Design and Development of a Human Powered Vehicle: NASA Rover Competition

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Donors: Great Bicycle Shop, University Cycles

Sponsor: Florida Space Grant Consortium

TEAM 17

The Competition Basics

Prototype a vehicle that …

- Is human-powered
- Accommodates two people
- Has off-road capabilities
- Is ‘small’ and ‘light’
- Is safe
- Wheels must be manufactured

Needs Statement:
“There needs to be a ground vehicle powered by fit male and female drivers that is capable of competing in the NASA Human Exploration Rover challenge.”

Restated Goals Statement:
“Successfully create a working prototype. Attempt to win the rookie award at competition.”

CHALLENGE OBSTACLES

FIGURES 2-5. PURDUE-CALUMET WINNING COMPETITION FOOTAGE[1]

Benchmark

- Rhode Island School of Design (RISD)
- 2nd place at the 2016 competition
- Approval from Thomas Brenner from RISD team to use his online webpage(s) as resources for our design.

Figure 6: RISD Rover 2016

Component Morphology

Design of chassis

- Truss design
- Mid Chassis Hinge Split

Design of drivetrain

- Chain driven
- All-wheel drive
- Separate drivetrains

Steering

- Hand lever Steering

Brakes

- Single Axle Disc brake

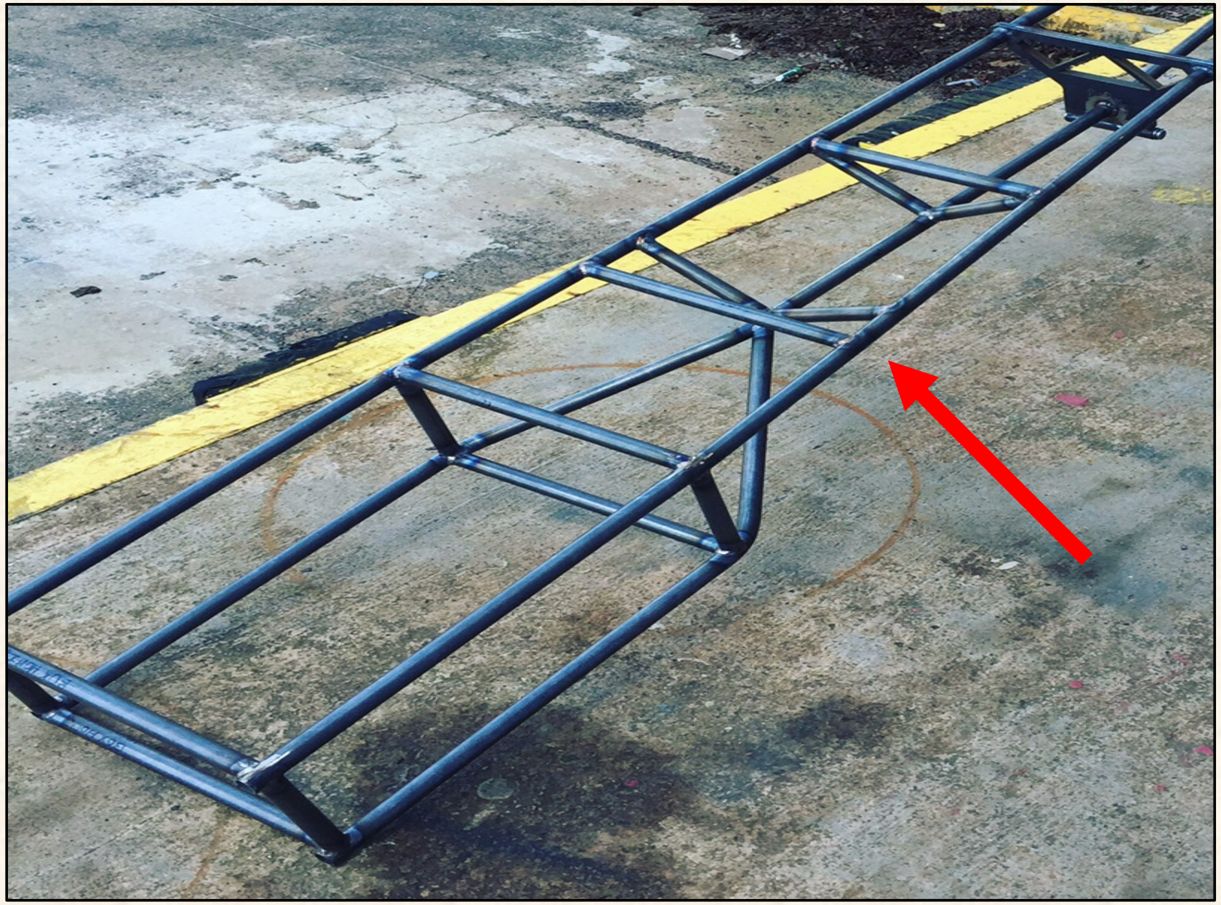
Design of wheels

- Spoke Style

Design of Suspension

