TOYOTA SUPRA MK5

COMPETITION SERIES AERO KIT

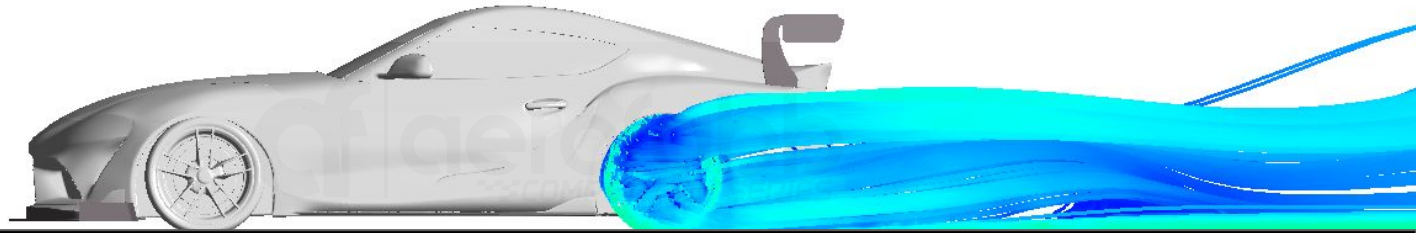
OVERVIEW

This report outlines the methodology employed for a simulation conducted using Ansys software's Fluent workbench. The objective of the simulation was to model the behavior of a car in a steady-state scenario, utilizing the k-omega turbulence model to account for turbulence.

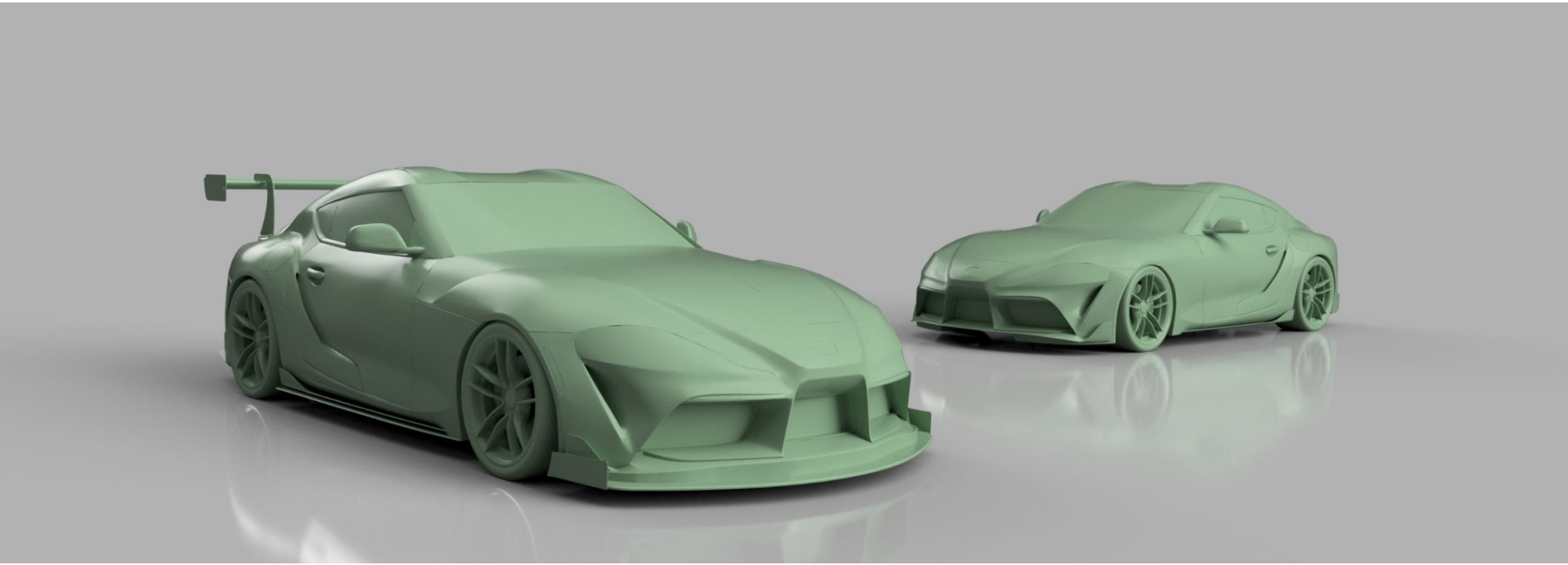
The simulation process involved creating different settings based on the mesh elements to ensure the accuracy of the results. Boundaries for the inlet, outlet, ground, and sky were established, with the same velocity applied to each to better simulate the actual scenario.

