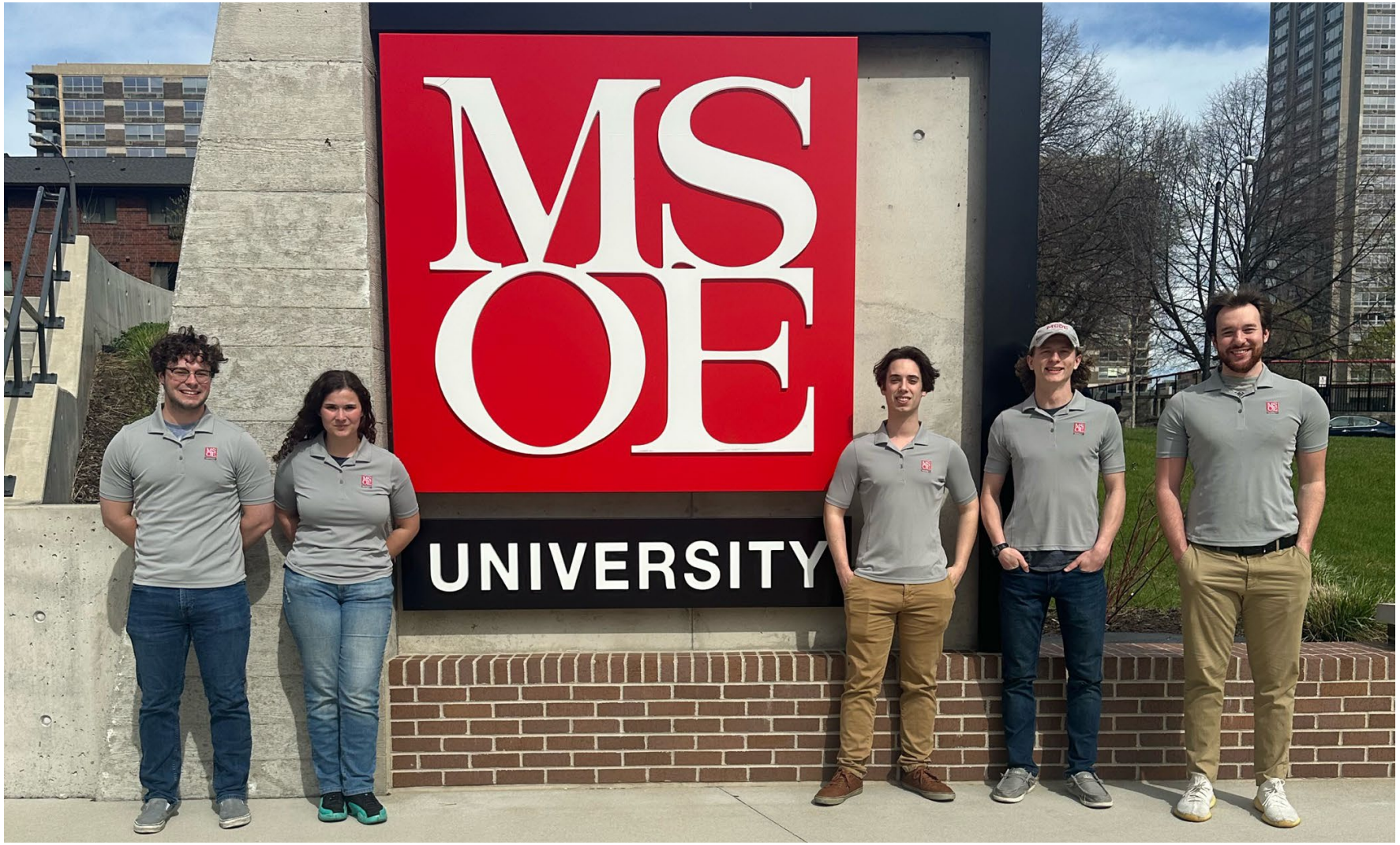
NFPA Fluid Power Vehicle Challenge

NFPA Education and Technology Foundation

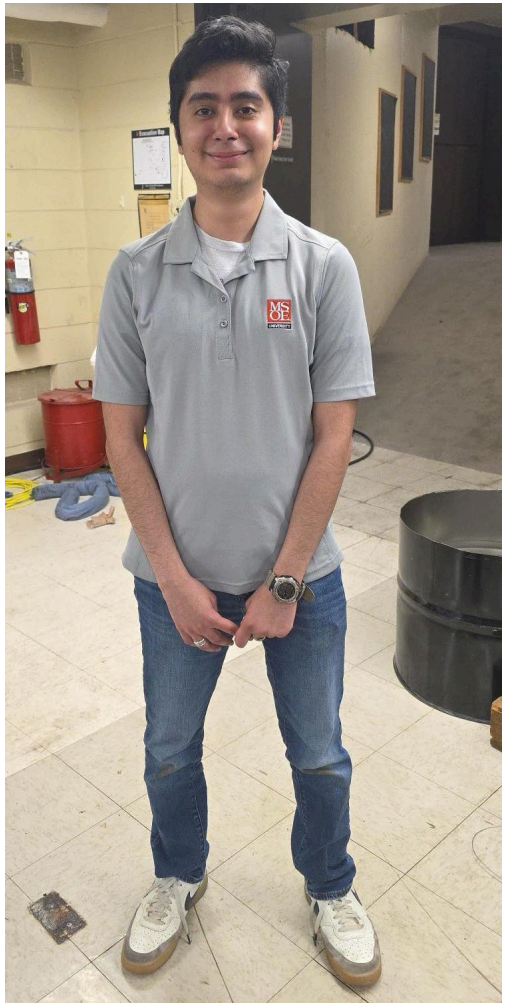
FINAL PRESENTATION & DESIGN REVIEW
MILWAUKEE SCHOOL OF ENGINEERING
DR. RODRIGUEZ AND GRANT NOLL
4/08/2025

MSOE UNIVERSITY

Meet the Team



Left to Right: Ethan Hunt (Electrical and Pneumatic Lead), Emily Hince (Frame Design Lead), Thomas Pollock (Fabrication Lead), Abel Backus (Team and Hydraulic Lead), and Jacob Gadek (Regeneration Lead)



