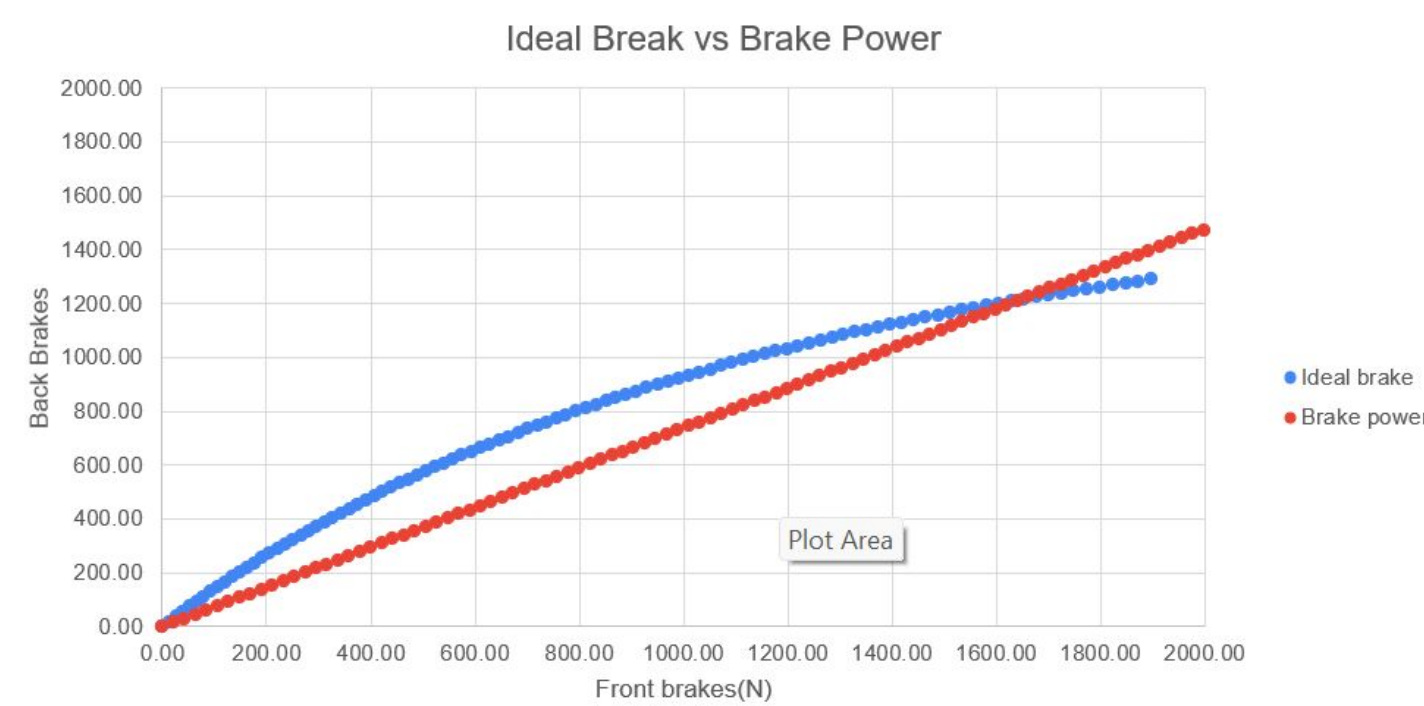


## Introduction

The FSAE EV braking system is engineered for **maximum stopping power, efficiency, and reliability**. It features **drilled & slotted rotors, hydraulic actuation, and optimized brake bias** to enhance performance. A key aspect of our design includes a **chart representing the ideal brake curve**, ensuring balanced braking force distribution for optimal control. The focus is on **functionality, simplicity, and meeting competition standards**.

