

# HR 2 BREAKDOWN

**TEAM: SAE Baja Team #20F01**



**Figure 1: Current State**

Figure 1 shows the fully assembled, fully working Baja car during track testing.

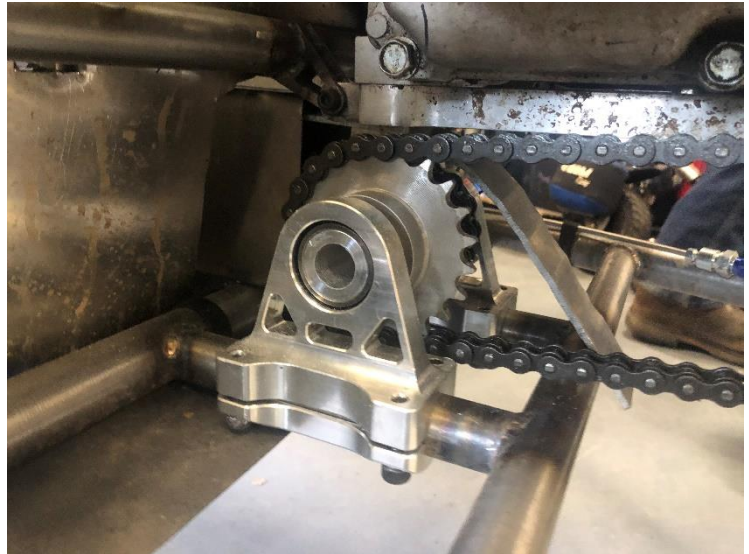
The following are the Action Items each person completed between Hardware Review 1 and Hardware Review 2:

**Team Member: Emily Kasarjian**

<b>Action Item</b>	<b>Date Completed</b>	<b>Result/Proof of Completion</b>
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Finished all sprockets and shafts for chain drive system

3/22/21



Intermediate shaft connected to sprocket on output shaft. Two sprockets machined using the lathe, HAAS CNC mill, and vertical mill. There is a keyway on the shaft and sprockets. The shaft is press-fit into the ball bearings in the pillow block clamps. The materials of the sprockets and shaft on this portion of the chain drive are all 7075 aluminum. Performed well during testing, however a spare titanium shaft was also machined.



The front shaft connects to the small sprocket on the intermediate shaft. The sprocket is also 7075 aluminum, and the shaft is machined out of titanium. The ends are plates which get screwed into the shaft in order to provide a means of connection for the front half shafts. The sprocket and shaft also have a keyway and set screw. This assembly was machined using the lathe, HAAS CNC mill, and vertical mill.

Spare sprockets and shafts with alterations have been made since some of the sprockets in hardware review 1.

Finished first iteration of the chain drive guard

3/23/2021



1/8<sup>th</sup> inch sheet metal was bent to cover the front shaft to protect the user while driving, and satisfy the SAE rule requirements for competition.



1/8<sup>th</sup> inch sheet metal was also bent and cut to cover the length of chain going from the intermediate sprocket to the



front sprocket. This tunnel passes underneath the seat, and was secured around the chain using rivets.

