# SAE Mini Baja Drivetrain

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Team 02

## Mid-point review

REPORT

*Submitted towards partial fulfillment of the requirements for*

***Mechanical Engineering Design II – Spring 2014***

Department of Mechanical Engineering

Northern Arizona University

## 1. Introduction

The Baja Vehicle Design is a competition sponsored by the Society of Automotive Engineering (SAE) and hosted in different locations across the country. The teams will have to build the vehicle to fit that engine and maximize their designs to meet the design objectives and win the competition. In NAU, teams are tasked with frame, suspension, and drive-train design. Our team aims to build the drive-train and assemble it along with the engine so that the Baja vehicle can achieve all of the competition events. In this report, more details will be provided regarding the current progress of the project. This will include parts completed and other parts that need modifications. Also, a project plan is provided to show that all the tasks will be done in time for the competition.

## 2. Parts Order Status

Since last presentation, the engine, differential, CVT, and two half shafts are all ordered and arrived. The team also has the material arrived to manufacture the keys and the other parts like shifter and engine mount. The figures of the engine, CVT and half shaft are shown below in figure 1 to figure 4. The differential will be shown later in figure 5 with engine mount.


Figure 1: Engine

Figure 2: CVT Input Pulley and Belt

Figure 3: CVT Output Pulley

Figure 4: Half Shaft

## 3. Parts completed since last presentation

### 3.1 Engine Mount

According to the design of the engine mount, the team orders four pieces of aluminum. By using the numerical control machine, the team manufactured the four pieces into the designed shape and bolted

three of them together with the differential as shown in figure 5.

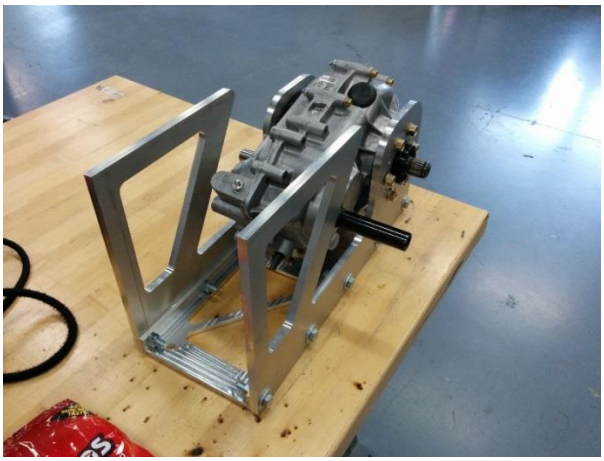

Figure 5: Engine Mount

The fourth piece will be welded at the top of the two vertical pieces, and the engine will be bolted onto it.

## 4. Parts designed since last presentation

### 4.1 CVT

The team found out that the CVT output pulley doesn't fit the input shaft of the differential. The diameter of the input shaft on the differential is greater than the inside diameter of the CVT output pulley. The output pulley is shown in figure 3.

The team first decided to change the input shaft of the differential, then the team found out that the input shaft on the differential is integrated with the gears inside of the differential. Therefore, the team could either reshape the inside diameter of the CVT output pulley or order another output pulley that fits out differential from the supplier. After the CVT output pulley being reshaped or replaced, the main part of the drivetrain will be assembled.

### 4.2 Throttle cable

Figure 6: Throttle Cable

As of two weeks ago the throttle cable assembly consisted of three main connections, a cable and a pedal assembly. The cable and connections were ordered from Control Cables out of Southern California and have since arrived (see figure 6). These parts were to be connected to the pedal assembly provided by Polaris Motorsports and installed in the nose of the buggy (see figure 7). However, we were unable to find thorough drawings of the pedal assembly providing us with the dimensions to properly analyze the compatibility of the system and the volume in the nose. Thus, a decision to fabricate a custom pedal assembly was decided on March 4, 2014.