The simulation was further enhanced by giving rotation to the cars tires, therefore increasing the realism and accuracy of the entire simulation.

Post-processing was performed in CFD-Post.



VISUAL COMPARISON - AERO VS NO AERO



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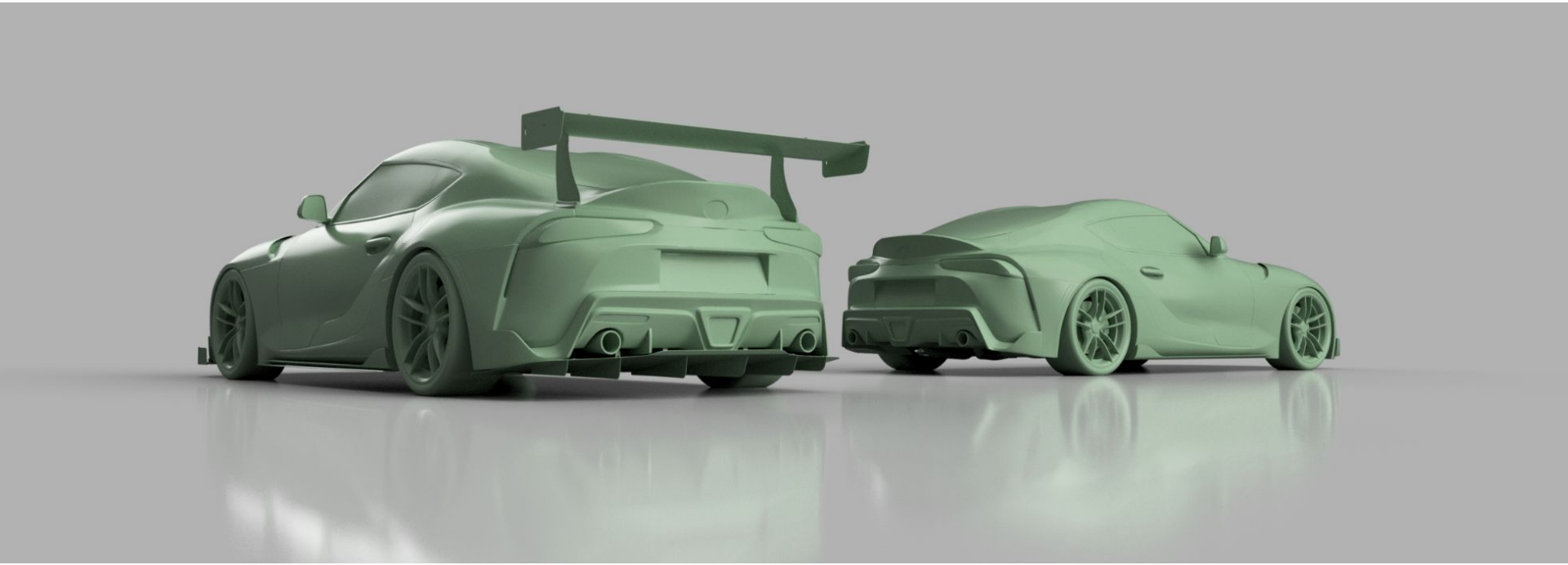
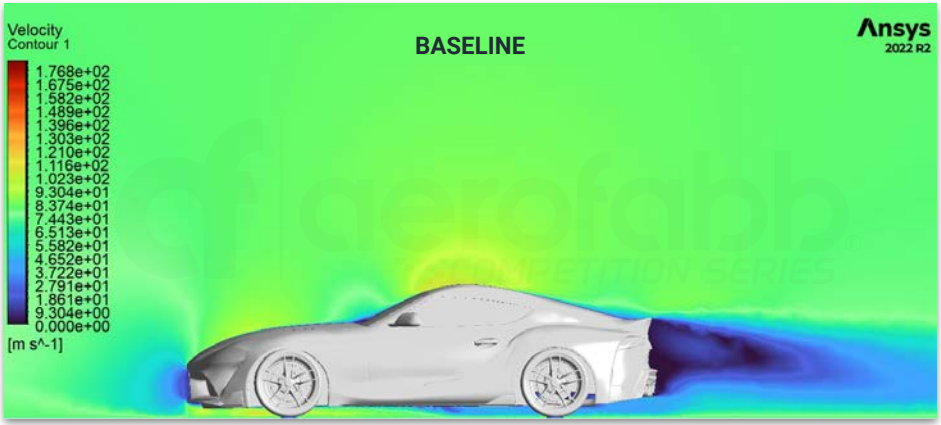