Finished chain tensioner

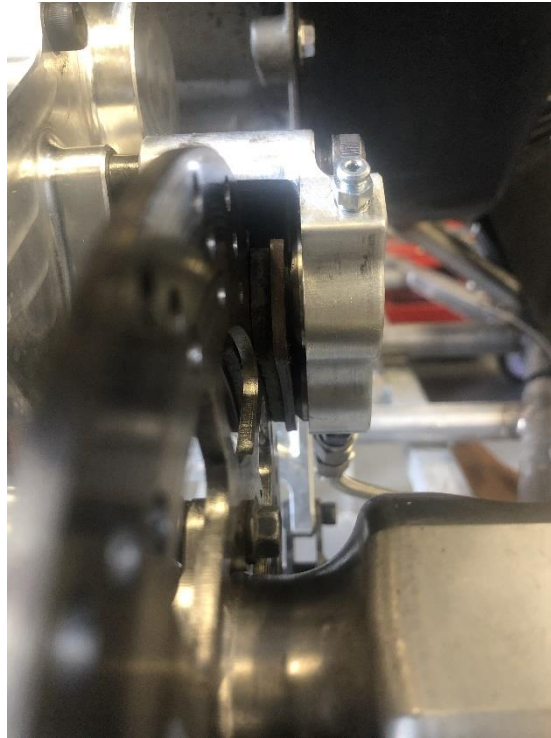
3/23/21



This tensioner was machined out of aluminum, with the support roller machined out of coextruded ABS cellular core DWV. The support roller is connected to the tensioner base using 1/4 inch bolts. The final springs on both sides add extra tension to the chain and connect to the frame.

Machined two break caliper plugs

03/08/21



On the inside of the exterior brake caliper body, two cylindrical titanium plugs were machined out of titanium.

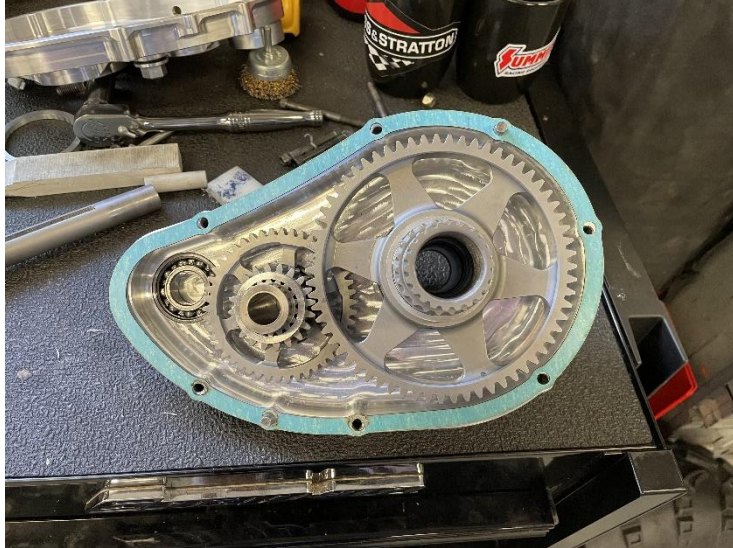


**Team Member: Tyler Trebilcock**

Action Item	Date Completed	Result/Proof of Completion
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Machine and Assemble gearbox and components.

3/2/2021



Gear box shown has laser cut gasket installed to seal from leaking. Case is made from 6061 Aluminum and gears are made from 9310 alloy case carburized to .02" depth

Machine brake pedal and reservoir mount for pedal assembly

2/14/2021



Brake pedal designed with a 7.4:1 ratio reiterated to set drivers foot further forward. Master mount rotated upwards so assembly can be more compact. Mount constructed from 4130 and welded to chassis.

Machine and assemble front hub/knuckle.

2/08/2021



Hub machined from 6061 and bore was designed for a .004" shrink fit to slip the fit before over torquing the sprag element. Sprag was pressed to splined sleeve for mounting up to the CV axle.

### Team Member: Tanner Gill

Action Item	Date Completed	Result/Proof of Completion
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Machined CV extensions for the front CV shafts.

