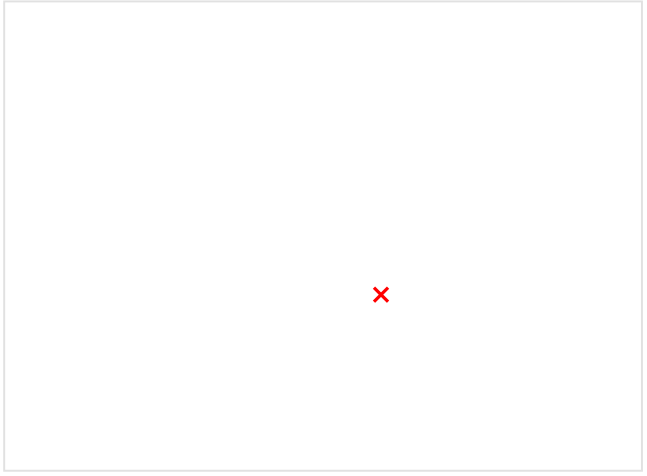


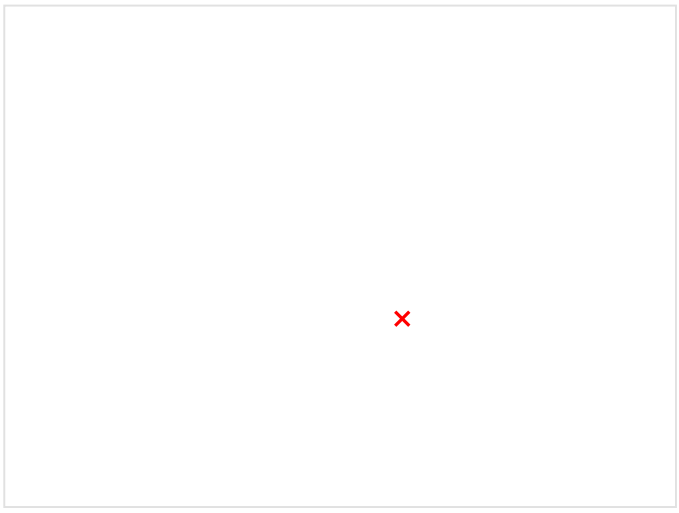
Photos from Dye Penetrate Testing at OXOS

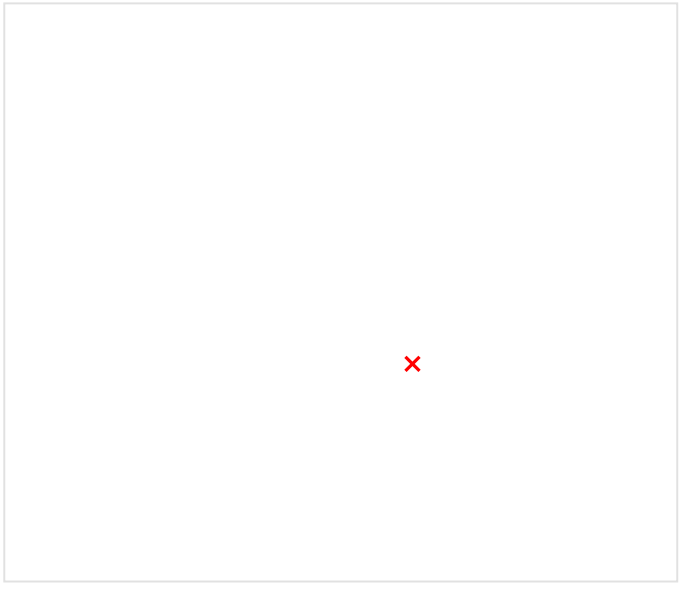
- Front Right Upright

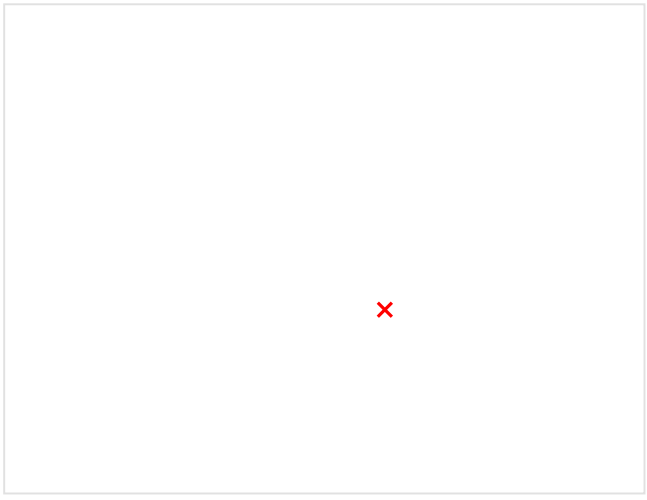


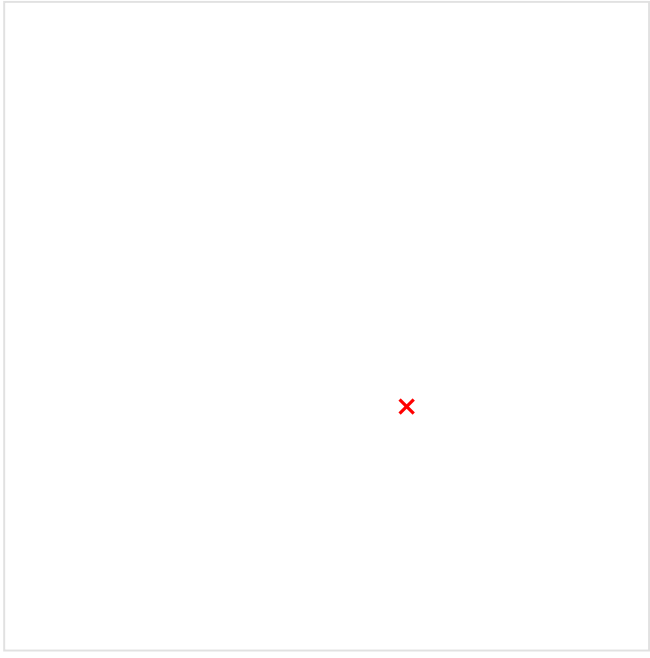






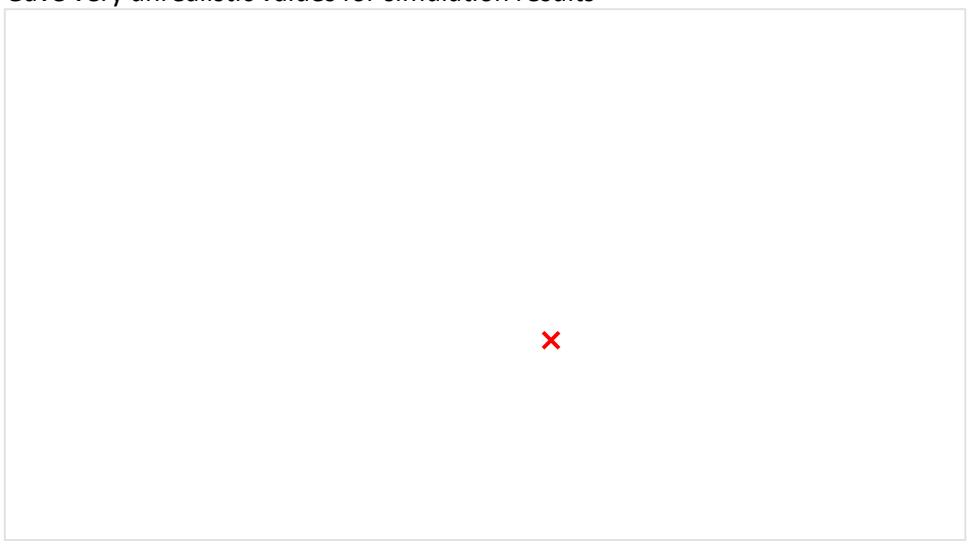
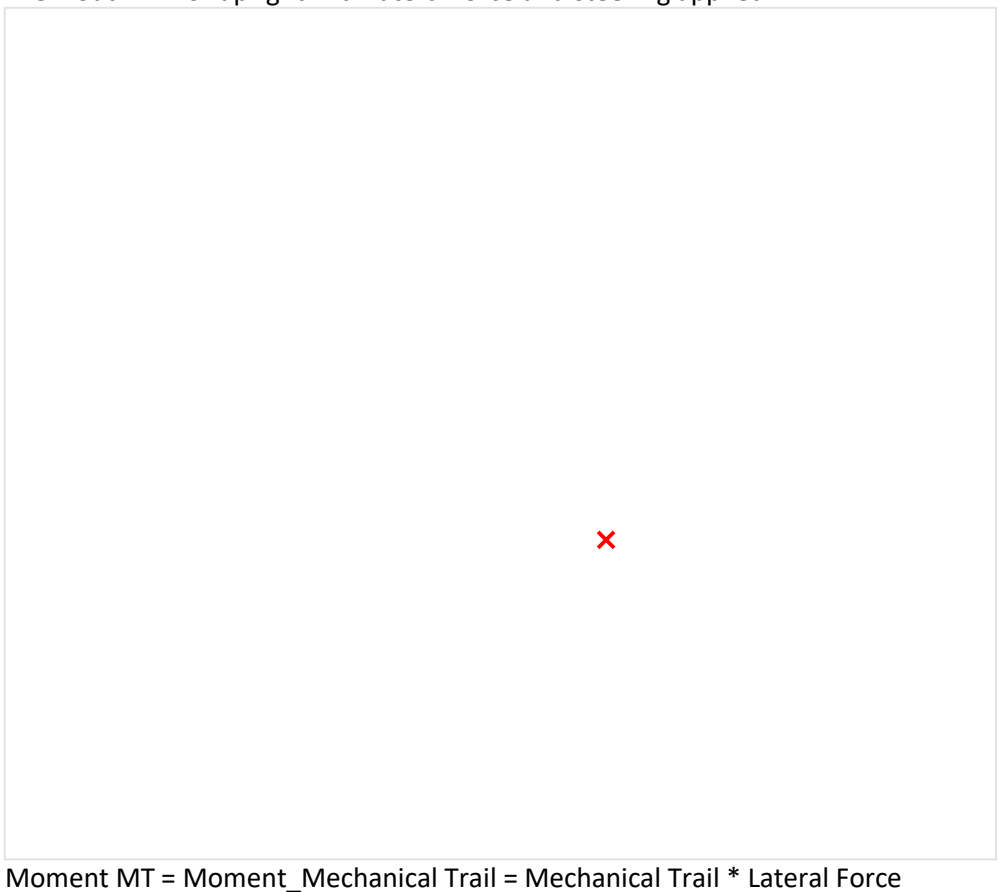




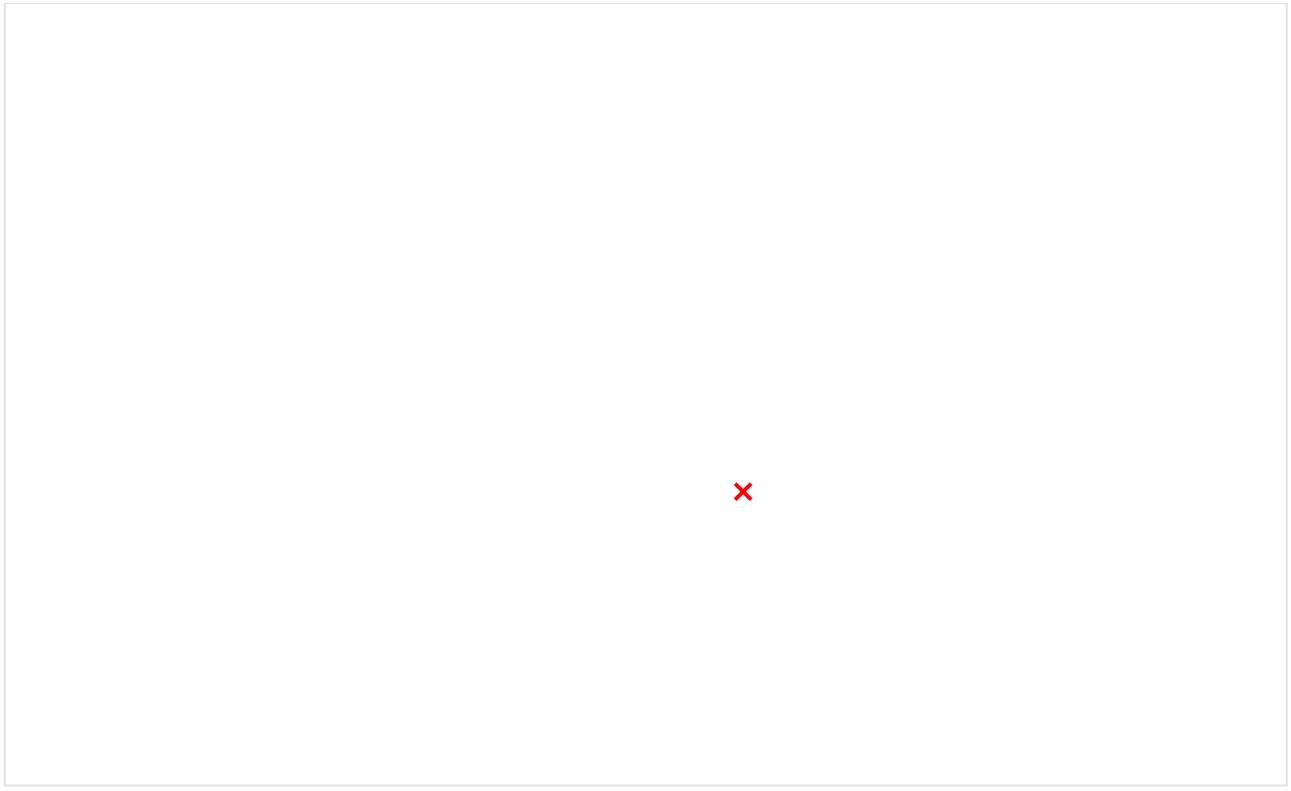


FBD and Calcs

Tuesday, December 10, 2024 7:20 PM

- Previously tried to run simulation of remote load
- Gave very unrealistic values for simulation results
- 
- Have to spend more time understanding where forces are acting across the upright pickup during steering
- Drew out FBD for upright with lateral force and steering applied
- 
- Moment MT = Moment_Mechanical Trail = Mechanical Trail * Lateral Force
- Tie Rod Force = Moment MT / Steer Level Length
- ***Values got from static kinematics***

-



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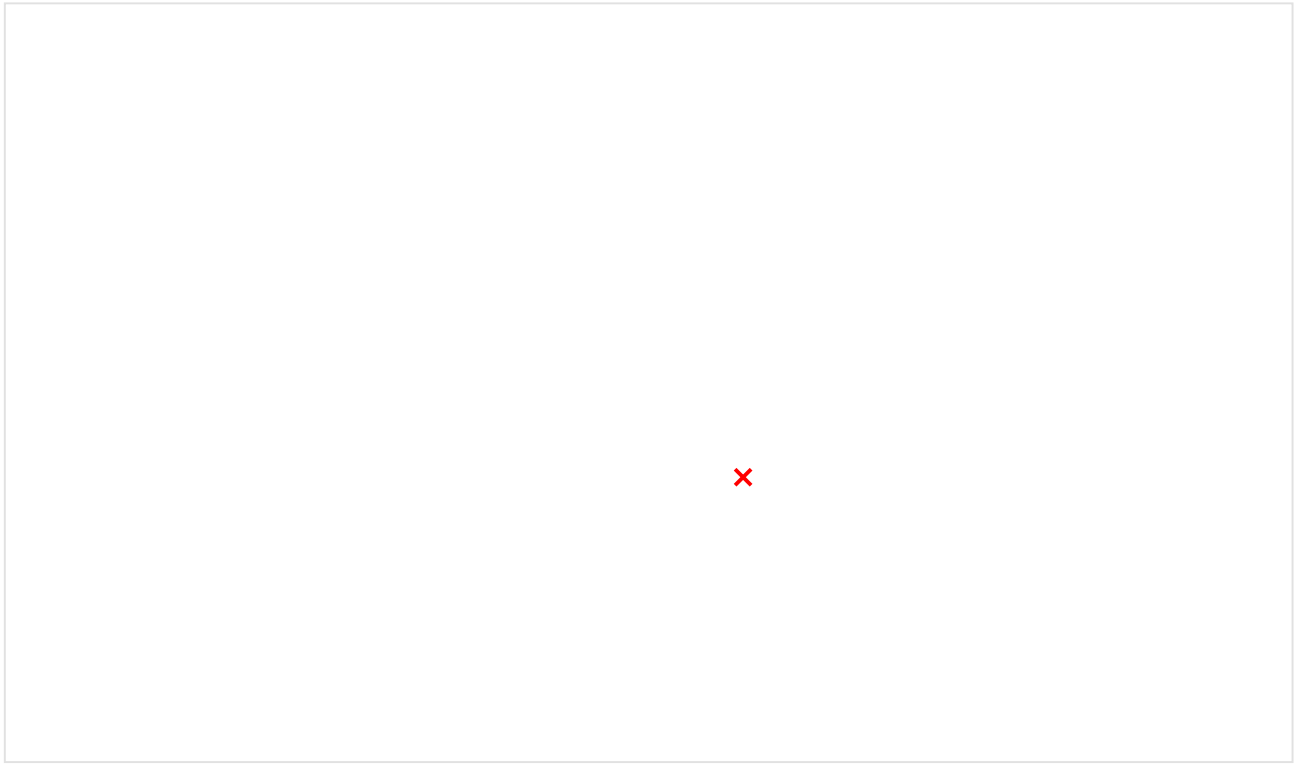

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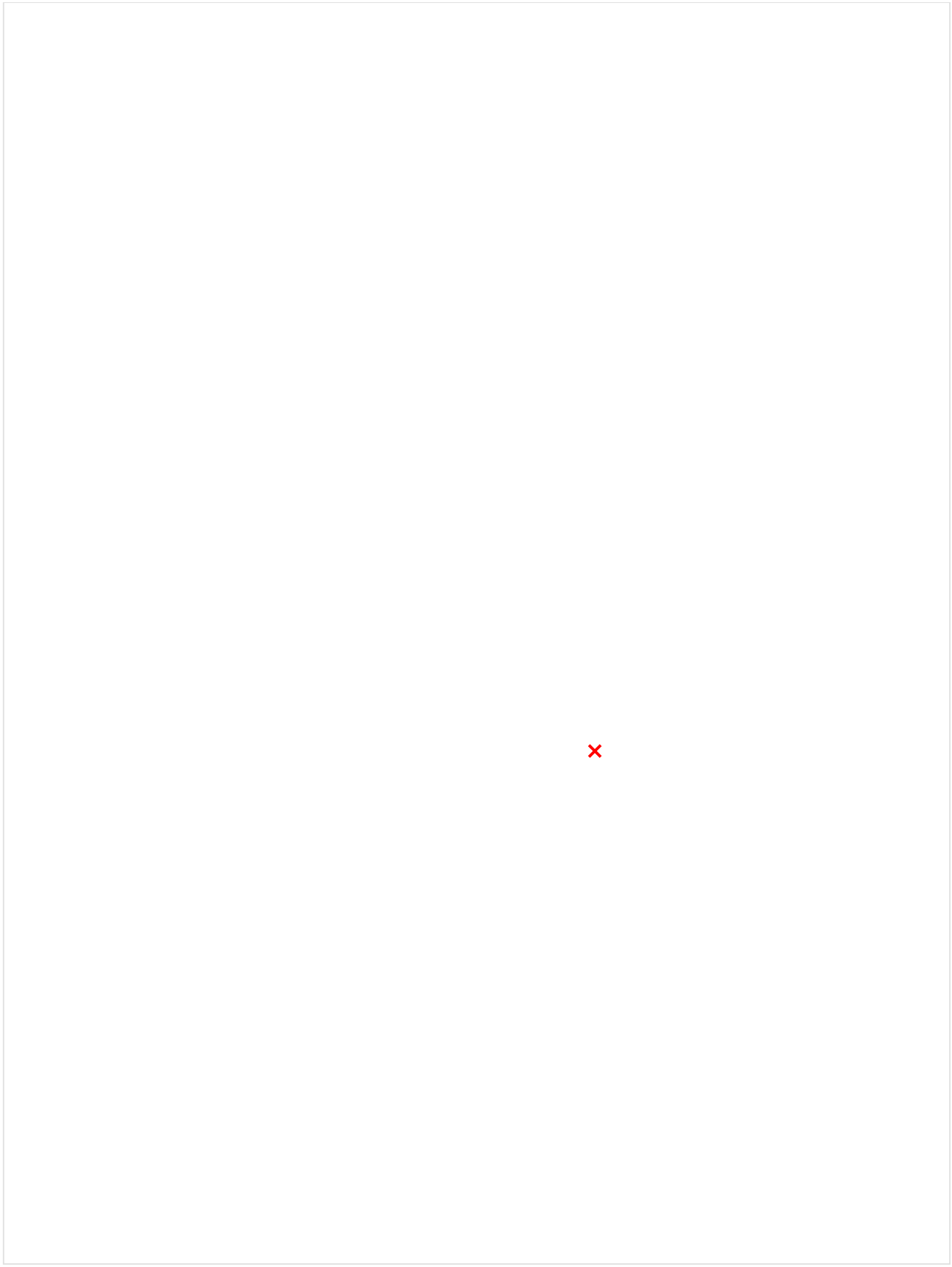

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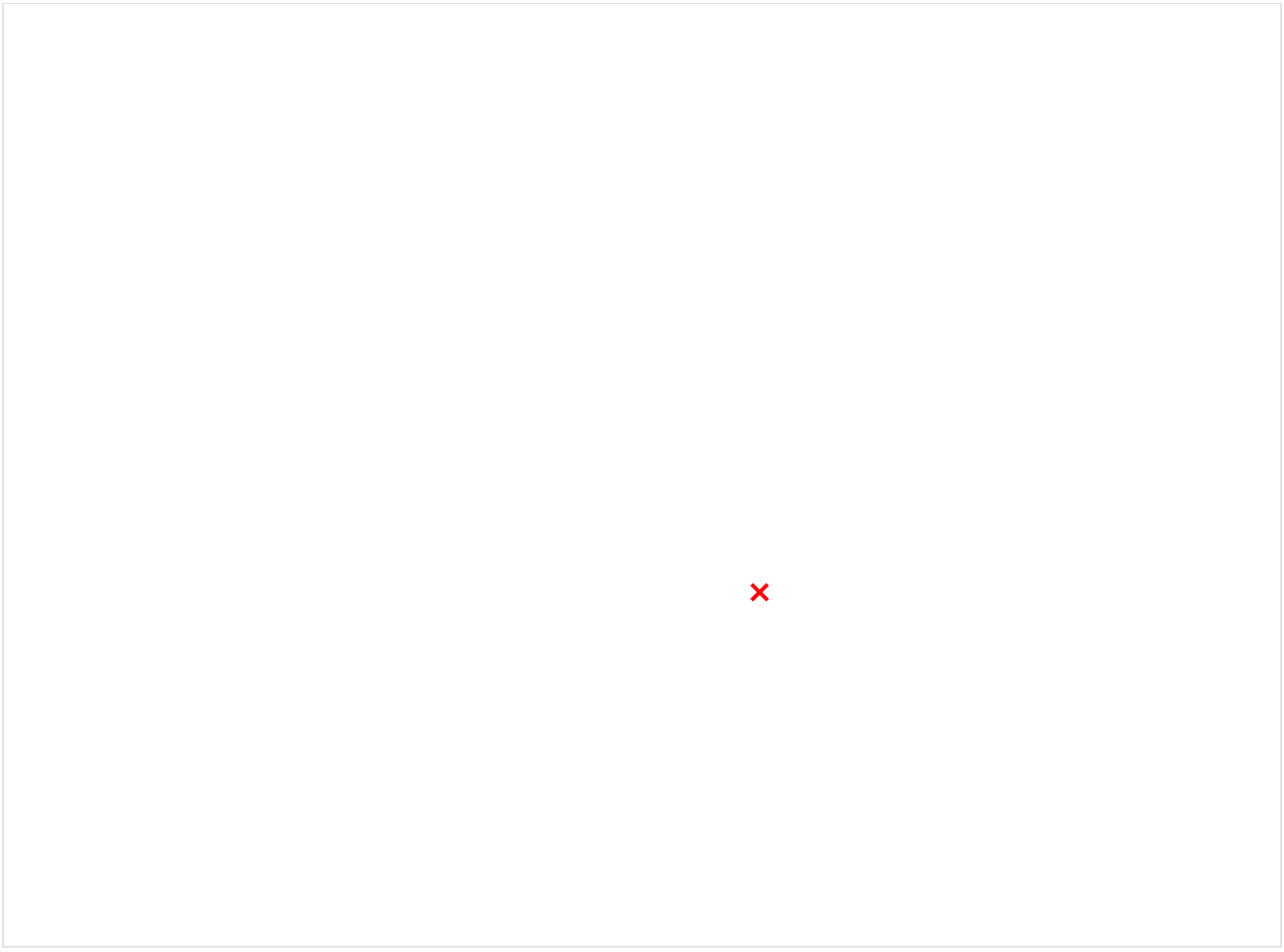