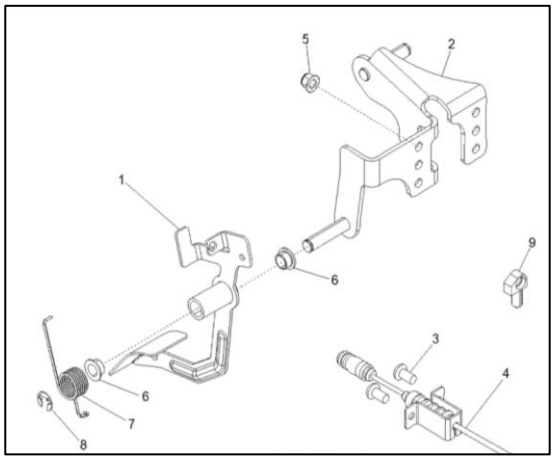


Figure 7: Gas Pedal

Currently the throttle assembly will remain as previously designed with all specified parts. This includes; the 96 inch cable, quarter inch cable stop, quarter inch ball joint and a 90 degree elbow (see figure 15, 16, 17 in Appendix). All inclusive, these make up the throttle assembly that will run down the fire wall, along the bottom of the BAJA to the pedal assembly. The new design of the pedal assembly is currently incomplete but will follow a similar design to the Polaris assembly. It will essentially be a lever system with a single pivot point allowing for 1 and 3/8th of an inch translation. The pedal assembly will be mounted slightly off center and to the right of the vehicle. This will allow for adequate spacing for the pedal translation as well as the steering casing at the nose of the vehicle.

### 4.3 Shifter

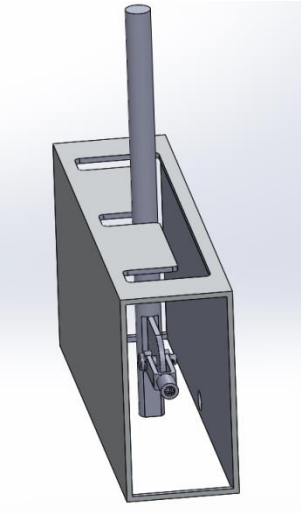

Figure 8

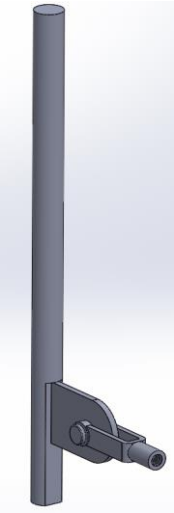

figure 9

(Figure 8: Shifter Box Design Overview Figure 9: Shifter Bar Design Detail)

The shifter box includes a shifter housing and a shifter bar (Figure 8). There are slots on the top side of the shifter housing, and these slots can make the shifter bar stock into the right positions. The shifter bar is connected with the housing by a spring, which can make the bar locked into the slot easily. On the right side, the bar is connected to the housing by a ball bearing, which can let the bar move around.

On the shifter bar shown in Figure 9, there is a small piece connected both bar and a clevis, and the clevis is connected the shifter cable.

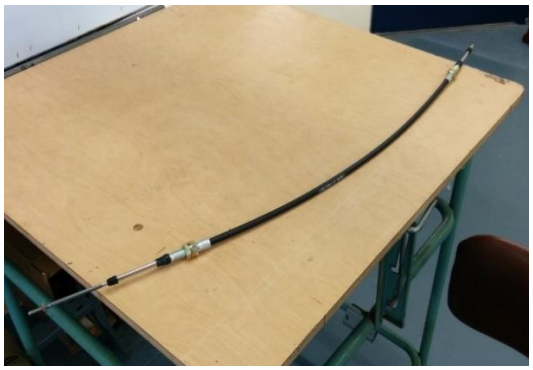

Figure 10: Shifter Cable

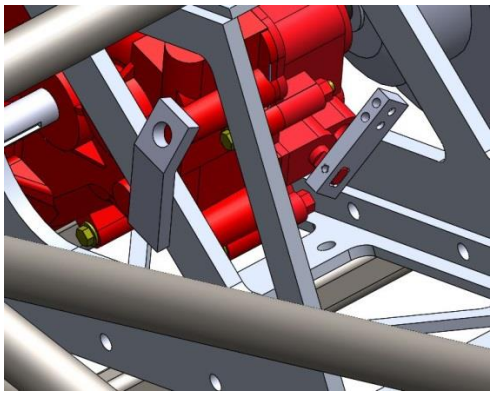

Figure 11: Detail View of Differential Connection

The shifter cable (Figure 10) was ordered and the length of the cable is three feet. The cable has two heads connect with the clevis on the shifter bar and differential.