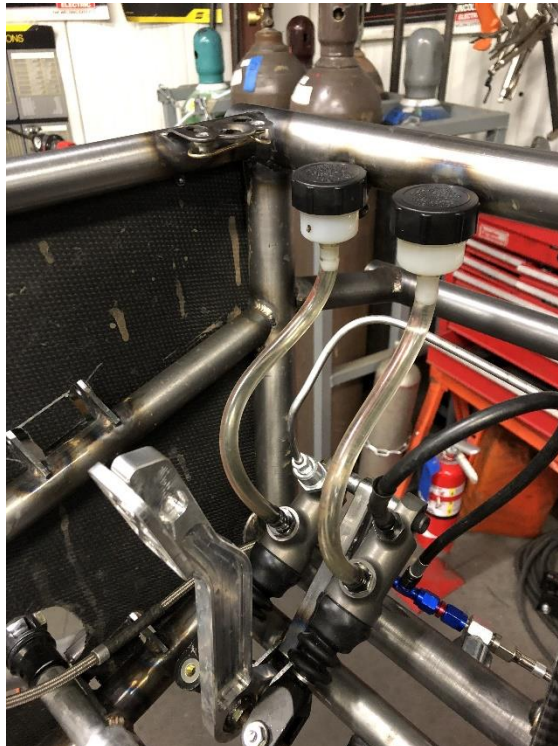
3/15/21



To install the front CV shafts, the tube members needed to be extended to correctly fit between the front knuckles and the sprocket shaft. I machined 4130 shafts and weld-in press fit inserts for the cv joints.

Designed and fabricated brake fluid reservoirs and mounts. Spent many hours bleeding brake system. Installed brake fittings, braided lines, and hard lines.

3/8/21




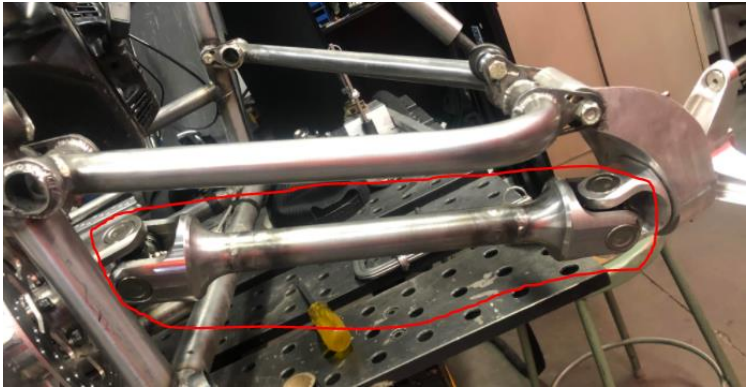
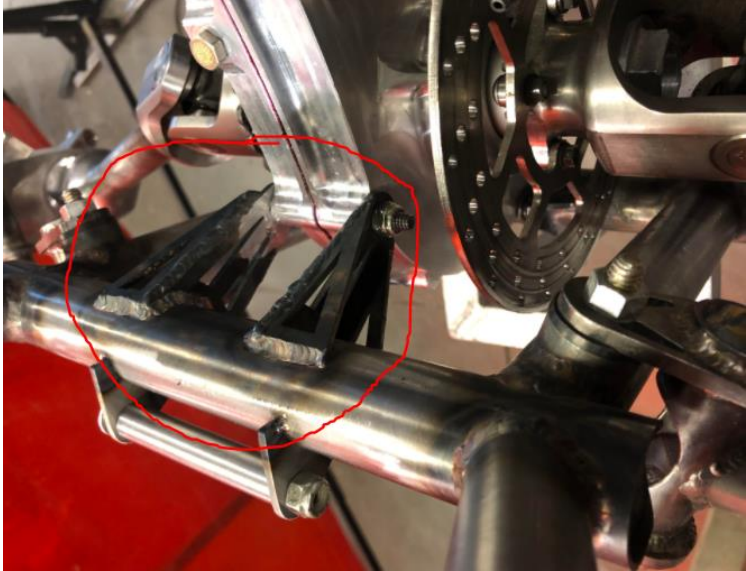
Fabricated brake fluid reservoir mounts and installed the reservoirs. Spent about 7 hours doing the initial brake system bleed including multiple full dis-assemblies and re-assemblies. Mocked up hard line routing and bent and flared the final product. Routed front brake lines.