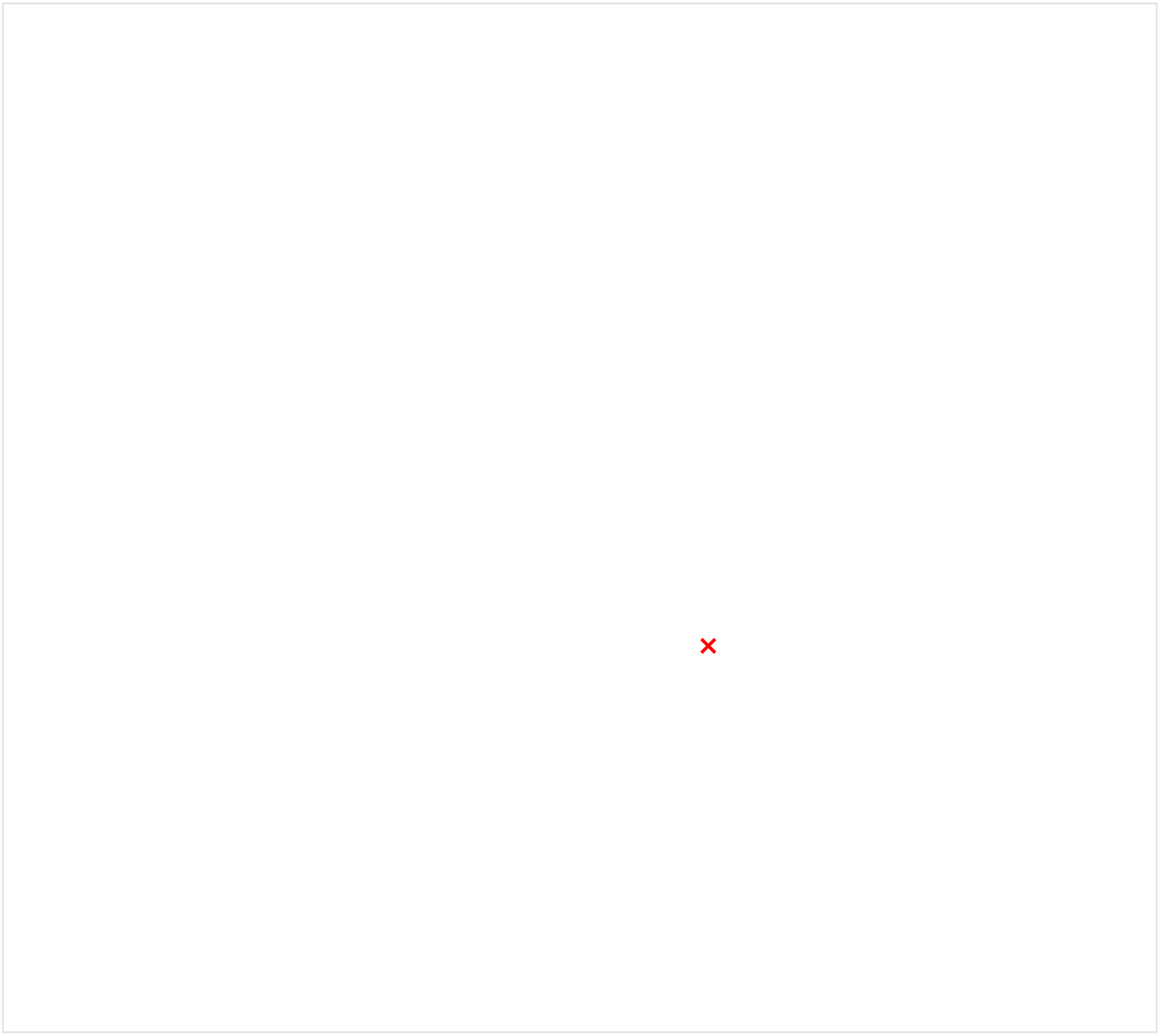
- The discrepancy between the hand calculation and the simulation is about 39.1%, which is moderately high. Some of this could be how the upright was loaded, as well the calculation is a simplified cantilever beam calculation
- Could investigate how to apply the loads into FEA more accurately, steering pickup had to be removed because of failure on the inside of the steering pickup
- More complex calculations can be done for the steering pickup to account for the cross section of the steering pickup
- Overall the simulation gives us an insight that at that high steering force, that was the point of failure for the steering pickup point

KS8 Front Upright Redesign

Tuesday, December 10, 2024 1:27 AM

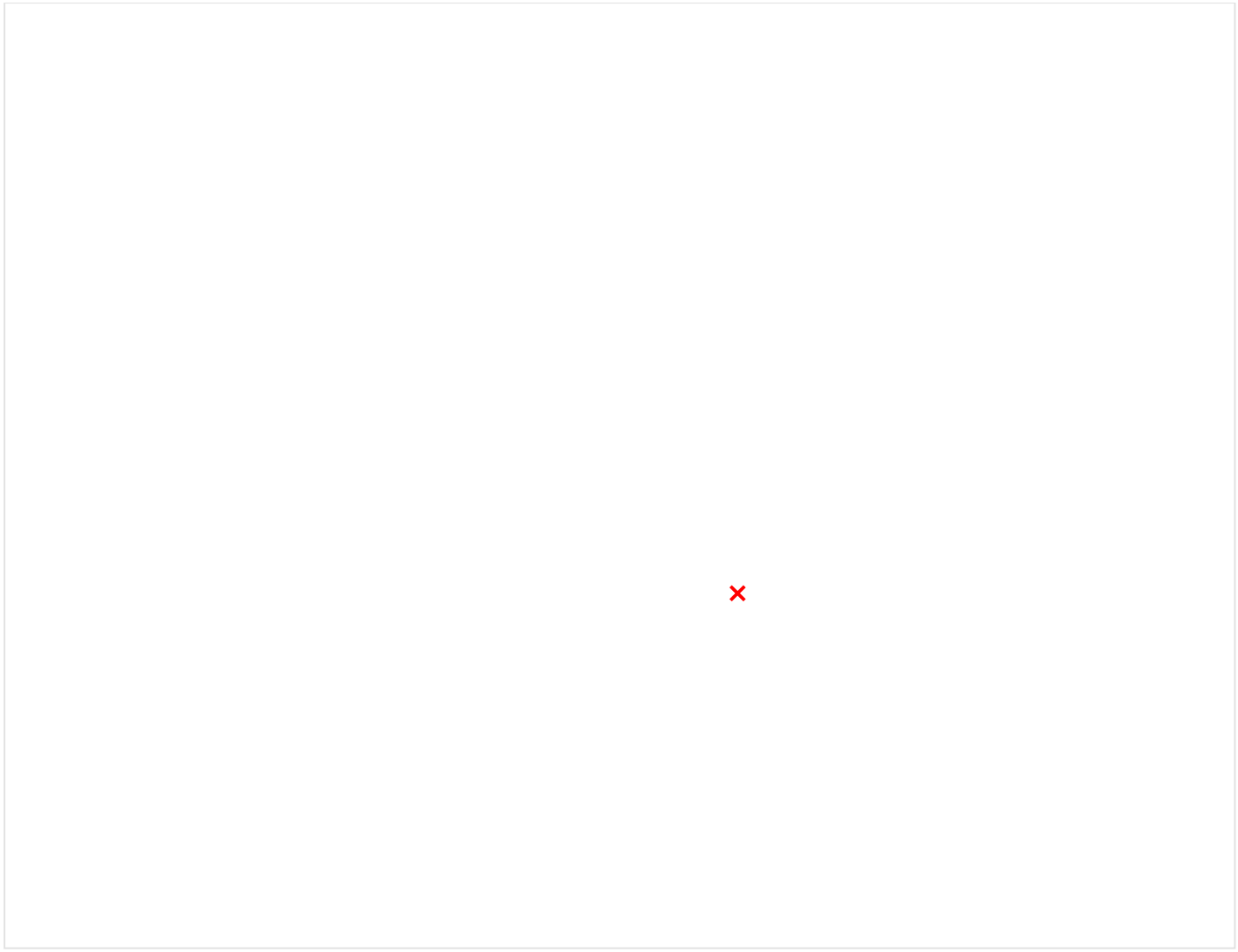
Goals:

- Strengthen steering pickup region - Target FOS is 1.5 under same FEA that was redone
- Weight cannot exceed 1.25 lbs. (125% increase from previous design)
- Improve camber adjustment accessibility in the upright
- Meet all upright strength requirements in typical load cases with target FOS of 1.5



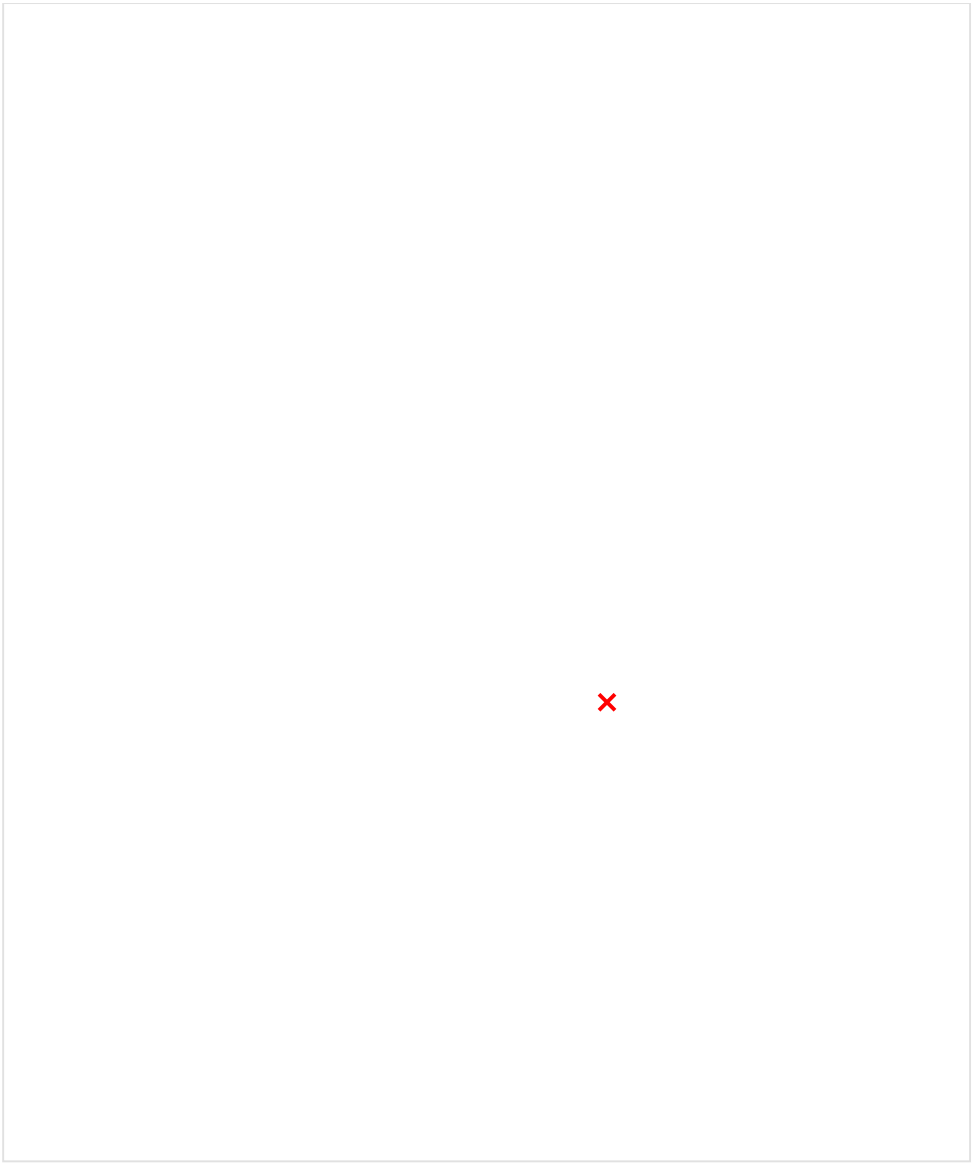
- Upright camber adjustment and pickup mount was moved to the top of the upright for ease of use
- To find an appropriate amount of max camber adjustment made a sketch in SolidWorks and saw how far the upright pickup could move from the UCA mount point

-



- As can be seen in the sketch, 0.75 in of depth gives a max negative adjustment of 3.5 degrees
- The team has a history of always ending up with positive camber that has not been properly diagnosed so 3.5 gives a large buffer and room for adjustment when testing the car
- As well every 0.25in of adjustment provides about 1.2 degrees of adjustment which will simplify values for setup adjustments

-



- Different light weight feature used to make it easier for manufacturing, previously holes would need to be drilled through at the edges of the triangle features then cut outs would get smoothed across the inside edges
- Now tool can just go inside and create the pockets on the inside of the upright

KS8 Front Upright Notes

Friday, April 4, 2025 2:43 AM

- Went with the low profile Allen head bolts in the upper control arm mount
- Upper control arm mount seem to have more clearance
- Female end on the upright and male end on the pickup was hard to manufacture
- Pocket design was a lot easier to manufacture
- Can definitely lose weight across the upright
- Could look to add better clearances on the bottom mount
- Soft jaw method ass, left front upright definitely shifted points

Shit to add on the next one:

- LOSE WEIGHT
    - Characterize better load casing
    - Stop being scared
- Investigate wheel spacing
    - Requires different hub as well most likely
    - Especially with brake mount spacing
- Upright pickup method is definitely not optimized
- Buying specific tooling for the upright when manufacturing
- Weight savings between the bearing housings???

Chassis / Frame

Friday, August 16, 2024 1:34 AM

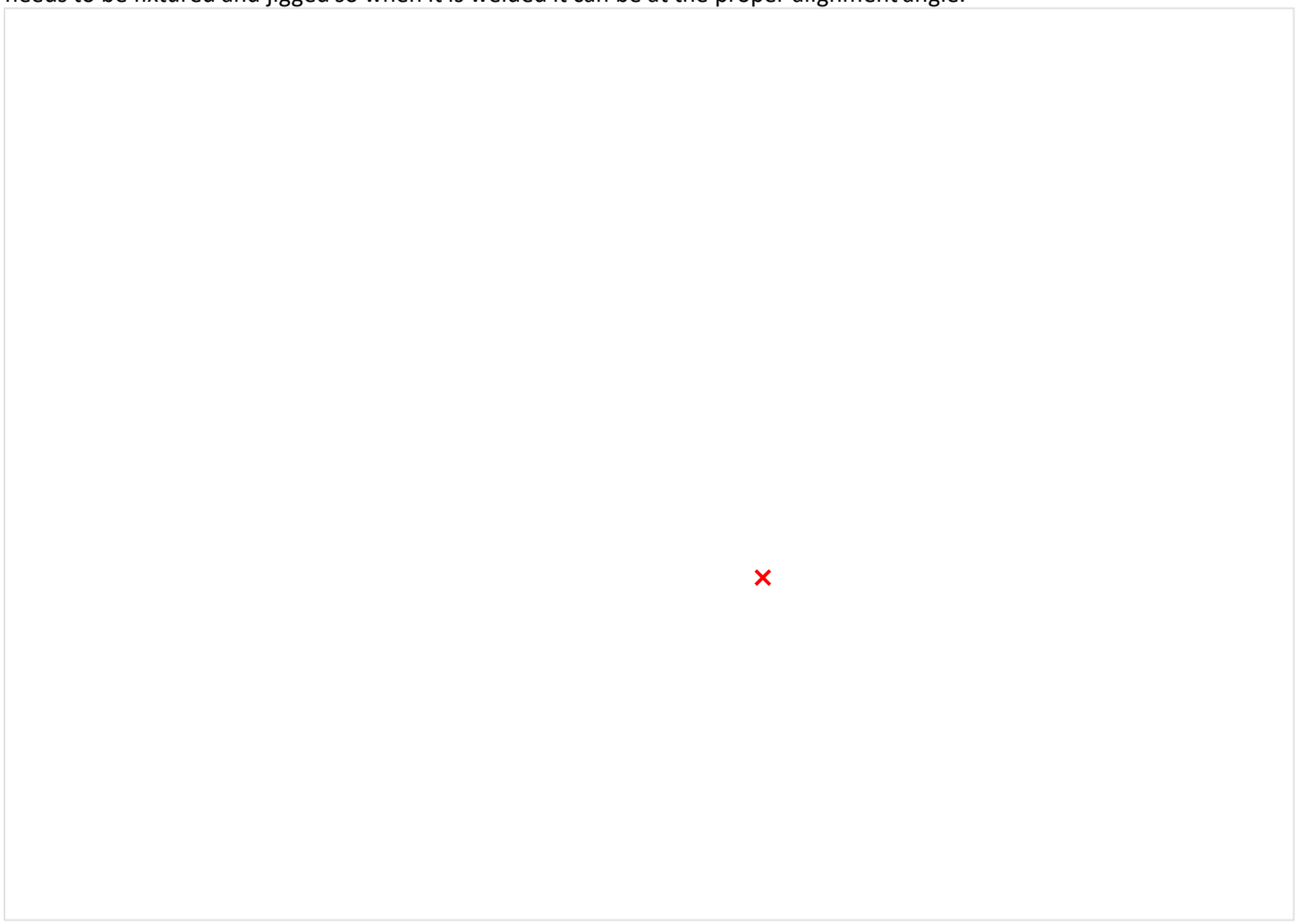
Works to develop the chassis to pass regulations while delivering on performance aspects like stiffness and weight. As well is mindful of other chassis changes that might take place during the development of the car and have it all finalized. Development is mainly led by making it lighter and stiffer while collaborating or working on their own simulations to understand handling effects with torsional rigidity to account for.

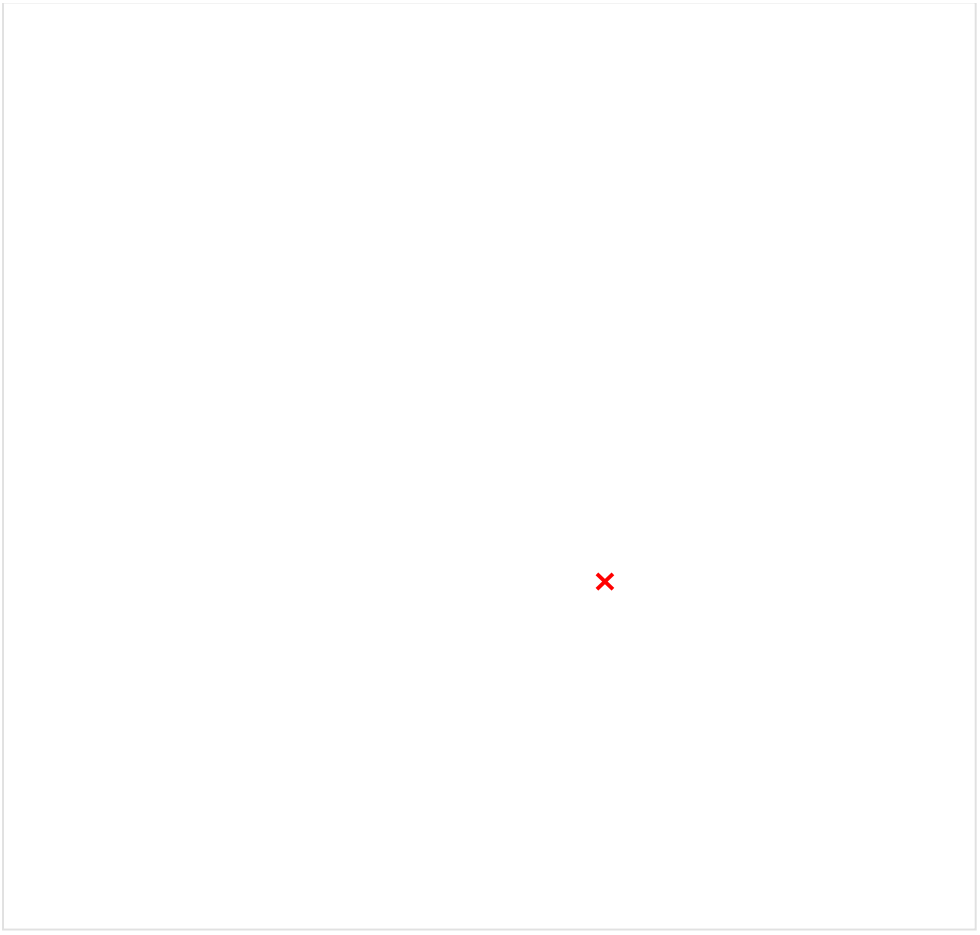
Steering Joint Jig

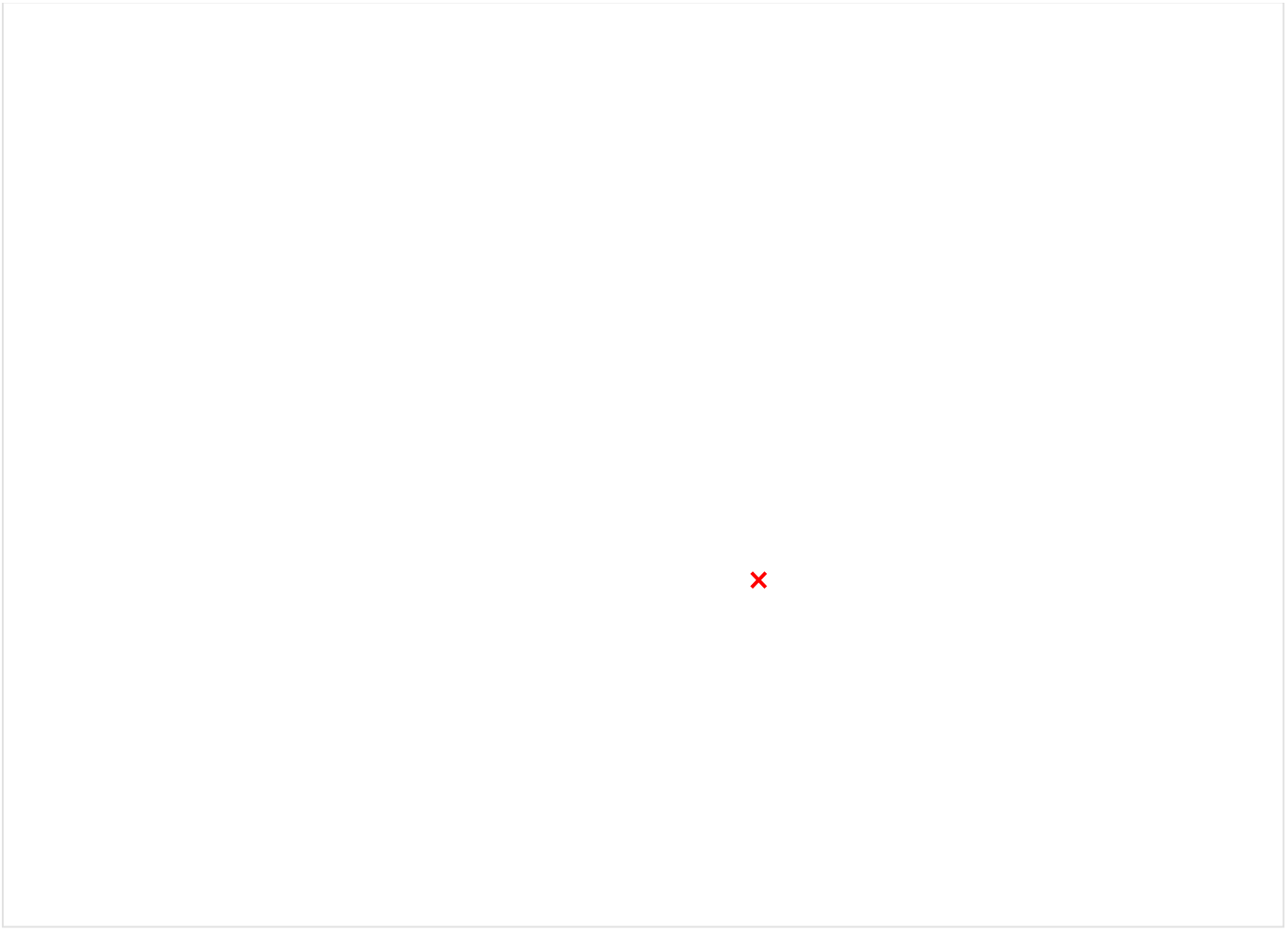
Tuesday, August 20, 2024 1:06 AM

Link to Emil's investigation of Steering U-Joint Alignment HERE

In the side view of the car, the angle at which the steering joint is welded to the main hoop of the car needs to be fixtured and jigged so when it is welded it can be at the proper alignment angle.







