Cockpit/Controls/ Brakes/Safety

Driver interfaces, seat, belts, steering wheel, steering column, control panel/dash, cockpit sizing & protection, driver comfort/ease of control, shifter, pedals, braking system. Safety considerations. Selection and material use.

Pedals

Design Goals

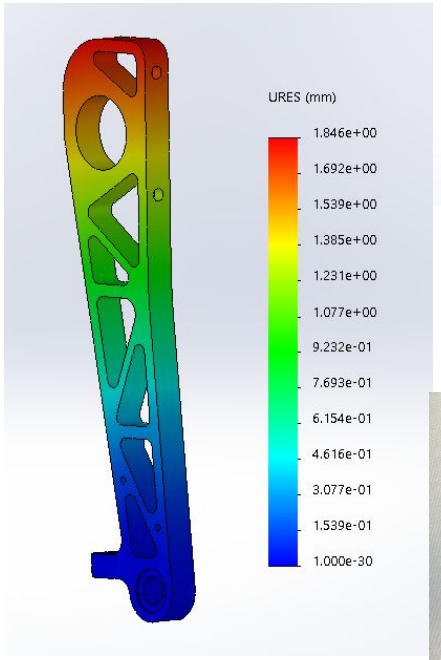
- **Meet Packaging Restraints:** 11x6 Baseplate, 98th percentile tall male & 5th percentile short female
- **Adjustability/Serviceability:** pedal rails allow easy movement for different height drivers, standard bolt size
- **Ergonomics/Simplicity:** initial pedal angles, pedal pad area
- **Reliability/Safe:** BOTS, sensor protectors, FEA's

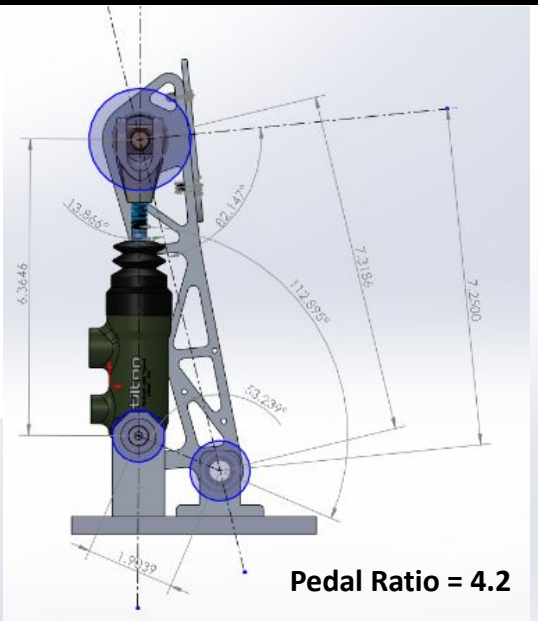
Materials

- 6061 aluminum baseplate
- Stainless steel pedal rails
- Carbon fibre heel rest
- EV West Billet Al APPS Sensor
- Brake System Encoder (BSE)
- Break Over Travel Switch (BOTS)
- Tilton 78-Series Master Cylinders