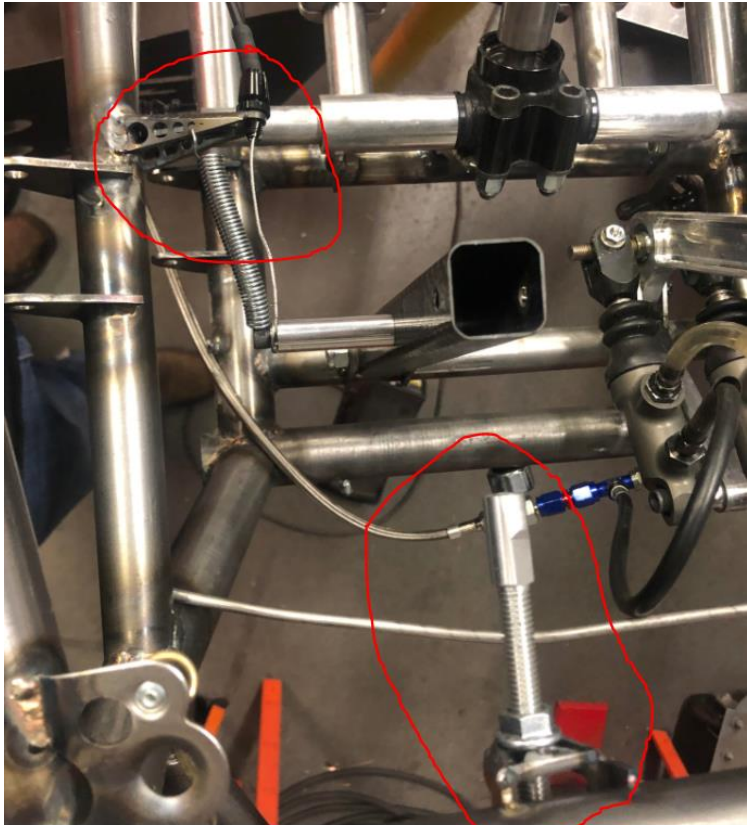


<p>Spring and shock testing, bump stop assembly.</p>	<p>3/20/21</p>	 <p>Tested front spring rates, installed 140 lbs/in primary springs with heavier secondaries. Designed and manufactured bump stop assembly with off-the-shelf components combined with custom 6061 aluminum pucks.</p>
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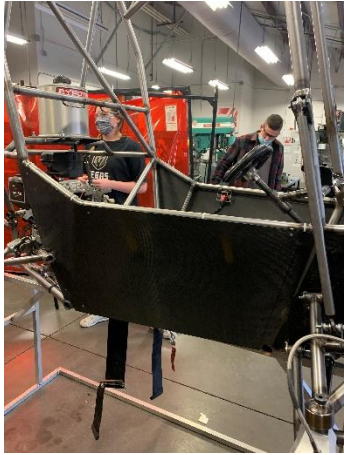
**Team Member: Colton Lacey**

<p><b>Action Item</b></p>	<p><b>Date Completed</b></p>	<p><b>Result/Proof of Completion</b></p>
<p>Finish fully welding all frame members</p>	<p>2/20/21</p>	 <p>Welded all frame tubing members fully, making sure to create a strong weld with deep weld penetration while keeping heat used to a minimum to reduce warping. As seen is an example of some of the welds done on the frame.</p>


<p>Welded half shafts for rear end axel</p>	<p>3/5/21</p>	 <p>After Half shaft plugs were machined. The center half shaft tube needed to be machined to an accurate size and the plugs were welded onto each end. Four plug welds were used on each end of the plugs as well as a seam weld for maximum torsional strength. Welding heat was kept very controlled as the welds need to be very accurate and warping must have been kept to a minimum. This is because the shafts rotate and will vibrate if they are not straight.</p>
<p>Assembled and welded various mounting tabs</p>	<p>2/25/21-3/10/21</p>	 <p>Welded various mounting tabs for A-arms, gearbox mounts, steering rack stabilizers, and gas tank mounts. As seen above is an example of the welded gear box mounting tabs.</p>