There is a small part (Figure 11) connected both differential and head of the shifter cable. When the driver pull or push the shifter bar the small part on the differential can be rotated and the gears can be shifted.

### 4.4 Drip Pan

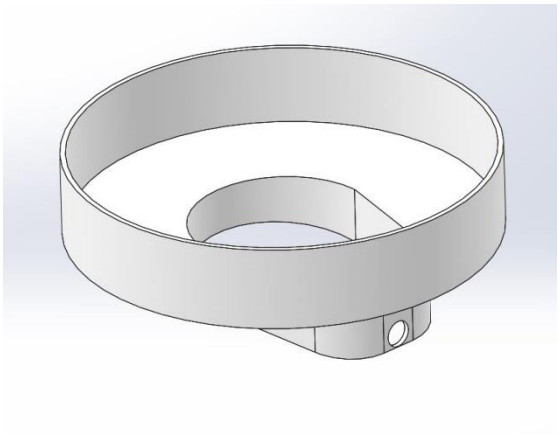

Figure 12: Old Drip Pan

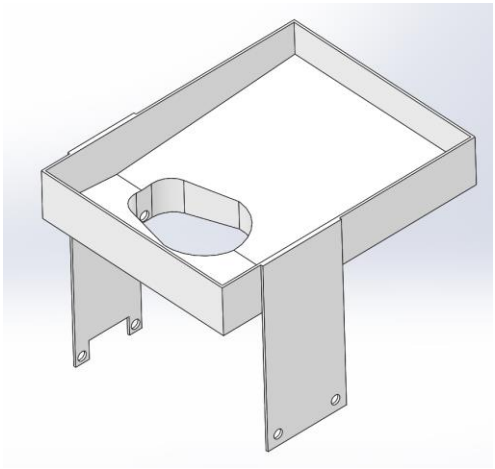

Figure 13: New Drip Pan

The drip pan design was changed a little since last presentation, as you can see from the figure 12 and 13. Because drip pan will be put on the top of the engine gas tank, we add two long extended parts to connect the drip pan to the gas tank. That will make it more stable during the race. In order to connect the stables to the main body, the shape of upper part changes from circular to rectangular. Also, the surface of the bottom was designed to have a small incline, so the gas spilled off when refilling will not stay on it. The drip will be made by 3-D printer.

### 4.5 CVT guard

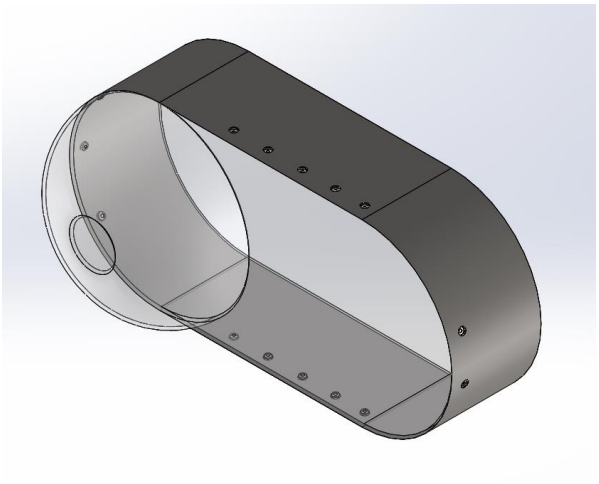

Figure 14: CVT Guard

The CVT guard (Figure 14)is designed to cover all the rotation part of CVT. The side wall will be made with sheet mental and the cover will be made of plastic sheet. It will be bolded somewhere to the engine mount, but that is something we will decide last, because it is so close to the frame, we want to make sure it fit our dimensions.