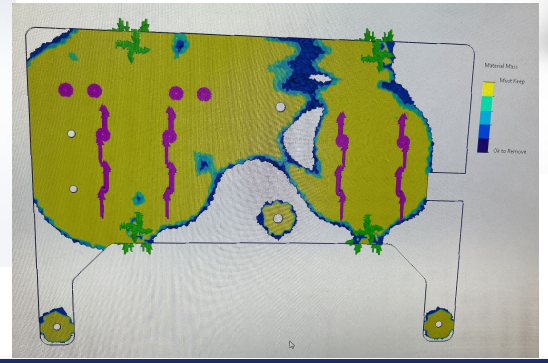
Analysis/Testing

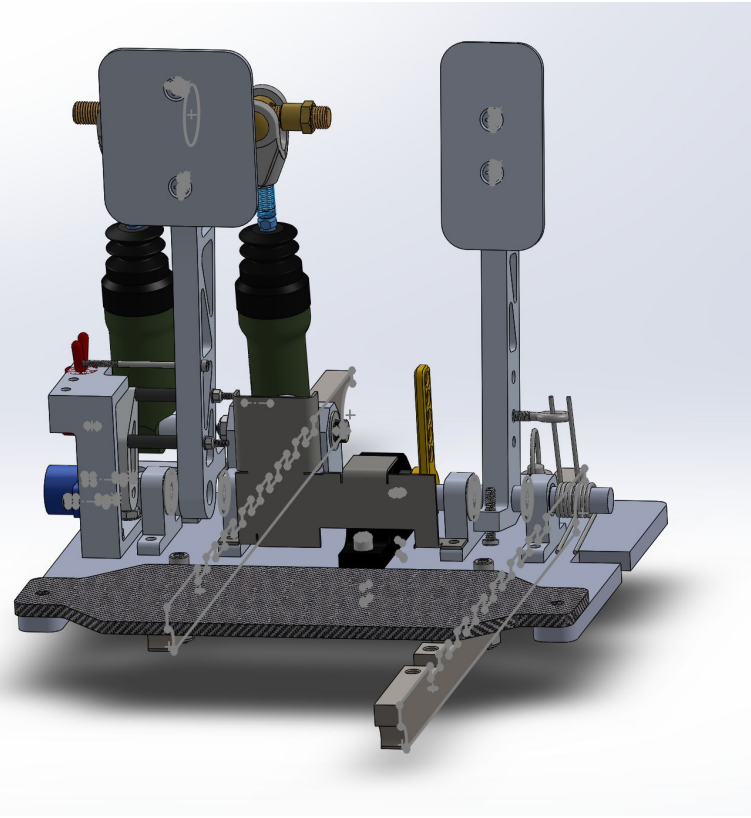
- Minimum factor of safety: 2
  - Topology optimization test
- Driver's comfortability test, reasonably stiff throttle





Pedal Ratio = 4.2





Dashboard and Peripherals (LV Mounting)

Goals:

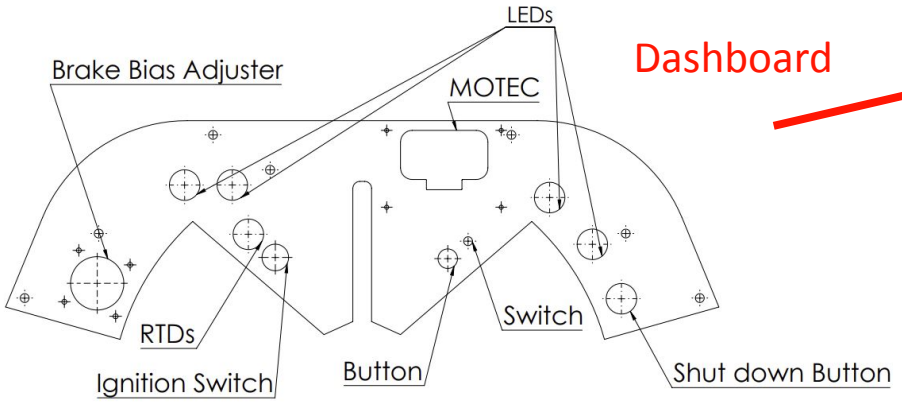
- Rigider mounting
- Waterproofing
- Stronger mounting material