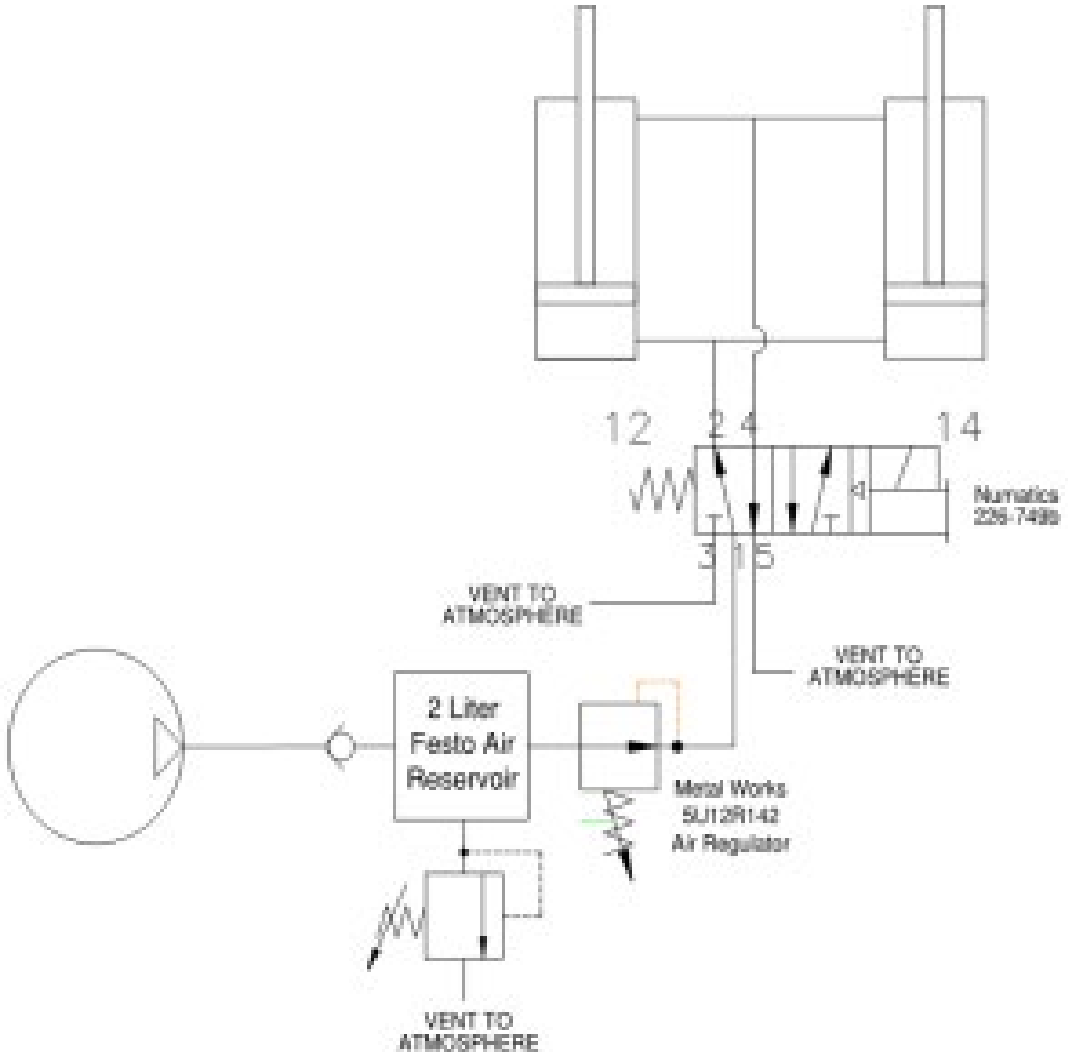
Ernesto Sandoval, Team Member

Vehicle Construction

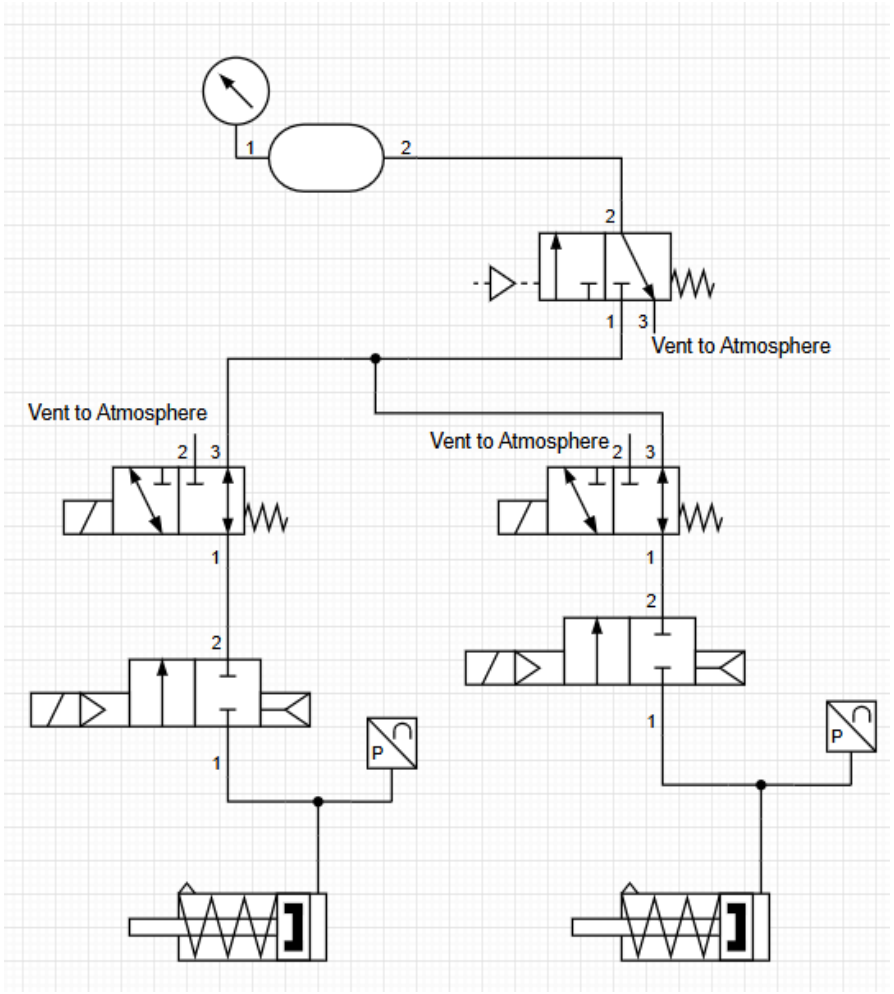
Vehicle Construction

Final Vehicle

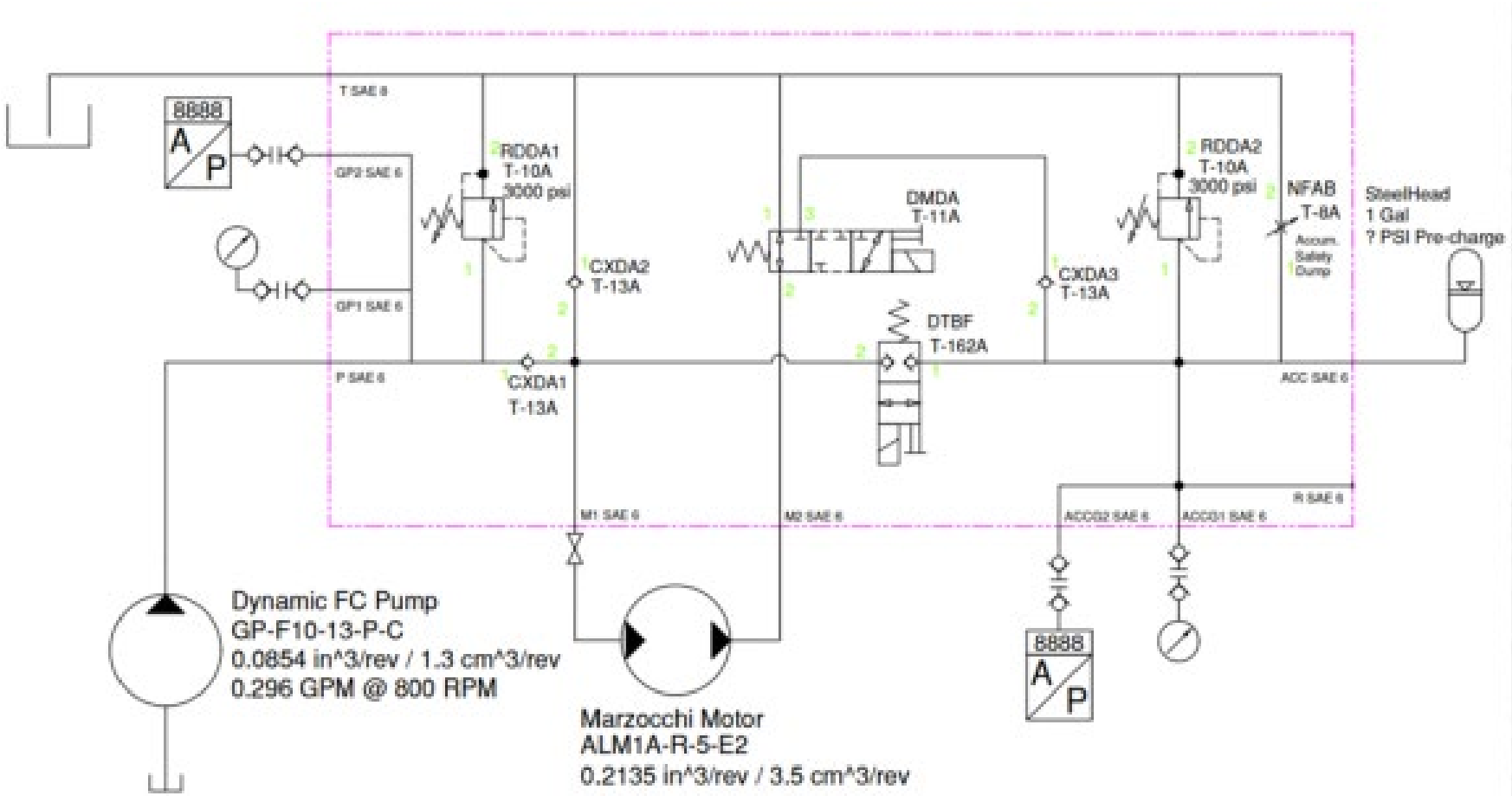
Previous Years Pneumatic Circuit



