

# Numerical/Experimental Validation of AER Electric Racecar Aerodynamic Package

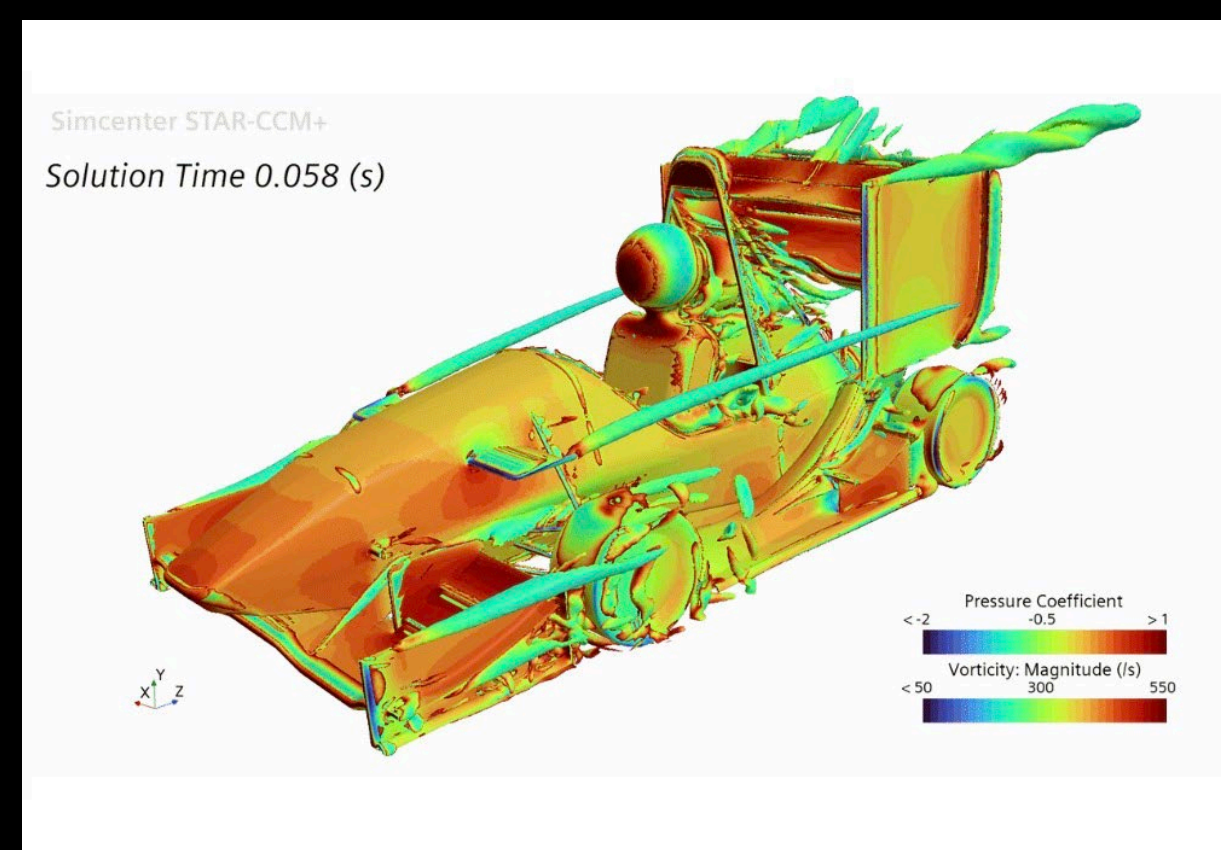
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## 1. Introduction

Aerodynamic performance plays a critical role in maximizing tire grip, vehicle stability, and lap time performance in electric Formula SAE vehicles. This study investigates the aerodynamic characteristics of the SDSU Aztec Electric Racing (AER-26) vehicle through a combined experimental and computational approach. A quarter-scale model of AER-26 is manufactured and tested in the SDSU subsonic wind tunnel to evaluate aerodynamic force and pressure distributions across aerodynamic surfaces. Experimental results are compared with computational fluid dynamics (CFD) predictions to assess correlation and validate aerodynamic behavior, contributing to the overall refinement of the aerodynamic package for future SDSU Formula SAE vehicles.