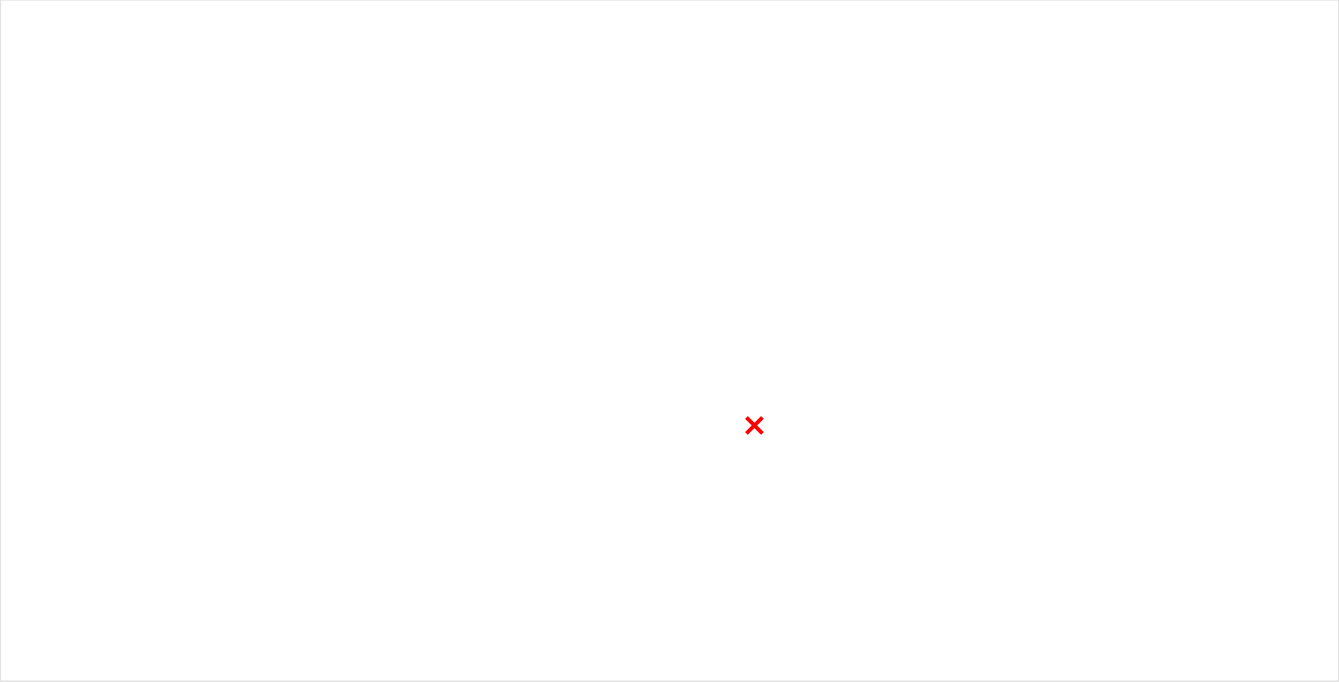
In the photos above hopefully you can see the specific tube that needs to be fixtured. In the final picture the orange is supposed to be some sort of support frame for the steering joint. This jig can be made out of laser cut wood and can sit onto the chassis tubes and fit into themselves with no glue.

Control Arm Pushrod Jigs

Tuesday, August 20, 2024 7:02 PM

On the control arms of the car, on some of them there are tabs on the outer point to mount the push rod bolts into. These make sure that the actuation of the suspension is direct acting. A rough idea is something that fits into the spherical hole and holds the two tabs that could weld onto it.

You have to align these tabs to make sure they are welded to where they are in the CAD



In the top photo is a ***crude*** drawing for a concept that could work. Having a triangle or a plate with holes in orange and a bolt in green that holds the tabs in place. You would need something on the other spherical to ensure that the placement is correct and enough clearance for ample weld area. Can be something that is prototyped.

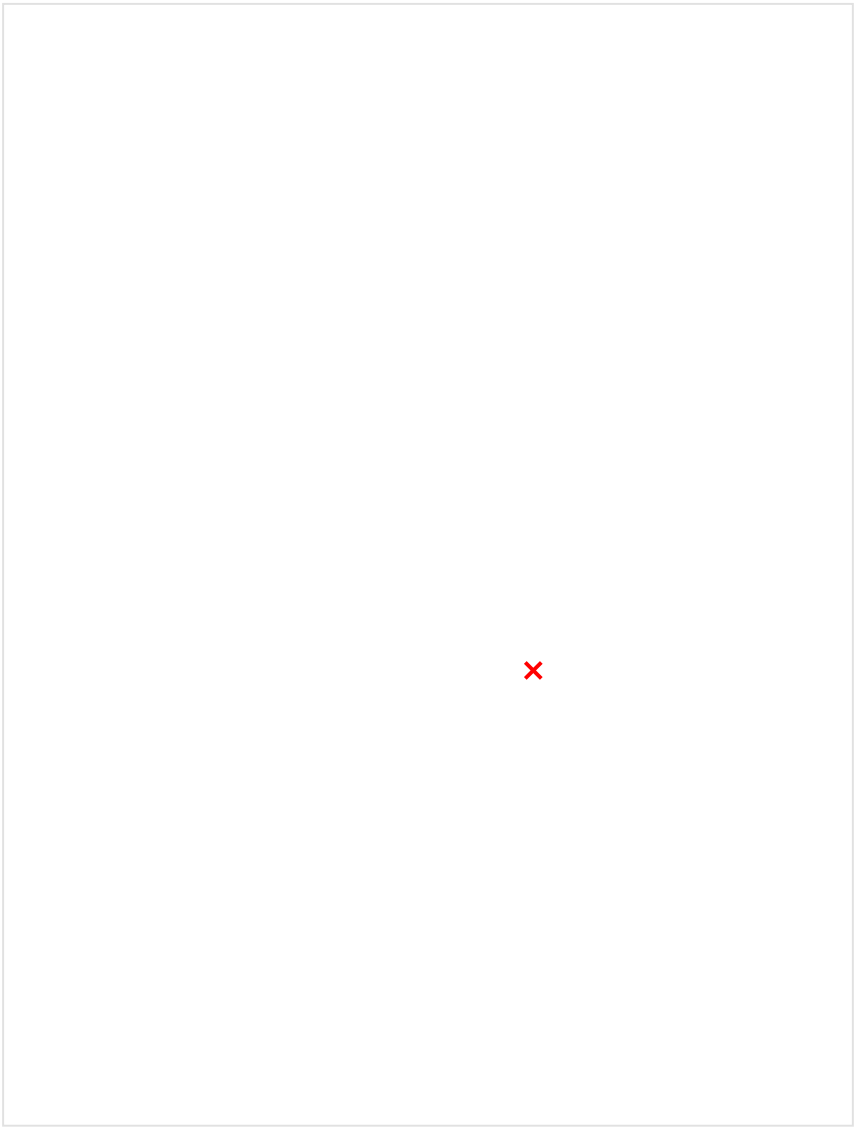
Torsion Tester Hub Mount

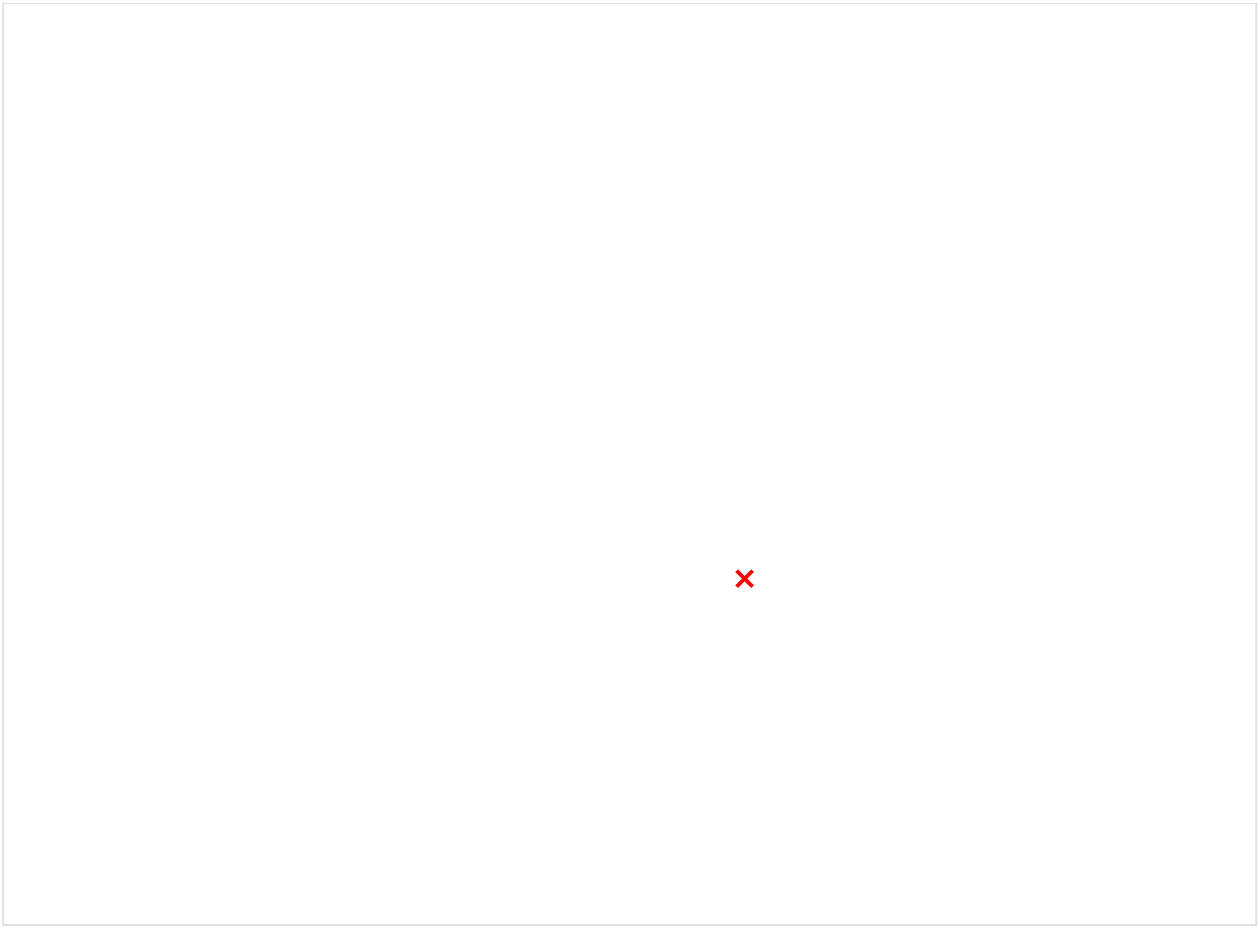
Tuesday, August 20, 2024 7:12 PM

Chassis torsional rigidity is important because it has many effects on real suspension and handling characteristics due to the stiffness and displacement of these points under load. To be able to measure and verify if your simulated chassis torsional rigidity is consistent with the real world version we can run chassis torsional tests on a testing jig.

To simplify, we twist the chassis to different degrees and measure how much the wheel and suspension location change. We have a chassis torsion rig in dyno lab but only have done it once in recent memory.

The dial indicators in the image below show the direct displacement at the suspension node of these points so we can approximate the torsional rigidity of the chassis.





One of the things stopping from the test happening is creating a mount to the chassis torsion rig. Need a component to directly mount to the hub then mount to the chassis torsion rig.

Chassis 2024-2025 Rules Changes

Wednesday, August 21, 2024 1:51 PM

2024-2025 Rules Changes

Note: Red highlights are previous rules, blue highlights are new rule changes

Required Chassis Changes:

- Upper side impact tube lower limit has been increased 240 mm ->265mm
- Impact attenuator
  - Distance from lowest SIS tube changes
  - Should just affect the height we bond the attenuator to
- 25 mm to accumulator from tubes on all sides of acc
  - Check that rear impact protection is still met for any rear end change on Ecar
- Accumulator box can no longer attach to main hoop

Reference Images for design documentation:

Jig Printing Tracker

Monday, November 18, 2024 1:32 PM

- [x] IC Left Hoop Attachment
- [x] EV Hoop Cross Jig
- [x] EV Left Hoop Attachment
- [x] EV Left Hoop Base
- [x] EV Right Hoop Attach
- [x] EV Right Hoop Base
- [x] EV Seat Tube Jig
- [x] IC Cross Hoop Jig
- [x] IC Hoop Jig Right
- [x] IC Hoop Jig Right Attach
- [x] IC Hoop Jig left base
- [x] EV Motor Jig
- [ ] Steering Rack Jig
- [ ] EV Acc Chassis Box Jig Right
- [ ] EV Acc Chassis Box Jig Left

Damper + Roll Bar

Friday, August 16, 2024 1:34 AM

Focuses on getting body movement targets from the aerodynamic team and translates that into real suspension adjustments. Understands the stiffnesses for all parts of the car and makes sure they are all accounted for into getting aerodynamics in the correct operating condition for the car. Development can come from component side but testing and simulation knowledge of the vehicle harmonics is super vital.

Damper + Roll Bar Flowchart

Wednesday, August 28, 2024 5:54 PM

Damper Rebuild Instructions

Thursday, October 10, 2024 11:24 AM

ASSUMING NOT CHANGING VALVE SPECIFICATION

https://www.ohlins.com/en-us/motorsports/track/ttx25-mkii

https://www.ohlins.com/storage/5904EE9833117D5DEE5D1D47613D367B320F35BB86F8899FA0ABF5328A20A755/b09e818b80e845e8a1366fa9147bb4cc/pdf/media/2785b362e6044e51bc809195b7a0e742/WSM_TTX25_3.pdf

https://www.ohlins.com/en-us/dealer-locator

okay actually we should probably just get this done by a service center this is convoluted as shit and we can't pressurize it ourselves

1) 1.1 - Depressurize
2) 2 - Remove Shaft Assembly
3) 3.1 - Disassemble End-Eye
4) 4.1 - Disassemble Seal Head
5) 5.1 - Disassemble Piston Band
6) 6.1 - Disassemble Separating Piston Seal
7) 4.2 - Assemble Seal Head
    a. Wait to install until '8 - Oil Fill Procedure'
8) 3.2 - Assemble End Eye
    a. Wait to install until '8 - Oil Fill Procedure'
    b. **If installing alternative mounting, wait to assemble until after '8 - Oil Fill Procedure'**
9) 5.2 - Assemble Piston Band
    a. Wait to install until '8 - Oil Fill Procedure'
10) 6.2 - Assemble Separating Piston Seal
    a. Wait to install until '8 - Oil Fill Procedure'
11) 8 - Oil Fill Procedure
12) 1.2 - Pressurize

KS8C Tire Testing

Friday, February 7, 2025 1:48 PM

Skidpad: 12m, 24m, and 36m

Toe 1 = Toe in
Toe 2 = toe neutral
Toe 3 = toe out

Key Points:

- Which of the two tires we have provide more grip?
  - Using data of tire performance
    - Based on the two tires set on 3 different rear toe in skidpad, autocross, and accel
- Which tire is more consistent with the drivers?
  - In terms of feel
  - Driver feedback doc
    - Make it
- How different tire temperatures impact tire performance?
  - Check tire temp after skidpad runs
- Skidpad:
  - Large Circle = skidpad track
    - Set at 3 different radii
      - 12m, 24m, and 36m
  - Easy to keep track of laps and time them
  - Drivers will feel the same conditions throughout the laps, so differentiating different independent conditions (tire temp, toe, pressure) gets direct results
    - Tire temp
    - Toe
    - Pressure
    - Camber
- Accel:
- Autocross:
- What do we want to find out?
  - which tire provides more grip in skidpad
  - which tire is more consistent with drivers
  - how temperature effects tire over runs
  - Test tires while adjusting small setup changes
  - Main metric
    - Best times on track
    - Consistency (based off standard deviation)

Back

	Toe 1	Toe 2	Toe 3
Time			

Accel

Back

	Toe 1	Toe 2	Toe 3
Time			

Autocross

Back

	Toe 1	Toe 2	Toe 3
Time			

Turn this into a checklist of stuff we need for the testing. For example, we have the feedback doc, final draft for KS8C tire testing setups(in progress), tech inspections, track condition/ time of day, maybe outside temps, etc. We want the data to be efficient and refined to possibly repeat in the future for future team members usage without too much input from current authors

https://www.rowegraham.com/tire-selection

Basics about tire grip

Tire grip factors:

- Slip angle: angle(degree) formed between the direction of travel of the wheel and the 'pointing' direction of the wheel(perpendicular to axis of rotation)
- Cornering stiffness: measuring grip capability in the lateral sense
- Slip ratio: basically slip angle in the longitudinal direction, relates to amount of a slip a tyre experiences relative to a sliding condition
- Toe: in, out neutral
    - Impacts
-
- Friction Circle: illustrate limits of a tyre generating both longitudinal and lateral acceleration simultaneously, allows understanding of how the vehicle is driven
- (KEY) Coefficient of Friction(mu): relates the frictional force to the reaction force between two objects in contact
- (KEY)Compound temp: temp affects adhesion by increasing conformance and penetration of peaks and valleys in the road into the contact patch
    - Also increases rate of chemical reaction between rubber and asphalt
- (KEY) Inflation pressure: pressure introduces deformation, concave profile(low pressure) to convex profile (high); affects surface area of contact patch
- Track conditions: Depending on team limitations, certain racing teams take into consideration how smooth or grainy certain tracks are
    - We don't care too much since the tracks we run are usually the same and regardless it shouldn't affect it too much for a general idea of comparing grip between two tires. As long as the tires are tested in similar conditions.

source

Rough final draft version of KS8C Tire Testing :

- Timeline:
    - 4 rounds split between two sessions(days)
- Track: East parking lot ***
- Time of day: depends …***
- Round setups
    - Round 1:
        - setup the parking lot in a skid pad format with 3 different radii***

        - Large circle with a set radii
    - No setup
        - Basic toe, camber, and pressure we usually run
            - Get this data***
        - This is for analyzing tire warm up data. See how fast the tires can warm up
            - Clear runs for this?, basically how like do we do just 4 laps and then check tire temps, we can ask driver in post runs feedback to guestimate how long they took to feel max grip on tires***
    - Run using ___ amount of laps***
- Round 2:
    - Set the skid pad track to 18m radii
        - This is the radii used for the full skid pad track(figure 8) for fsae
    - Now we will focus on setup changes by varying the toe, camber, and tire pressure
        - Toe:
        - Camber:
        - Pressure:
            - This is to get a good base of these three setup changes. Find a base the drivers are comfortable with without ruining lap times but not sacrificing comfort of driver

    - We will use this data to start the analysis for comparing the two tire compounds
        - Compare lap times at the different setup changes
        - Include input from the drivers' feedback doc. Essentially the drivers will describe their preferences with each tire (ASK HOW TO MAKE A GOOD FEEDBACK DOC FOR THIS)
- Round 3:
    - Autocross
    - Endurance
    - Accel
    - Attain feedback
    - Lap times
        - Direct comparison of both tires' lap times here. Will tell which tires perform better in these track setups.
- Round 4:
    - Rerun round 1
    - Goal for this decision?
        - To find the end of life for tire. To see the characteristics of both tires after a long session. Great data.
        - See how long the tires last before they start slipping a lot.(losing grip).

