

Barneveld Skills USA

Instructor: Duane Elfering

Team Members:

Aaron Ripp***

Cory Oimoen***

Josh Bollinger***

Jack Hetue***

Charlie Humphrey***

Jeff Wright

Unlimited Class

SKILLS USA

V I C A

Log Book

As all great creations start, the diesel car started as a simple drawing on a piece of paper, and then it got scaled out and drawn on the AutoCAD program. This program allows us to see the vehicle in 3D, and the program allows us to put it under tests that shows us weak points on the frame, and gives suggestions for how to reinforcement.

Then we started to cut and lay out the pieces to make sure our measurement will still work. Then when welding we tack weld first in order to make sure our pieces are level and square before we weld them solid. When working on the frame we started from the ground up, because it can all be built off of one base. When the body was being built we have the roll bars also facing forward coming down from the top at about thirty degree angles to protect the driver's face. The frame was built around the facts of; making sure the driver will be able to see, the steering wheel will be able to operate without it being in the way of the driver. The next day on the car would start out with the grinding out the welds smooth from the day before. In order to make the building process easier on ourselves, we put the body on the car last so we are able to work on the brakes, seat, engine, etc... without fishing our hands through a series of snakes to get to the parts. After we got the motor mounted we put together the hardest part of the entire vehicle.

The steering we found out a unique way to be able to turn the wheel and not turn too much. At the end of our steering wheel we mounted a seven tooth sprocket, and across a piece of square tubing was a chain welded to it. Then when we turned the steering wheel, it would catch on the chain and move the tie rods, thus turning the vehicle.

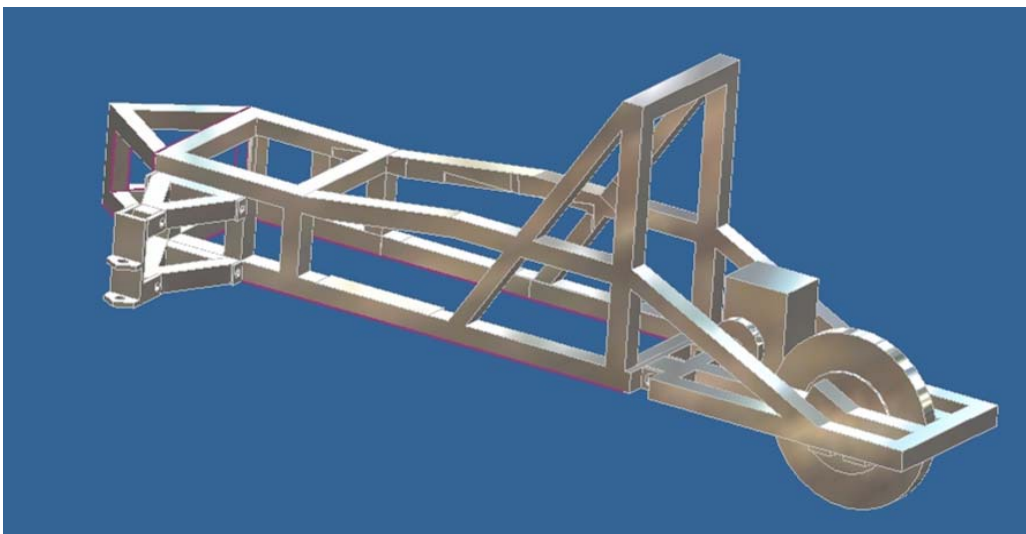
The front suspension and A-Arms took us about a month to get perfect and mounted on the body, and they operate without drag and sticking. When that long process was over we found some wheels by paying a visit to the local scrap yard and found some motorcycle tires, that way they are factory made, are able to hold lots of pressure and abuse,

and are factory perfect when it comes to drag and coasting. In order to drive the car we put a centrifugal clutch on it, because the motor is already heavy enough so a transmission would make it a tank. Then the diesel has so much power we can put a 90 tooth sprocket on it, which we carved out with a C&C, but not too, that way the idle speed can engage the clutch and get up to a reasonable speed.

The body was made out of air liner plastic that molds to the car when heated, for a smooth texture in order to increase airflow. We first painted the body and put stainless steel on as the firewall and floor panels. So we tried to make the body out of clear in order to share the beauty and unique designs.