## 5. Project plan

Our team had experienced a delay because of the parts not arriving in a timely manner. However, the engine mount was meant to be built by 3/ 9/ 2014 but we were able to finish it before that. This helps give us a head start on the other tasks. When looking at the Gantt chart (Figure 18 in Appendix), it can be seen that all tasks can still be done in a timely manner to test the system at least twice. Testing the system twice will allow us to make sure that our system is fully prepared for the competition events.

## 6. Conclusions

Our team has confirmed that all the parts have been received. All design process has been completed including CAD drawing and all that left is building or assembling the system. So, our team has started the building process and we were able to finish the engine mount so far. We plan to build the dripping pan and the shifter next. Some of the parts received needs to be modified to fit our design such as the half shaft or the input pulley. However, we expect to be able to follow the project plan to finish all of the tasks in a timely manner to participate in the competition.

# Appendix:

Figure 15: Ball Joint

Figure 16: Cable Stop

Figure 17: 90 °Elbow

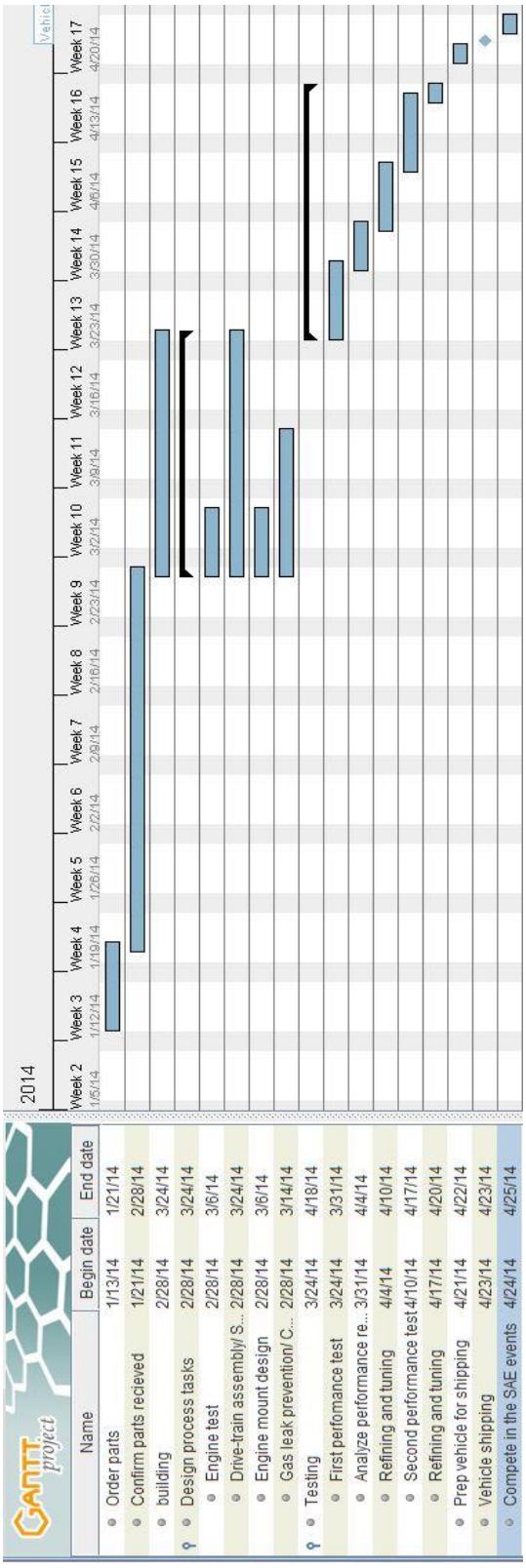


Figure 18: Gantt Chart Spring 2014