<p>Gas pedal improved and gas pedal stopper manufactured</p>	<p>3/23/21</p>	 <p>Revamped gas pedal for increased stability and durability. As shown in the top left of the image above gussets were added to throttle cable mount. As shown in the bottom right of the image an adjustable aluminum gas pedal stopper was added to ensure the throttle cable was not overstressed from excessive force. A mount for the stopper was threaded and welded onto the frame.</p>
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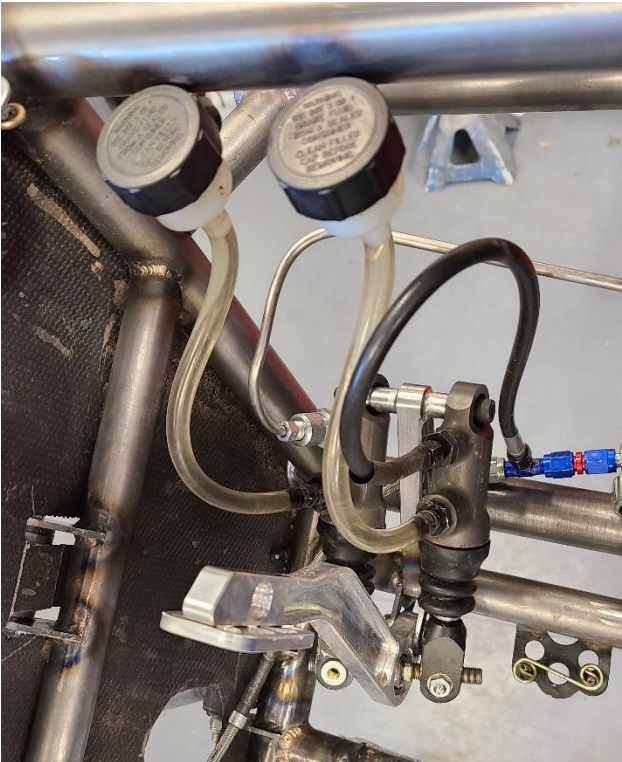
**Team Member: Brendan Paulo**

<p><b>Action Item</b></p>	<p><b>Date Completed</b></p>	<p><b>Result/Proof of Completion</b></p>
<p>Assisted in the design of carbon fiber panels, and completion of manufacturing panels.</p>	<p>2/26/2021</p>	



<p>Completed firewall fitment and holes for the seat tabs and seat belt harness.</p>	<p>3/22/2021</p>	
<p>Fitted the seat properly with all 6 mounting points and adjusted seat belt mounting</p>	<p>3/23/2021</p>	<p>(picture above)</p>

**Team Member: Jacob Kelsey**



<p><b>Action Item</b></p>	<p><b>Date Completed</b></p>	<p><b>Result/Proof of Completion</b></p>
<p>Complete Brake Assembly</p>	<p>3/8/21</p>	 <p>Installed brake lines, reservoirs, master cylinders and calipers.</p>

<p>Spare set for steering rack extensions</p>	<p>3/24/21</p>	 <p>Machined rack extension as well as extended bushing.</p>
<p>Manufactured Hardware</p>	<p>3/12/21</p>	 <p>CNC machined various axle nuts/bolts for the vehicle.</p>

**Team Member: Ryan Meyer**

<p><b>Action Item</b></p>	<p><b>Date Completed</b></p>	<p><b>Result/Proof of Completion</b></p>
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<p>Ran and bled all brake lines</p>	<p>3/12/21</p>	
<p>Front Hub assembly</p>	<p>3/3/21</p>	
<p>Prove Integrity of Knuckle design</p>	<p>3/20/21</p>	<p>Done as part of individual analysis, through damping of spring</p>

