Getting Jiggy with It

An issue that we had always ran into when it came to manufacturing suspension arms was a way to properly jig the tube so that it could be welded exactly where it needed to be. In the past, wood molds, square steel tubing and aluminum plates where used for constructing these jigs. However, by using these methods the jigs could not be reused for different designs. It took a lot of time to make new jigs every year which put a burden on the progress of the car.

The method that we have developed now includes making suspension jigs out of 8020 extruded aluminum and fabricating small pieces for the inboard and outboard mounting points out of billet aluminum. This method of fabricating suspension arms has saved us a lot of time and we are now able to manufacture multiple identical parts much faster!

With the aid of calipers we are able to locate the inboard and outboard mounting points within a couple thousands of the design. For future design this mounting points can be adjusted which will make the jig design process substantially faster compared to previous years!

-Berto Perez, Chief Engineer
Following the informal Midnight Mayhem competition in October 2014, a catastrophic failure in the frame was discovered. It appeared as though the forces generated by the drivetrain had sheared apart two straight tube members between the engine and gearbox. To verify this hypothesis, Abaqus FEA (Finite Element Analysis) was performed on the frame based on the drivetrain mounting system in use at the time, with the engine mounted on square tubing, and the gearbox mounted on two steel plates, all independently welded to the frame. This analysis did indeed uncover stress concentrations located in the same spots where the frame failed. Because of an approximation used for analysis in previous years, this went unnoticed until the frame failure.

In order to prevent this sort of failure in competitions to come, a new drivetrain mounting system was required. The final design incorporates two braces made of steel square tubing that hold both the gearbox and the engine. Each of the braces mounts onto the frame at three points, and is completely removable. This design not only remedied the stress concentration in the frame, but also resulted in other benefits. For instance, this design allows for a constant, precise center-to-center distance for the CVT (Continuously Variable Transmission). This is crucial for tuning the CVT, which will now be able to consistently provide optimal acceleration. The new design also improves serviceability of the drivetrain system, as removal of the belly pan is now no longer necessary to install or remove the gearbox.

-Connor Haddix, Drivetrain

Every year, dedicated Mini-Baja members spend an eternity machining the uprights. They work diligently day and night until the parts are completed. And after all this work, the machinists are exhausted and the part may have some imperfections. This year, both the front and rear upright when optimized, were much more difficult to manufacture through the usual methods.

James Powers, the team’s Chief Mechanic, sought companies that were willing to sponsor the machining of the uprights. Luckily James was able to find a company that would use their CNC to manufacture the uprights.

Another exciting opportunity for us came when a Rochester alum offered to 3-D print parts for us and is 3-D printing our uprights so we can continue to build our suspension while we wait for the machined uprights to be completed. Both sponsorships are incredibly valuable timesavers and are highly appreciated. Hopefully this will help us finish the car on schedule and grant us plenty of testing time before competition.

-Luis Martinez, Suspension
The frame design for the 2014-15 vehicle focused on reducing total size, strengthening system mounting points, improving ergonomics and packaging, and maintaining high standards of driver safety. Major changes include a segmented footbox design allowing for better driver-pedal interface and more total legroom. This design also eliminates difficult to produce 180 degree bends in small tube segments and reduces manufacturing time significantly. In addition to the footbox, the vehicle’s rear bracing was also modified to include an 8 degree bend to aid in suspension optimization.

A new, 6 point drivetrain mounting scheme was also implemented as part of a larger effort to strengthen the engine and gearbox interfaces with the frame. Additional modifications included an increase in firewall tilt to 15 degrees from vertical, slight adjustments to side impact member height and additional bracing for shock mounts were also implemented. Frame members are composed of 4130 Chromoly and 1018 Mild steel tubing. All changes were finalized in early October and frame team is busily working on construction in preparation for competition.

-Chris Plunkett, Frame

A crucial but often overlooked aspect of a Baja car is its brake system. At a minimum, the brake system must be capable of locking all four wheels, at rest or at speed, on a variety of surfaces. The 2015 car’s brake system will be capable of this, and also offers improved packaging, a more simple and streamlined design, and optimization for the projected weight and weight distribution of the car.

In the design of this year’s brake system, packaging was considered from the beginning of design. The design of the front brake system was driven by the Honda TRX-300EX calipers (which have been used in the past), which fit well inside the front wheels and offer a fairly large piston area of 1.75 square inches per caliper, meaning more braking force can be achieved. The rear brakes’ design was also driven by packaging considerations; the design of the new gearbox restricted the diameter of the rear brake rotor to 6.5 inches. Based on this and the projected weight distribution, an MCP Mini-Lite caliper was chosen for the rear. This caliper has an adjustable design allowing it to fit the necessary rotor, and can provide the braking force necessary to lock the rear wheels. In addition, the use of this caliper instead of a more powerful one meant that no biasing at the master cylinders was necessary (for example, a bias bar).

A highlight of this year’s brake system is the master cylinder mount. A top-mounted brake pedal was needed because of the location of the rack and pinion, and it was decided to combine the pedal pivot point and master cylinder mount. By using the same bolt to mount the master cylinders and pedal, a very compact and fairly simple design was conceived (see image). This system is attractive from a packaging standpoint, keeps the master cylinders away from the driver’s feet, and has fewer bending forces on its components than previous designs. The brakes on a Baja car are often overlooked, but this year’s system shows that a well-designed brake system can significantly improve ergonomics and handling.

-Laurence Lohman, Usability
Smart sensors such as the ADXL345 triple-axis accelerometer or L3GD20 gyroscope send their data to our master board using the I2C protocol. Other sensors, such as Hall effect sensors, need to be directly measured by the master board, which in turn encounters timing issues when we try to log the obtained data or try to measure two different analog sensors simultaneously. To overcome this barrier, we are now installing a dedicated IC to each Hall effect sensor, so we can obtain the data by using the previously mentioned I2C protocol.

-David Gonzalez, Electronics

Body 2015

The body shall be a neon sign
Play electric boogaloo in judge’s minds
Every zagg and curve defined in time
For now, plaster phantasms of past design

It began with prototypical poetry
As foam and tape and members three
As wedges and bulges and swishes extreme
And we chose the design we wished to set free!

Come cardboard and duct tape and wax paper too!
Come carvers to shape and sandpaper to smooth!
Line it up straight and duct tape every groove!
Capture the ghost with cloth plaster and glue!

Now wait for the movers and a shop on the move…

We’ll pour in the plaster and bolster with wood
Draw over hot plastic and fit ‘em real good
We’ll do what we must to be understood
With curving side panels and a mud-shielding hood!

-Yaron Adar, Exterior Design
Updates:
We’ve moved! As mentioned in our last newsletter, we have moved to a new shop (which is right next to our old one). Next time you’re on campus, stop by Gavett 113 to check it out.

Competition Dates:
Mark your calendars! This year, we will be attending 2 competitions:

Auburn, Alabama April 9-12th
Website: http://www.bajasaeauburn.com/

Portland, Oregon, May 27-30th
Website: http://bajasaeoregon.org/

We hope you will be able to join us at one of the competitions!

Did you know?
There’s a LinkedIn group for Baja team members and alumni (started by former president Phil Katz). Search “University of Rochester Baja” to connect.

Until next time,

Alycia Abbott

UR Baja SAE President ‘14-15

P.S. When is next time? Most likely we will send out our next newsletter after we attend both competitions, so check your inboxes around July. For news until then, be sure to like us on Facebook!