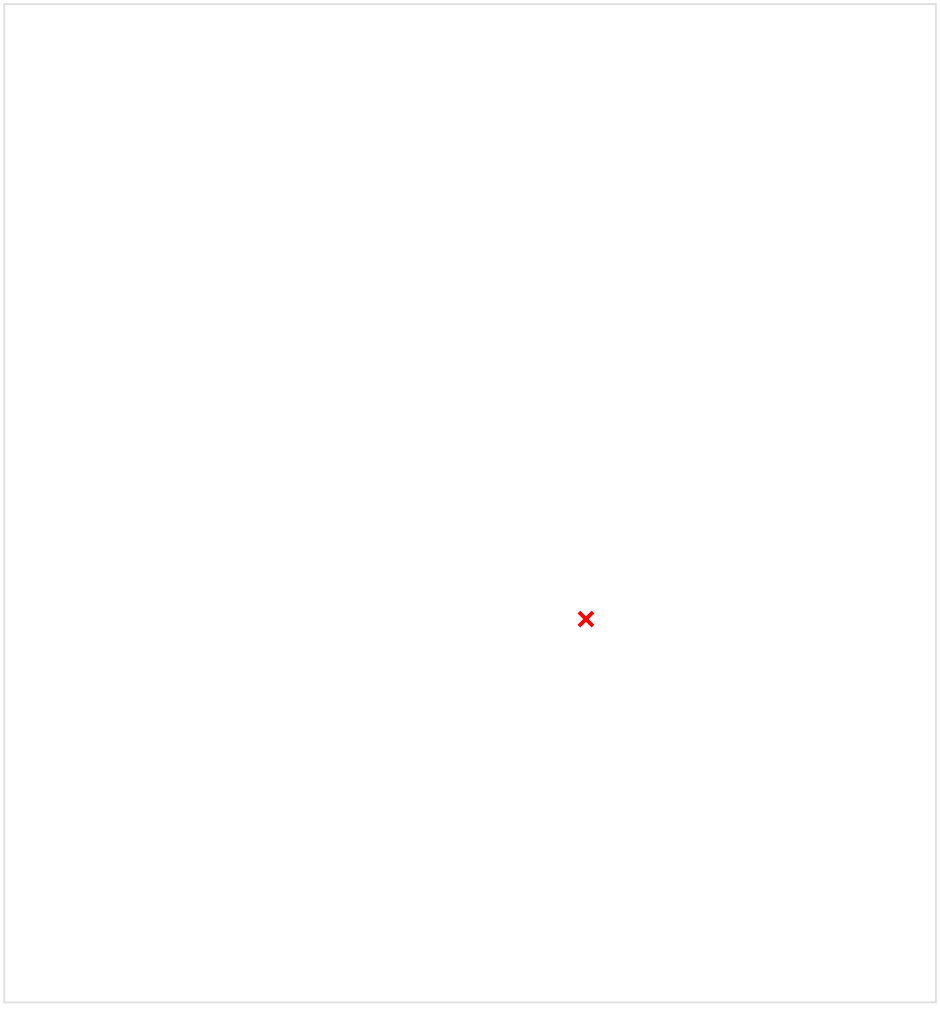
- Hypothesis?
    - Tire compound 1 vs 2

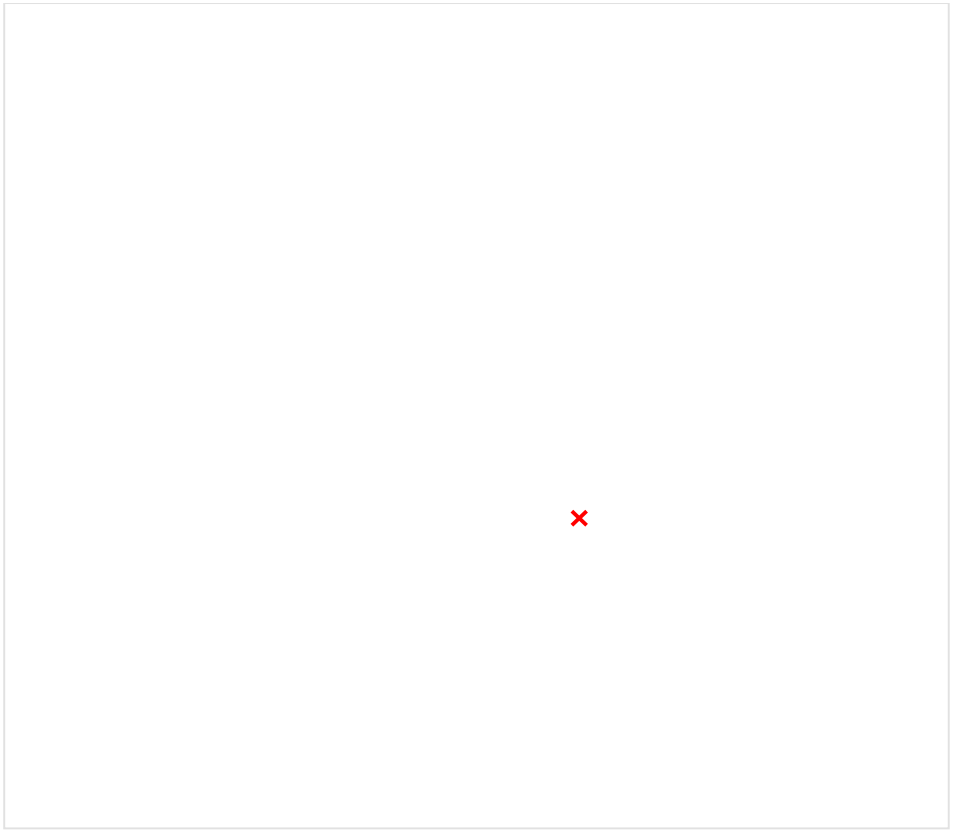
Grip Factor Tire

Thursday, February 27, 2025 11:52 PM

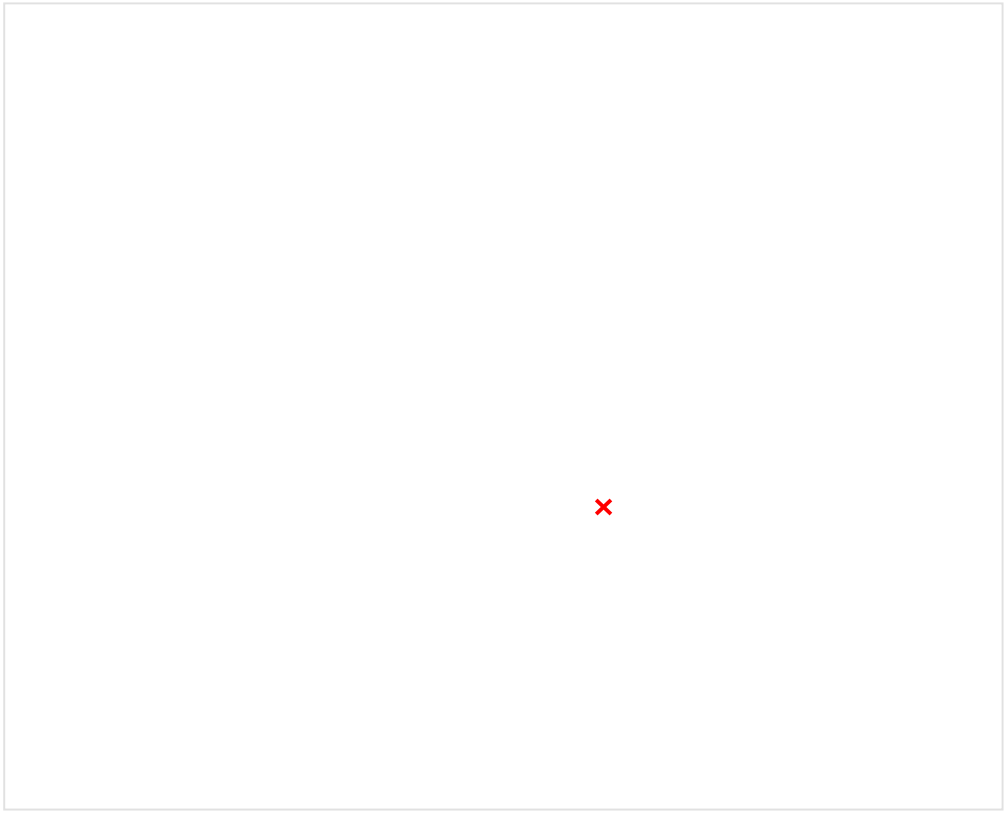
Plot is from SAE Dacq Book.

- Grip factor is combined acceleration from longitudinal and lateral
- Filtered between scenarios and removes values where car isn't grip limited but power limited





This plot shows how track conditions affected overall grip factor throughout the day



Testing and Setup

Friday, August 16, 2024 1:34 AM

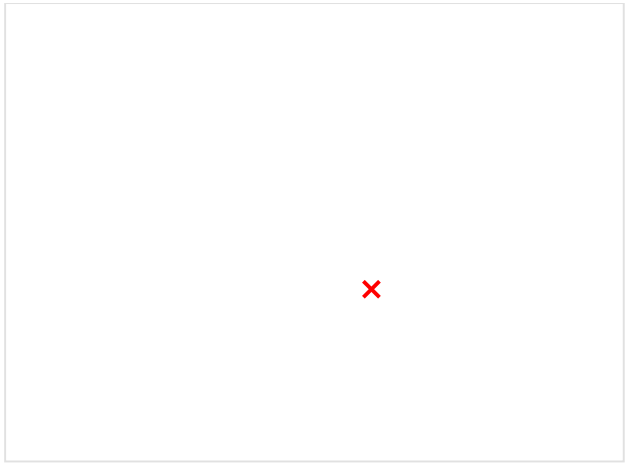
Develops testing plan and setup choices for the car based on the entire teams design background and suspension adjustments made year to year. As well works with drivers to develop driving simulation data and gets understanding of performance metrics for the car. Works on the data visualization and will work closely with data acquisition on setup choices and procedure but also sensor mounting and packaging.

KS8E Tire Pressure Testing

Thursday, April 17, 2025 9:13 PM

Key ideas:

- Characterize tire pressure
  - Find optimal performance of tire based on its tire pressure
  - Use any tire, record this
- How to test?
  - Run multiple skidpad runs with varying tire pressures
    - Record all variables here
- Why test this?
  - Team needs peak performance of car
  - Find best lap times with peak tire pressure
    - Have even tire wear across all the rubber
    - Have optimal handling and overall vehicle stability of car for drivers
      - Run the car to the limit without the tires feeling too spongey or too responsive/twitchy/sensitive
- How do different tire pressures feel?
  - Low tire pressure characteristics
    - Sluggish, non-responsive, and unstable
    - Car feels soft and spongey as tires flatten out when taking a corner into the tire, with a larger contact patch
    - Sloppy steering, braking slower, generally causes more understeer,
    - Excessive heat buildup, reducing grip
  - High tire pressure characteristics
    - Harsh, less responsive, twitchy, sensitive steering; steering feels light and less commanding
    - Less contact with the road resulting in reduced grip and reduces cornering ability
- Evaluate tire pressure with tire temp sensors
  - To evaluate tire pressure based off tire temps, you compare the temperature of the inside of and outside shoulder to that of the center section of the tire. Figure 8.30 below
  - Too low tire pressure has shoulder temps that are higher than the center section of the tire
  - Too high tire pressure is opposite
  - How calculate?
    - Find difference between center tire temp and the avg inner and outer temp(take into account camber effects)
    - Formula in Figure 8.30 below
  - For evaluating the data given by the pressure temperature, any negative values are low pressure, positive value is high, and 0 is correct*

- 

Testing:

Before testing:

- Car fluids check
- Car tech check
- Procedure

Testing setups:

- Independent variables
  - Tire pressures we are comparing
    - 8, 10, 12, 14 (psi)
  - Track Setup:
    - Skid pad track
  - While car running:
    - The car will run ____ runs for ____ (3-6) laps each

- Dependent variables
  - Lap times (record)
  - Driver feedback per tire pressure
  - Evaluate tire pressure of each run after recording necessary variables
    - Center tire temp, inside shoulder tire temp, outside shoulder tire temp

Suspension Static Tests

Tuesday, December 10, 2024 2:38 PM

Overall Vehicle Tests:

- Center of Gravity
- Static Corner Weights + Ride Heights
- Inertia Tests

Suspension Tests:

- Motion Ratios
- Bump Camber
- Bump Toe

KS8C Testing Flowchart

Wednesday, November 20, 2024 6:01 PM

Brief of testing for Combustion Powertrain from Brenden and Carter

- **BEFORE Anything Send ECU off to get repaired - Can push more testing for launch control**
- Testing pneumatic shifting system on ETS
- First need to do headers - degree by degree for tuning. Will take a long amount of time
- Heat map for engine, per cylinder steady state tuning - AFR Tuning
- Thermocouple rad characterization
- PVC Intake to change runner lengths, PVC's will not fit on the car, lower priority - characterize for design

- Per event tuning for different competition events and different drivers
- *Sim test gearing testing - if faster can try running it in the summer*
- Launch control testing
- Differential Sweeps
    - Preload and Ramp Settings

Base Testing Strategy for KS8C

Car Release

Combustion Powertrain-

- Headers Tuning + Validation
    - New design, need to update tune for Car
    - Degree by Degree
- Heat Map Generation for Engine
    - Per Cylinder Steady State Tuning - AFR Tuning
- Thermal Characterization
    - Thermocouple, On-Dyno, Radiator Testing
- 3 - Step Tuning Process
    - Reference Brenden Flowchart for Breakdown
- Differential Tuning
    - Slalom testing with different ramps - should narrow down ramp angles between two because flipping it is hard lol - can also carry over ramp angle setup

Aero + Suspension-

- Tire Testing
    - Same construction, Different Compound, Reference Testing Breakdown
- Tire Pressure
    - Characterizing pressure is simple and can be repeatable. Can also be done with aero off the car
- Ride Heights
    - Straight Line Testing of the Car at base ride height. Make adjustments to static ride height on setup pad up and down and check for scraping but also for DF from damper pots
- Ride Heights GG
    - Ride Heights Sweeps with GG. Roll and Pitch will be static values and can use sim data to get sensitivities to get most amount of grip.
- Wing Flap Angle
    - Energy Consumption and Real Drag Level Sweeps for the car during accel.
        - Rope in where CoP is
- Springs
    - Test lighter spring setup on car IF ride height shows non aggressive scraping. Run on slaloms and Skidpad. Should measure DF under accel as car will pitch more.
- Toe
    - Steady State Sweeps. Start with course testing and move more and more finer. 9 different

levels of adjustment with toe in out and mid. Can be all Skidpad.

KS8E Testing Flowchart

Wednesday, November 20, 2024 6:02 PM

Base Testing Strategy for KS8E

Car Release

EV Powertrain-

- Cell Cycling - Dyno
- Energy Characterization
  - Consumption across the same scenarios (easier to correlate to)
- Thermal Characterization
  - How quickly accumulator heats up for continuous Skidpad, Acceleration, and Autocross runs
- Motor + Inverter Tuning
  - Power delivery will change all the setups + handling
- Differential Tuning
  - Slalom testing with different ramps - should narrow down ramp angles between two because flipping it is hard lol - can also carry over ramp angle setup

Aero + Suspension-

- Tire Pressure
  - Characterizing pressure is simple and can be repeatable. Can also be done with aero off the car
- Ride Heights
  - Straight Line Testing of the Car at base ride height. Make adjustments to static ride height on setup pad up and down and check for scraping but also for DF from damper pots
- Ride Heights GG
  - Ride Heights Sweeps with GG. Roll and Pitch will be static values and can use sim data to get sensitivities to get most amount of grip.
- Wing Flap Angle
  - Energy Consumption and Real Drag Level Sweeps for the car during accel.
    - Rope in where CoP is
- Springs
  - Test lighter spring setup on car IF ride height shows non aggressive scraping. Run on slaloms and Skidpad. Should measure DF under accel as car will pitch more.
- Roll Bar
  - Decouple suspension modes. If we find during Skidpad testing excessive scraping during roll can try to fit out the current one in the shop.
- Toe
  - Ye old toe sweeps. Start with course testing and move more and more finer. 9 different levels of adjustment with toe in out and mid. Can be all Skidpad.

Aero Goals

- Is car faster with or without?
- Are our sims correlated?
- Real aero numbers (Lift, Drag, CoP)
- What flap angle for endurance?
  - Energy consumption & grip performance balance
  - Start with Accel. Get base sensitivities between downforce & energy consumption.
- What CoP is best for Auto X?
- What CoP is best for Skid Pad?

Does CoP Change matter? Don't you want high downforce? Research

Could be more but that gets into weeds, these are most important.

*KS8 Setup Template

Monday, August 19, 2024 2:37 PM

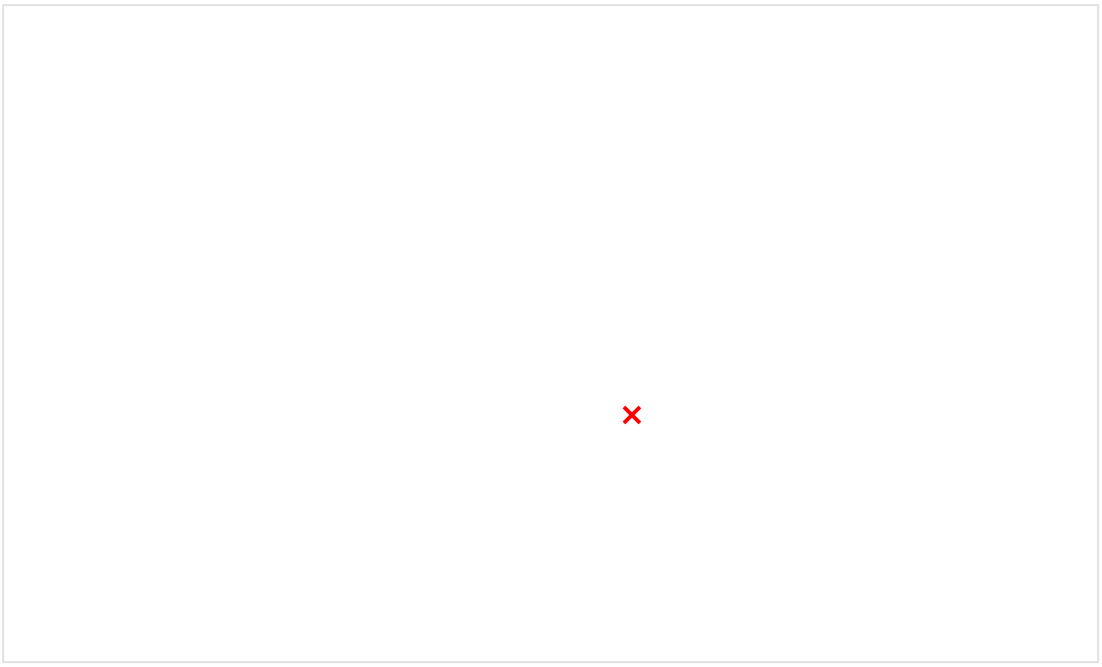
Full Link to Suspension Template in Teams HERE.

Based it off a Claude video on suspension testing. Has parameters that were changed throughout the testing and development of the KS7E as well as other parameters that would be used in the testing and tuning of the KS8E Suspension.

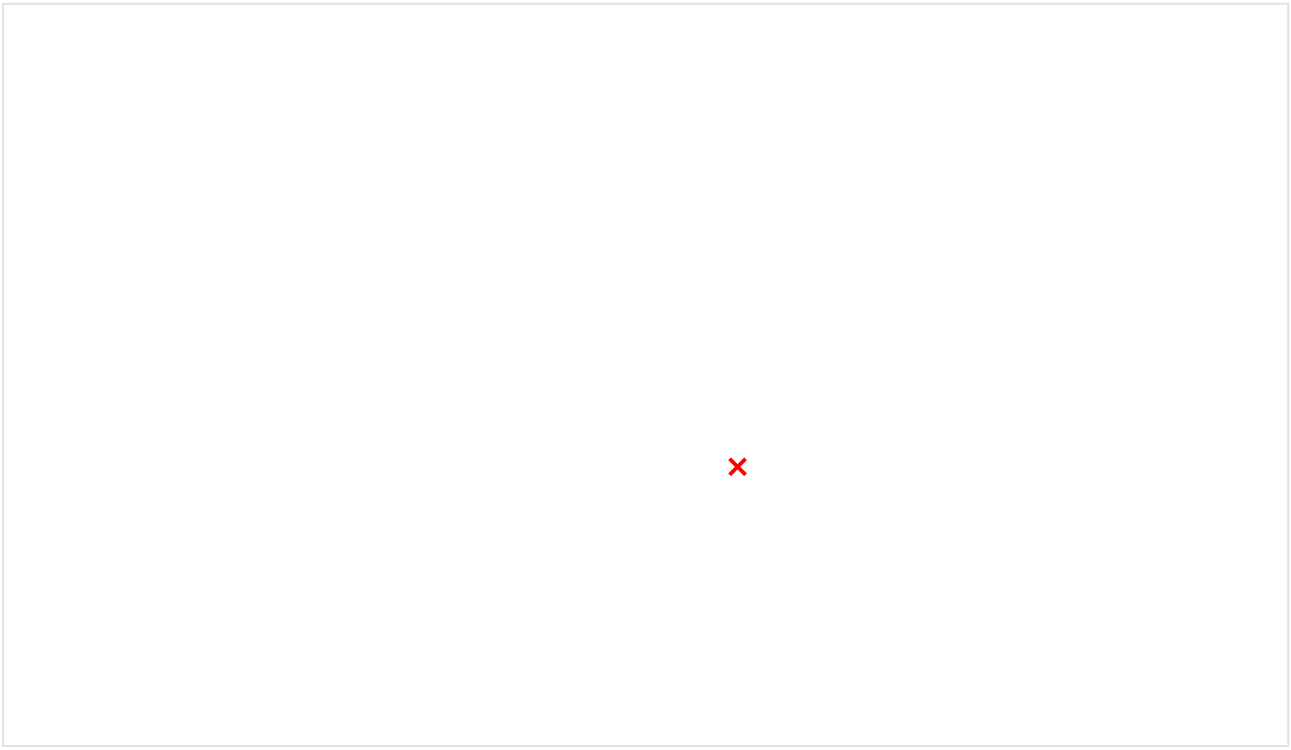
*Track Layout Analysis

Saturday, August 24, 2024 12:05 AM

SAE Suspension Tuning Video HERE



2023 Pitt Shootout Autocross Course



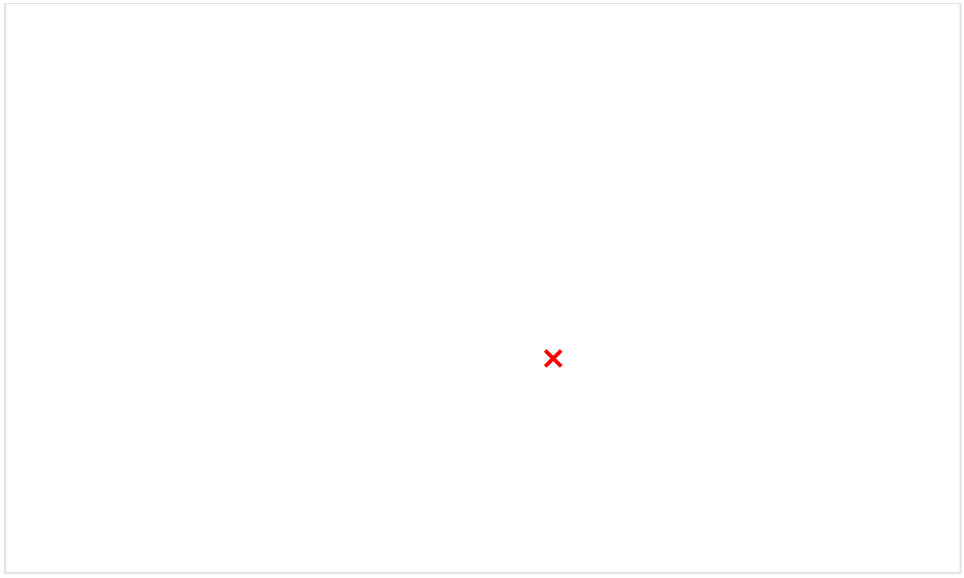
2023 Pittsburgh Shootout Autocross Track

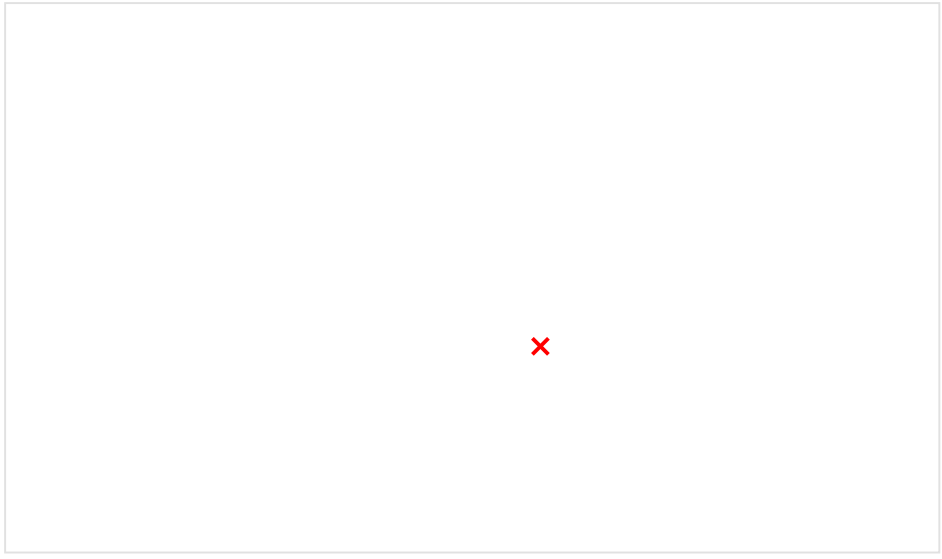
SolidWorks file with the sketch HERE

Corner Radius Report:
Max Radius- 74.4 ft

Min Radius- 20.56 ft
Median- 33.74 ft
Average- 35.88 ft

Type	Length (ft)	Radius (ft)
Straight	118.13	-
Right	39.26	39.31
Straight	56.47	-
Left	50.2	39.21
Straight	103.55	-
Left	79.54	30.22
Straight	128.76	-
Right	75.17	30.25
Straight	127.41	
Right	75.02	46.46
Straight	106.61	
Right	20.60	37.32
Left	40.52	20.94
Straight	14.97	
Right	26.41	35.57
Straight	100.18	
Left	79.81	31.13
Straight	116.32	
Right	92.66	45.490
Straight	101.36	
Left	65.78	37.84
Straight	31.95	
Left	26.63	20.56
Straight	40.13	
Right	46.18	74.4
SLALOM		25
Straight	60.52	
Left	21.48	31.91
Straight	95.83	
SLALOM		31.52
Straight	22.26	
Right	45	42.16
Left	32.77	26.5
Straight	97.94	





*KS7E ARB Testing

Wednesday, August 28, 2024 7:13 PM

Assigned: Adi
(ARB = Anti-roll-bar)

The team has a prototype ARB that was built a long time ago and could possibly fit on the current electric car. We know that the ARB will help the aero platform for the car stay off the ground but what for an ARB will affect the handling for a car. Design a test that isolates the effect of the ARB on the car.

