NFPA Fluid Power Vehicle Challenge

NFPA Education and Technology Foundation

FINAL PRESENTATION
Iowa State University
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Team Introductions

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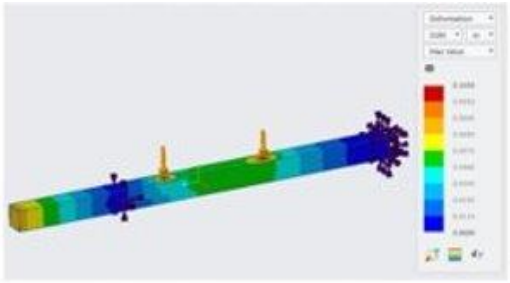
Overview

- Vehicle Construction
  - Component Design
- Final Vehicle
- Hydraulic & Pneumatic Circuits
- Bike Changes & Improvements
- Electronic Controls & Instrumentation
- Lessons Learned

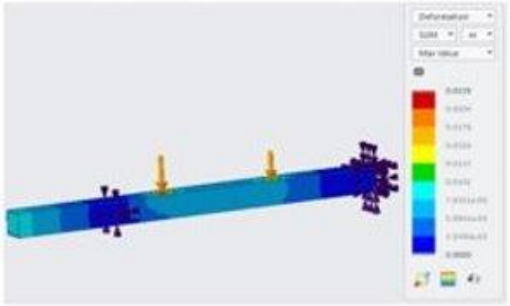
Vehicle Construction

Deflection Analysis

Current Design:
Max. Deflection: 0.10 in.

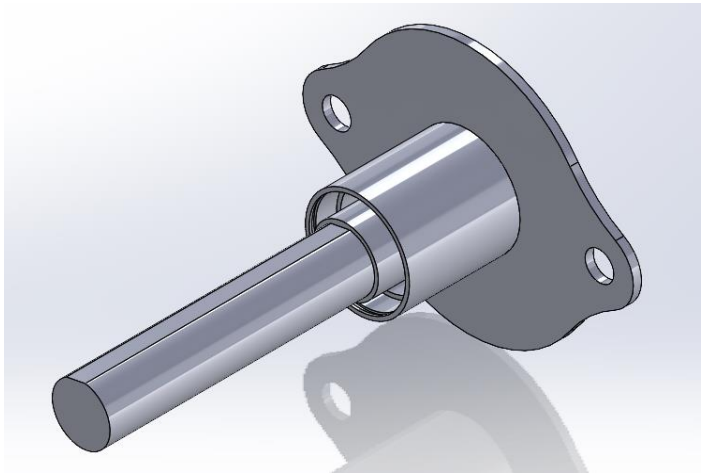


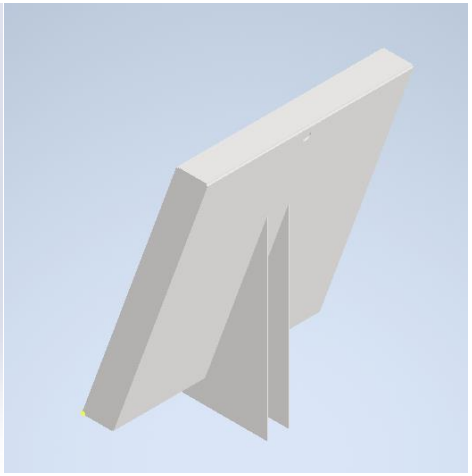
Proposed Design:
Max. Deflection: 0.02 in.