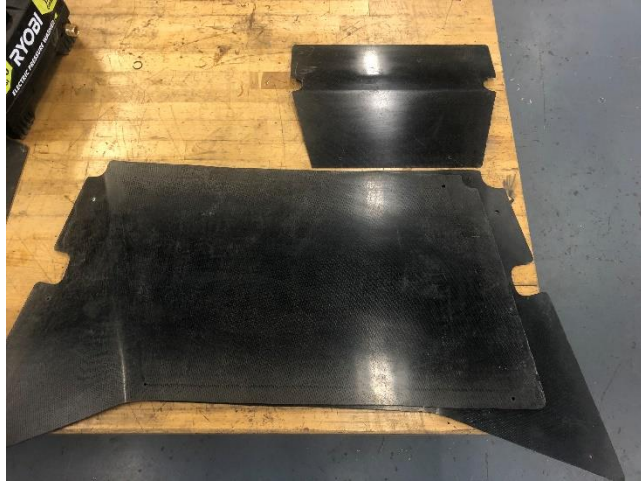
**Team Member: Ashley Redmond**

<p>Action Item</p>	<p>Date Completed</p>	<p>Result/Proof of Completion</p>
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Created carbon fiber panels, seat, and steering wheel

2/25/21



Cut and finished side and front panels. Other panels are mounted on vehicle.

Cut and mounted throttle pedal

3/3/21



1" x 1" carbon fiber pedal.


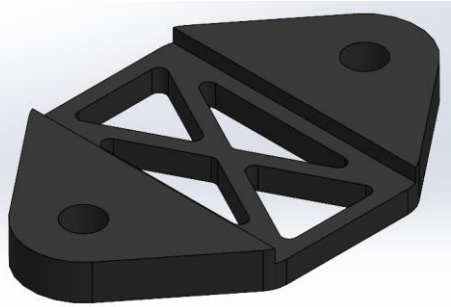
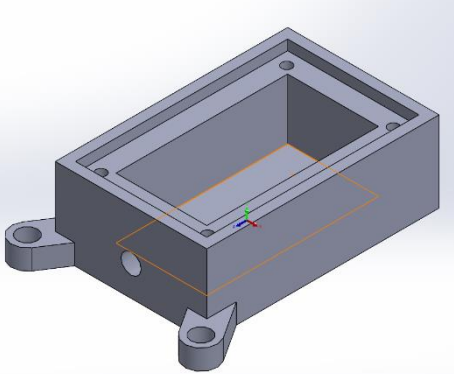
Designed and assisted in fabricating frame gussets

3/10/21




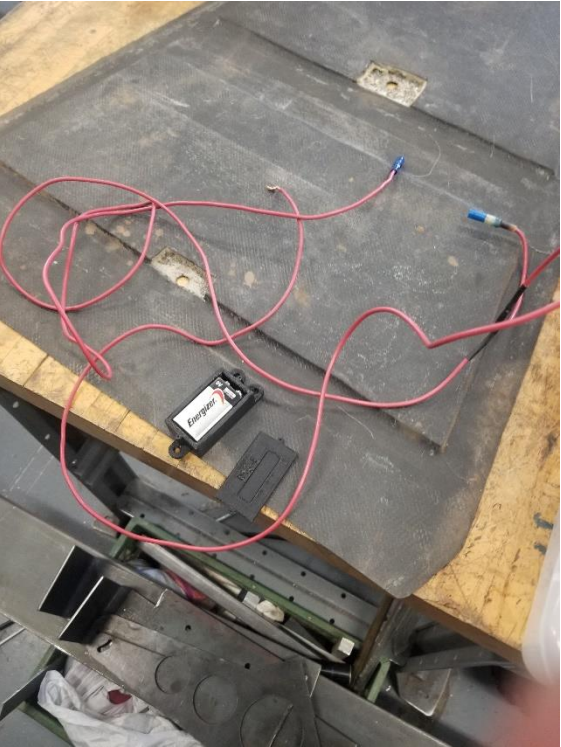
Cut left gusset member, designed in accordance with the rules.