Initially, I made an assumption that ARBs solely have substantial impact on initial turn in, but after some reading on the one and only reddit, I have found that ARBs have most effect mid-corner, due to springs being at the most compressed state, which means that the stiffness of the ARBs are the only thing that
Another assumption I made was about the change of direction being reliant on ARB stiffness. This turned out to be true.

There are 3 main parts of an ARB that need to be considered in order to calculate bar stiffness.
The **two cantilevers** (the parts that mount to the drop links), and the main thickest part in the middle called the **torsion bar**.

For the calculations, first the torsion bar, we need the modulus of rigidity (depends on material), internal/ external diameter unless it is one solid piece, and the length of the torsion bar, measured between the two cantilevers. And length of where the cantilevers from where they meet the torsion bar to the connection point.

ARB Testing Preparation

Testing Brief:
To test effects of a potential ARB, a slalom test with each test having varying radii/ distance between cones, provides a consistent way of testing with relatively low variables including driver input.

Testing Setup Information:

Haven't made a chart yet, but take the equations from ARB website and make a chart with the calculated values and baseline setup, with lap time being recorded.

Independent Variable:

- Baseline setup
- ARB stiffness
- 20 ft
- 25 ft
- 30 ft

Dependent Variable:
Lap Time
Driver Feedback
Accelerometer Data
Steering Data
Yaw Data

Tire Temperature

Controls:
Test will be run on same day and same parking lot

- Weather
- Track surface
- Surface Temperatures
- Baseline setup
- Hopefully driver

Procedure:
3 Warmup laps at 20ft between cones
Check for any issues or faults on car

Run 5 laps on 20 ft Radius
Record tire temperatures and reset tire pressures

Increase distance between cones and run 5 laps
Record tire temperature and reset tire pressures

Change Setup and re-run
Change Radius and repeat

Tasking Before Testing

- Sheet Template for Driver Feedback and Procedure
  - HERE

Test Day Information:
AMB-TMP: --- F
Surface Temperature: --- F

*KS7C Spring Testing

Wednesday, August 28, 2024 6:45 PM

The KS7C will likely not get an aerodynamic design due to lack of resources. To combat this, testing needs to be done if all the aerodynamic grip can be regained through mechanical grip by lowering the spring rate of the corner. Design a test where we can measure the performance advantage of stiffer or lighter springs on the combustion car.

Before starting on variables or procedures:

- What is happening to the car when we lower the spring rate for that wheel?
- Which event will we see the biggest benefit in lowering the spring rate?
- What data might we see or what handling effects will the driver experience when changing the spring rate?

BEFORE TESTING:

Replicate race conditions as directly as possible:

- Check brake fluid
- Check gas
- Check oil
- Check tires **(do throughout test)**
- Weigh with driver6
- Whatever else

STATIC TESTING:

Important information/notice:

- Unsprung weight as estimated by wheel assembly weight is 27 lbs per corner
- Greater sprung weight to unsprung weight ratio = better grip (less comfort but who cares)
- DO NOT adjust push/pull rods after initial balancing on control suspension

Procedure:

1) Note spring rates of front and rear suspension.
2) Add car to corner weighing system.
3) With control suspension, balance the car as much as possible using push/pull rods.
4) Record corner weights.
5) Remove car from corner weighing system & set on flat ground.
6) Measure ride height without driver.
7) Record driver weight.
8) Add driver and record ride height.
9) Prepare for dynamic testing and perform dynamic testing.
10) Change springs to experimental springs.
11) Repeat steps 2 & 4-9, record data.
12) Repeat steps 2-9 (this time with step 3), record data.

KS7C Spring Testing - Spreadsheet

We're sorry, we couldn't make a preview image.

Right-click and pick Refresh and we'll try again

DYNAMIC TESTING:

Important information/notice:

- Be sure to correct any knocked over cones.

Record:

Beginning time of dynamic testing (HH:MM AM/PM)	
Rain in prev. 24 hrs? (Y/N) If Y, how many hrs ago?	
Ground observably wet? (Y/N)	
n cones (#)	
Any issues present with car?	

Procedure:

1. After static testing the control springs, prepare for dynamic testing in open parking lot, ideally east lot.
2. Set up 3 different slalom routes, one with 25ft of spacing between cones, one with 32ft, and one with 40ft. Use same amount of cones *n* for all slalom tests. Entry and exit gates will be perpendicular to first & final slalom cone respectively.
3. Set up skidpad route according to Formula SAE Rules 2024.
4. Record spring rates and driver performing test(s).
5. Have driver perform one practice run at the 25ft slalom route to warm up and acquaint with suspension setting. Time and record practice run.
6. Have driver perform 3 real runs at the 25ft slalom route. Time and record runs.
7. Repeat steps 5 & 6 with 32ft and 40ft slalom routes.
8. Have driver perform one practice run at skidpad route to warm up and acquaint with suspension setting. Time and record practice run.
9. Have driver perform 3 real runs at the 25ft skidpad route. Time and record runs.
10. Repeat steps 1 & 4-9 until satisfied. Check routes referred to by steps 2 & 3 before running them after a period of inactivity and/or usage.

KS7C Spring Testing - Spreadsheet

We're sorry, we couldn't make a preview image.

Right-click and pick Refresh and we'll try again

SWAP DAMPERS USING EV SO WE DON'T HAVE TO FUCK WITH SPRINGS AGAIN

*Driver Feedback Sheet Template

Friday, September 6, 2024 3:59 AM

Turn 3

_____

BR

GR

T

	1/3	2/3	3/3
U			
O			

NOTES:

Slalom 3

_____

BR

GR

T

	1/3	2/3	3/3
U			
O			

NOTES:

Slalom 4

_____

BR

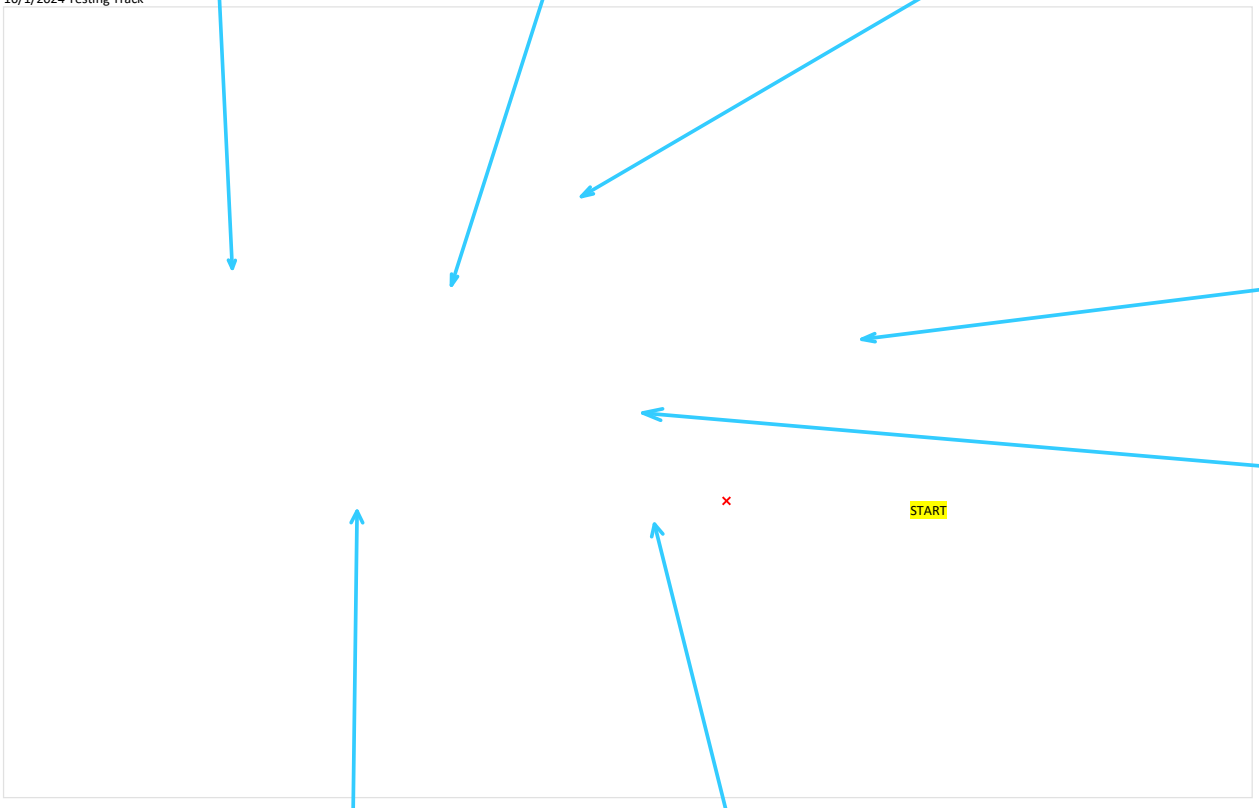
GR

T

	1/3	2/3	3/3
U			
O			

NOTES:

10/1/2024 Testing Track



Turn 2

_____

BR

GR

T

	1/3	2/3	3/3
U			
O			

NOTES:

Slalom 2

_____

BR

GR

T

	1/3	2/3	3/3
U			
O			

NOTES:

Turn 1

_____

BR

GR

T

	1/3	2/3	3/3
U			
O			

NOTES:

Slalom 1

_____

BR

GR

T

	1/3	2/3	3/3
U			
O			

NOTES:

Testing KEY:

In the feedback boxes put a box	for 1-5 and U at 1 and O at 5

Means Under/Oversteer

LEGEND:

BR	Braking

GR	Gear
T	Touching
U	Understeer
O	Oversteer
1/3	Entry
2/3	Mid
3/3	Exit

Team Driver Program

Sunday, September 8, 2024 1:33 AM

Drivers are a large part of performance for FSAE. To sustain performance over a long time need to regulate how we prepare and train drivers.

1. Open form for driver program positions
2. Chief Engineer and VD Lead finalize leads for driver program, considerations include
    a. Years on Team
    b. Contributions on Team
    c. Previous Experience in Racing
    d. Access to Sim Racing
3. Pre Sim Session with finalists to observe racing technique **8 - 10 People**
    a. Same Car and Track
    b. Different Setups beforehand
    c. Observe driver feedback, lap time consistency, lap time performance, etc.
    d. Ask them afterwards where they could've improved
4. In-Class Lectures **8 - 10 People**
    a. One to Two week instructions on basic driving techniques and safety of the car
    b. Involve simulator time as well
5. Post Sim Session **4 - 6 People**
    a. Evaluate how much each person improved over the course of the training
    b. Re Evaluate the stuff from the previous sim session
6. In Car Testing Session **4 - 6 People**
    a. How they handle the car in accel, Skidpad, autocross, and mini endurance
    b. Evaluate lap time, driver feedback, and consistency
    c. Review GoPro Footage
7. Compare Against Previous Drivers
    a. Skidpad Drivers for previous year compare to the in car testing trials
    b. Do the same for autocross and endurance
8. Goal of Training
    a. Fill out drivers for all 4 Events
    b. 2 more spots for practice and testing drivers

*Shock Pot Damper Indexing

Monday, October 14, 2024 9:38 PM

Purpose: Create user script in foxglove that reads values raw shock pot values and converts to inches

Baseline of values here

1. 57mm (stroke) / 0-2^16 (bit) = Constant
2. Average all total messages in shock pot
3. Subtract messages from static value
4. Convert this bit length to mm
5. Convert from mm to inch

(look at user script videos on foxglove)

More measurements are needed for the relation between length of the dampener and the shock pot.

Measurements from shock pots to dampener:

Skitter Visit with Drivers

Saturday, December 7, 2024 11:30 AM

Key Takeaways From Skitter:

- Treat sim like testing, so when learning something new write it down

- Driver stuff: when taking compound corners, you point out the points of inflection and drive through them fluidly
    - Don't try to go into a turn tight, try to straighten out
- Ev enduro strategy: most teams go full throttle for the first stint and then the driver has to
    - Attempt to regen
        - Skitter thinks having a 3rd left pedal(instead of a clutch) as the regen pedal
        - Regen usage: what is it?
        - Regen: a system that captures kinetic energy when the car brakes and converts it into electricity; most of that kinetic energy from braking is dissipated with the friction of the tyres; regen trys to recoupe that energy
            - F1: used to do KERS but stopped bc it was too heavy and
            - Ers is more advanced using energy store(es) and control electronics (ce)
- Team Strategy(Insight from Skitter):
    - Create team code similar to rally driving codes
        - It doesn't have to be the same
        - Create a coding language that all members of the team understand
        - Important for track walk and being able to understand changes from the competition track to those the drivers practice
    - Setup a track of the previous years(skidpad)
        - Most of the time the tracks are similar year to year
        - Have drivers compare their ideal track line for the previous years track
        - Create a track of last years and when the new one comes around make that one too
        - When track walk for comp have drivers use the team code to see any differences to the released track
- Testing Strategies:
    - Use low fuel in sim racing to teach drivers how to drive the EV on low energy ..

KS8C Data Acquisition

Thursday, February 20, 2025 7:28 PM

Sensors for Testing

- IMU
  - Accel
  - Gyro
- Steering
- Wheel Speed
  - 2 Rear
  - 1 Front (should do 2)
- Shock Potentiometers
  - Will need if want to do aero testing

Telemetry

- Not needed
- More important is being able to output into .csv
- For sustainability should have both systems for dacq on IC and EV be the same

Summer Testing Dump

Thursday, June 12, 2025 9:35 PM

- Skidpad inverted L/R, so left first to check for left brain right brain
- Pressure sweep and balancing for acceleration event
    - Low pressure rear, high pressure front
- Rerun the F/R toe sweeps we had from the KS5
- Asymmetric car corner weight performance in skidpad

KS7 INFO

Monday, August 19, 2024 10:56 AM

KS7 Comp Notes

Monday, August 19, 2024 10:56 AM

- toe compliance = FX * scrub radius
- Anti geometry more feel of braking bc through linkages
- Do we want toe in or out in bump/ braking
- Better justification against R20
- Understanding where aero balance is how and where does aero effect the vehicles suspension
- Where we want our grip to be, front and rear grip balance (I got this right like a fuckin boss)
- Need to understand where grip is on each part of a hairpin and how static balance and dynamic characteristics can change grip and where we have it
- Understand suspension in different modes of roll pitch and heave
- Look to decouple more suspension modes and be able to tune each decoupled
- Shit we could do to understand our aerodynamic operating range
- Need to prepare something that wows the judge at the end. Has to be something we do exceptionally well in either our resting, our iteration tracking etc.
- Need to define more target parameters from design, makes design more concise
- Better justification for no ARB needed look at chassis stiffness and into what roll stiffness necessary for aerodynamic operating window
- control inputs for driver are represented with steer input and feedback loop across

Aero shit

- aero is define by 3 performance deliverables drag, downforce, and CoP and all of theee are sensitive to pitch, speed, ride heights, and roll angles
- Can evaluate the effect of CoP migration under pitch on performance and stability of the car
- Stability target usually derived from previous data, instead should use pitch interactions to get pitch target
- Combined with existing test data to evaluate rate and damping targets for different suspension modes
- PDR, move away from anecdotal and move towards numerical
- “Suspension was not designed for aero”
- “Car don’t turn good”

Design Feedback

- Design for experiments
- Why go outside green box
- Aero platform before anything
- Immediate aero before anything esp bc of overall grip
- More testing data
- Design report good
- Model driver loop
- Make justification for changes of all possible changes in setup and show with real data
- Launch control was adjusted during practice
- Wingdebond- check vibration of aero
- Talk to Emil Jonathan chance about what worked on cone counter, how to make better
- Pneumatic tank mounting not cut
- How to strategize
- How to trackside engineer
- How to organize tea

- test weldment properties of using insert for control arm instead of squished
- Fit n finish for suspension components goes a long way into how presented
- Comfortable seating vs. function(egress, driver strength at different steering angles)

- Split VD up into theory/design + test/validate and tuning
- Parametric SW model for vehicle preliminary architecture would be bussin
- PERCENTICLE BASED WIFHT GOALS YOU FUCK
- When looking at design for next year draw out the control scheme for different maneuvers
- What IS the driver doing in a slalom and what parts of the design can we optimize
- What is happening to the suspension in a steady state corner what is happening in a slalom
- Ricer parts>>>>
- Assume some level of confidence with modeling and retrace with physical testin

Rain Tire?

- chosen off of ground outside gate still being wet
- Sky visually looked cloudy
- The windchill was significant so running the softest tire we can was very important
- What to do? Have a sufficient weather tracker in the area
- Have a tire durometer tool that measures the stiffness of the surface of the tire
- Once we get in the gate we really can't change tires or change up?
- Look for standing water?
- Look at shift tank sizing we have a number of amount of shifts for endurance we can quickly count this and time 1.5
- NC State Launch Control optimized for a throttle plot of an acceleration run and auto shifts
- If we want IC to do very well need to deconstruct vehicle demands in each event and understand what real world sensitivities
- Indicator on bottom of car to measure ride height displacement during roll and figure out specifically when aero is bottoming
- Real testing for ride stiffness targets? Change spring
- Suspension takes the loads generated by other subsystems and transferring it into the tires
- Aero mounting repeatability
- Design with understanding of setup windows of the car using driver performance for yaw accel. Estimate suspension tuning window
- Add sun stuff to packing list
- Split up planning and execution of year into three steps
- High load sensitive R20
- Bad at Skidpad for low slip angles and temp rise during
- R20 good at Accel and AutoX for high load sensitivity
    - Understand what loads camber and toe tires see in each event
- Wheel and ride rates for car necessary to understand
- Know suspension member dimensions for the car
- Run through more hypothetical questions for our car
- What necessary roll stiffnesses are necessary
- Steering infront of center of wheel changes the axis you have toe compliance in
- Learn about static weight distribution effects on car balance and how it would change car behavior
- Have a better response to how design was started
- If you car had a 50 50 weight distribution and had a jello chassis
- What chassis changes would you make for X
- If I have a driver 50lb heavier than the other on the front what sh
- What necessary steering angle is required
- What is the shock doing in steady state with small adjustments
- If aero was roll sensitive but not ride sensitive how would you size and spec springs and roll stiffnesses
- Clear tape on aero and trailing edge

KS8E Differential Integration

Wednesday, August 21, 2024 1:36 PM

EV Powertrain + Drivetrain:

- Tensioning Method
  - Shims or Rotating Feature on Carrier
- Chain Selection
- Sprocket Mounting
  - Mounted onto bolt pattern of Differential
  - Carter assigning someone to it so they can get the proper ratio and create lightweight design (make solid AL design for back up)
- Tri Pod Housing Selection
  - Backwards Compatibility?
- Axle Lengths
  - Sweeps with Suspension Linkage
  - **Be the same for Combustion and Electric**
- Motor Packaging
  - Spacing for accumulator in chassis with the motor.

Suspension/ Frame:

- Rear Suspension Kinematics
  - Copy the one from the KS7C for similar handling characteristics
- Control Arm Mounting Points
  - Mount along frame points where motor housing is
- Suspension/ Damper and Bell crank Mounting
  - Can mount along the side of the Accumulator Packaging (WILL BE OUT OF PLANE WITH EACHOTHER AND NOT DIRETLY ACTUATING)
  - Mount shocks overhead like the combustion car
    - Easier and more discrete roll bar packaging possible
- Rear Impact? VISIT RULES CHANGES
  - Create structure from the frame tubes itself, would make integrating both diff carrier motor mount easier because can all be in line with each other, just has a larger foot print
  - Using the diff carrier? Common design, very similar to combustion car just has to mount to middle of tube because no engine mount

Design Concepts:

Project Goal:

- Integrate Drexler Differential onto KS8E rear w/ required packaging changes.