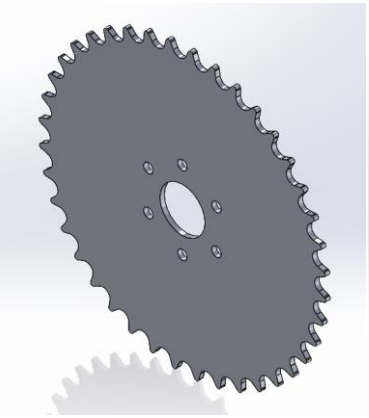


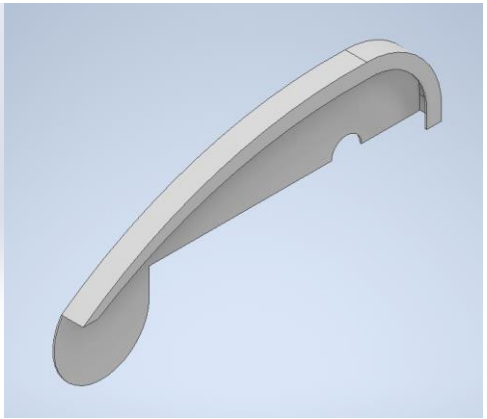
Aesthetic Design

Designed Components



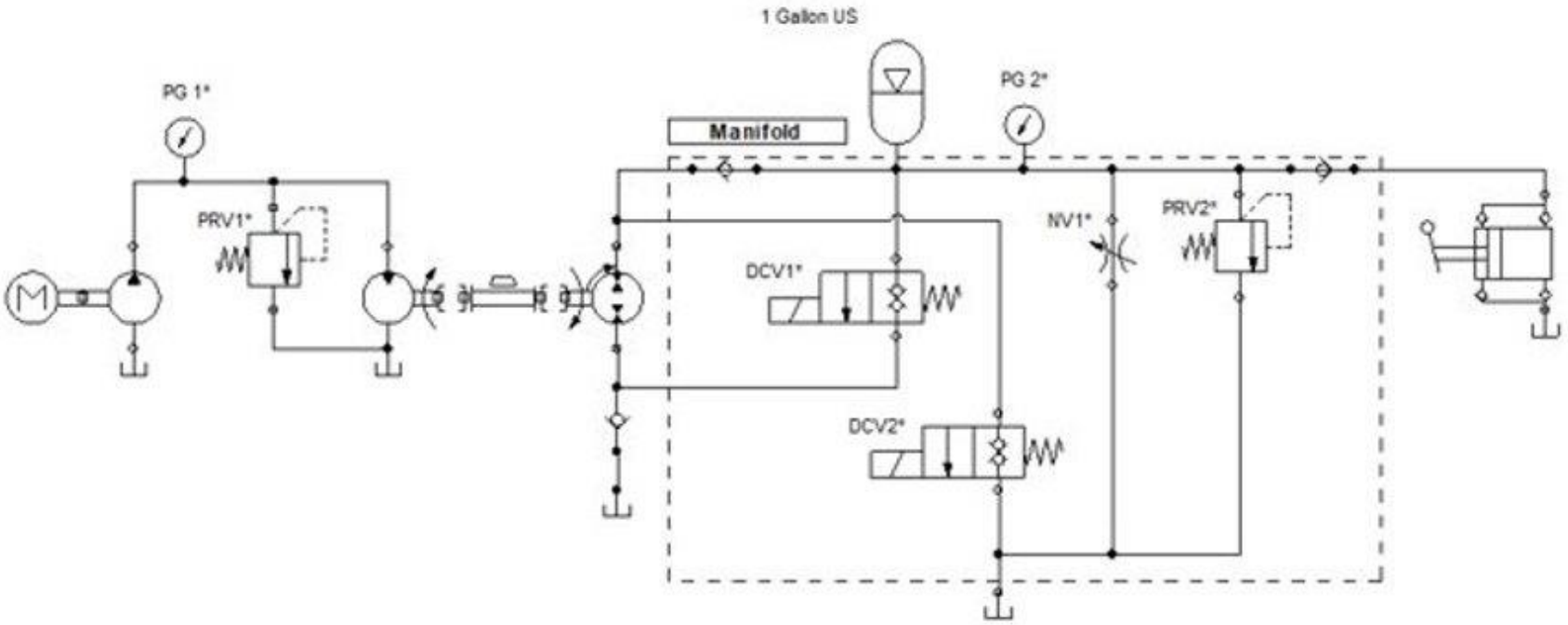




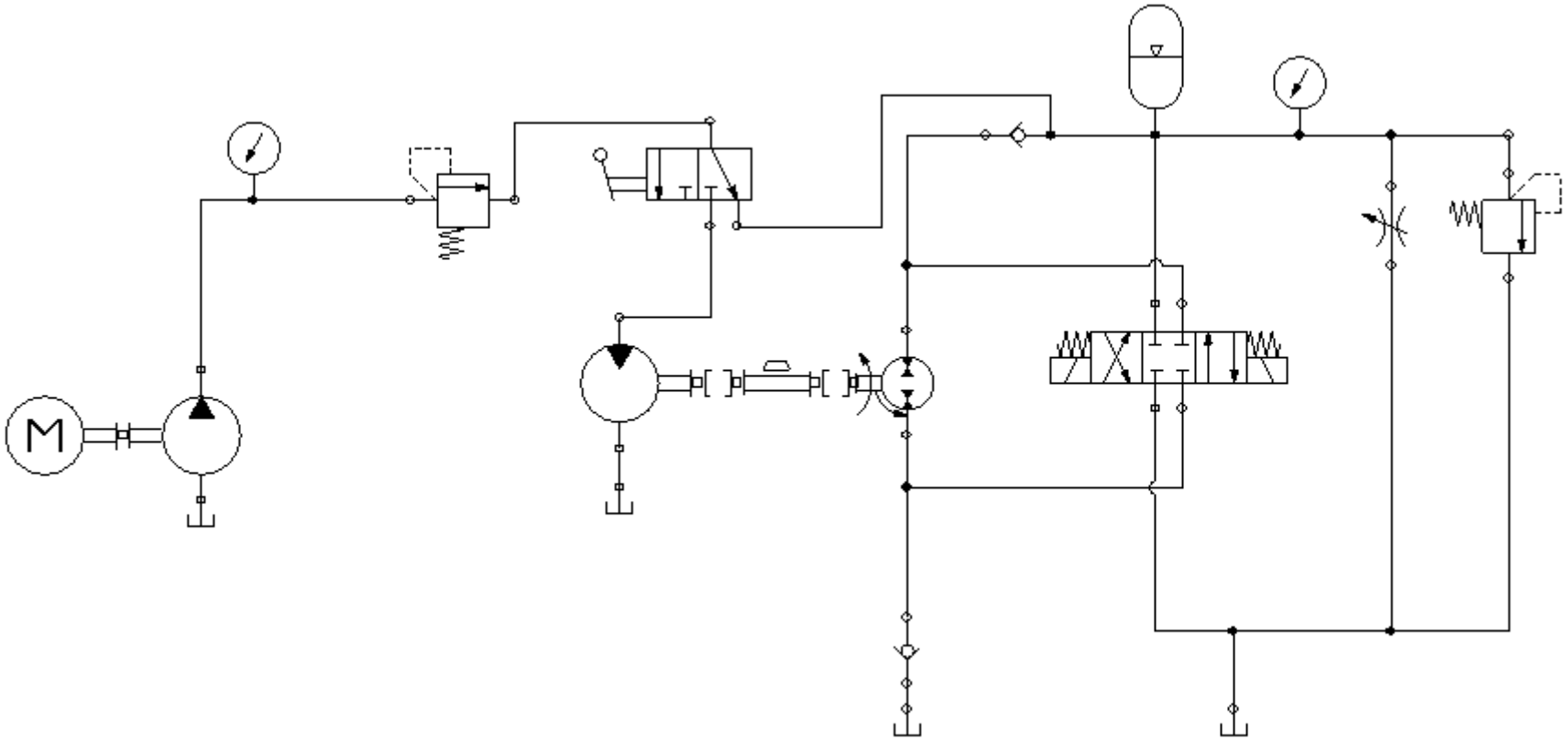


Final Vehicle

Previous Hydraulic Circuit



Current Hydraulic Circuit

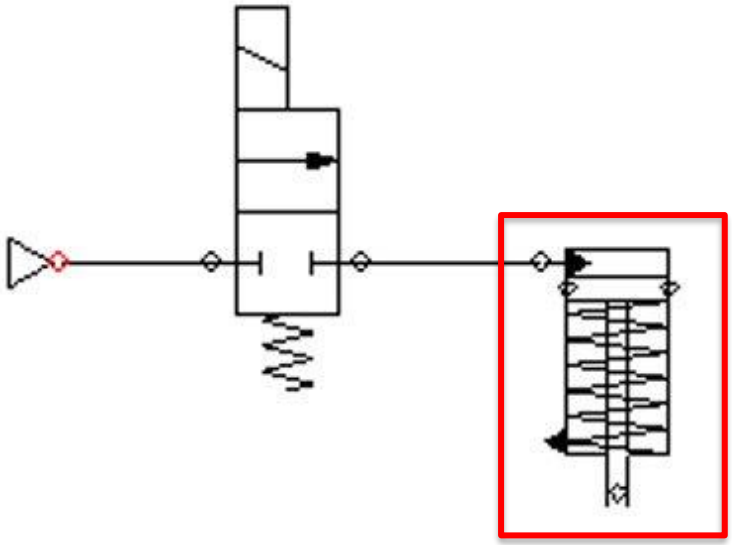


Motor Size Testing

- Used a combination of calculations and testing to determine motor displacement
- Prior Year Pedal-Powered Motor Displacement:
  - 2.1 cc/rev
- Current Pedal-Powered Motor Displacement:
  - 2.8 cc/rev
- 2.8 cc/rev displacement should provide more torque and acceleration

Pneumatic Circuit

Previous Year Circuit



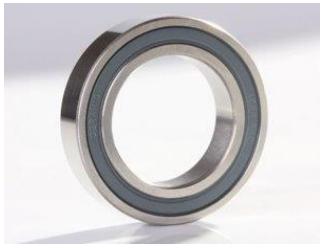
Current Circuit Modification

Improvements

Bike Hardware Design Approach

1. Tires and Tubes
2. Ceramic Bearings
3. Hydraulic Brakes (180mm)
4. 8 Speed Derailleur

(1)



(2)

(3)

(4)

Clutch Design

- Pneumatic clutch
- Friction clutch from Nexen
- Improved efficiency and proper sizing
- 144 in-lb corresponds to the 450 clutch

Previous

Current

Electronics

- Using the EXOR 705 platform for display and control
- Display pressures, speed, and allow for control of clutch and valve

Electronics

- Balluff BES007J Proximity Sensor
- HYDAC pressure sensor
- Full control and feedback with the Exor HMI

Mode Table

Mode	Valve	Clutch
Coast	Off	Off
Discharge	On	On
Regen	Off	On

- Only 3 states
- In discharge mode the clutch engages 500 ms before the valve turns
  - And again, when disengaging this mode
- Special thanks to Josh Scarbrough, IFP for the coding expertise

Lessons Learned

- Long lead times for components
- Chain alignment and hardware must be precise
- Utilize knowledge of industry professionals
  - Clutch
  - D03 Valve
  - HMI/Controller Coding
- Setting deadlines is essential
  - Planned worktimes and meetings
- Communication with group members and mentors is important

NFPA Fluid Power Vehicle Challenge

Thank you!