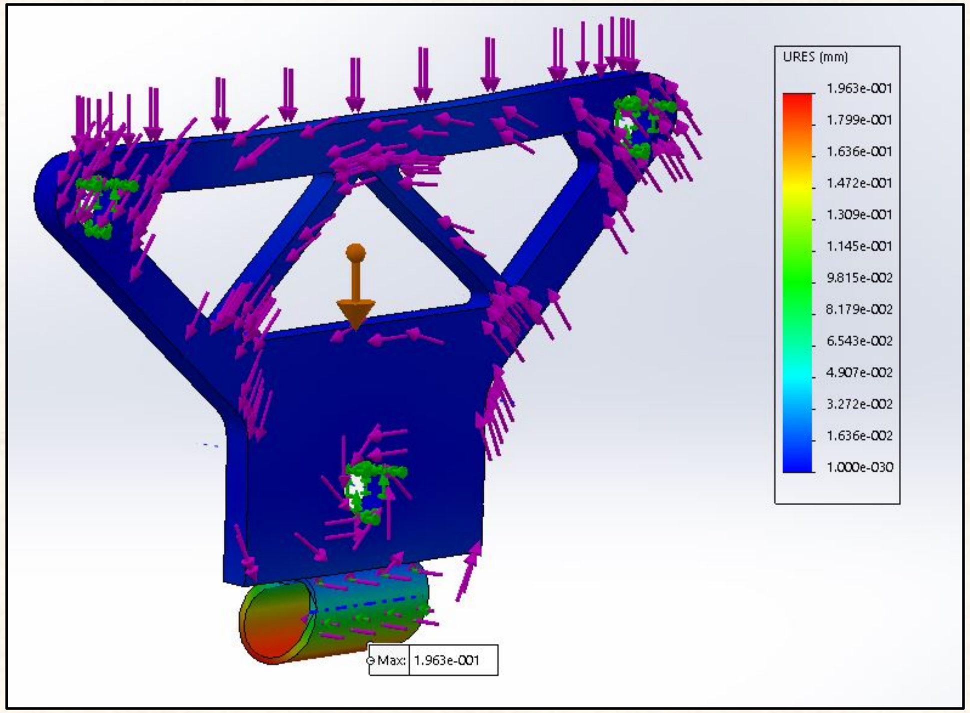
- Double Wishbone Suspension

Frame Design and Manufacture

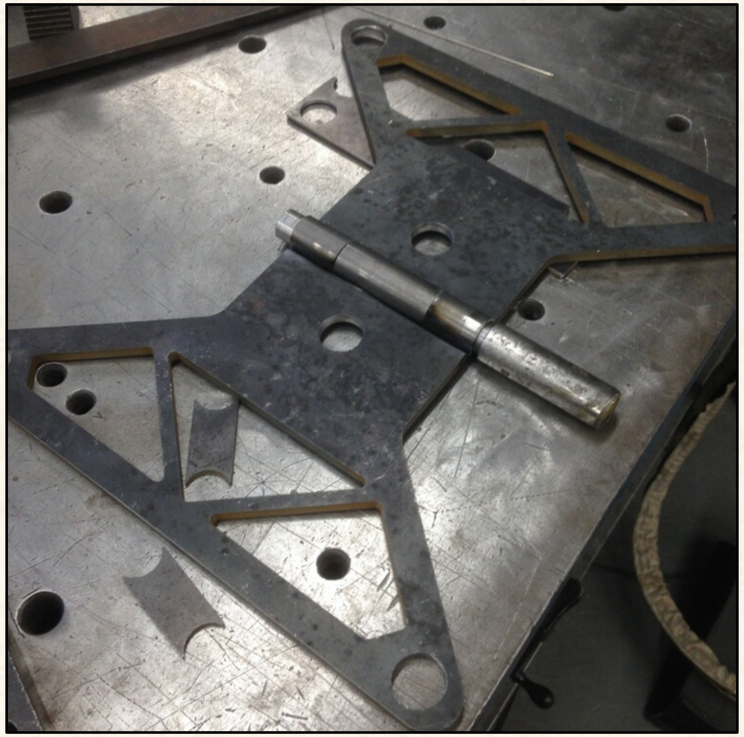


- Truss Modifications
- Accuracy in welding dimensions

Collapsibility

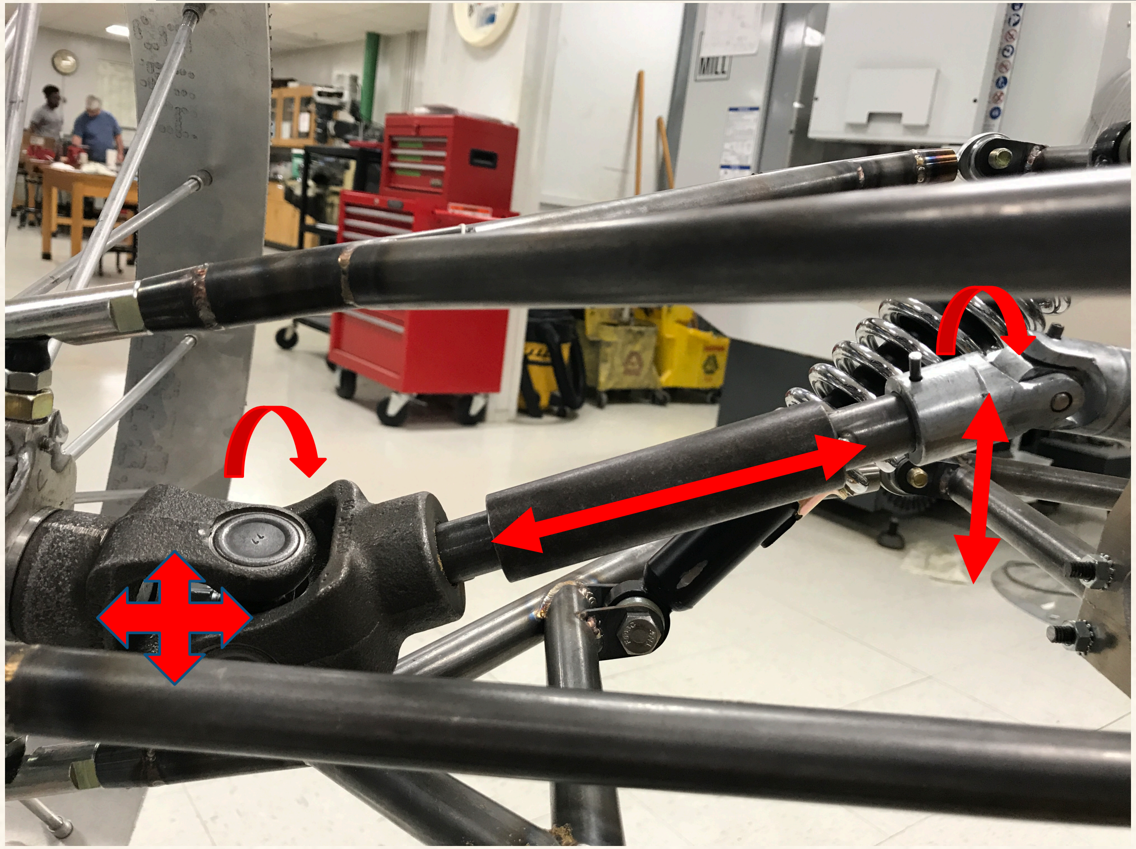


Folding Chassis Joint Assembly



- Frame Torsion Increased

Front Drivetrain



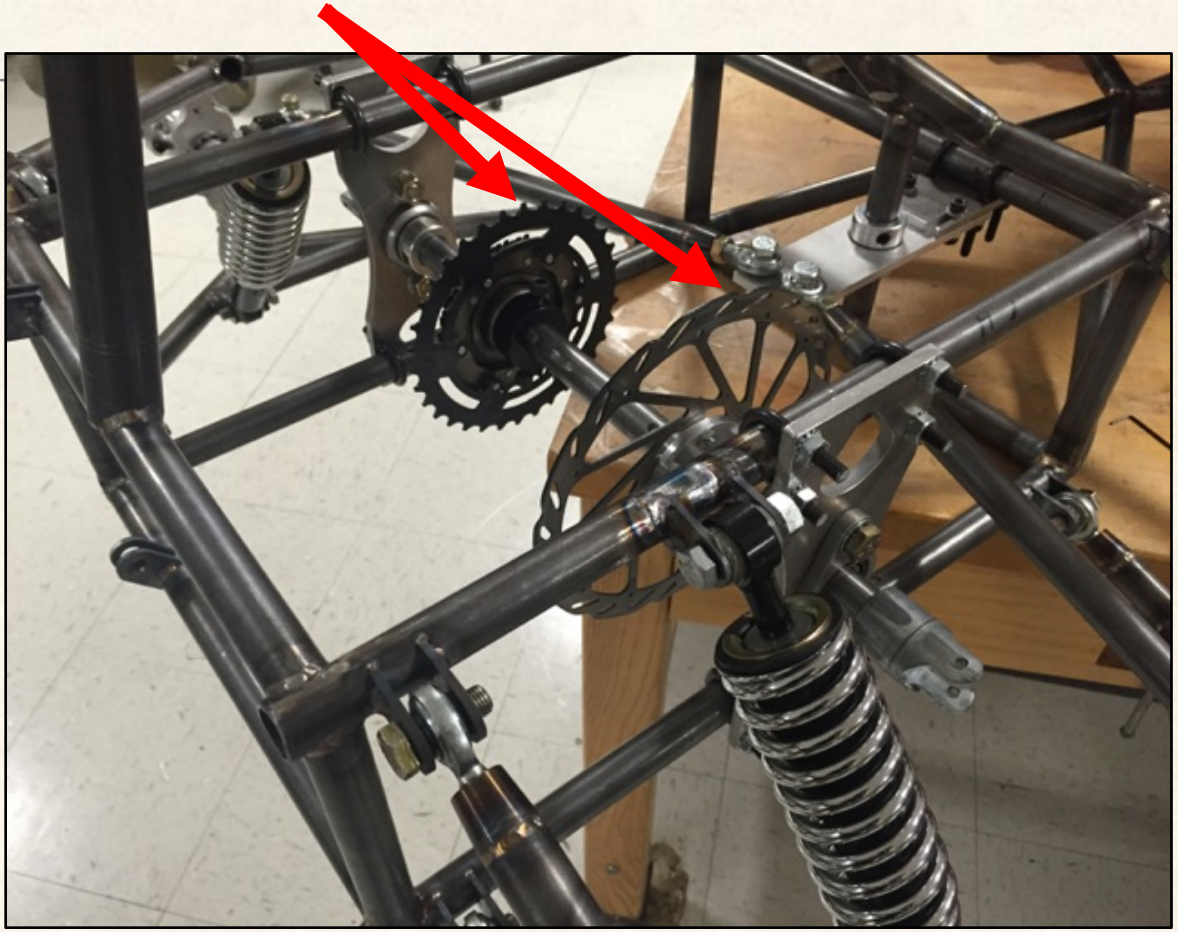
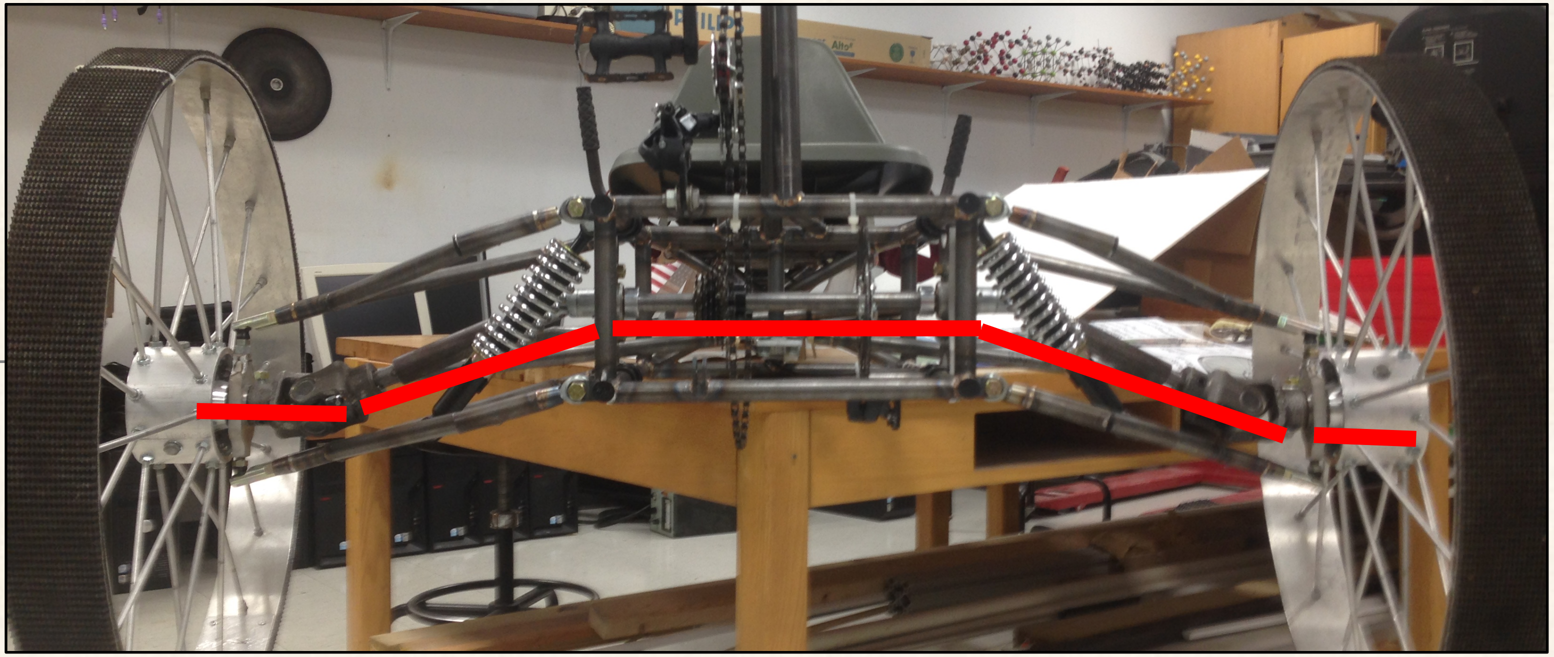
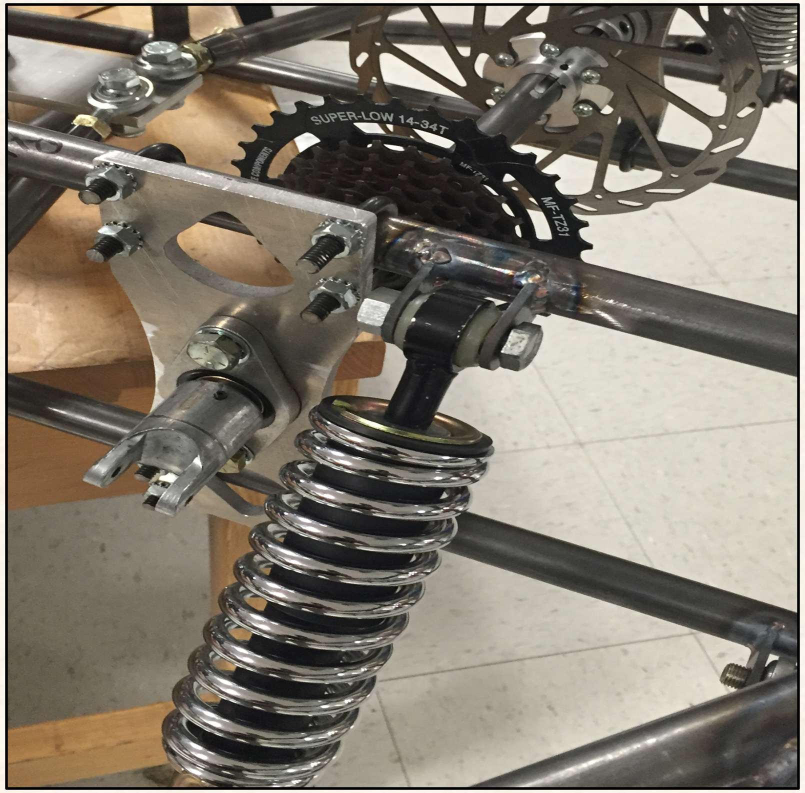