Ideology:

- Pull heavy from Berkely rear, keep wants list to items affected by required changes (shock mounting)
- Bolt through tube diff carriers with shims

Staying:

- Motor plates (possible lightweighting)
- Shim Tensioning method (CAM is unneeded change with split carriers)

Needs:

- Diff Carriers
- Tripod Housings
- Sprockets
- Shock Mounting
- Jacking Bar

Wants:

- Match IC Rear Kinematics
- New Chain/Final Drive
- Axle Compatibility
  - Match IC Axle lengths

Owners:

Sammy: Rear Kinematics, Node Placement (CA Mounts), New Shock placements

Mihai: Rear Chassis Structure, checking new node placement against rear impact and SES

Carter: Co-Owner of Sprockets and Chain, Tripod housing, Axles, Diff Carriers

Bailey: Co-Owner of Sprocket and Chain, Structures check against tractive system and cooling

Notes:

- Mihai and Sammy to start spit balling new node placement and rear structure
- Need to get who was handed what projects yesterday.
  - Somebody owns tripod housing and axle sweeps
  - Sprockets and chain can be combined or two projects
    - Sprocket to diff mounting is decided
      - Through mount to diff housing
    - New FD and Sprocket analysis with new pack
      - Look at lower pitch chains
    - Can lightweight sprockets
- Keep crushable items (cooling loop and LV power distribution board) in mind for pathing

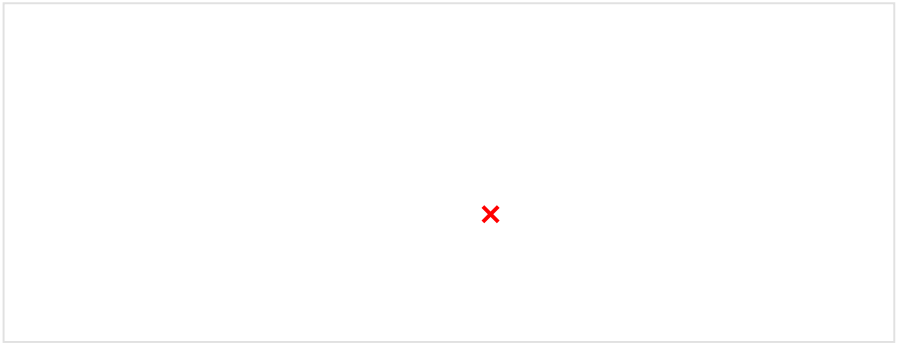
KS8E Driveline Assembly

Thursday, August 29, 2024 11:34 PM

Things that need to be added:

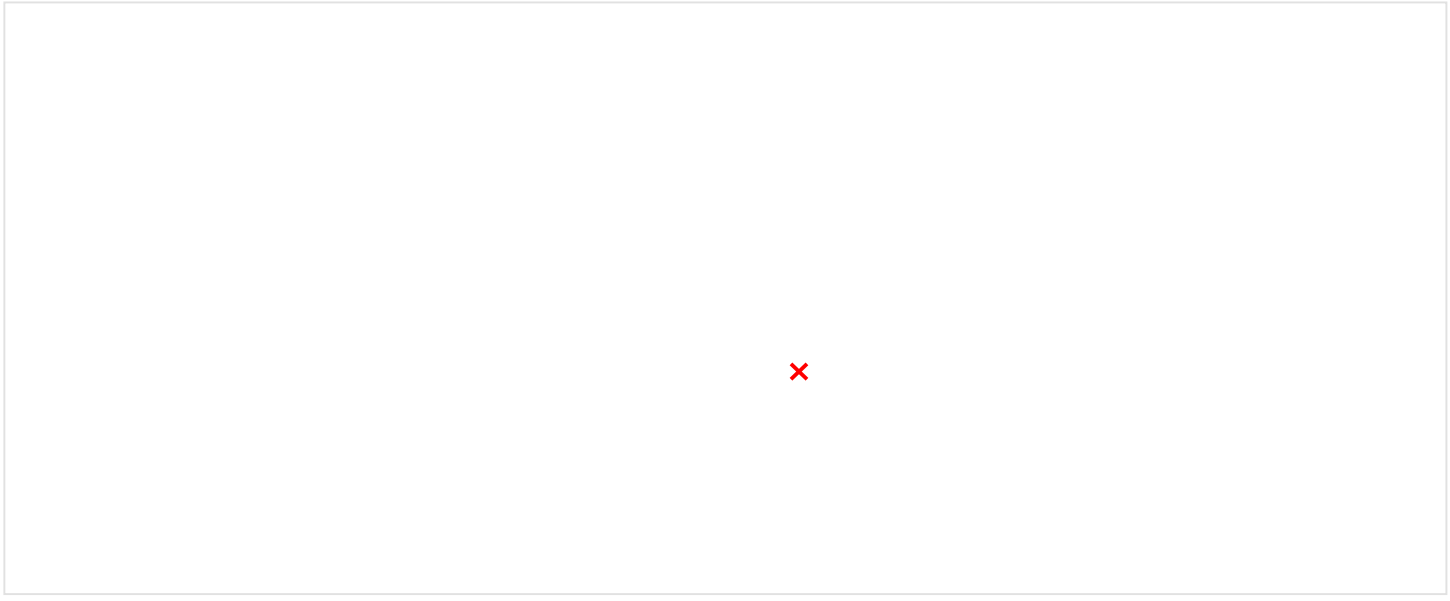
- Larger rear sprocket to hit target final drive
- Drexler V2 Assembly
- Appropriate tripod housing sizes for differential
- Axle lengths to match tripod housing and track width
- Lineup to motor output shaft

9/30/2024 Meeting:

- How tall does the diff carriers need to be?
  - Normally make as tall as possible but don't need to change constraints for it
- How wide does the rear structure need to be?
  - Within the diff centers
  - 
- Axle spacing for the rear differential?
  - After Kinematics of Suspension
- Mounting rear sprocket directly to the differential?
  - Would be down

10/3/2024 Work Session

Need to move this tube backwards to meet Control Arm



October 10 Stuff to Do:

- Create pseudo Driveline Assembly with drexler differential

    - Proper spacing for tripod housings
    - Attach final drive gear for car onto diff
- Add motor assembly into RnD Chassis
    - Use KS7 Assembly
- Create outline for yoke assembly
    - Differential Spacing to Rear Bulk Tube
        - Tractive system distance to accumulator (100mm)
        - Differential Carrier Pseudo CAD and Mount
    - Damper Mounting

Project Proposal Breakdown

Component	Part 1	Part 2	Part 3	Manufacturing Plan
Yoke Plate	x			
Rear Sprocket				
Bearing Carrier				
Motor Plate				

October 24 Stuff to do:
PLATE

-

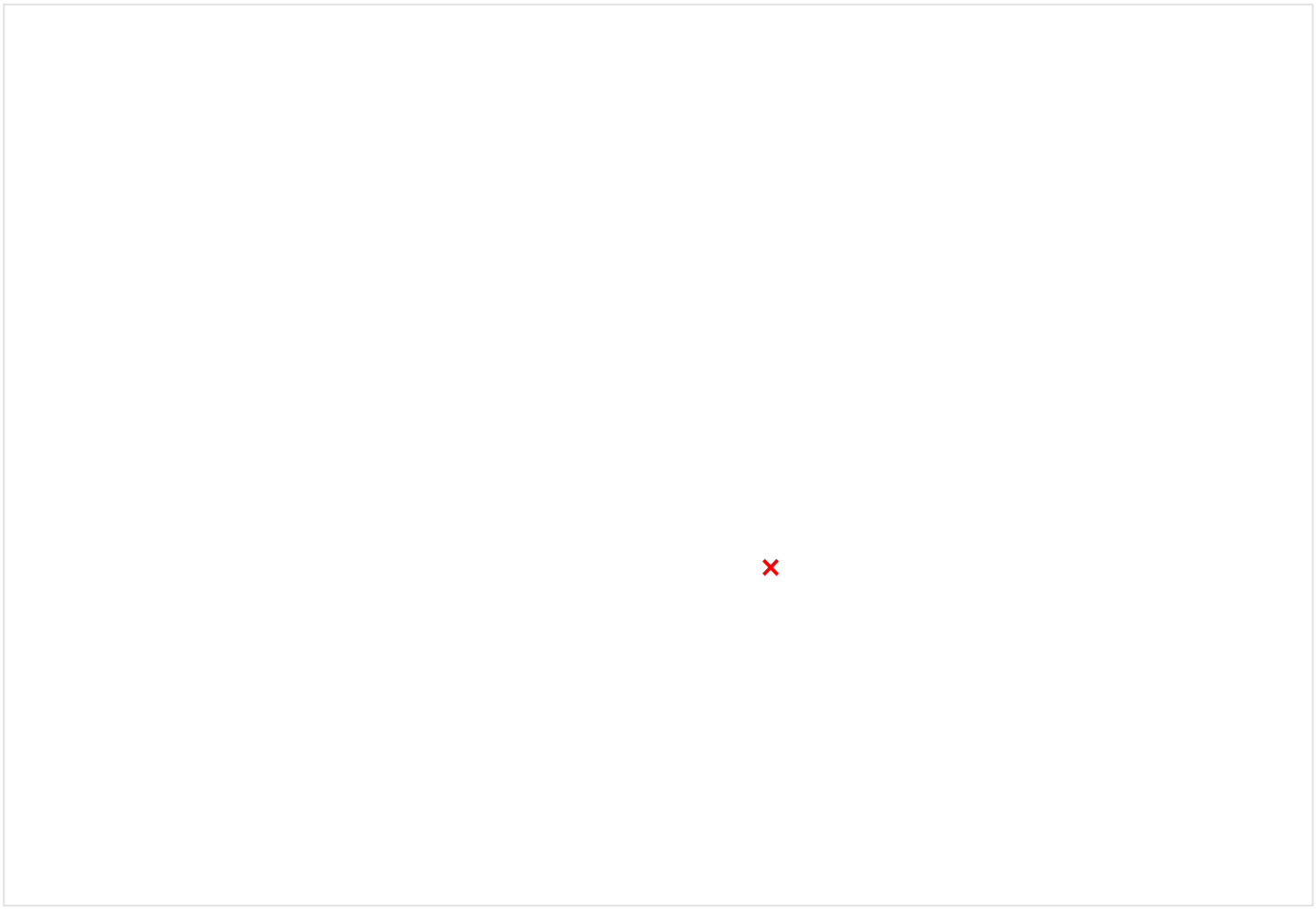
2024 Pittsburgh Shootout

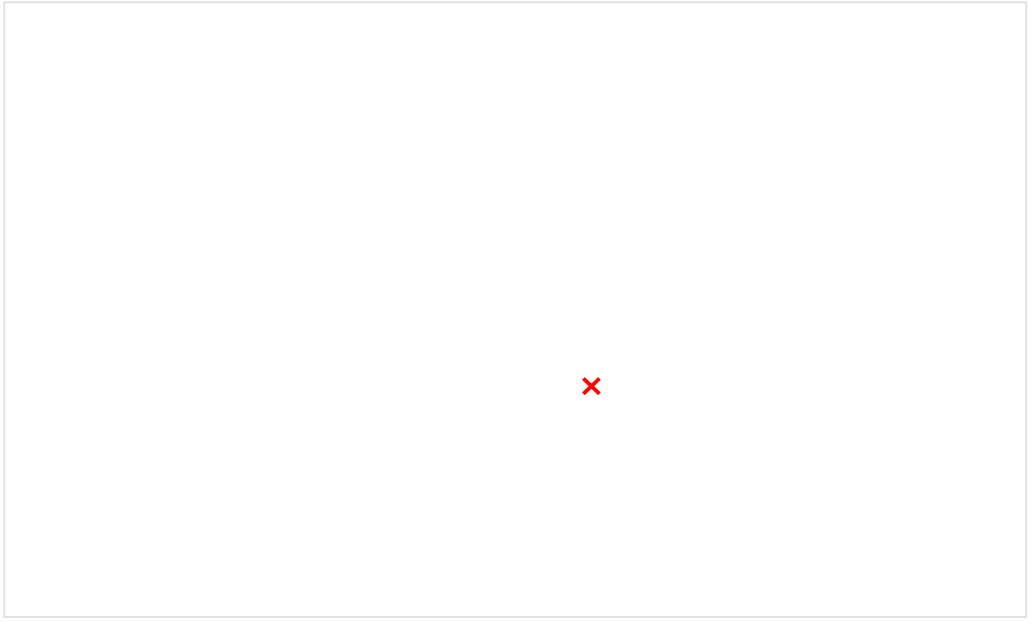
Saturday, August 24, 2024 3:07 AM

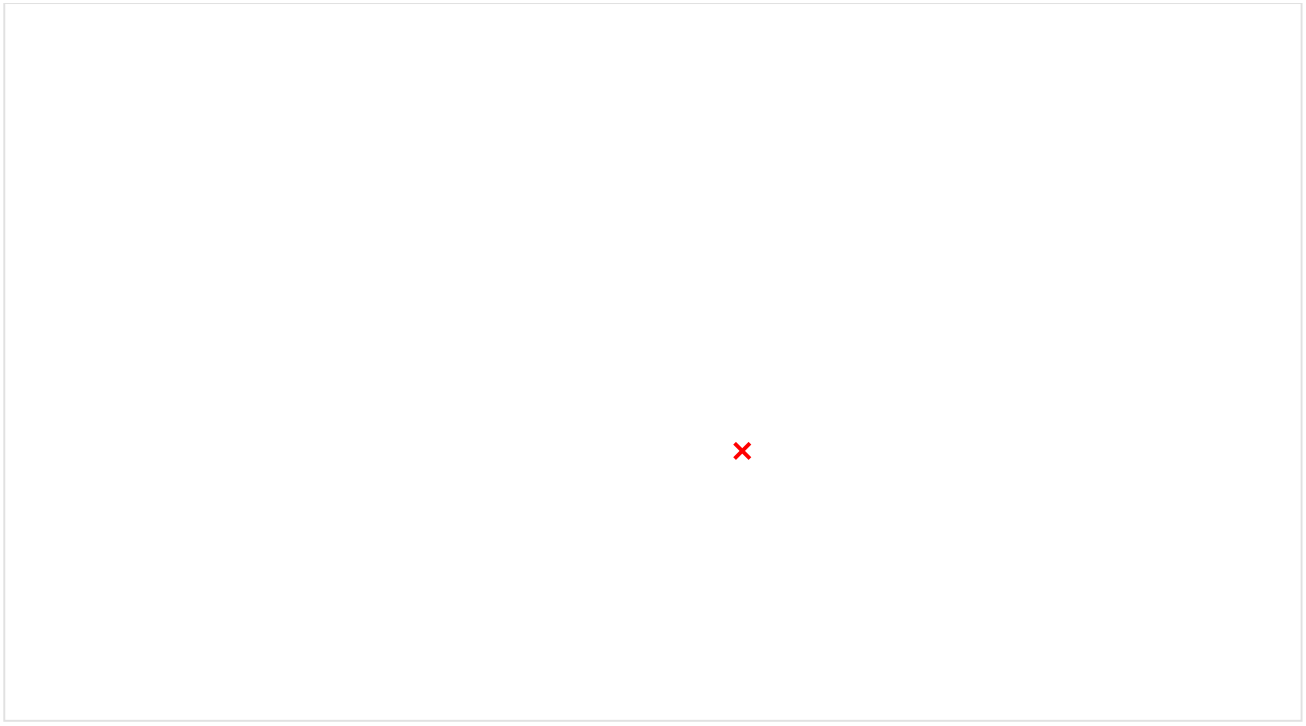
Documentation for all of the prep work taking the KS7E to the 2024 Pittsburgh Shootout

Track Analysis

Saturday, August 24, 2024 3:07 AM







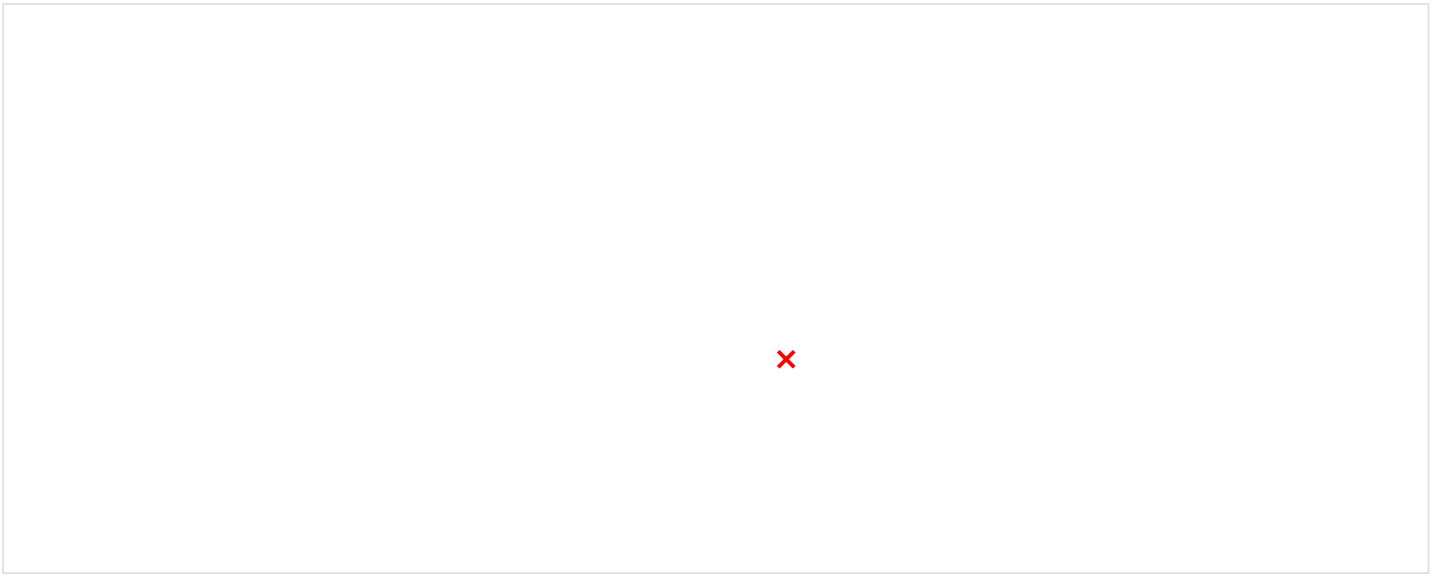
Corner Radius Report:
MAX: 60 ft
MIN: 20 ft
MEAN: 23 ft
MEDIAN: 28 ft

Competition Overview

Sunday, August 25, 2024 8:12 PM

EV Teams:

Car Number	Team	Year
202	Carnegie Mellon	2024
204	RIT Racing	2024
285	Penn State	2024
231	Pitt FSAE	2024
283	Western Ontario Racing	2024
277	Waterloo Electric	2024
201	Formulé ETS	2024
205	Uni Toronto	2024
206	Kennesaw State	2024



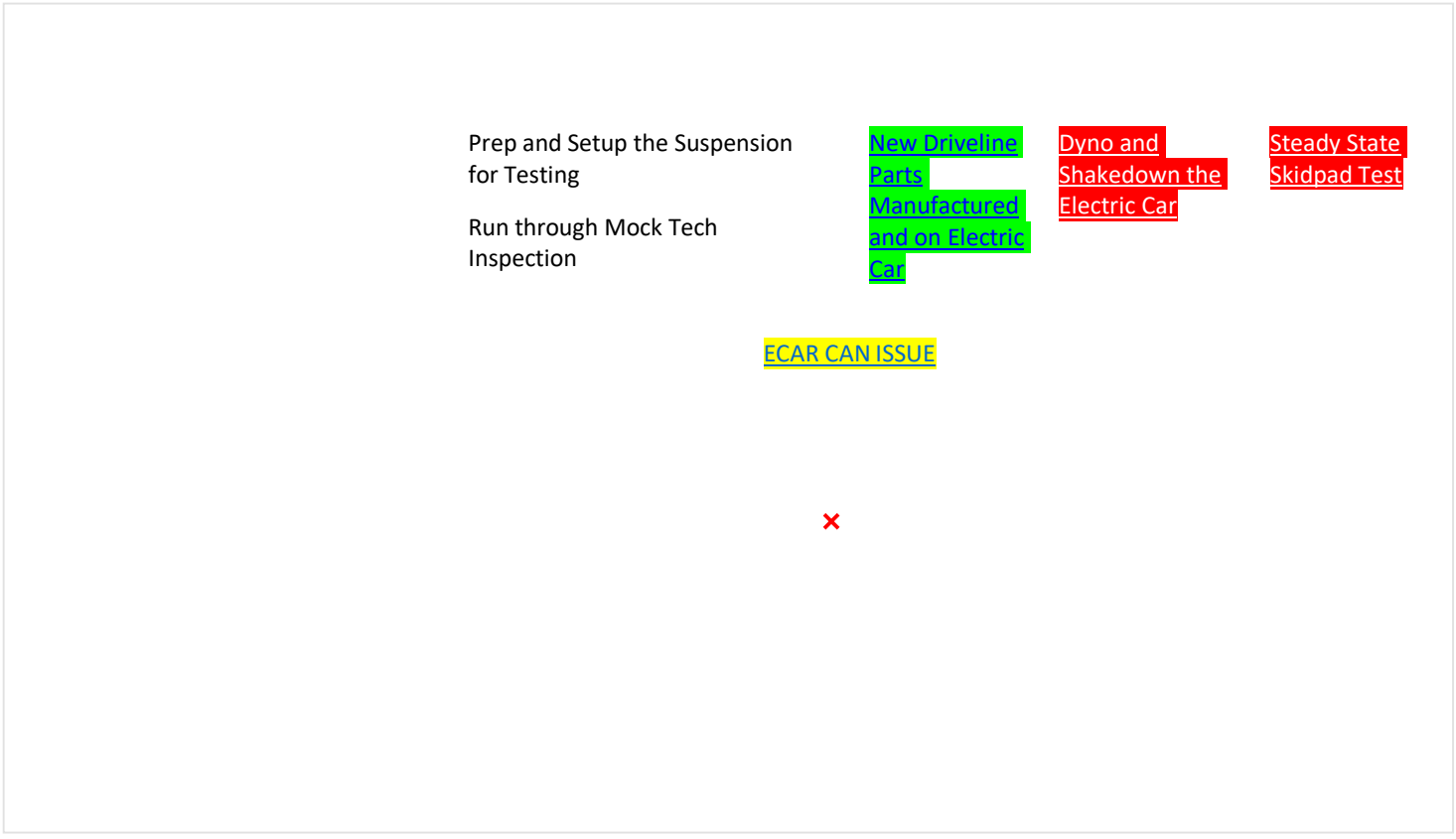
Times are based on performance at FSAE Michigan 2024. ETS had to be taken from 2023 because they did not compete in all of the dynamic events.

KS7E is not far off the pack in both Skidpad and Autocross. Testing and preparation will reflect tuning the car for these events.