## Team Member: Brian Connors


Action Item	Date Completed	Result/Proof of Completion
Integrate cockpit Killswitch to electrical harness.	3/18/2021	 <p>The kill switch has been connected to the kill switch right off the motor, using bullet splices, and a spade connector. All using enough 16-gauge wire to be attached to the frame.</p>
Killswitch brackets design	3/9/2021	 <p>This design fits to the kill switch tabs, using a 1/4 inch bolt, designed to withstand the force of pushing the kill switch in while using less material and saving weight.</p>
Battery Box redesign	3/22/2021	

		Initial design could not fit the 9-volt battery connector, or hole on bottom for wires to exit. Now includes 4 8 <sup>th</sup> inch bolts to connect to cover. 3D printed.
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**Team Member: Matthew Woodward**


<b>Action Item</b>	<b>Date Completed</b>	<b>Result/Proof of Completion</b>
Finished the final product front tow point.	3/1/21	
Help design and produce the first electrical box as well as lay out the wiring for the brakes.	3/20/21	



<p>Designed and assisted in fabricating frame gussets</p>	<p>3/10/21</p>	
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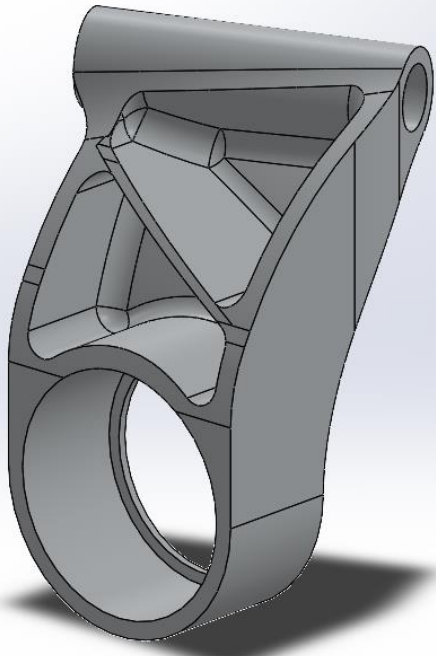
**Team Member: Bailey McMullen**

<b>Action Item</b>	<b>Date Completed</b>	<b>Result/Proof of Completion</b>
<p>Fabricating frame gussets, riveting carbon fiber panels</p>	<p>3/5/21</p>	<p>Assisted frame sub-team with fabricating gusset members for the frame of the vehicle for structural enhancement and meeting SAE rulebook guidelines. Assisted frame by drilling holes and riveting the carbon fiber panels to secure them to the vehicle.</p>
<p>Design new rear control arms</p>	<p>3/22/21</p>	<p>New rear control arms were designed with thinner, lighter .035" wall 4130 tubing. These arms will further decrease the overall weight of the vehicle while still fitting in the template used for the current control arms, requiring no additional modifications to any mounts on the vehicle.</p>

		
Fabricate new control arms	3/22/21	<p>Left and right arms were mitered and are ready to weld. Arms should be complete by 3/31/21.</p> 

**Team Member: Logan Faubion**

<b>Action Item</b>	<b>Date Completed</b>	<b>Result/Proof of Completion</b>
Configure throttle cable	3/4/2020	Throttle cable routed but needs major work to be strong enough for competition. Lacks some of the hardware necessary, were lost while I was away, so more must be purchased to ensure cable tube does not over-crimp and restrict throttle movement.

Re-design rear end knuckles	3/14/2021	 <p data-bbox="706 856 1437 951">Knuckle weight reduced to 1.07lbs while retaining a minimum factor of safety of 0.98 when loaded with 1,000lbs of force on the rear hub (not pictured).</p>
Set up brake light	3/12/2020	Brake light set up, but some components missing for battery mounting and connections. Brake light system predicted to be finished by 3/26.

The following are the Action Items for each team member between HR 2 and the Final Product presentation:

Team Member	Action Items	Date Due
Emily Kasarjian	<ol style="list-style-type: none"> <li data-bbox="451 1507 943 1539">1. Solidify chain configuration and cover</li> <li data-bbox="451 1539 1138 1570">2. Work on design presentation for SAE Baja competition</li> </ol>	<ol style="list-style-type: none"> <li data-bbox="1252 1507 1354 1539">1. 4/11</li> <li data-bbox="1252 1539 1354 1570">2. 3/28</li> </ol>
Tyler Trebilcock	<ol style="list-style-type: none"> <li data-bbox="451 1646 899 1677">1. Re-machine TI u-joints for spares</li> <li data-bbox="451 1677 976 1709">2. Machine longer rack for rack and pinion.</li> <li data-bbox="451 1709 786 1740">3. Machine spare gear box</li> </ol>	<ol style="list-style-type: none"> <li data-bbox="1252 1646 1354 1677">1. 4/25</li> <li data-bbox="1252 1677 1338 1709">2. 4/1</li> <li data-bbox="1252 1709 1354 1740">3. 4/15</li> </ol>