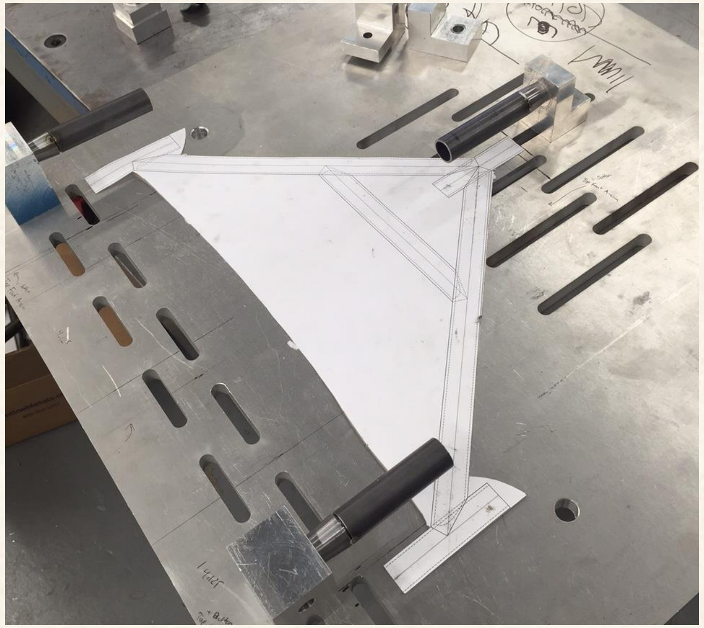
Figure 9: Front Drive Train

Suspension

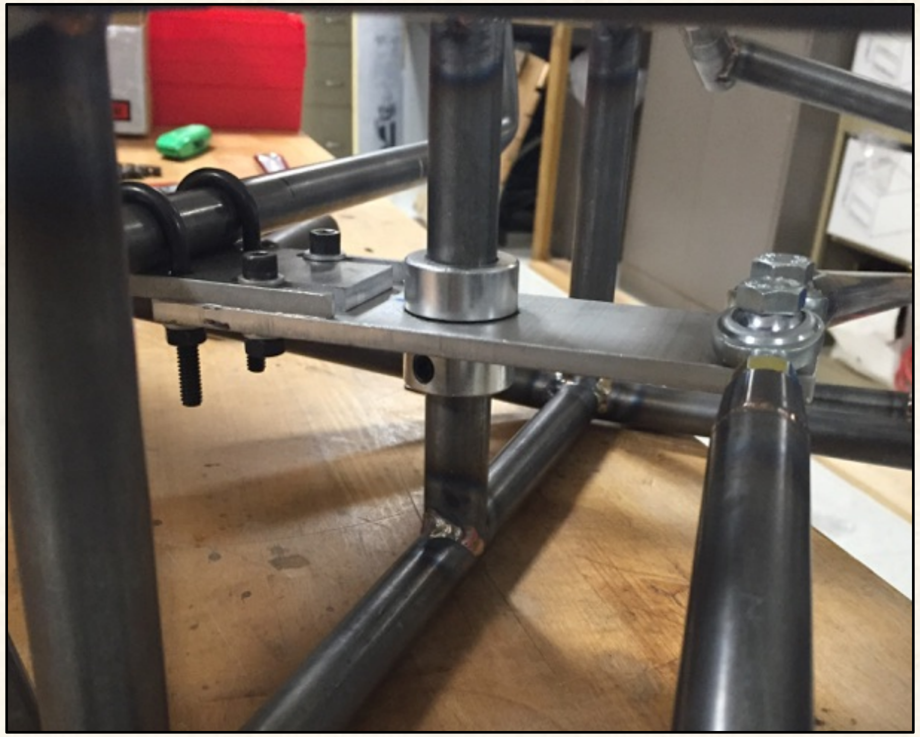




- Control Arm Jig
- Ride Height Requirement
- Shock adjustability and offset



Steering Assembly



Rear Drive Train

Seating

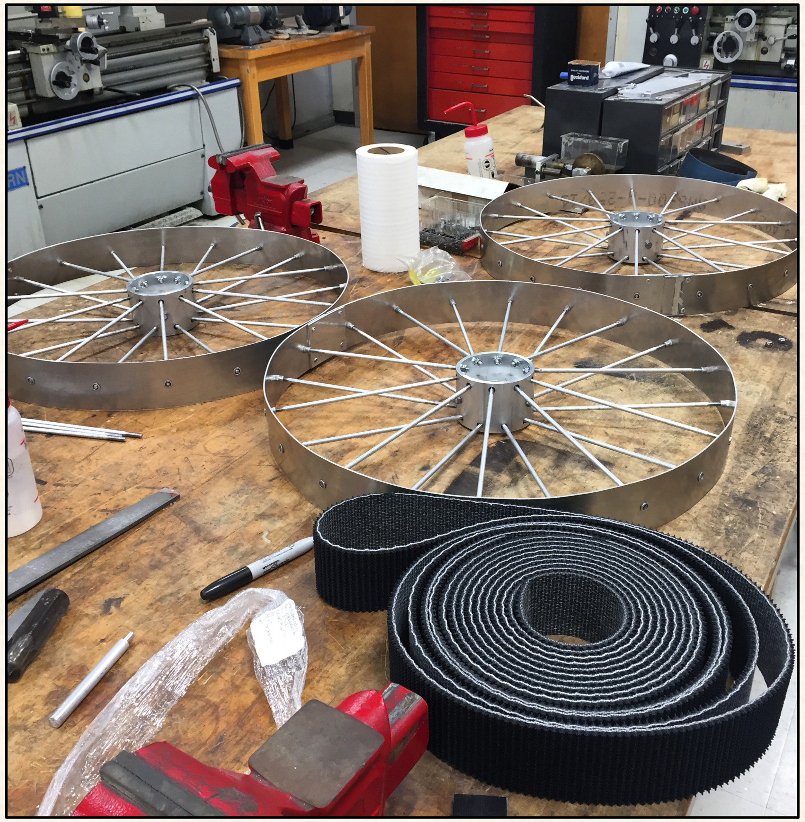
Wheel Design

- Spokes: Aluminum 7075
- Rim: 0.125” thick Aluminum 5052
- Hub: Aluminum 6061
- Tread: PVC Rough Top