## Brake Bias Calculations



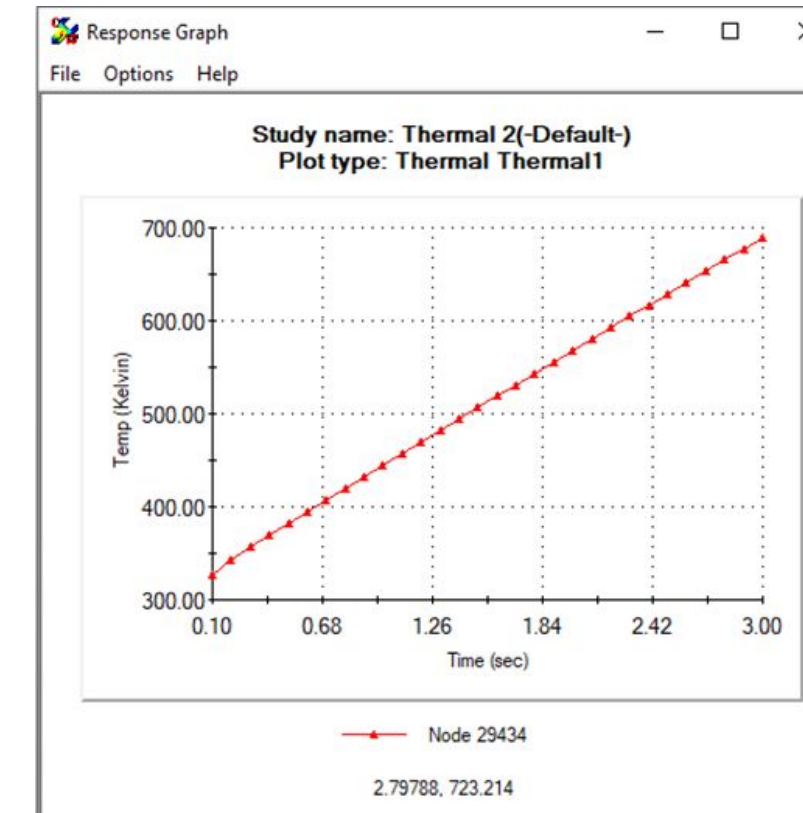
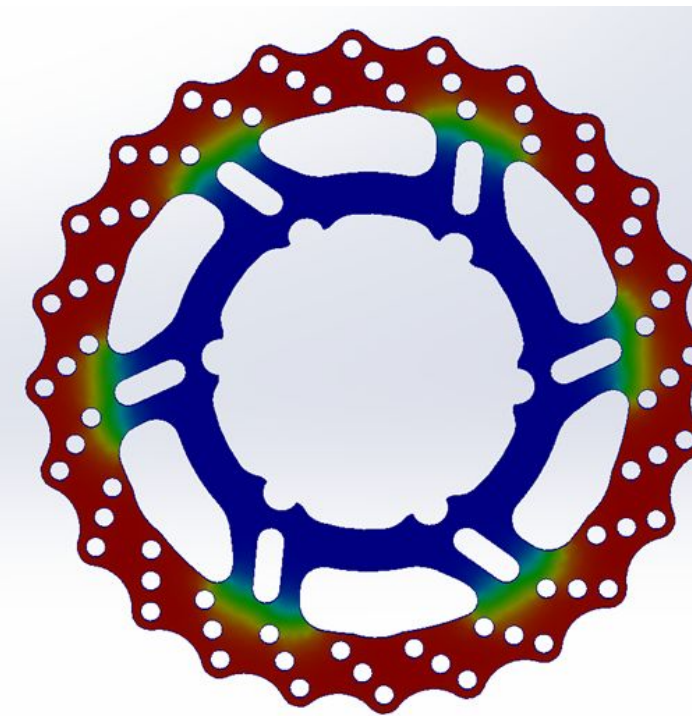
- The graph displays two equations:
  - Max system brake output
  - Our brake system output
- The lines indicate braking stability: Red line above blue → Rear brakes lock first → Risk of spinning out
- Chosen brake bias: 35% rear / 65% front

## Future Improvement

- Refine pedal mounting plate (currently wood)
- Incorporate brake sleeves for protection of brake lines (previously used pool noodles)
- Route wires without interfering other components such as the drivetrain; needs to be accessible as well.
- Include brake bias for better control and brake efficiency
- Aiming to incorporate regenerative braking