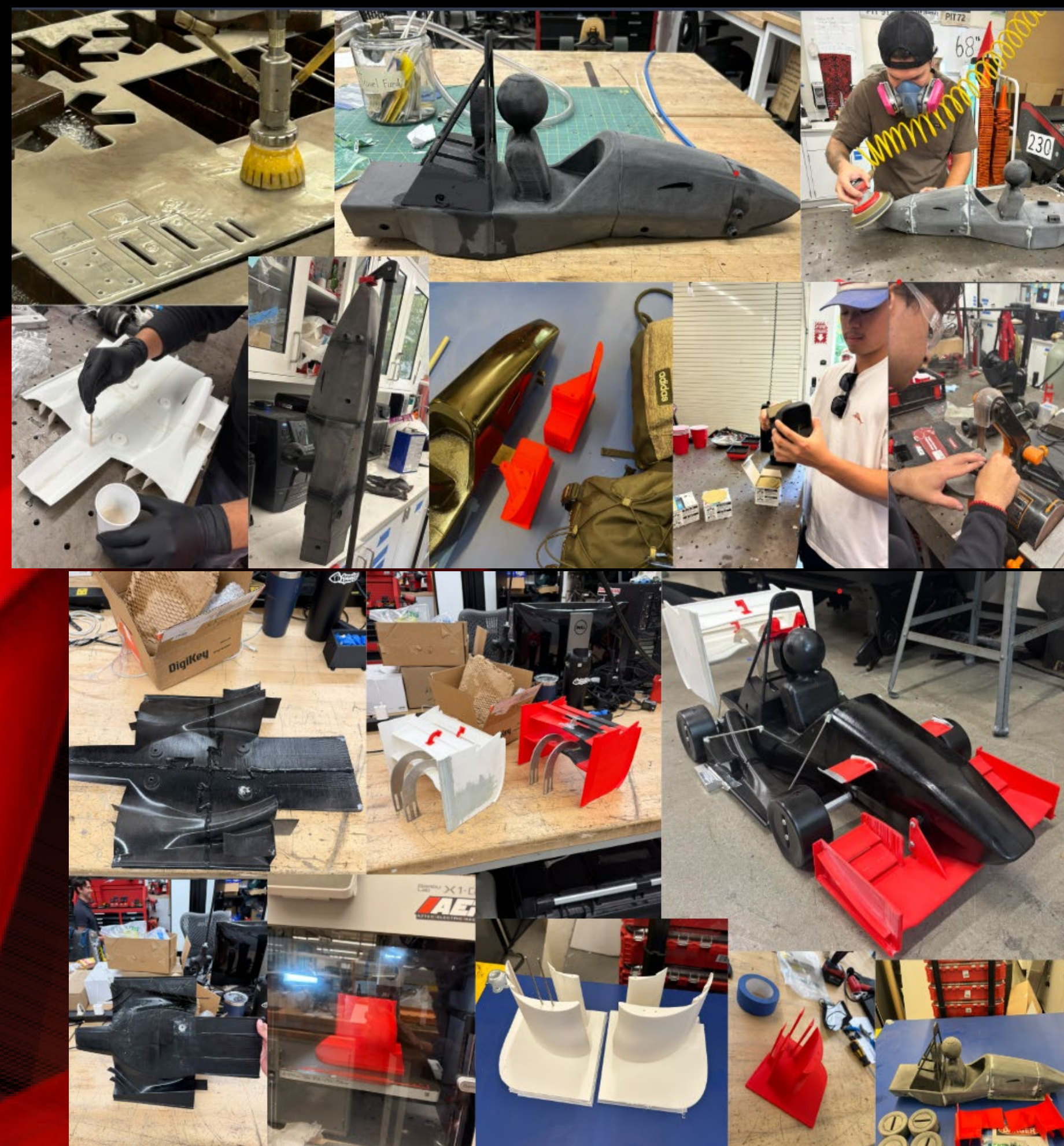
## 2. Project Objectives

- Perform experimental analysis on 1/4-scale wind tunnel model of AER-26 with respect to aerodynamic forces and pressure distribution on the aerodynamics package
- Provide Aztec Electric Racing with comprehensive aerodynamic data analysis and correlation to AER-26 CFD