Basic Vehicle Configuration

Our car is an "open cockpit" model where the driver can sit up fully and this allows the driver to have a good field of vision while driving. Because our car has an actual steering wheel, we also put in pedals for accelerate and brake. The accelerator pedal is on the front right of the car with the brake pedal opposite it on the left. The choke (kill switch) is easily reachable to the driver on the right side of the frame. Directly above and behind the engine, there is an additional throttle and choke control. The control consists of a steel tube and a brightly colored golf ball mounted on top for easy visibility. The engine, and drive wheel are located directly behind the driver and fire wall. Our car has two wheels in the front of the vehicle, both of which control turning and braking. The rear wheel cannot turn or brake, so it is used to as the drive wheel. Our engine assembly is a separate piece from the main chassis. It is attached at the base and middle section with two motorcycle shock absorbers. The front wheels are attached to the vehicle by two "A-Arms" The A-Arms are used as the vehicle's suspension with two compression springs used to adjust the vehicles tilt on turns, adjust the height on bumps, and make the control and ride more comfortable for the driver.



Power Train Configuration

Our car uses a 4.6 Horsepower single cylinder Hatz diesel engine. It has a centrifugal clutch that utilizes a 40 chain. We make our own sprockets on our Computer Numeric Control Router at school, so, as such; we have tried several sprockets on our car. Most of our sprocket testing is performed on our school's driveway. We have a very long driveway at our school, and the turns and elevation changes make it very well suited for sprocket testing. We have tried sprockets as big as 120 teeth which perform very well on our hill, and, we have tried sprockets as small as 60 teeth which do not always make it up the hill, but have great acceleration and good speed. We are most likely going to use a 90 or 96 tooth sprocket because they provide a balance of speed and power.



Performance

The majority of our car's testing was performed in our school's parking lot or driveway. Because we have a relatively small school, our parking lot is safe enough to perform tests in. One of our tests was previously described in the Power Train section. We tested our sprockets on our school's driveway. This is an efficient test because the hills in our driveway are similar to the hills at Road America. Another of our tests was to go over the rough areas near our driveway. This helped to test our suspension. We also tested our suspension on the hills at one of our team member's houses. The driver sat in the vehicle while he was pushed along the driveway to test the effectiveness of the springs and shock absorbers on rough terrain. Finally, we measured the distance around our parking lot into a mile until we were able to monitor our own gas mileage for test runs. This allowed us to practice different methods of driving and acceleration to see how they impacted mileage.

Brakes

How the brakes work...

- The drum brake has two brake shoes and a piston. When you hit the brake pedal the piston pushes the brake shoes against the drum.
- The brake shoes touch the drum. There is a kind of wedging action, which pushes the shoes into the drum with more force.
- The braking force provided by the wedging action lets the drum brakes to use a smaller piston than disc brakes.
- Because of the wedging action the shoes must be pulled away from the drum when the brakes are released.

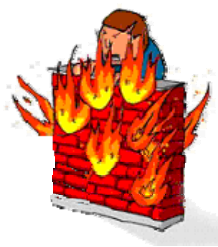


How the brakes are used...

- The brakes are located on the front two wheels. Wires located on the brake pedal that are connected to the drum of the wheel. When force is applied onto the pedal, force is pushed onto the drum. Then the drum is pressed down onto the wheel which stops it from moving. The harder you press on your pedal the harder the drum pushes on the wheel.

Safety Features

Fire Extinguishers – The diesel car has got a fire extinguisher located easily within reach of the driver just in case the car starts on fire; the driver will have a way to put it out. Without the fire extinguisher, the driver will be helpless and most likely just burn.



Fire Wall – In-between the driver and the engine there is a back rest that is also used as a fire wall. This fire wall is made out of heat-resistant stainless steel so that the wall won't get so hot from the engine and won't injure the driver and won't be a danger hazard. Our car has a fire wall that is double the thickness that is required.

Seat Belt – Our car has a five-point harness belt installed so that if the driver runs into something head on or rolls the car, the driver will not fall out because the seatbelt is holding him in. If the driver was to hit a wall head on, there is a good chance that he could go flying out and be ejected from the car. The harness prevents this.