## Brake Rotors - Drilled & Slotted Design

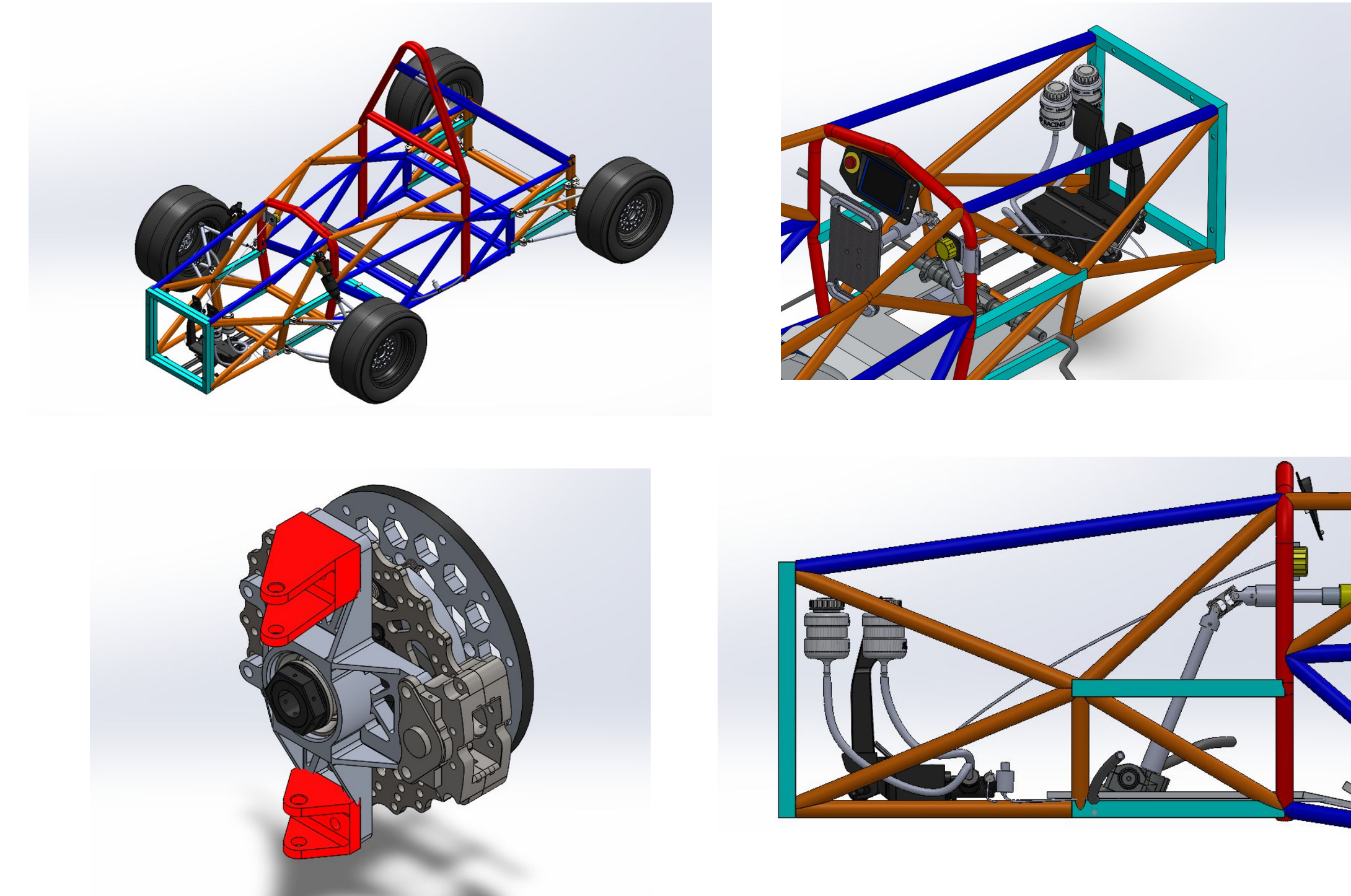
- Objective:**
  - Analyze **heat buildup in brake rotors** under worst-case braking conditions
  - Ensure rotors operates within safe temperature limits to prevent failure
- Simulation Parameters:**
  - Ambient Temperature:** 305K (hot day in Michigan)
  - Vehicle Speed:** 25 m/s
  - Braking Time Interval:** 3s (with 0.1s increments)
  - Total Mass (Car + Driver):** 326 kg
- Results & Implications:**
  - Max Rotor Temperature:** 689K ( $\approx 416^{\circ}\text{C} / 780^{\circ}\text{F}$ )
  - Material:** 4130 Steel (Annealed) operates at  $425\text{--}540^{\circ}\text{C}$
  - Potential Concern:** Overheat, requires better airflow



## References

- Brembo. "Brake System Technology." Brembo Brakes, n.d. Accessed 25 Feb. 2025. <https://www.brembo.com/en/car/original-equipment/brake-systems>.
- Grzes, Pawel, and Zbigniew Adamowicz. "Analysis of Disc Brake Temperature Distribution during Single Braking Under Non-axisymmetric Loads." *International Journal of Automotive Technology*, vol. 13, no. 1, 2012, pp. 57–63.
- Limpert, R. (2011). *Brake Design and Safety* (3rd ed.). SAE International.
- Smith, John R. *High-Performance Brake Systems: Design and Engineering*. SAE International, 2020.
- Wilwood Engineering. *GP200 Brake Caliper Specifications*. Wilwood, 2024, [www.wilwood.com](http://www.wilwood.com).

## Modeling of Brakes Subsystem



- Brake System Components**
  - Tilton 600-Series 2-pedal underfoot assembly**- compact and ergonomic
  - Mechanical bias bar** - adjustable front-to-rear braking force
  - Hand and Soft brake lines** - routed for efficiency and clearance
  - Wilwood GP 200 calipers** - reliable stopping power
  - Drilled & Slotted Rotors** - improved heat dissipation
  - Remote reservoir system** - easy maintenance, consistent fluid supply
  - Dot 5.1 Brake Fluid** - high boiling point, low viscosity for racing

## Proof of Concept



- Prototypes** of braking system were installed on EVO, EV's old race car
- Components will be **tested for effectivity and duration** through a series of track tests
- Custom fixtures** were made in order for the parts to fit properly as EVO was not the car that they were originally designed for
- Braking system will be tested on a race track
- Data will be collected to determine its effectiveness