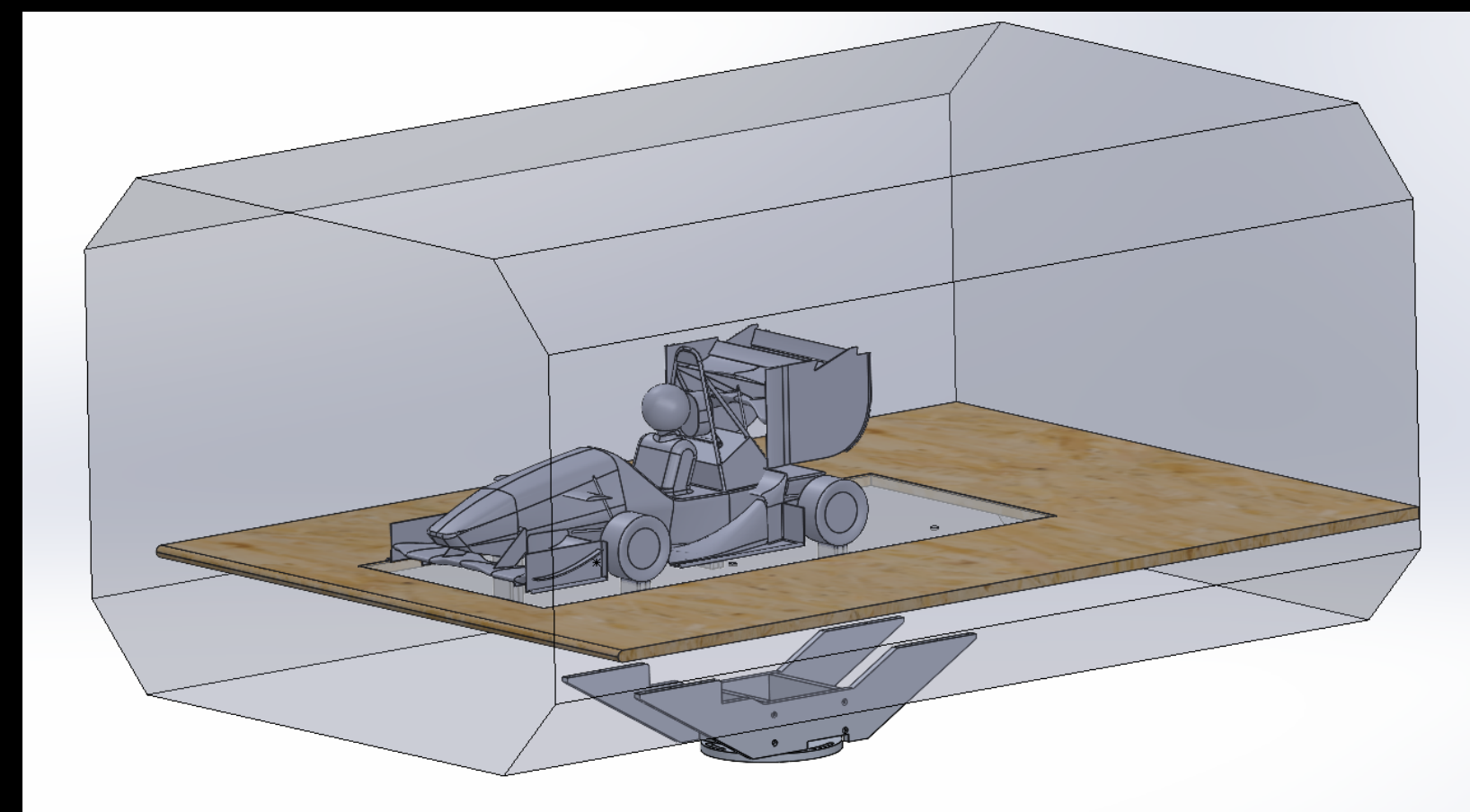
## 3. Manufacturing

The wind tunnel model's body and aerodynamic surfaces are entirely 3D printed with PLA. The wind tunnel model features adjustable ride height and variable rear wing position mechanisms, as well as being heavily modular for different configurations.