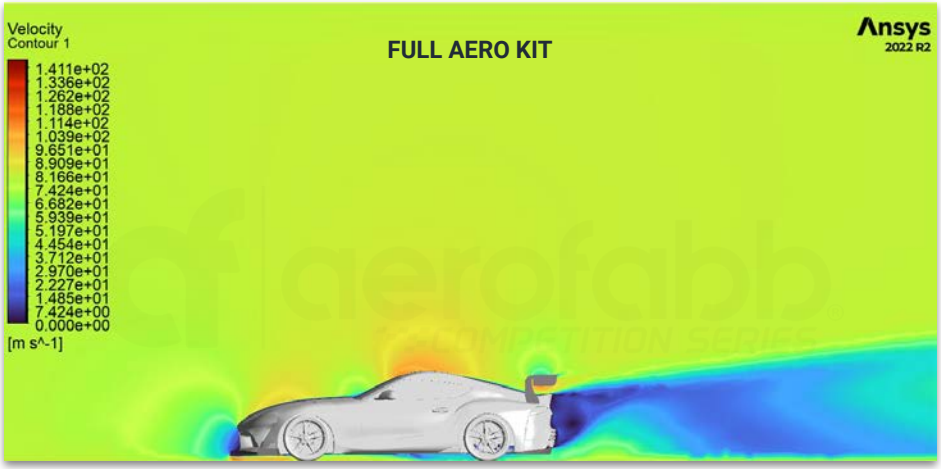
DATA - BASELINE

To establish a baseline, the car was simulated in stock body form without any aftermarket aero components.

Note: *Tire, wheel, and suspension specifications remained the same throughout all simulations. Car is equipped with*

- Refer to page 11 for full details on our vehicle set-up.





DATA - FULL AERO KIT DOWNFORCE VS. DRAG

Figure 1. compares DOWNFORCE produced by the Full Aero Kit installed (Front Splitter, Rear Diffuser, Rear Wing, Side Splitters) vs. total downforce the car produces without aero (baseline).

Figure 2. compares total DRAG produced by the Full Aero Kit installed (Front Splitter, Rear Diffuser, Rear Wing, Side Splitters) vs. total drag the car produces without aero (baseline).

- A downforce increase of 556% with a drag penalty of 42% is recorded at 11° AoA.

Fig 1.