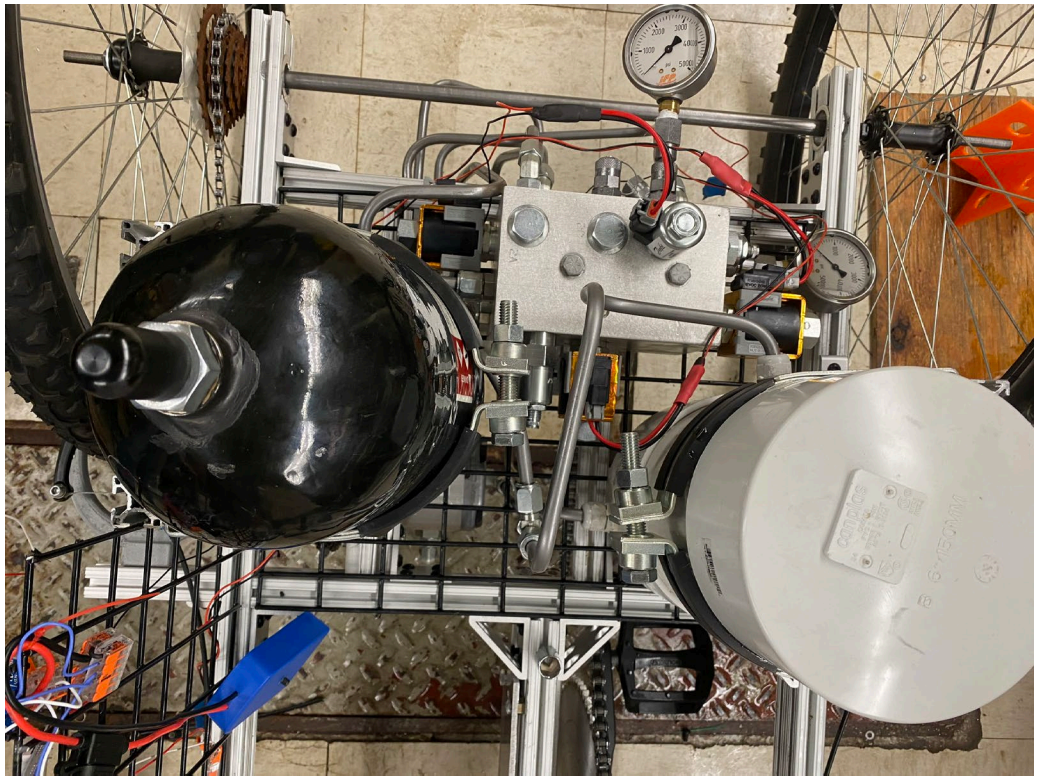
This Years Pneumatic Circuit



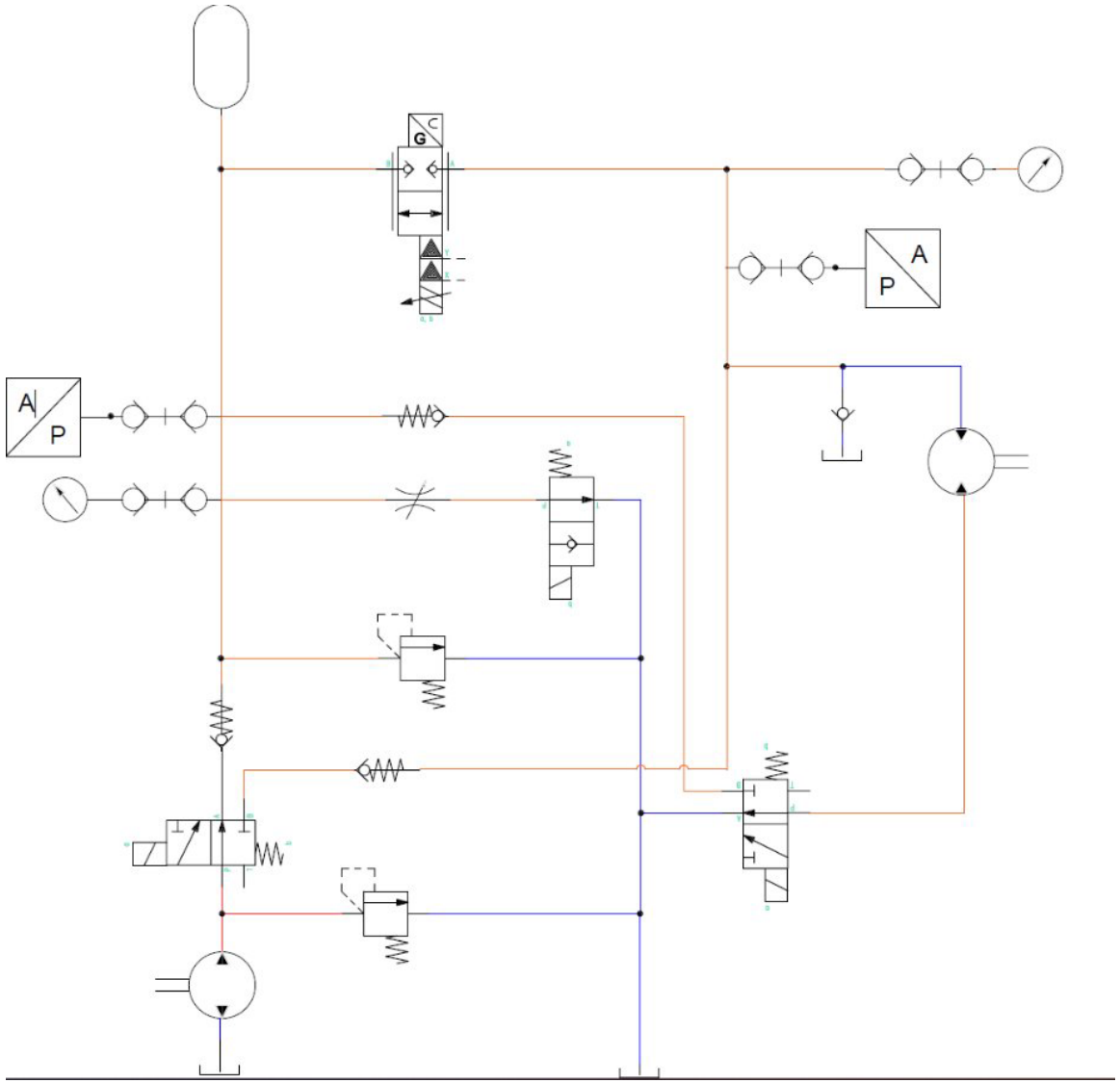
Previous Years Hydraulic Circuit



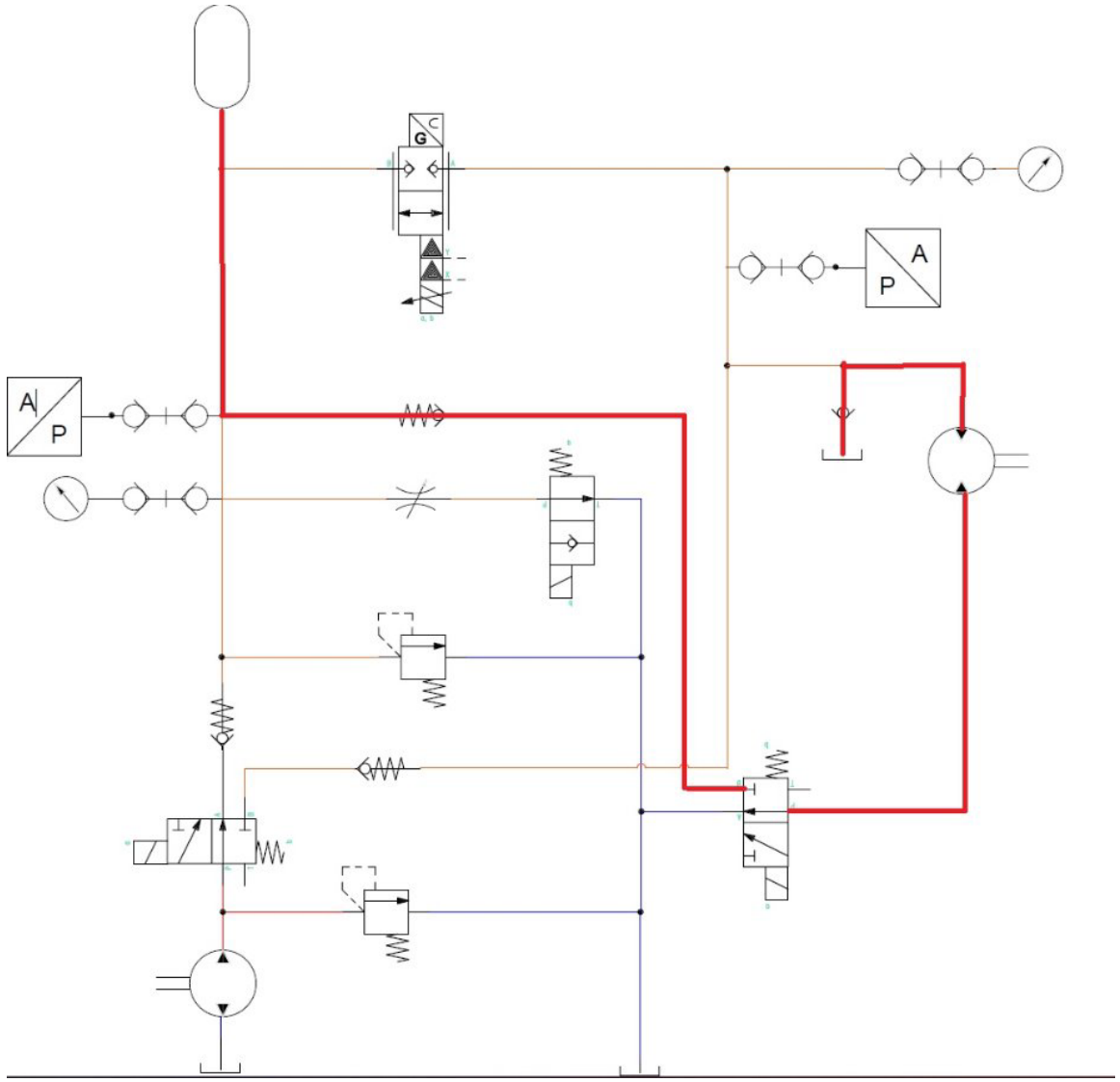
This Years Hydraulic Circuit



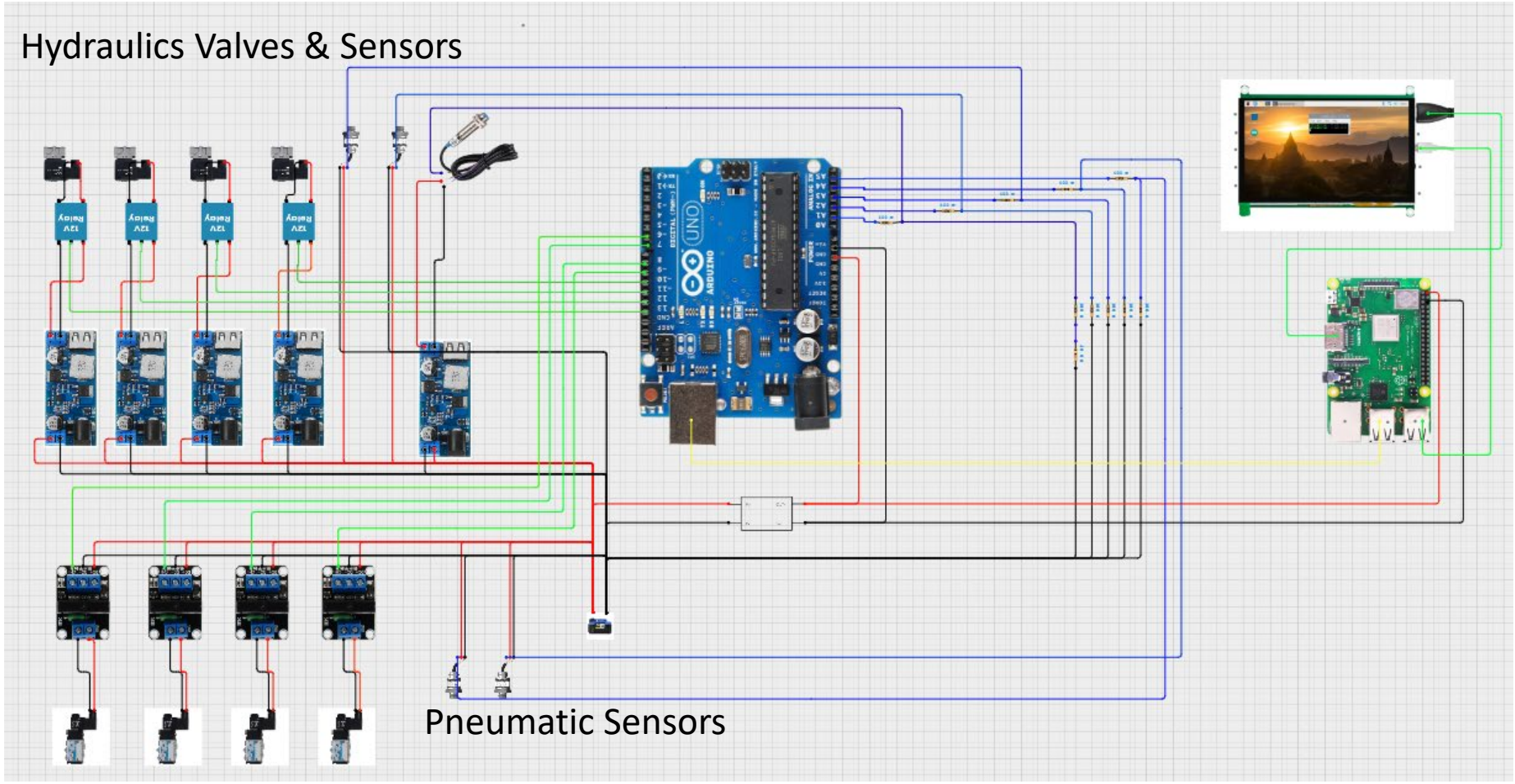