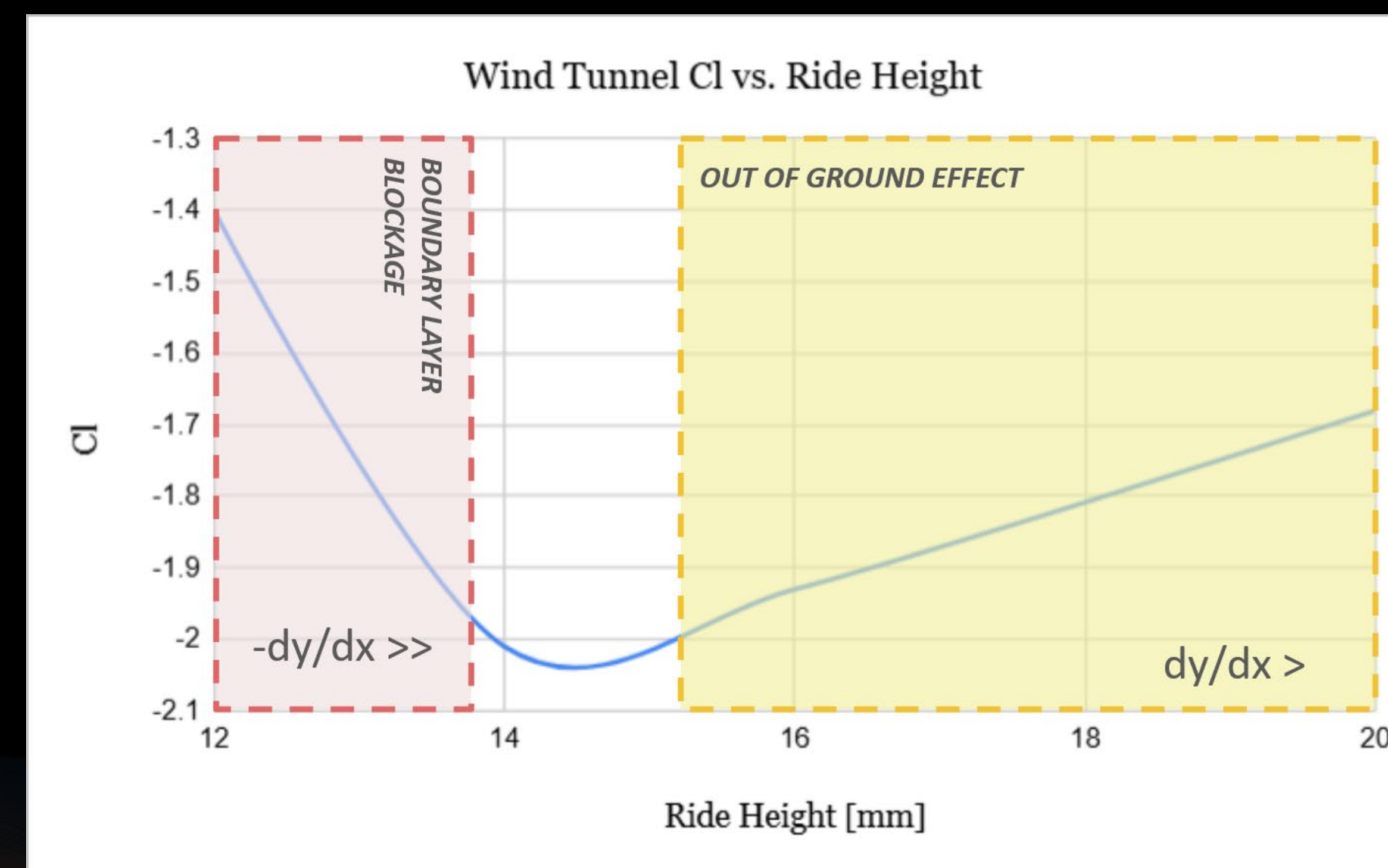
## 4. Experimental Objectives

- Force Analysis**
  - Investigating effects of varied ride height and rear wing position on car's downforce, drag, and aerodynamic balance
  - Validation of High-Downforce vs High-Efficiency aero configurations
  - Creation of OptimumLap simulation for comparison to AER-25
  - Correlation to AER-26 CFD expectations
- ScaniValve Implementation Testing**
  - Measuring local pressure and overall aerodynamic pressure behavior of undertray and rear wing
  - Creation of pressure maps and analysis of aerodynamic flow behavior over rear wing and undertray