Tanner Gill	<ol style="list-style-type: none"> <li>1. Shock disassembly for bump stops</li> <li>2. Redesign steering mounting system and manufacture steel rack.</li> <li>3. Spare upper A-arms</li> </ol>	<ol style="list-style-type: none"> <li>1. 4/2/21</li> <li>2. 3/31/21</li> <li>3. 3/31/21</li> </ol>
Colton Lacey	<ol style="list-style-type: none"> <li>1. Weld up rear tow point</li> <li>2. Tack and fully weld rear arm spares</li> <li>3. Re-valve the rear shocks when the valves are delivered in the mail</li> </ol>	<ol style="list-style-type: none"> <li>1. 3/29/21</li> <li>2. 3/31/21</li> <li>3. 4/2/21</li> </ol>
Brendan Paulo	<ol style="list-style-type: none"> <li>1. Read through rule book with sub-team and complete all technical components of vehicle.</li> <li>2. Complete splash shield</li> </ol>	<ol style="list-style-type: none"> <li>1. 4/15/2021</li> <li>2. 4/1/2021</li> </ol>
Jacob Kelsey	<ol style="list-style-type: none"> <li>1. Spare set of Control Arms</li> <li>2. Aluminum Clevis Bolts</li> </ol>	<ol style="list-style-type: none"> <li>1. 3/31/21</li> <li>2. 4/5/21</li> </ol>
Ryan Meyer	<ol style="list-style-type: none"> <li>1. Fix hardline that was damaged during testing</li> <li>2. Help rebuild 52</li> </ol>	<ol style="list-style-type: none"> <li>1. 3/28/21</li> <li>2. 4/1/21</li> </ol>
Ashley Redmond	<ol style="list-style-type: none"> <li>1. Order safety equipment and any last spare parts</li> <li>2. Design and fabricate rear panels</li> <li>3. Create tie rod boots</li> </ol>	<ol style="list-style-type: none"> <li>1. 3/28/21</li> <li>2. 4/5/21</li> <li>3. 4/7/21</li> </ol>
Brian Connors	<ol style="list-style-type: none"> <li>1. Connect the External Killswitch to the wiring system</li> <li>2. Wire battery box to the brake light system</li> <li>3. Overnight test the single battery system</li> </ol>	<ol style="list-style-type: none"> <li>1. 3/31/2021</li> <li>2. 4/1/2021</li> <li>3. 3/29/2021</li> </ol>
Matthew Woodward	<ol style="list-style-type: none"> <li>1. Finish the back panels.</li> <li>2. Help with electrical braking system</li> <li>3. help rebuild 52</li> </ol>	<ol style="list-style-type: none"> <li>1. 4/2/2021</li> <li>2. 4/1/21</li> <li>3. 4/1/21</li> </ol>
Bailey McMullen	<ol style="list-style-type: none"> <li>1. Finish welding up rear control arms</li> <li>2. Re-valve rear shocks for better performance</li> <li>3. Get final t shirt design sent out to get printed by sponsor</li> </ol>	<ol style="list-style-type: none"> <li>1. 3/31/21</li> <li>2. 4/2/21</li> <li>3. 4/2/21</li> </ol>

Logan Faubion	<ol style="list-style-type: none"><li>1. Finish and tidy all wiring components</li><li>2. Manufacture updated knuckles</li><li>3. Manufacture bushings for updated knuckles</li></ol>	<ol style="list-style-type: none"><li>1. 4/2/21</li><li>2. 4/9/21</li><li>3. 4/2/21</li></ol>
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