This Years Hydraulic Circuit



Regenerative Braking Circuit

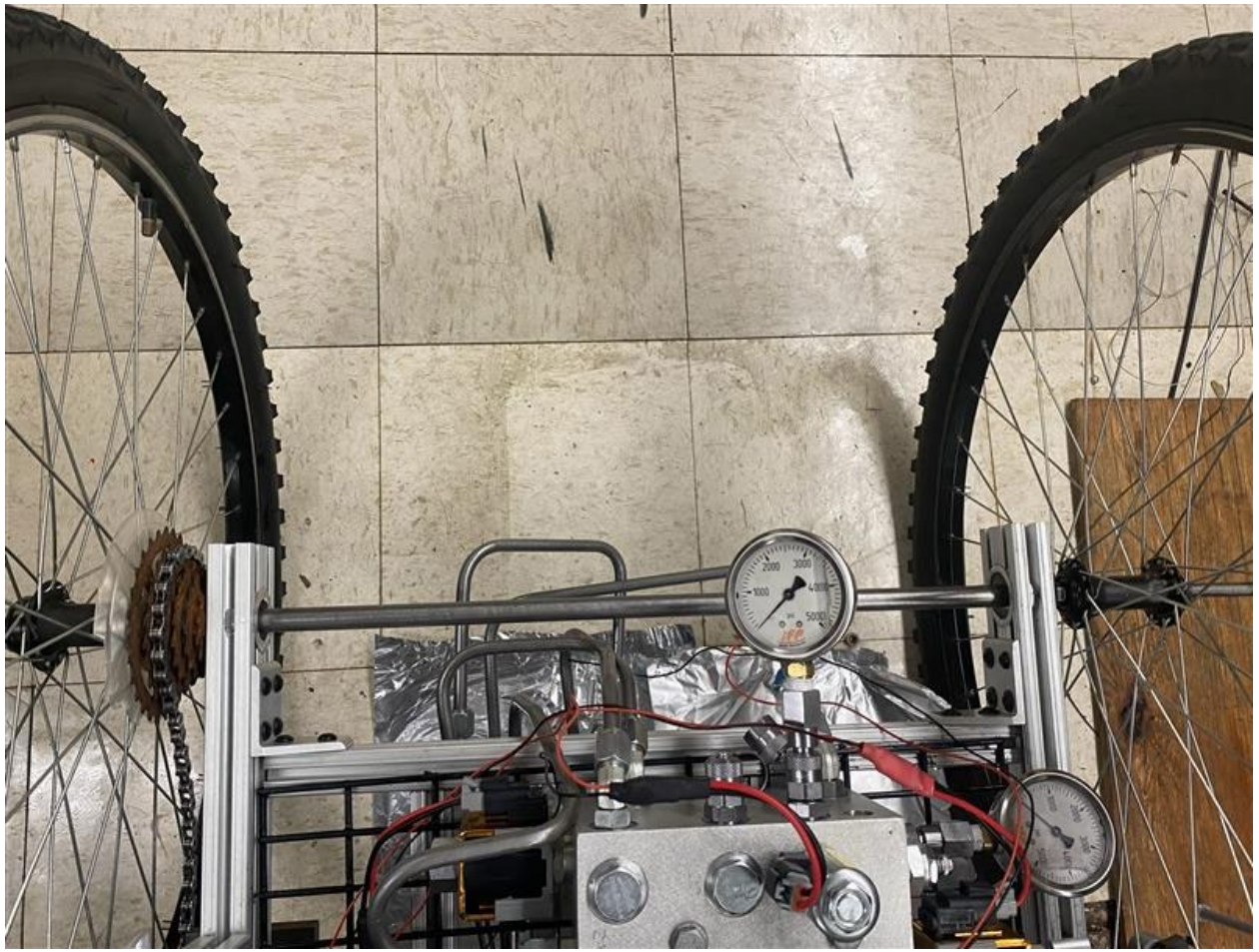


This Years Electrical Circuit



Vehicle Stress Testing

Weaknesses in Axle



Reduced bending moment on axle and used thicker material