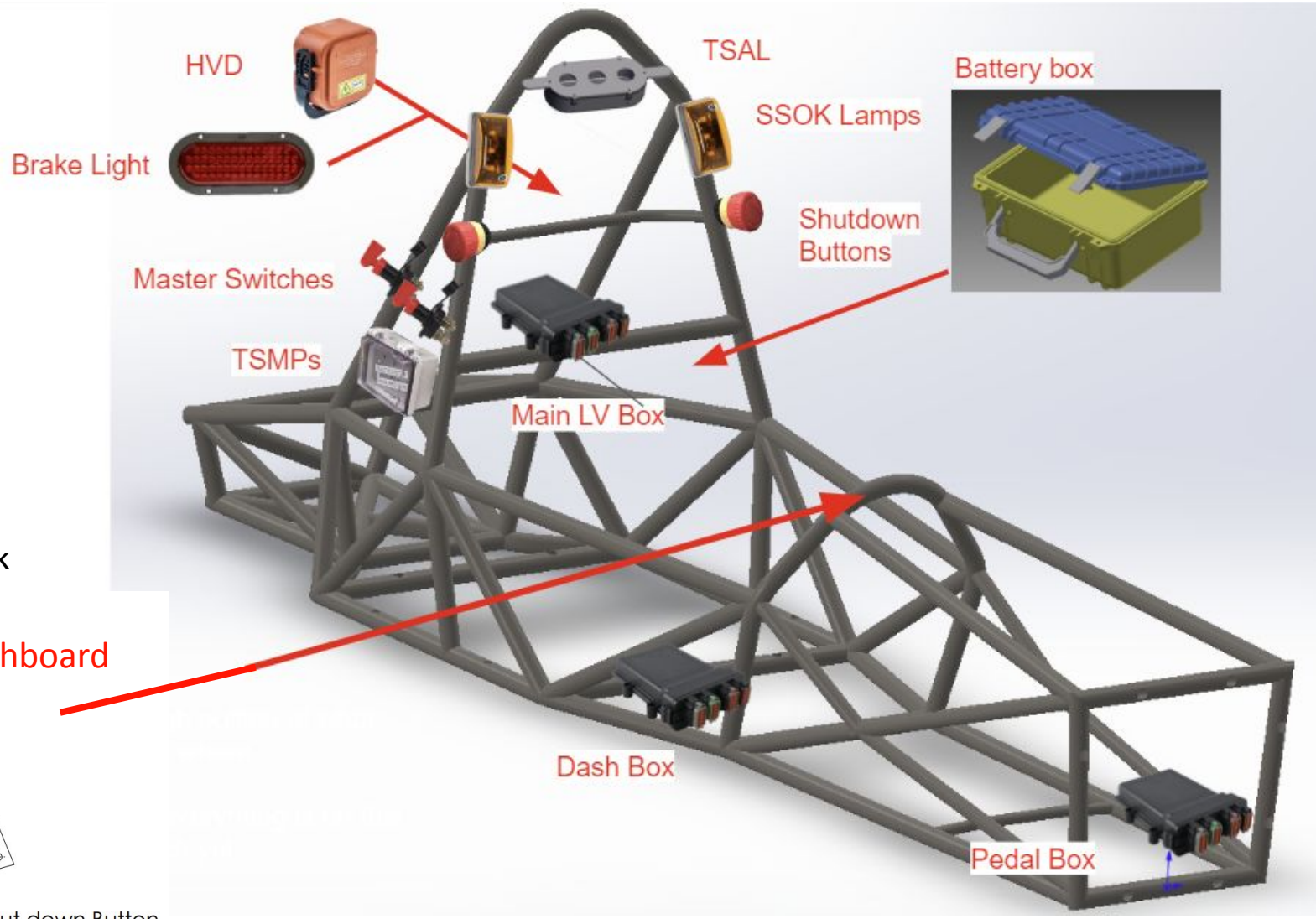
Implementations:

- Aluminum 6061 → dashboard
- Welded tabs over zip-tie

Test:

- Test LV components fit before machining final stock





Cockpit

Headrest

Carbon Fiber Backing
Foam Headrest

Goals:

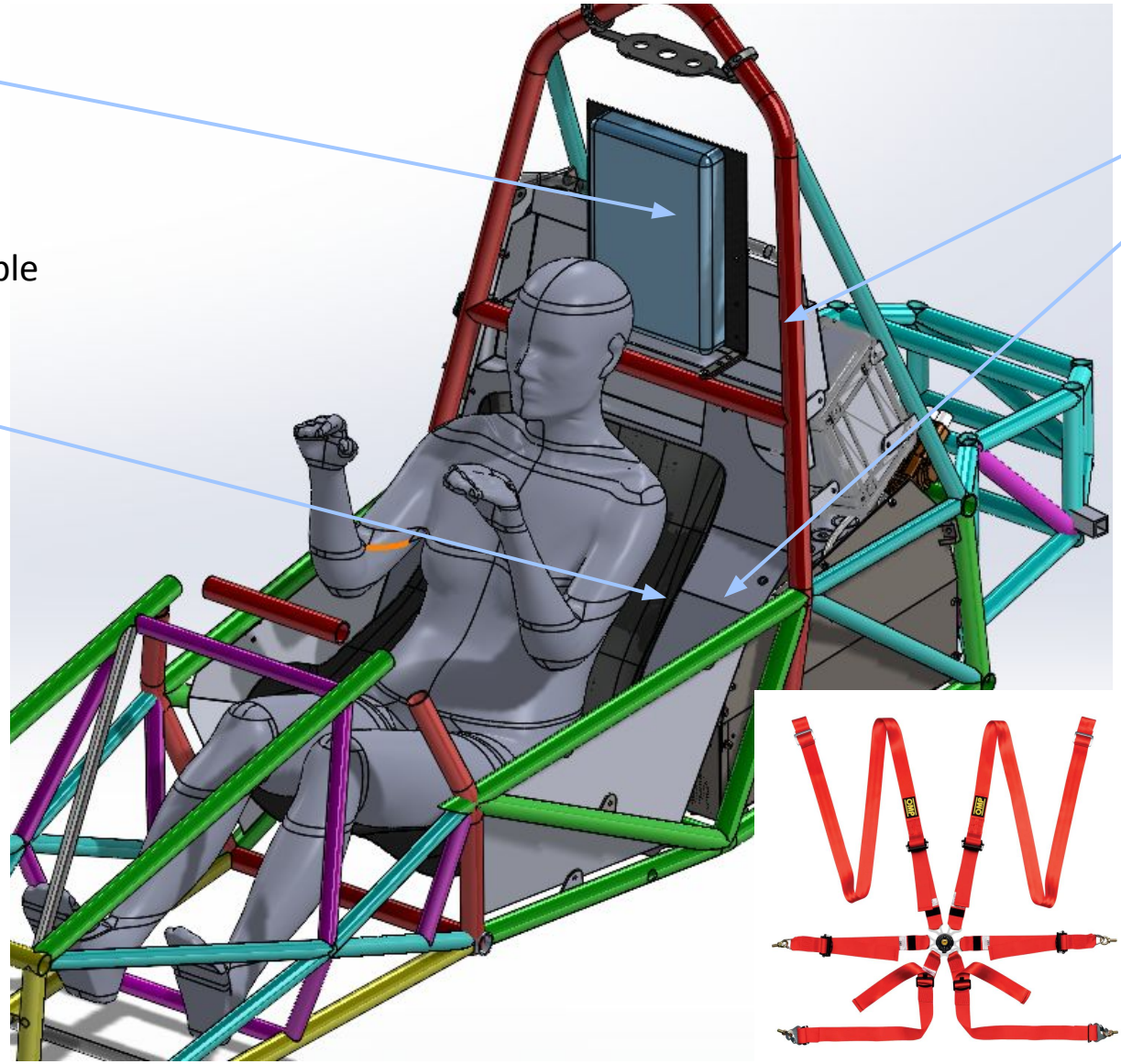
- Sturdily mounted and adjustable

Seat

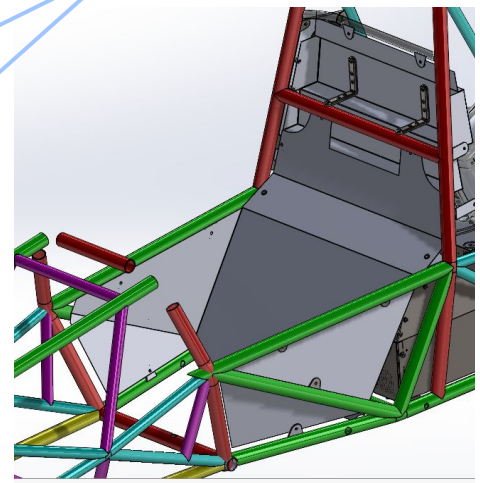
Carbon Fiber Shell w/ Creaform Molded Seat

Goals:

- Seatbelt is accessible
- No interference with belt and mounting points



Firewall



5052 Aluminum
Kydex 100 Insulation Material

Goals:

- Full coverage of cooling, electrical components and others for driver safety
- Accomodations for seatbelt and brake line routing and headrest mounting

Brakes

Design Goals:

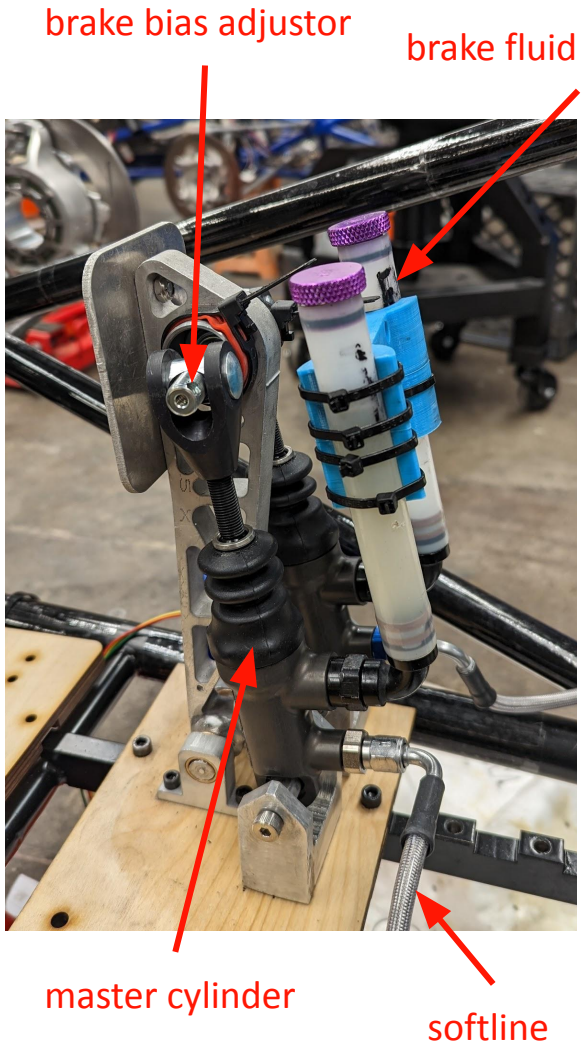
1. Pass the Formula SAE IN.12 Brake Test

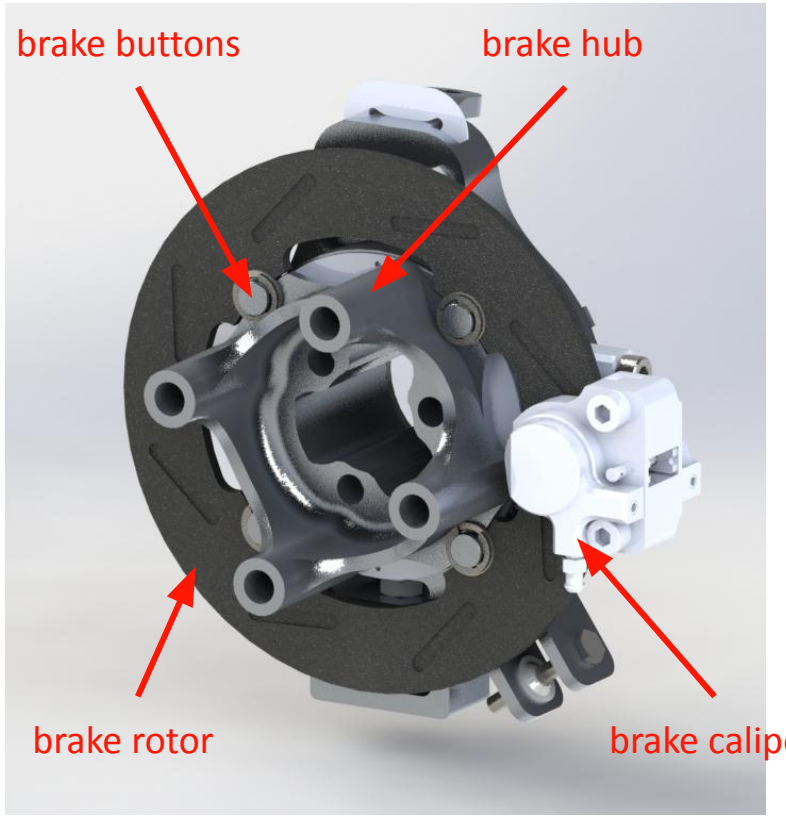
2. Robust and Reliable System

Hardware Specifications and Vehicle Spec/Parameters:

- Brake Calipers:
  - Front: 4 Piston, 25mm dia.
  - Rear: 2 Piston, 25mm dia.