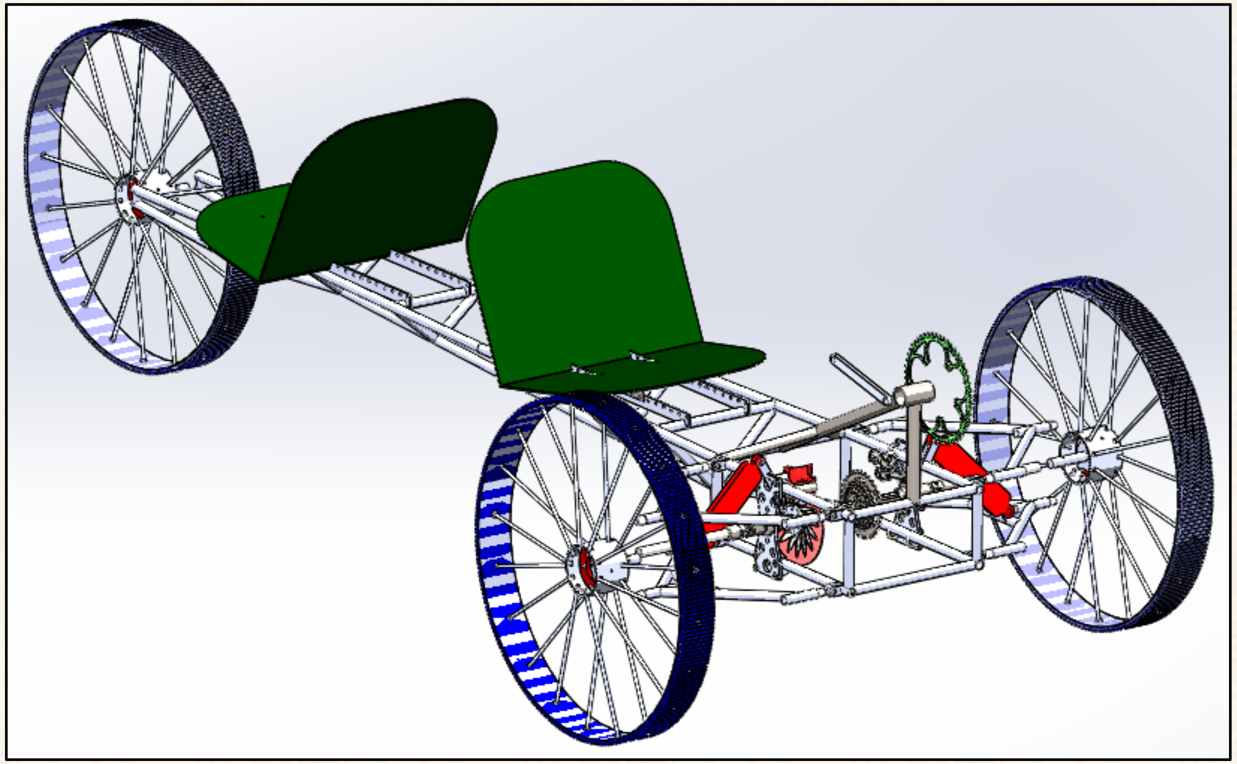
Dimension	Value
Outer Diameter (OD)	26 in.
Axle Diameter (ID)	0.75 in.
Wheel Width/ Tread Width	3 in.