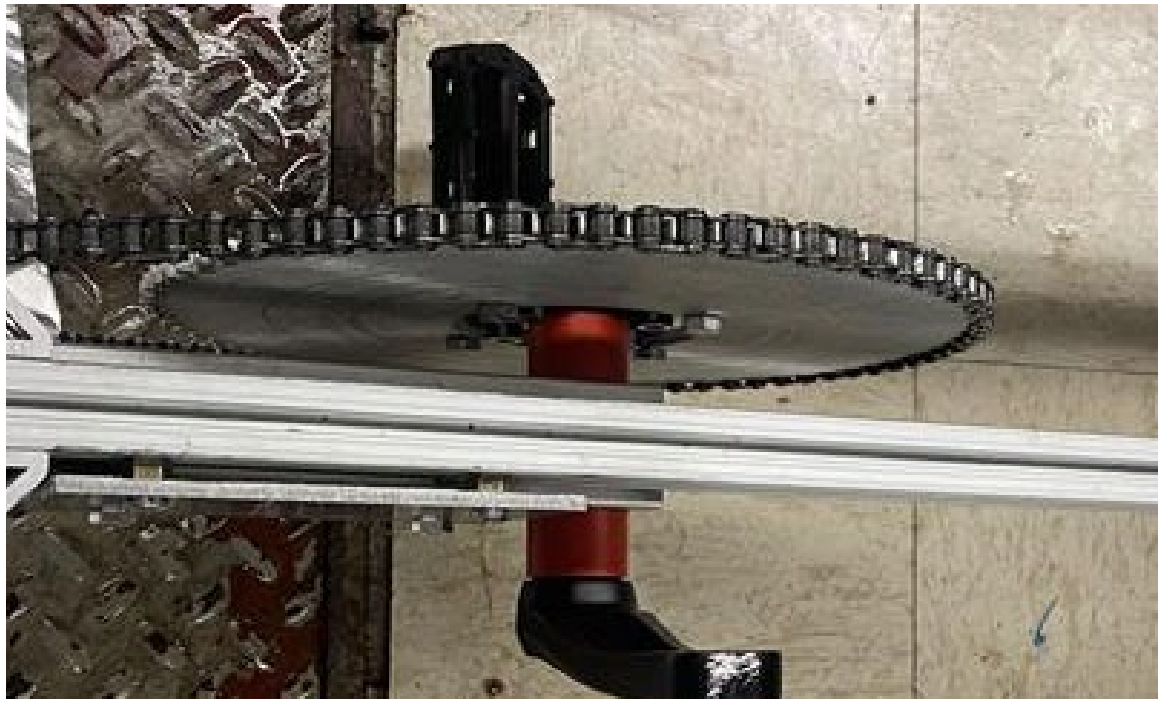
Vehicle Stress Testing

Weakness in Pedals

Mounted pedals in 3-point bending rather than a cantilevered beam

Vehicle Stress Testing

Misalignment and lack of tension in chains



Replaced mount hardware and adjusted frame layout to improve tension

Lessons Learned

- Consideration of how changes will affect the entire bike not just future plans
  - Raising seat to give more space to the rider caused higher center of gravity, compromised stability.
  - Moving wheels out to allow extra space for chain system caused large bending moment.

Lessons Learned

- Chain Tension is Critically Important
  - A mechanical tensioner is critical to ensuring chain does not skip
  - “Hand tight” is not tight enough

Lessons Learned - Hydraulic

$$T = \frac{D * P}{2\pi}$$

- Incorrect Pump/Motor Specifications lead to unachievable operating point
- Decreasing pump displacement allows for higher pressures
- Increasing motor displacement increases output torque without increasing required pressure