- Rotors
  - 4.75mm Dura-Bar G2 Cast Iron



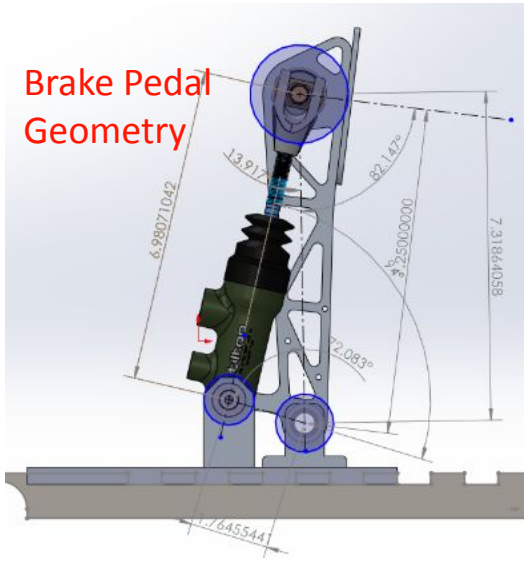


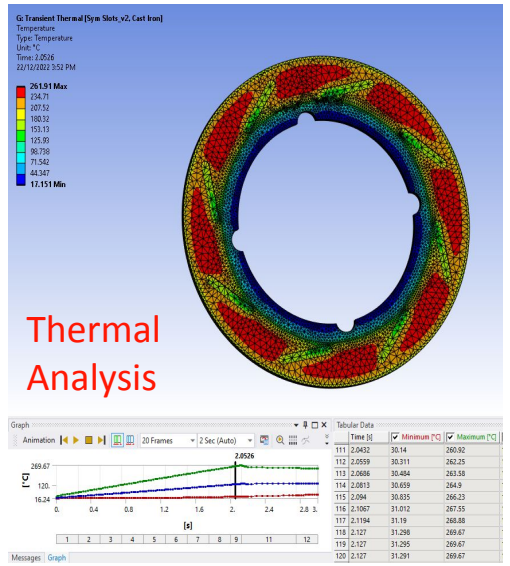
Brakes Analysis

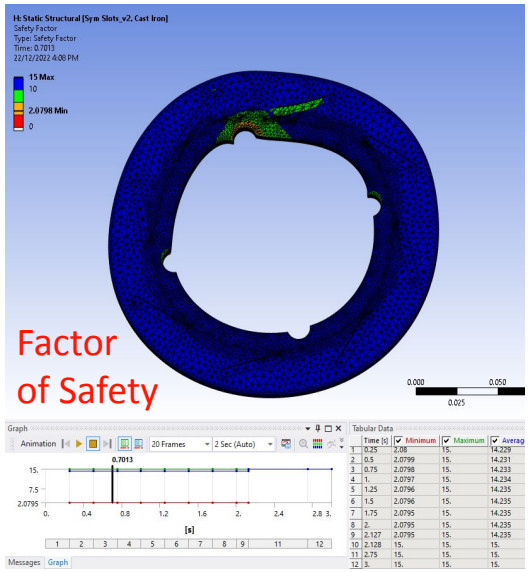
- Master Cylinder (MC) specs:
  - front: 7/10” diameter
  - rear: 13/16” diameter

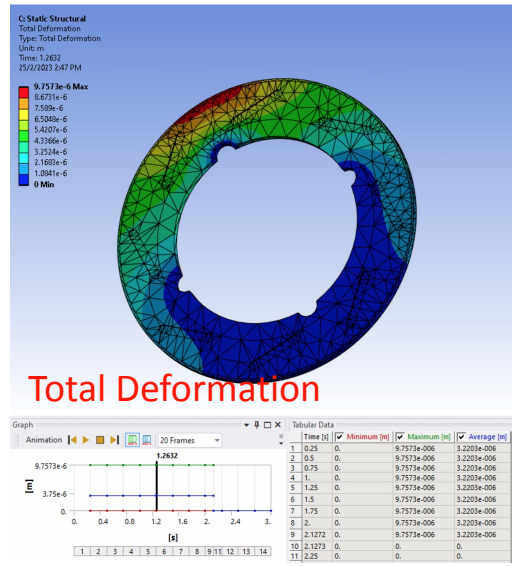
- MC Mounting
  - pedal geometry
    - pedal ratio: 4.16
    - Angle/mounting of master cylinder determines pedal ratio geometry

- Rotor analysis – minimum safety factor
  - Front: **2.309**
  - Rear: **4.8648**
  - Safety Requirement is met