Table 1: Wheel specs

Figures 16-17: Wheel manufacturing process



Assembly

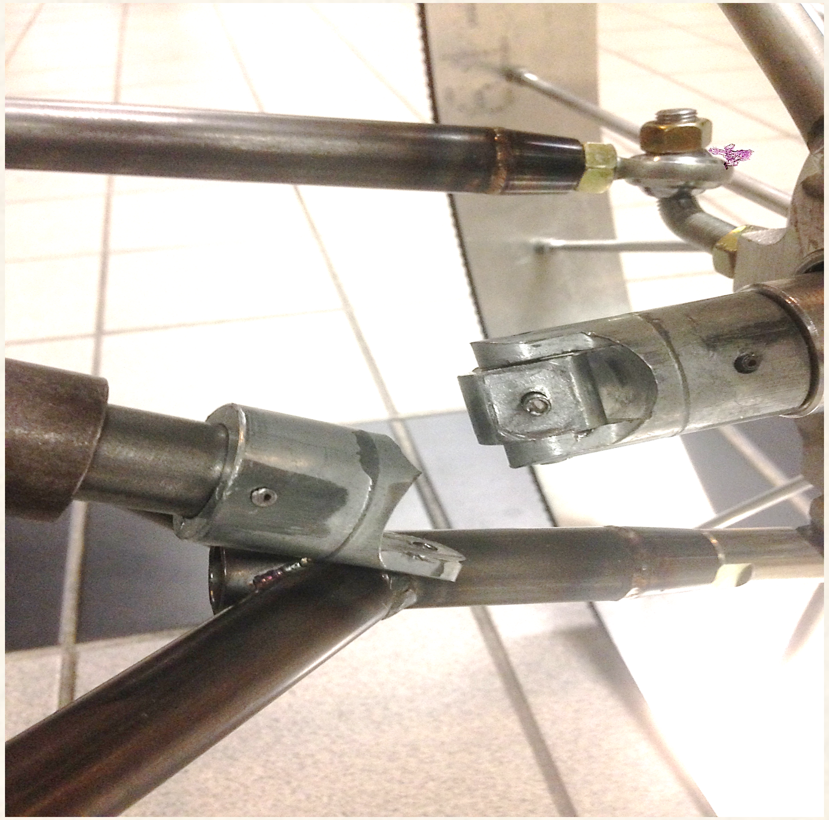


Figures 21-22: Current Assembly

Testing Phase

Universal Joint Shear Failure

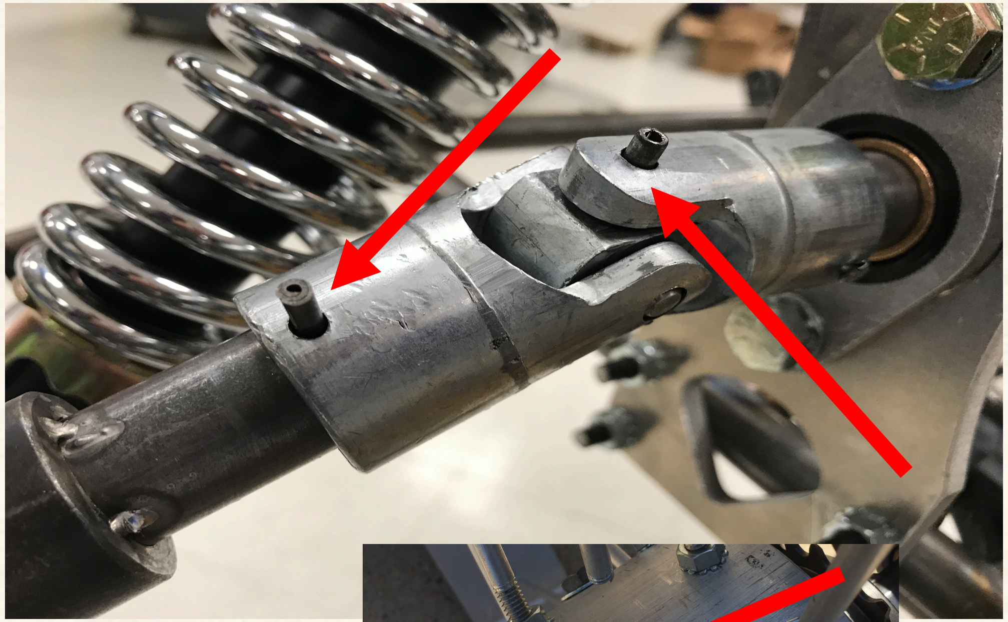
Solution:
Heavier-duty joints with larger transmission angle

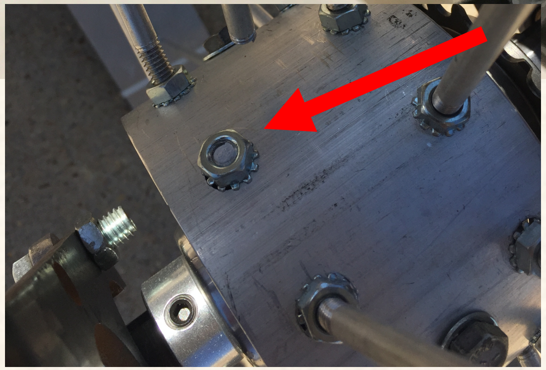


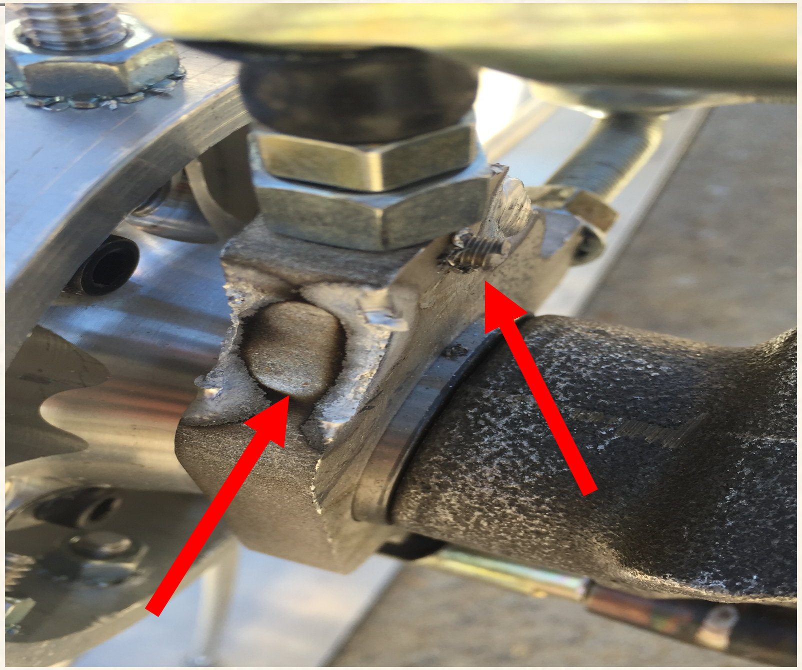
Competition Results

Critical Failures:
- Drivetrain roller pins shear
- Spindle tear out

Semi-critical Failures
- Fender attachment
- Steering loosening
- Wheel Spokes bending/ tearing







Future Improvements

- Steering
  - More complex and **rigid** system
  - Analyze dimensions much more carefully
  - Modify geometry for tighter turns
- Front Drivetrain
  - **Belt Drive**
  - **Gear for torque**
  - Change to drum brake
- Wheels
  - Analyze Rim more closely
  - Tougher and more flexible
- Rear Drivetrain
  - Reinforce Boom further
  - Develop more rigid idler gears
- Seating
  - Consider custom seats
- Suspension
  - Upgrade Shocks
- Frame
  - Construct new rear section for shorter wheelbase
- Overall: tighter tolerances and higher spec components

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References

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