Good Suspension – Our car has extension springs on I-hooks that are attached to the A-arm in the front. When the car goes over a bump, the springs give way so that the driver won't be bouncing around all the time and lose control. Because of the springs, the car has the ability to give way to the ground and not impact the driver as much. The vibrations from the engine will not be felt as much by the driver because the engine is on a separate piece and it has its own shock absorbing springs to itself.

Padded Seat and Back Pad for comfort – The driver will most likely go over some kind of bump throughout the ride and if he hits the bump wrong and comes down on his tail-bone, it will hurt him so much more. Our car has a back pad and a padded seat so that the driver will be more comfortable and not have to worry about hitting a bump and injuring his tail-bone or back. Also if the driver isn't comfortable while driving then he won't be as focused on succeeding.



Problem Solving Essay

Our first step was to come up with a basic idea of what we wanted our car's chassis to look like. We made our first scale model out of popsicle sticks. This gave us a basic idea and a smaller model what the car should be like. After we made the model, we started to decide what supplies we needed for the job, we decided on using 1.25 inch square tubing to build the car. After having the idea of how and what we were going to use, we started to get to work. We started to make the frame of the body; since this car was intended to be an "open cockpit" type vehicle, we didn't make the roll cages that are common in many of the cars we used. Instead of a roll cage, we simply have a supported steel bar with about 1 foot of clearance between the peak height and the drivers head. We were planning on the extra clearance as an added safety feature for the driver.

For the rear frame of our car, we decided to mount the engine on an entirely separate piece from that of the driver's area. The engine is on an independently flexible base at the bottom of the piece, while the top is secured by two high quality shock absorbers. We built our car this way for two main reasons. One, the separate piece would significantly lessen the vibrations from the engine. Because our engine is simply mounted directly to the frame, the vibrations are quite powerful. This separated frame allows the driver to maintain better control over the vehicle because the vibrations from the engine are not affecting the driver. Our second reason for choosing the separated frame was so that firewall construction would be simple. Because the pieces are almost entirely separate, the firewall was easy to install, and does not occupy the space of any of the engine's components. The separated frame also allows for plenty of air flow near the engine, reducing the heat in the car. Originally we had planned to use the separated frame as a way to use a car in both the Electrathon and Supermileage competitions, but as time progressed, we realized that our car was much too heavy to be run as an electric car. The car's size was also a deciding factor. The car was too wide to be an Electrathon car.

At this point in the production of our car, we hadn't decided what class of vehicle we were going to run. We knew that we couldn't use the car as an Electrathon vehicle because of its size and weight. We considered using a modified engine for a while, but eventually we decided to run the vehicle in the unlimited class using a diesel engine.

With the frame almost completed, it was time to move on to the wheel base. We chose to use a side-mounted "A-Arm" structure for our front wheels. As described in the safety section, we take pride in our vehicles good suspension. Our A-Arms are constructed to be attached to the vehicle by the means of a compression spring on each side of the vehicle. As more weight is applied to the base of the vehicle, the springs compensate for the weight and allow the driver to remain stable and unshaken in the vehicle. Since the vehicle has two front wheels and one back wheel, the vehicle is easily turned from the driver's seat. Our turning mechanism consisted of a pipe which is attached to an 11 tooth metal sprocket. The sprocket rests along a number 40 chain which is welded to the wheel base. The wheel base connecting the two wheels easily turns the tires when the driver turns his wheel. Due to the compression springs, the driver can even lean in the direction he wishes to turn; this allows for a better feeling of balance as well as more speed while rounding corners.

Most of our vehicles have used a hand-throttle and brake system mounted on the steering column. Due to an excessive amount of space in this vehicle, the driver is fully sitting up while driving, and has room for a miniature steering wheel for turning. Because we used a steering wheel in our car, we decided to use pedals for the gas and brake. Our gas pedal is mounted on the right side of the front of the car. The gas pedal is intended for use solely with the right foot. Opposite the gas pedal, the brake pedal is on the left side of the vehicle and is intended to be pressed with the left foot only. As a safety feature, we mounted a choke switch to be used as our kill switch. This choke switch is in easy reaching distance on the right side of the driver. The driver must hold the switch for approximately 1-2 seconds until the engine dies entirely. At this point, he can use our effective drum brakes to slow his vehicle to

a complete stop in roughly 20 feet. At this time, we pass the requirement of a 25 foot stopping distance, but we are still striving to improve our vehicle in any aspect possible.