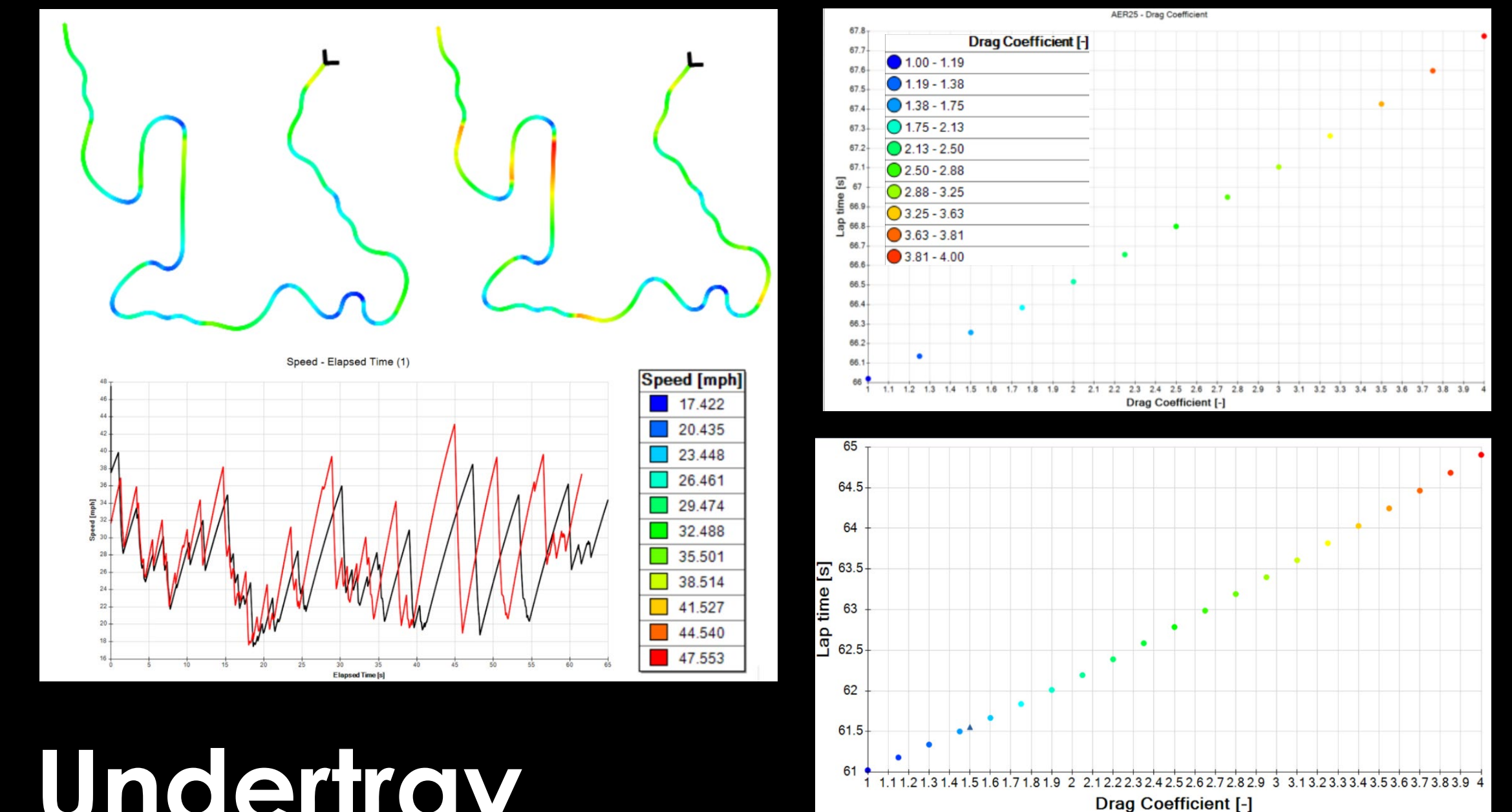


## 5. Results

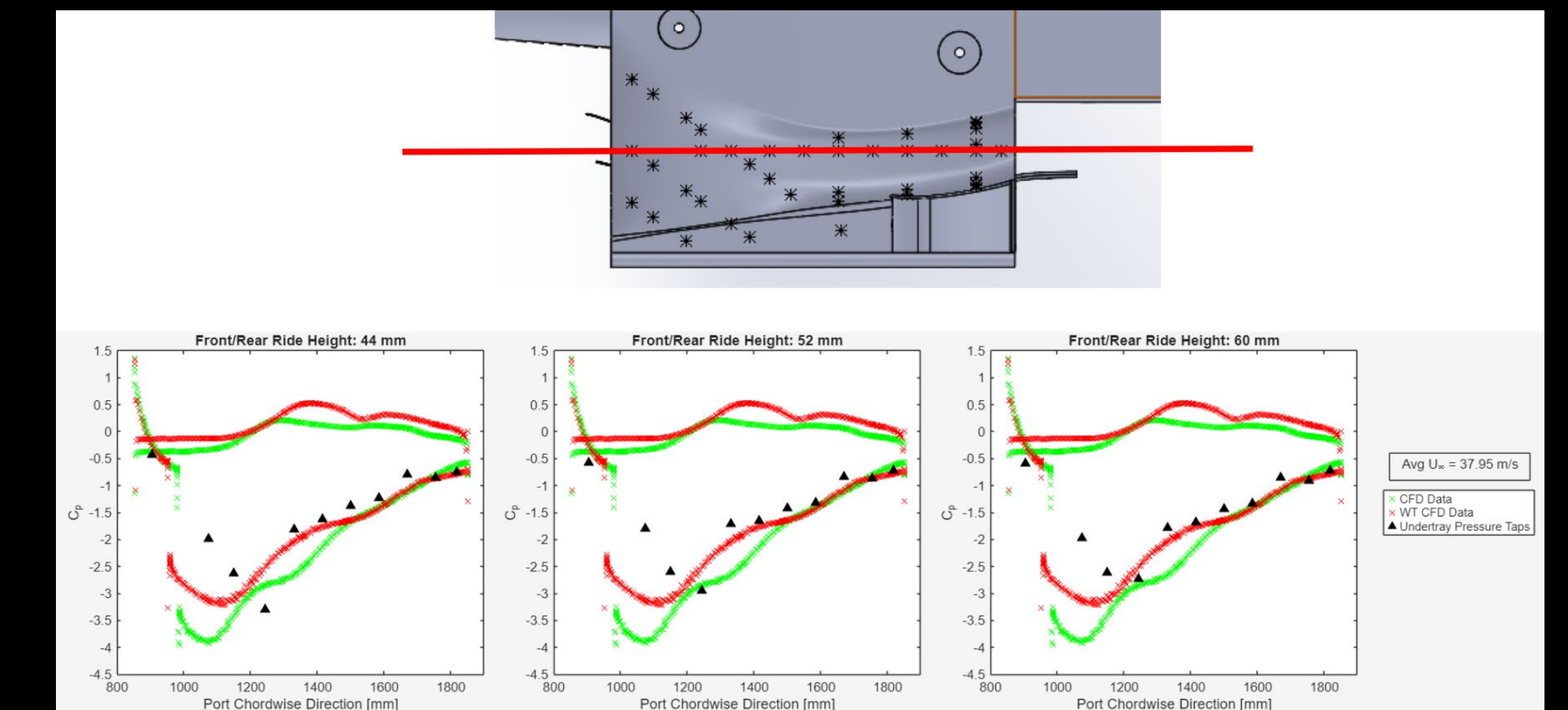
- Force Analysis**



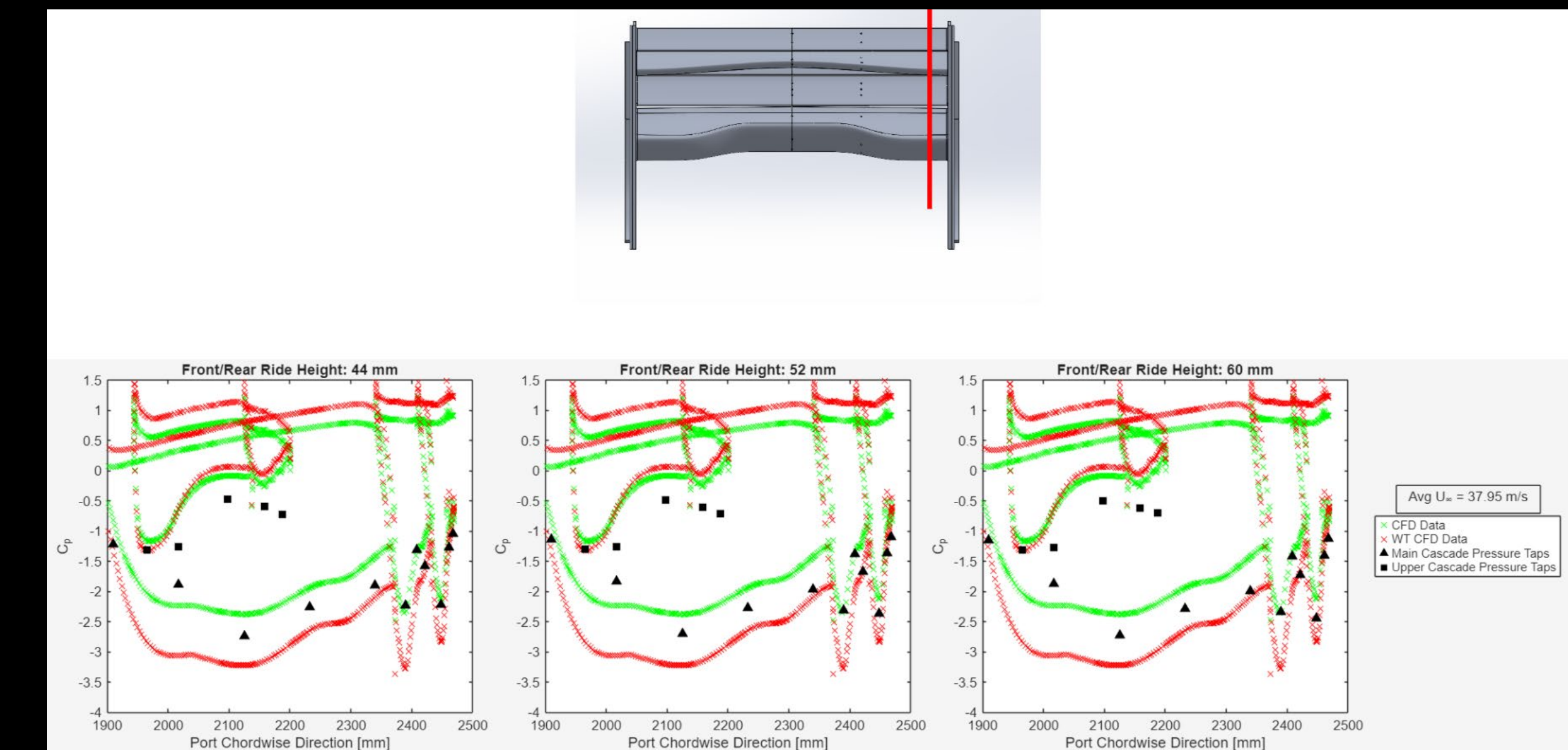
## OptimumLap Simulation



## Undertray



## Rear Wing



## 6. Conclusions

Our collected data and experimentation from the last 2 semesters show strong correlation to AER-26's CFD and expectations. Our force analysis resulted in 9-20% variation in values from wind tunnel testing to AER-26 CFD predictions. Furthermore, lap time simulations derived from wind tunnel data showed a ~5-6 second improvement in lap time over the previous design, AER-25. The pressure distribution maps over the rear wing and undertray both show trends very similar to both the AER-26 CFD and wind tunnel CFD.