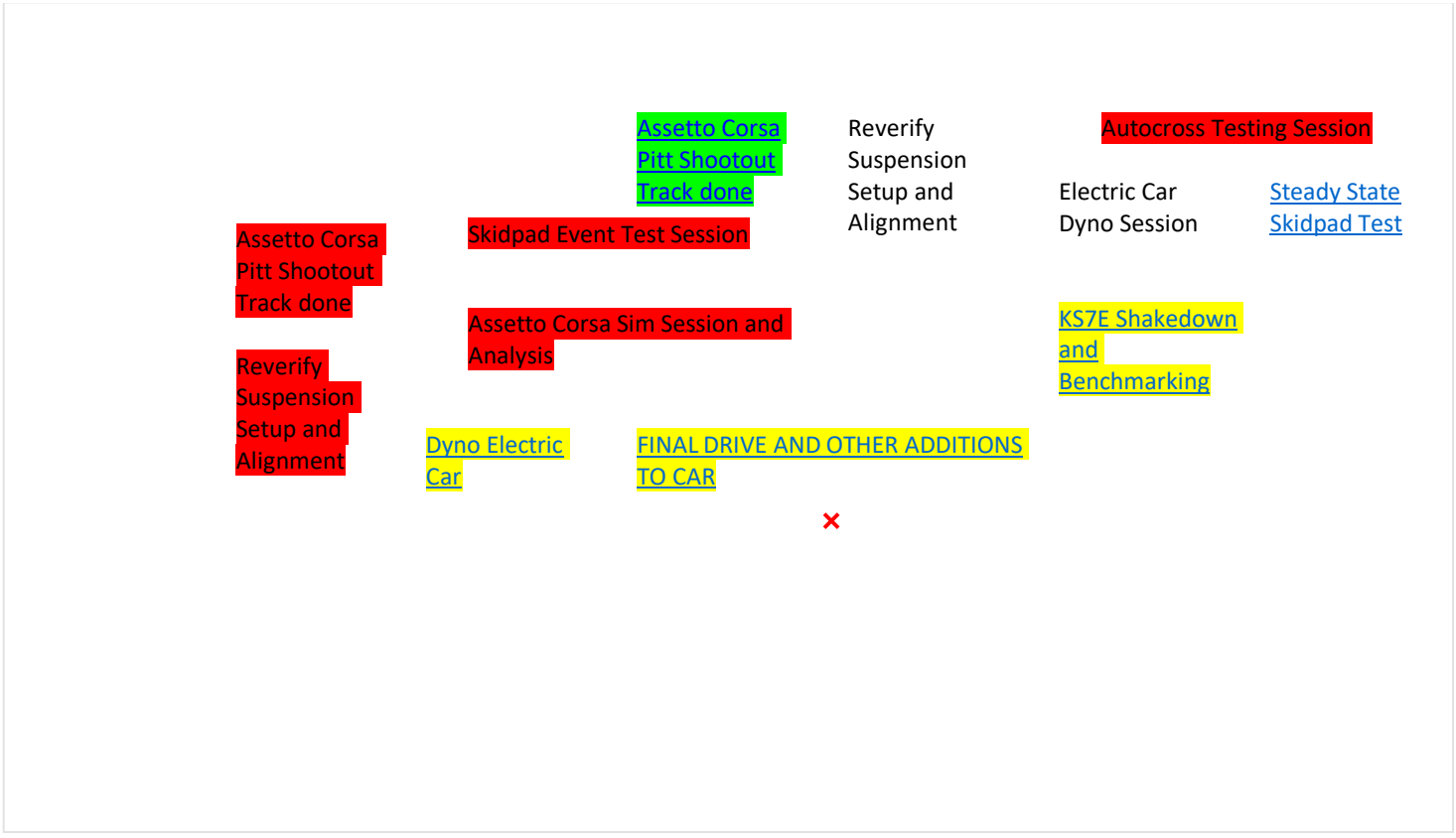
Testing + Prep Strategy

Sunday, August 25, 2024 7:12 PM

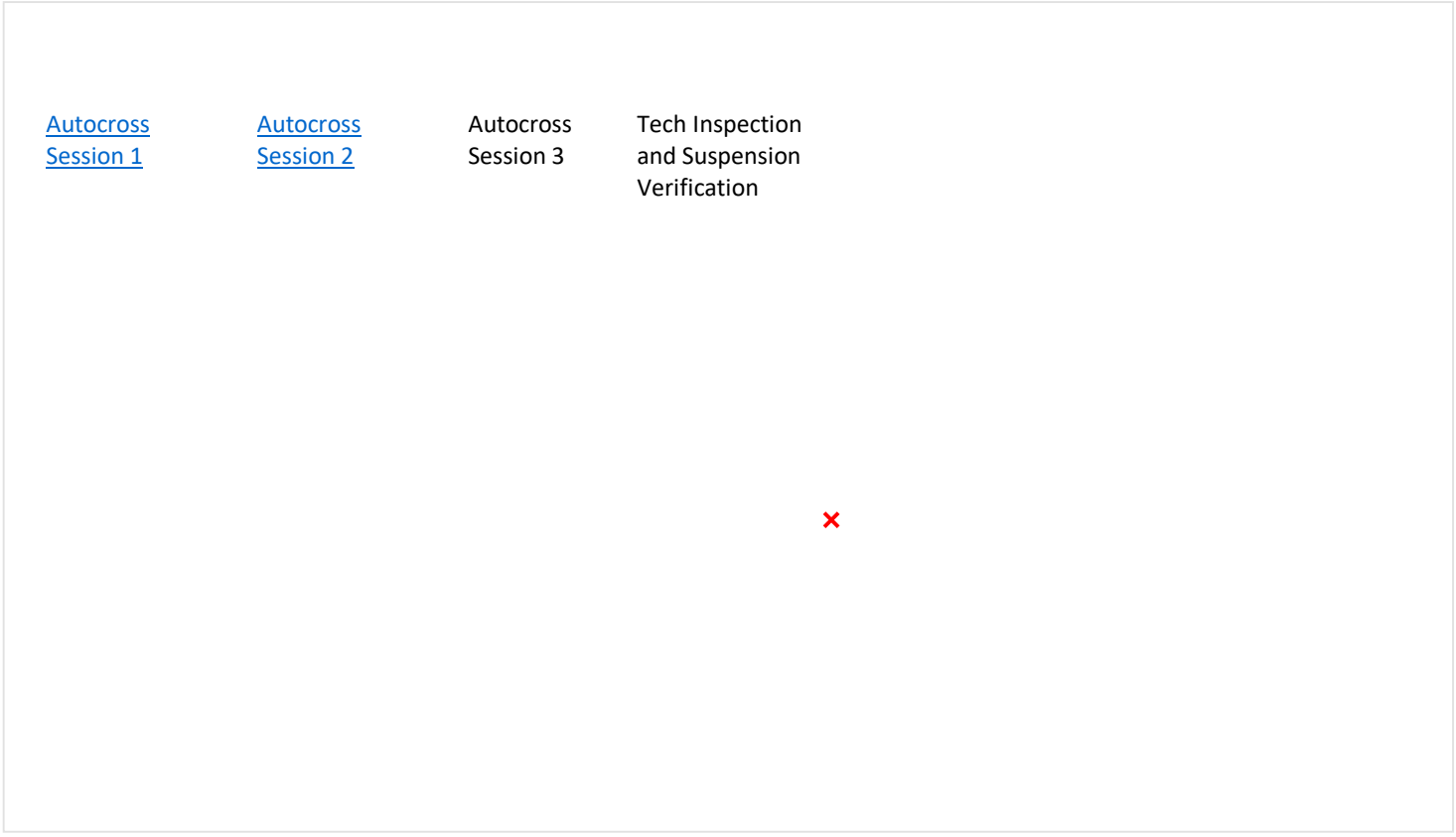
Week of 8/25 - 8/31:



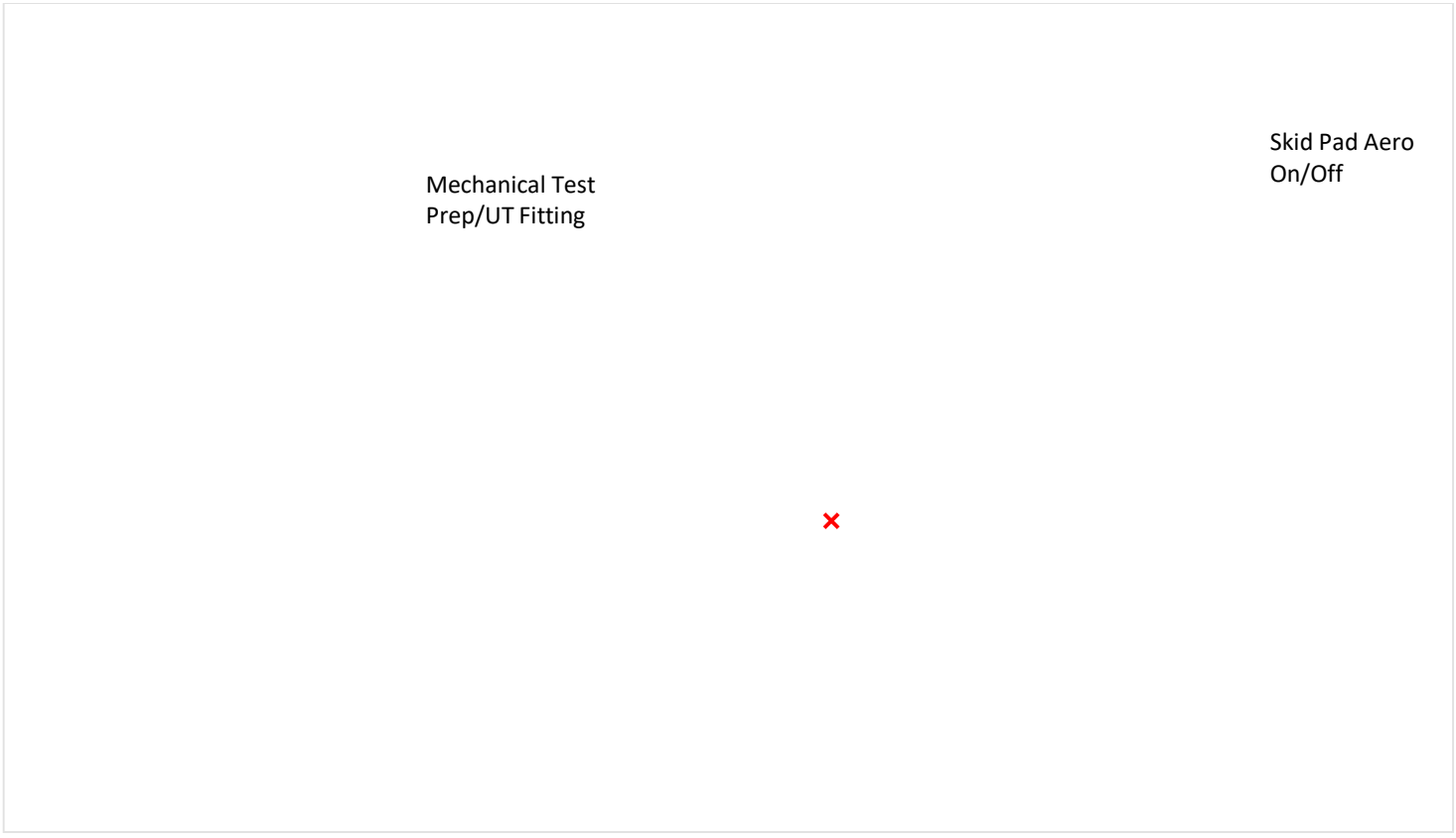
Week of 9/1 - 9/7:



Week of 9/8 - PITT SHOOTOUT:



Week of 9/16 - Post Pitt


Mechanical Test
Prep/UT Fitting
Skid Pad Aero
On/Off

Sept. 5 Shakedown

Friday, September 6, 2024 2:32 AM

Pre Shakedown Notes

- Testing timeline was pushed to accommodate for the better final drive to be put onto the car
- Main reason was to remain competitive overall during the event by improving acceleration performance by going from a final drive of 3.7 to 4.1 (Final Drive Sweeps HERE)
- Throttle pedal throw was adjusted to see if it would correct faulting issue when APPS was triggered during previous dyno testing

Sept. 5th Shakedown

- Car was shaken down to figure out why car was faulting during previous dyno testing HERE
- During shakedown testing, car was still faulting towards the end of a would be acceleration run
- Chance changed different inverter settings, defaulting to some values that we had set on the 228 Motor
- Did not completely solve the faulting issue but was better than what was done previously

Shakedown Suspension Notes

- Axles would find after every run
    - Typically axles have a good amount of movement side to side, after each acceleration pull there would be no amount of movement
    - The main hypothesis is overtime the inside housings of the hubs developed grooves which the tripod would get caught on when slamming during acceleration event
- Chassis would sag a lot
    - Chassis and suspension of the car would pitch heavy rearwards during acceleration
    - To accommodate the ride heights for the rear of the car were set a lot higher (nearly maximizing the rod end adjustments)
    - Did not corner balance after setting ride heights higher, ride heights were a higher priority at the time
- Potential noise on the Front Left Wheel
    - According to driver feedback (Emil), there was an audible clicking noise on the front left wheel during driving
    - When Sam tried to listen couldn't really hear much
    - After coming back from shop one of the three wheel nuts was loose (barely seated, could be hand tightened)
    - Will still remove wheel and investigate

Things Added on September 5th and 6th:

- New front and rear sprockets manufactured
    - Needed to achieve better final drive for car, would be necessary addition to car if team wanted to be competitive in acceleration event relating to team goal, top 3 in EV Overall
- New chain added to the car
    - 420 Chain added to the car to fit the sprocket and final drive selections. Bigger configuration would interfere with the chassis and yoke plate
- New Steering Column added to the Car
    - Based off of values in CAD
    - Done to improve steering effort by running the proper column length, improving the u-joint phasing

Sept. 6 Shakedown and Benchmark

Friday, September 6, 2024 2:52 AM

Testing Brief:

- Previous changes added to the car can be found HERE
- Main plan is to shakedown the car and benchmark it's performance with a new final drive configuration
- Procedure for the test will be to immediately run accel when accumulator is at highest available voltage to get an index time, then after around 5 attempts, run Skidpad
- Compare with pre-competition testing data and competition event data. See if aligns with simulation and how competitive against the competition field at Pitt Shootout.

Testing Setup Information:
Setup Template HERE

Independent Variable:
Suspension Setup on the Car

- Setup sheets above

Dependent Variable:
Lap Time
Accelerometer Data
Steering Data
Yaw Data

Controls:
Test will be run on same day and same parking lot

- Weather
- Track surface
- Surface Temperatures

Results:
Teams folder with full results HERE

THE ABOVE DID NOT HAPPEN FOR A COUPLE REASONS

- The inverter faulting persisted, @Bailey and @Chance spent time in the parking lot trying to resolve the issue for more detail
- That was a more pressing issue for the car at the time

Sept. 7 Steady State Skidpad Test

Monday, August 26, 2024 8:05 AM

Testing Preparation

Testing Brief:
To best approach creating an autocross setup for autocross, given we have some track information, need to first evaluate the car's pure lateral performance in cornering. Tuning a suspension setup that is both consistent and quick in different Skidpad distances can help get an idea of the pure lateral performance of the car.

Testing Setup Information:
Setup Template HERE

Independent Variable:
Suspension Setup on the Car
- Static Toe Setup
- Tire Pressures

Radius of Skidpad
- 20 ft
- 30 ft
- 40 ft
- 60 ft

Dependent Variable:
Lap Time
Accelerometer Data
Steering Data
Yaw Data
Tire Temperature

People:
1x Taking Timing / Communicating to Driver
1x Tire Pressure Logging
1x Tire Temperature Logging
1x ESF

Controls:
Test will be run on same day and same parking lot
- Weather
- Track surface
- Surface Temperatures

Procedure:
5 Warmup laps at 20 ft Radius
Check for any issues or faults on car
Run 10 laps on 20 ft Radius
Record tire temperatures and reset tire pressures
Run in the other direction
Record tire temperature and reset tire pressures
Change Setup and re run the 20 laps

Change Radius and repeatgu.,gtui

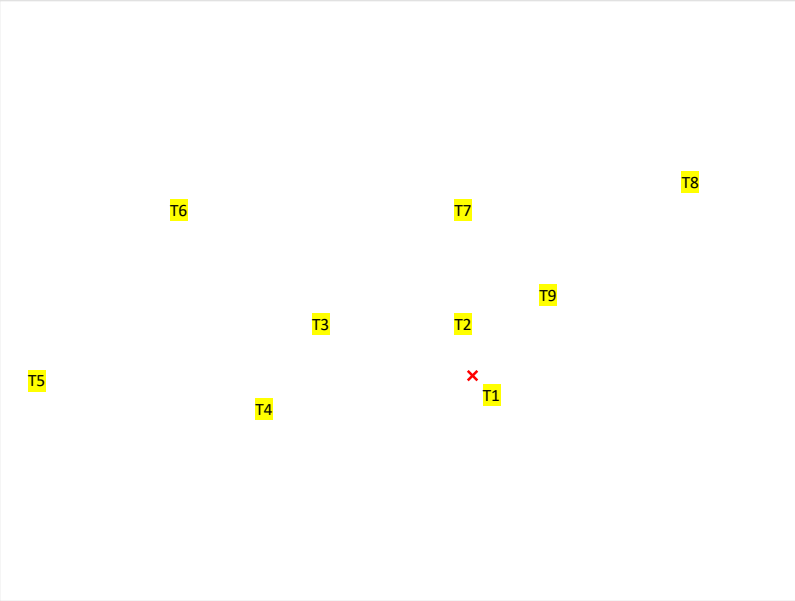
Tasking Before Testing

- Sheet Template for Driver Feedback and Procedure
  - HERE

Test Day Information:
AMBTMP: 72 F
Surface Temperature: 81 F

Sept. 8 Autocross Session 1

Friday, September 6, 2024 3:15 AM



Execution Debrief:

Preparation:
- Bring more batteries for the dacq pack
- Charging the car ahead of time

During Test:
- APPS triggering
- APPS could work only off of one of the potentiometer readings

Session 1- Toe 5F/0R

T1: Corner Entry, easy to rotate, felt like mid corner and corner exit small amount of understeer but straightened on exit

On transition/ corner exit, felt like small amount of understeer but overall not as much across the lap

Definitely easier going right than going left. Easier to go through T1 + T2 than T3 + T4

T5: felt pretty hard to get car to rotate under high speed, pretty quick corner trying not to use more brakes. Hard to get car to rotate with the brakes. When carried enough speed through exit of T5, car feel unstable. Mid corner under steer through T6 and T7 at pace. Depending on performance through T5, dictated how fast you were going through T6 and T7. Needing to lift off throttle at T6 when understeer, towards entry at T7 plowed through. Squirmy through the slaloms between T6 and T7.

Visually T7 was very shaky and car wanted to kick out. Not enough laps to get good representation of braking and turning zones. Plowed through T9, corner entry specifically on both setups. Was carrying too much speed possibly and hitting the brakes late. Could be driving thing.

Session 2- Toe 5F/1R

T1: throughout the sections of the turn, car would not rotate. Felt like it had significantly more rear grip, much harder to get the car to rotate. Felt like the ground speed was slower on the setup. The average speed could've been higher. Possibly brake earlier on the markers. Had to be a little more gentle or else could be giving too much throttle to make it through the turns.

T3+T4: felt almost identical. Definitely understeered. Corner entry and mid corner. T4 didn’t plow as much on exit.

T5: revisit telemetry but car felt it hit neutral steer at points, under braking on the corner entry. Everything past the T5 felt good on the setup, car could get to 100% throttle without much understeer. Definitely not as much as the other setup. Felt faster through the slaloms. Under higher speed, car had more grip in the rear.

T7: still a bit of understeer through entry, felt more stable, didn't have to perform insane micro corrections, felt it definitely understeer, mid corner and corner exit.

T8: grade of the parking lot on corner exit would unsettle the car, didn't feel crazy difference in T8 and T9, not enough laps to know what had to be done for it.

Sept. 9 Benchmark Testing

Friday, September 6, 2024 3:27 AM

Testing Brief
Get a good idea to understand where the performance of the car is after the changes made after EV Comp. Some of the notable changes that could affect performance is the final drive of the car. With that we can predict a higher score in acceleration as the car will have more available torque at the wheel. Knowing as well where the driver is in terms of performance after competition will be valuable for strategy for Pitt Shootout.

Testing Setups:

Competition Strategy

Wednesday, September 4, 2024 5:04 PM

New Member Tasks

Overall Outcomes:

- Learn how the car is run at a competition setting, see how autocross is done for the car and how other teams run these events
- Talk to other teams to get to know how the tackle the same type of problems
- Have fun or whatever

Actual Deliverables:

- Take photos of cool designs you like on other people's cars
- Take notes of other people's designs, how they prepare the car, the color of the sky, whatever you think is useful or cool
- Prepare a small ppt (can just be pictures) and present three good findings to the suspension subgroup the week after the event

Other Notes and Stuff to do:

- Both Adi and Wasim will go through mechanical tech inspection
    - Will have to run through sometime during the week
- Both will be with the car at some point in the day

Pitt Shootout Notes

Friday, September 13, 2024 3:29 PM

Sam Yang

Preparation

- Should have some unmovable events in the prep for the event:
    - Tech Inspection 1 (2-3 Weeks Before)
    - Tech Inspection 2 (1 Week Before)
- I think the time we told people they were going was actually sufficient, 2 weeks before, should probably have more information regarding logistics prepared when we do tell them, cost, time, classes, etc.
- Next year we need to be more precise with our planning for the event, leave out the guessing work we had to do. The paddock being across the site was a wakeup call
    - Pit cart location
    - Personnel location and job at the specific time of the event
- For competition trailer would be packed one week before so people can learn where tools are for the event, obviously with trailer repairs was disturbed, just want to continue into the next event

Event

- Bomboclat clipboard or folder for tech sheets-clat
- Ideally when you get trailer drop you just have to run through tech inspection and everything should have already been run through before
- Tire starts to bounce in the rear at like 3 psi and front pressures at 30 psi
- Ran fastest time during acceleration (4.222) with square pressures (~10psi)
- Could be a ton of reasons for this happening, we were also doing continuous runs on the combustion car in accel and as we were trying to lower pressures, times got slower
- Autocross is not good for trying to get many runs in towards the end of the day strategy is complicated with the electric car and when you are going to get the peak SOC and peak power
- Started a pit cart packing list, committing to that and getting a group of people to track and get everything ready for that would be ideal

2024 Michelin Shootout

Tuesday, September 24, 2024 9:25 PM

Testing + Prep

Tuesday, September 24, 2024 9:26 PM

Sept. 24 Endurance/ Shakedown

Tuesday, September 24, 2024 9:26 PM

Pre Testing Notes:

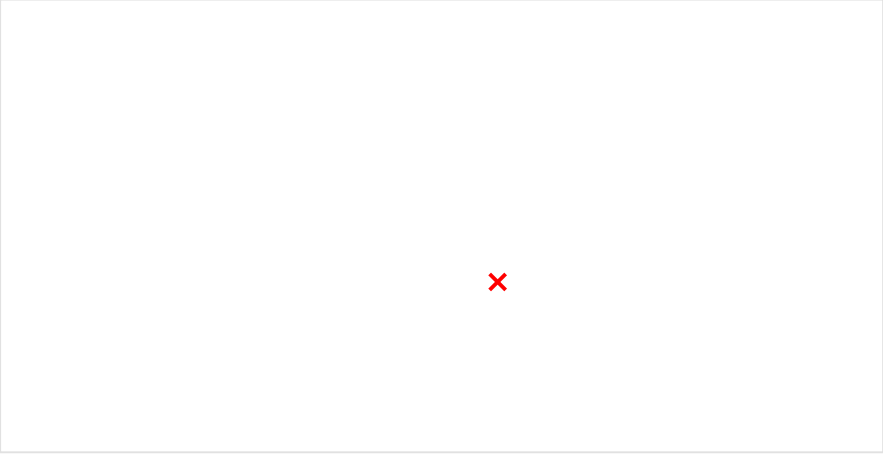
- Aligned the Toe
- Aligned the Corner Weights and Ride Heights

Testing Brief:

- Want to evaluate whether Brenden or Mihai should be taking the second endurance spot for Michelin with Bray
- Reliability check the car before going into the testing schedule ahead for the combustion car that week

Testing Results:

- Spreadsheet for Results HERE



Testing Observations:

- During Brenden's Stint, a lot of shifting issues
- During Mihai's stint, only one case of half shifting
- Notes for handling are in the comments of the Excel throughout

Oct. 1 Differential Baseline

Tuesday, October 1, 2024 10:38 PM

Pre Testing Notes:
- Suspension Bolts Check
- Fixed issue with shifting

Testing Brief:
- Want to run a baseline for the car before it gets its differential flipped on a track that will directly evaluate its performance

Testing Results:
- Spreadsheet for Results HERE

Testing Observations:
-

Turn 3

BR

GR

T

	1/3	2/3	3/3
U			
O			

NOTES:
- Not going fast enough to give real feedback
- Mostly the same as the second turn
- The throttle response at the bottom of first gear was garbage

Slalom 4

BR

GR

T

	1/3	2/3	3/3
U			x
O	x		

NOTES:
- On entry would oversteer, understeer on exit
- Could also be driver was figuring out way through the course