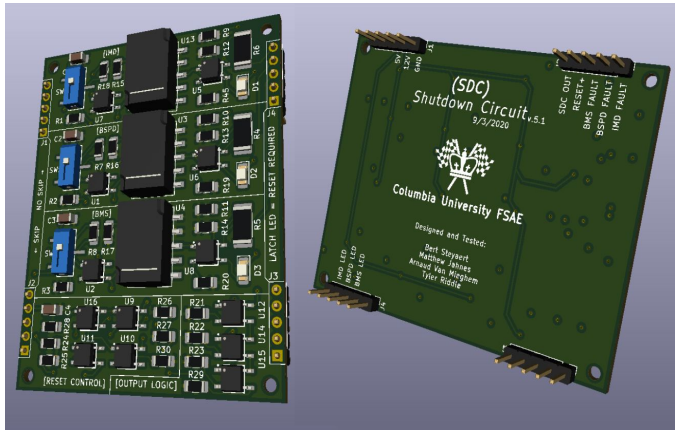


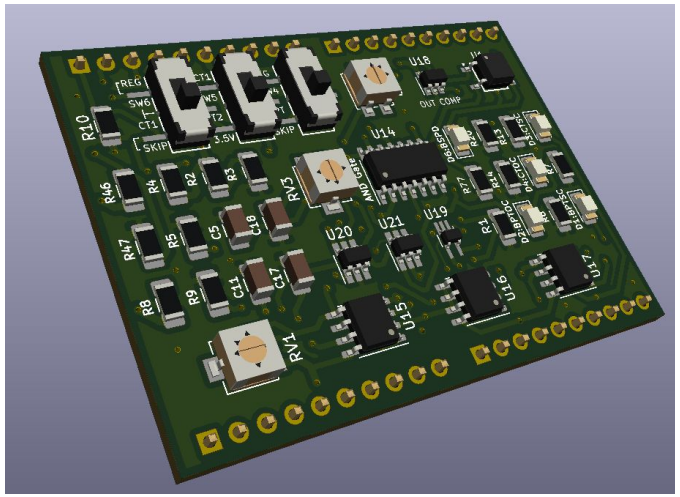




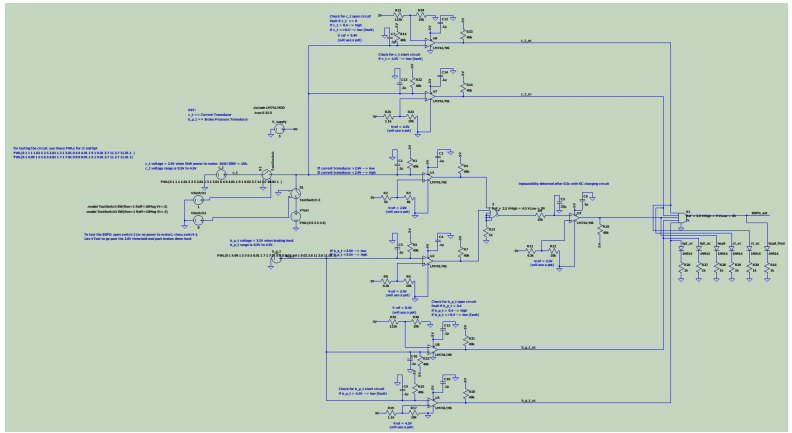
Shutdown Module and Switches

SDC and BSPD Circuits

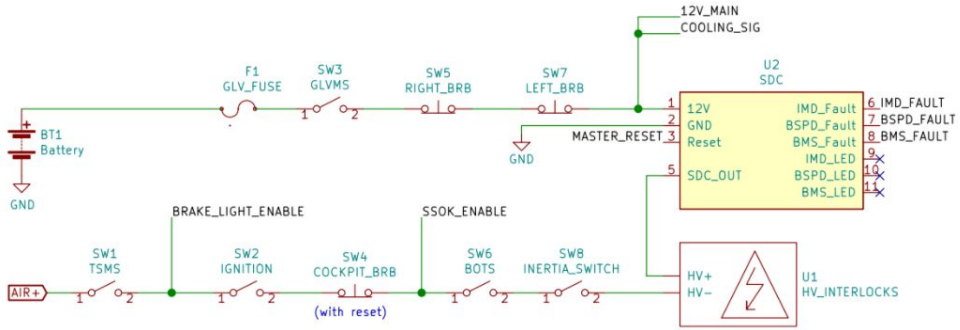




- Both the SDC (top) and BSPD (bottom) are designed with testing and packaging in mind
  - Switches and potentiometers allow for sensor simulation
  - SMT components and multilayer design allows for smaller packaging
- Operation of both boards verified on LTSpice with all possible fault conditions checked



Shutdown Loop



- Includes a car key switch for added safety
- A capacitor bank was added to the shutdown circuit to help provide the 100ms 1.3A spike required to initially flip the AIRs
- Faults on the shutdown loop are displayed to the driver through LEDs on the dashboard