Slalom 3

BR

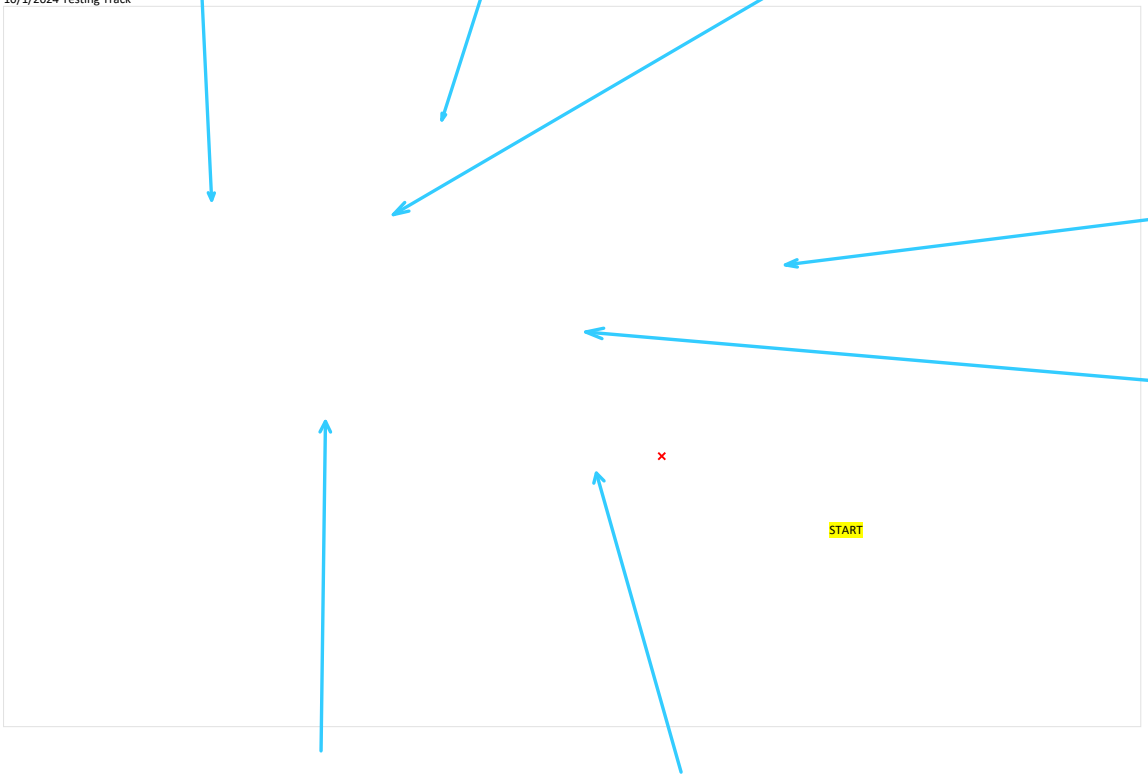
GR 3

T

	1/3	2/3	3/3
U			
O	x		

NOTES:
- Short shifting a little to the slalom
- Rear end felt it would almost fishtail throughout the entire time

10/1/2024 Testing Track



Turn 2

BR 60-75%

GR 1

T -

	1/3	2/3	3/3
U	x	x	
O			x

NOTES:
- Oversteering on the exit because has to use the throttle throughout to get it through
- Car would get stuck in gear throughout this maneuver
- Even under trail braking could not get enough rotation from the car
- Only way to go through the corner was to slow down the car a lot
- Car does not have enough turning angle to get through the corner

Slalom 2

BR -

GR 2

T -

	1/3	2/3	3/3
U			
O			

NOTES:
- Would start getting fast enough to where car would oversteer
- About halfway through the slalom you'd start oversteering and half way through you'd hit limit of the car
- This was while holding constant throttle
- Steering does not feel light or smooth, feels like needs to throw the car around

Turn 1

BR 45%

GR first into braking, second through corner

T -

	1/3	2/3	3/3
U			
O			

NOTES:

Slalom 1

BR -

GR 1

T -

	1/3	2/3	3/3
U	2		
O			

	1/3	2/3	3/3
U			
O			

NOTES:
- Not fast enough to provide notes for the corner
- Shifting took half a second to start working, half shifting was a real issue
- Sometimes would kick into gear mid corner and would setting car
- Would lead to oversteering on the exit

.

	1/3	2/3	3/3
U	2		
O			

NOTES:
- Steering was off, specifically going right it wasn't understeering. Only going left it was understeering.
- Felt like was going slow enough to feel tire feedback

Testing KEY:
In the feedback boxes put a box for 1-5 and U at 1 and O at 5

Notes:
- Bad RPM and tune could lead to bad throttle response in first gear
- Tires cold
- Car feels way too stiff throughout
  - Zero mechanical grip or mechanical feedback
- Car cannot make it through minimum radius turns unless he clutch dumps the car

Means Under/Oversteer

LEGEND:

BR	Braking
GR	Gear
T	Touching
U	Understeer
O	Oversteer
1/3	Entry
2/3	Mid
3/3	Exit

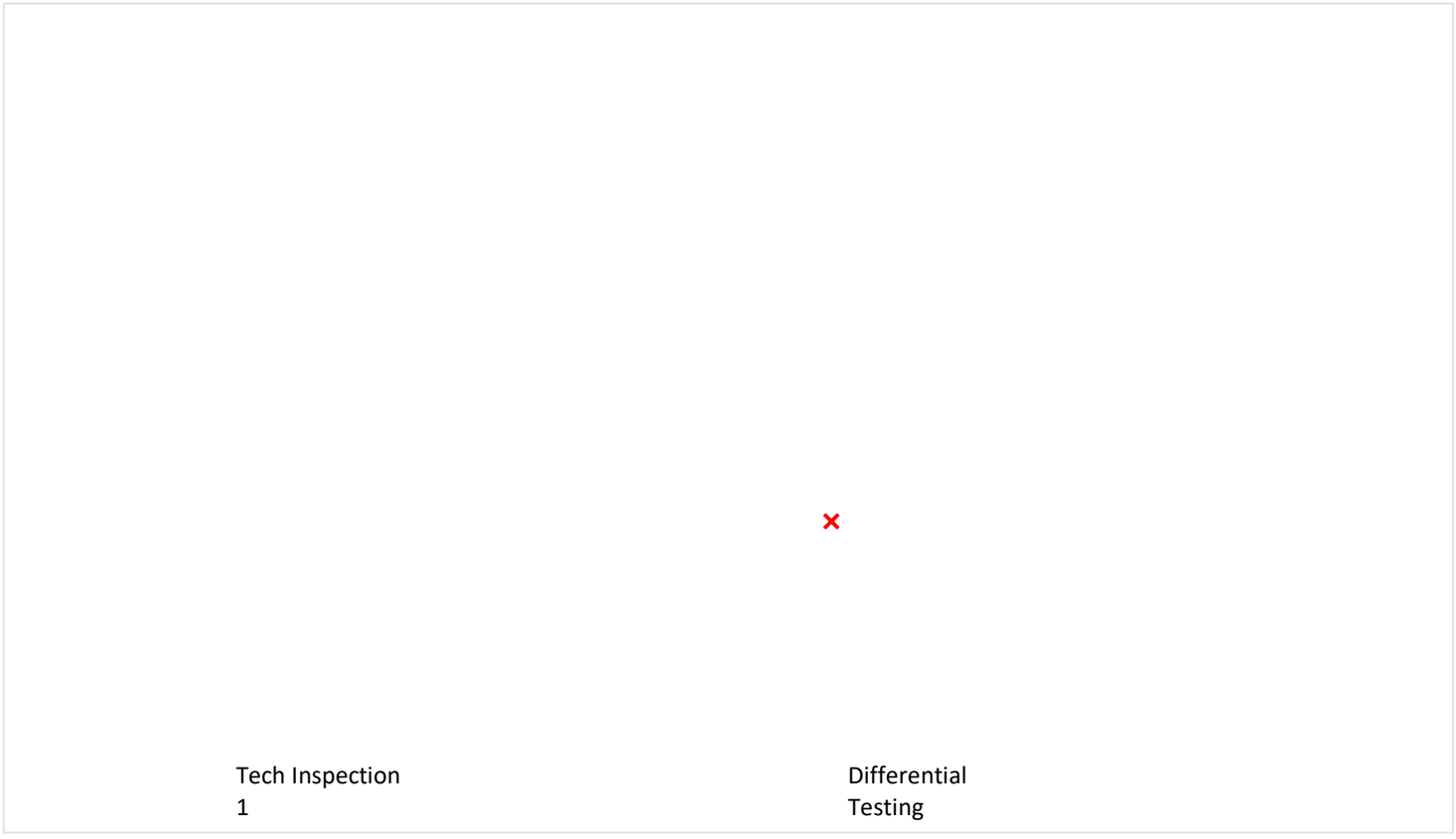
2024 Barnesville Event

Monday, September 16, 2024 8:03 PM

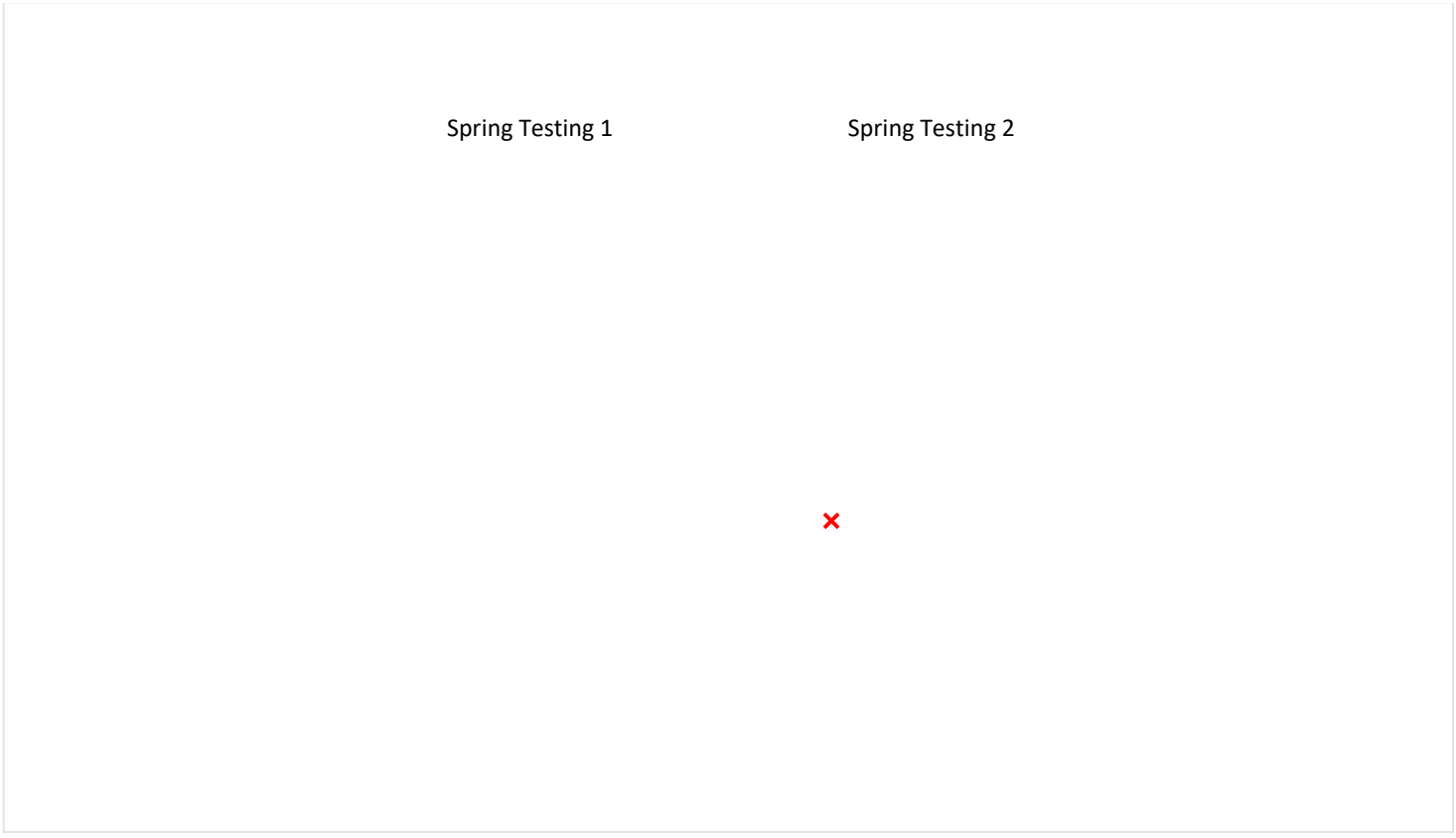
KS7C Testing Plan

Tuesday, September 24, 2024 10:20 AM

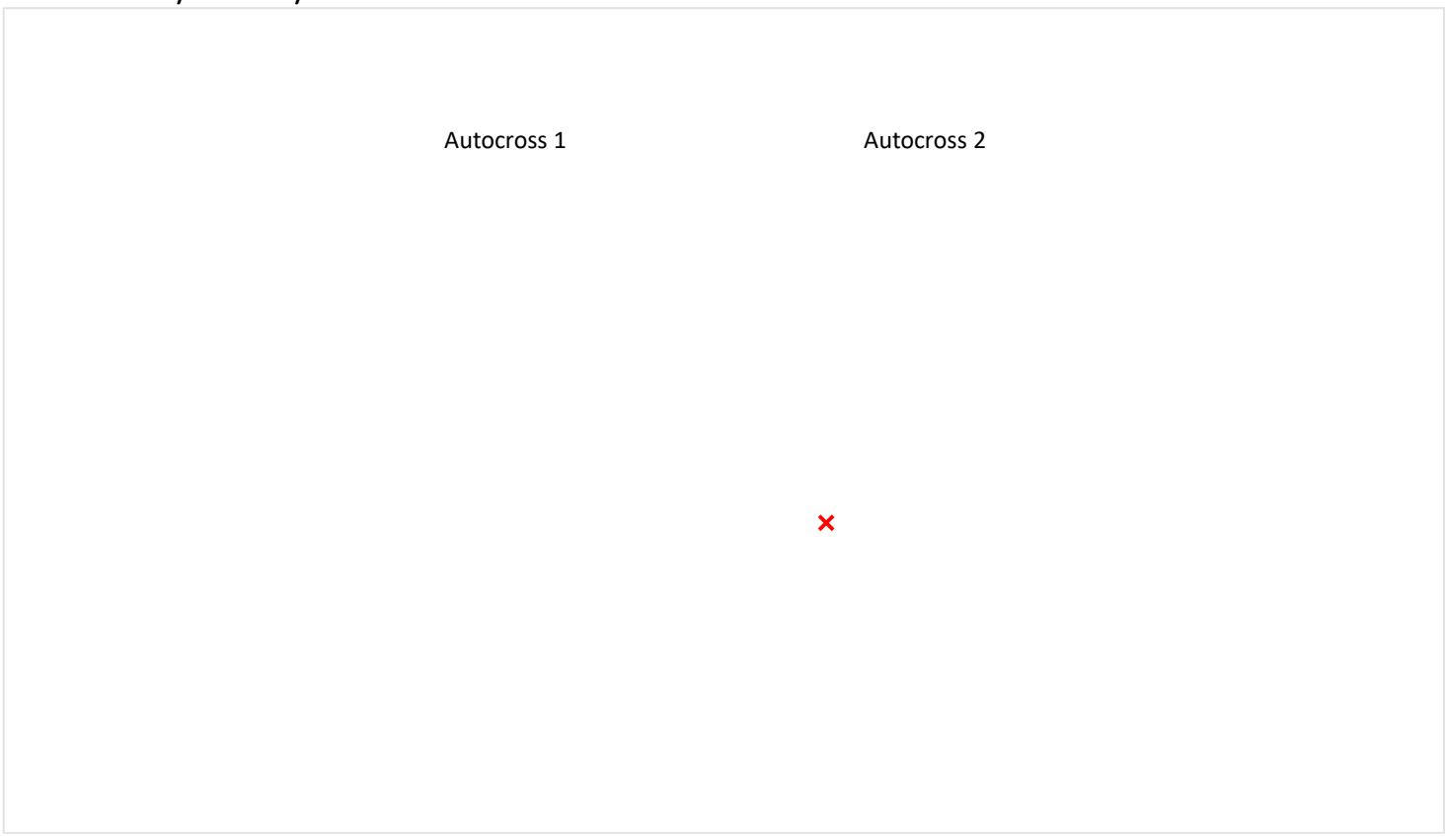
Week of 9/29 - 10/5:



Week of 10/6 - 10/12:



Week of 10/13 - 10/19:



Week of 10/20 - 10/26:

Tech Inspection
2

Autocross 3

Week of 10/27 - Barnesville:

KS8 Weight Tracking/ Breakdown

Thursday, January 23, 2025 2:19 AM

https://kennesawedu.sharepoint.com/:x:/r/sites/Team-KS6-C/Shared%20Documents/Vehicle%20Dynamics/Excels/KS8%20Suspension%20Weights.xlsx?d=wcbd74c1be7c6406dad5f905d101e79de&csf=1&web=1&e=yaSHgD

Fill out this sheet using the CAD components in SolidWorks. For CAD weight go to the part in the teams SolidWorks on the team computers then hit mass properties

Car Setup Guide

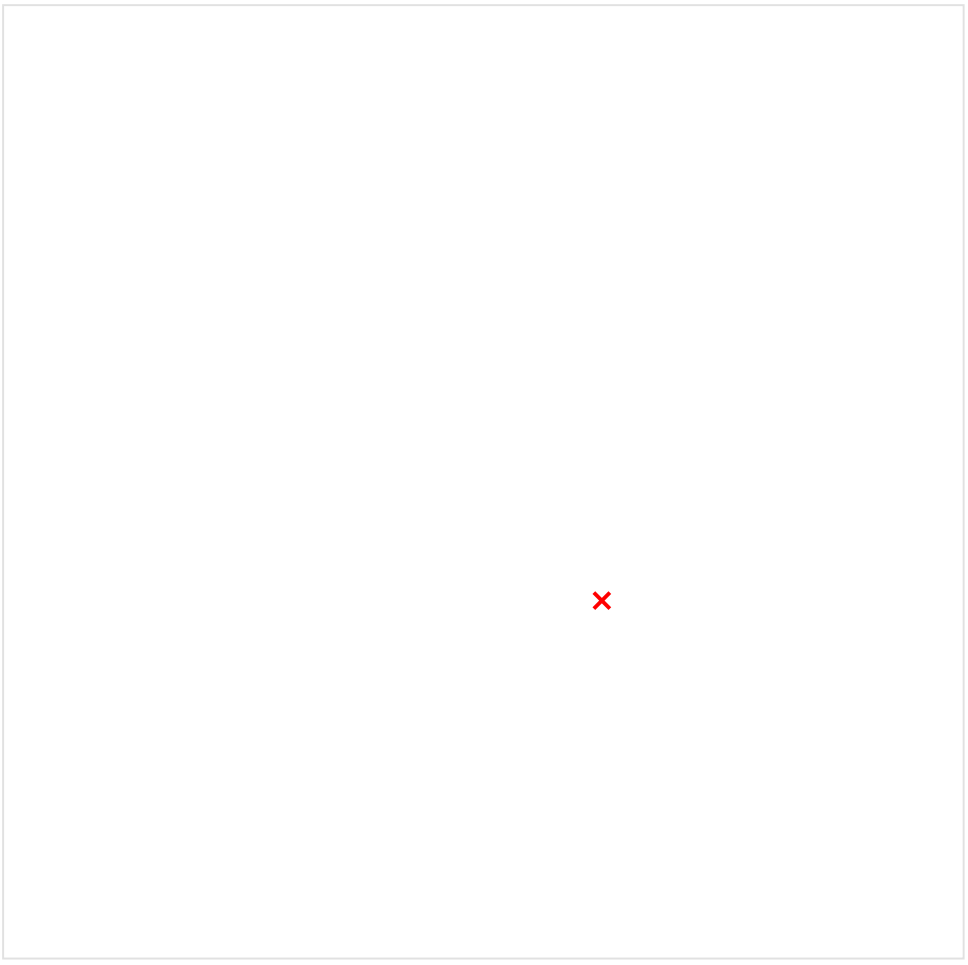
Thursday, February 6, 2025 10:28 PM

Rundown for setting up the car

Who? You and maybe another person
What? Setting up a car just means we are making sure the suspension alignment is what we intended. Recording and measuring everything that is done for a car before a test helps repeatability and accuracy
Where? Typically in the shop, can be done in the parking lot depending
When? Should be done the day before or two days before a test preferably. Shit usually falls through
Why? Suspension Alignment can affect the handling of the car in unpredictable ways, possibly ruining all the data collected on a test session, wasting time, bad for performance

KS8C Linkage Lengths

Monday, March 31, 2025 9:46 PM



KS8E Assembly Problems

Thursday, April 10, 2025 7:59 PM

- Shit that's fucked and need to redo:
  - Steering pickup interaction with toe rod end
  - Upper Control arm yoke plate interaction
  - Rear upright and upper control arm
  - Hub and brake rotor mounting
    - Remake brake rotors
  - Wheel Insert cracked
    - Old design
  - Studs popped out of some hubs
- Shit that is a problem -> can run car (I guess)
  - Bearing carriers just generally,
    - Clearances on either side very thing
  - Rear Sprocket and diff clearances
  - Sprocket Alignment
  - Steering Splines and Rack Splines are completely destroyed
    - Emil can go into detail
    - Cant currently align without disconnecting from top of column
  - Wheel assembly tolerance stack up
    - Reflected in brake caliper position
  - Steering bushing and input shaft are not concentric
  - Brake pedal has a lot of play due to slop
  - Steering has slop on both cars
  - Tension cap holes not drilled deep enough on some of the hubs
  - Rear bell crank and pull rod clearance very close
    - Swept and doesn't hit
  - Damper and yoke plate mounting is close
  - Toe in or out too much and axles will hit the hub
- Shit that is persistent
  - Steering effort is still high
  - Bell crank mounts are compliant
  - Axle alignment in rear is not great

Dev Folder

Thursday, April 17, 2025 7:05 PM

Wheel Insert

Thursday, April 17, 2025 7:05 PM

Wheel insert project

Design constraints:

- Dimensions:
- 12 bolt pattern
- Bolt shear out force:
- Weight:
- Material: Aluminum 7075 t-6
-

KS8C Comp Notes

Thursday, May 15, 2025 9:43 AM

Notes from: Sam, Wasim, Jordan
Design Event:

- Car goals slide
  - Kind of had a predictable, look say it, reading off the slides
  - Should know the substance of the slides a lot better
  - Ums between the slides made it look less confident in content
- Questions he asked:
  - Seemed like I knew the questions week (90% of them) explained well
  - Confused as to why we didn't account for driver feedback in the goals of the car
  - Digging into camber being important, explained it multiple times
    - Positive vs Negative camber, had to do for toe as well, clarify axis system
  - Why Caster question
    - Seemed to have answered the question, might've not been what he was looking for
  - Defining the order of what happened on the car
  - Defining consistency on what that meant to us on the car
    - Specific to the tire selection
  - Testing time clarification for the car
  - Missing more actual data plots from the dacq. System
    - Still answered the questions
  - Over explained a couple of times and had to go back
  - Asked if you adjusted setups for other drivers
    - Had to cheese a little bit
  - Asked questions about the anti
  - Question was how to adjust stiffnesses once car is built and tested
    - Was looking for kinematics
- Liked doing the failure analysis of the upright and said it was cool
  - Should have a new project every year and mention that at the end

Areas of weaknesses (Not asked just have to have in binder):

- Roll Centers, selection
- Wheelbase, Track Width, CoG, etc.
- Camber kinematics

KS8E Fall Testing

Monday, September 15, 2025 11:37 PM

9/13/25 Hub Thread Tearout

Monday, September 15, 2025 11:37 PM

While doing accel pulls on 9/13/25, two tension cap bolts tore out of the FR hub. On 9/15/25, the hub was pressed out and a spare, older one was pressed in. The bolts were some variety of 1/2" and 5/8" length 10-32 safety-drilled bolts. At minimum, for the 1/2" length bolts, through the .257" thickness tension cap, ~7.75 threads are engaged in the hub.