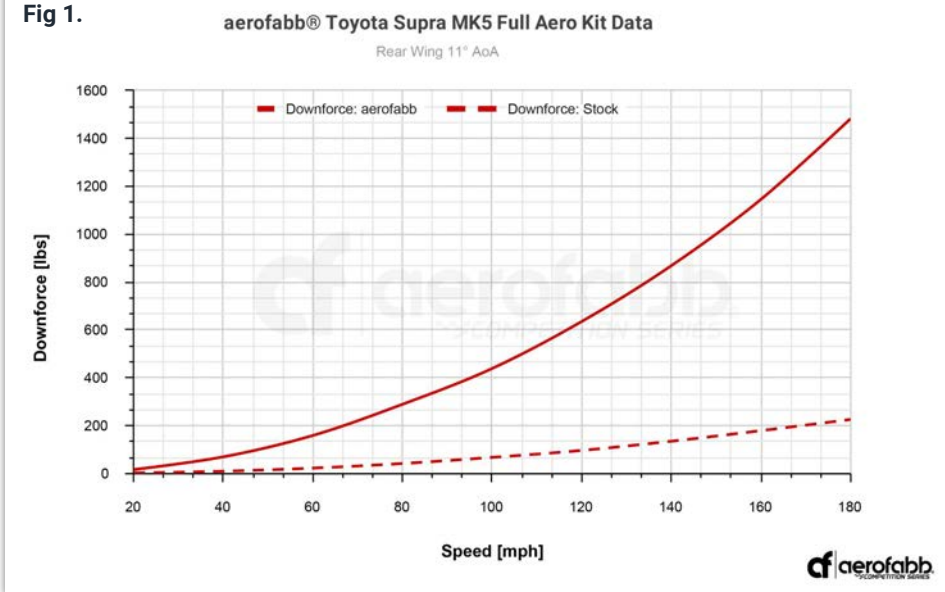
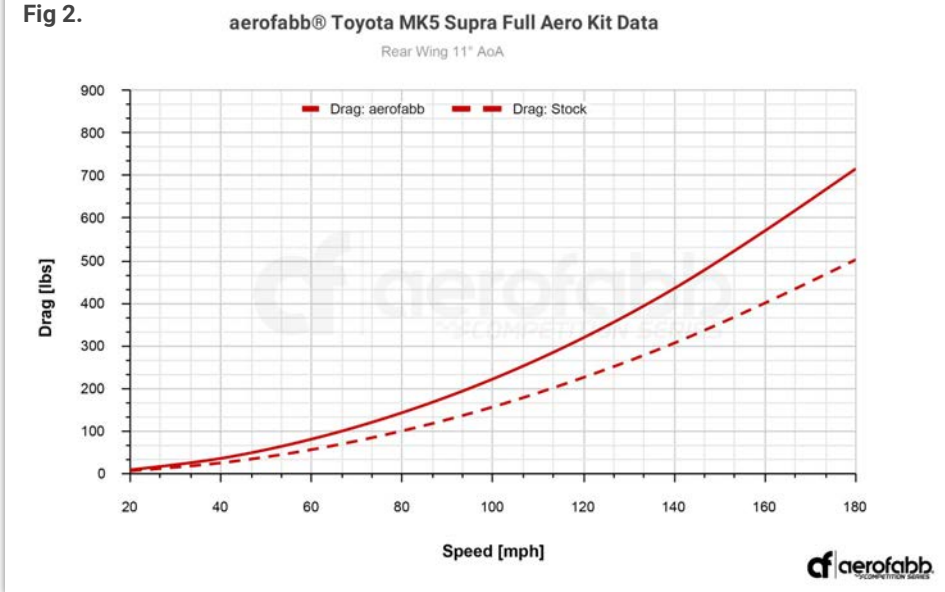
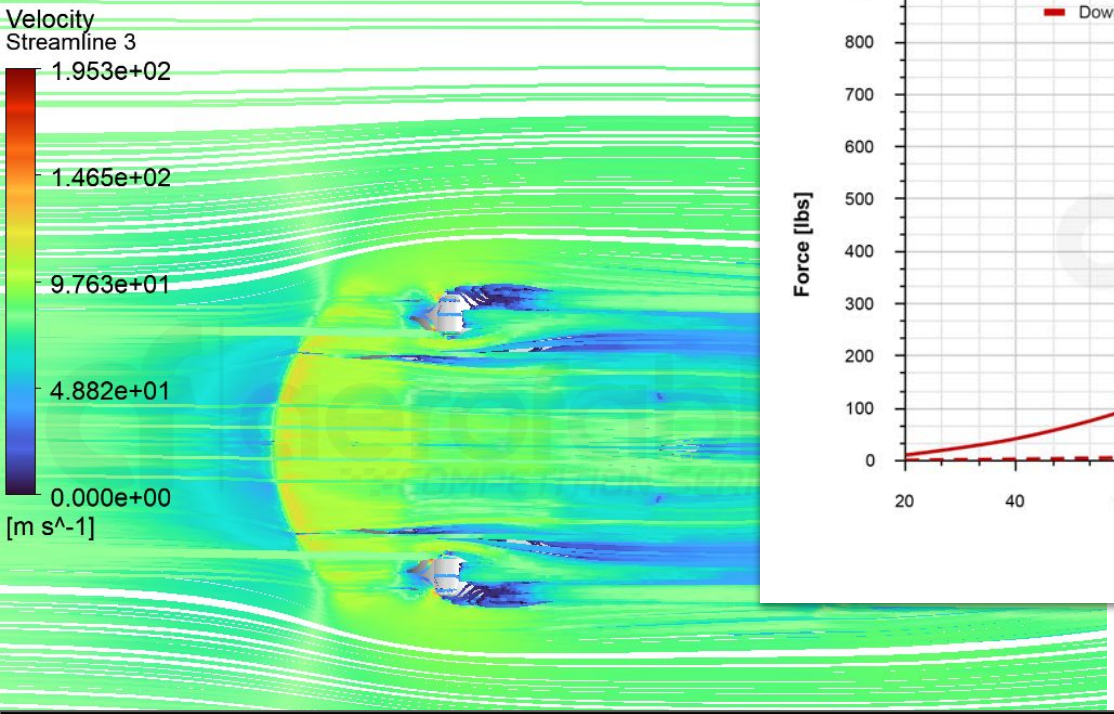


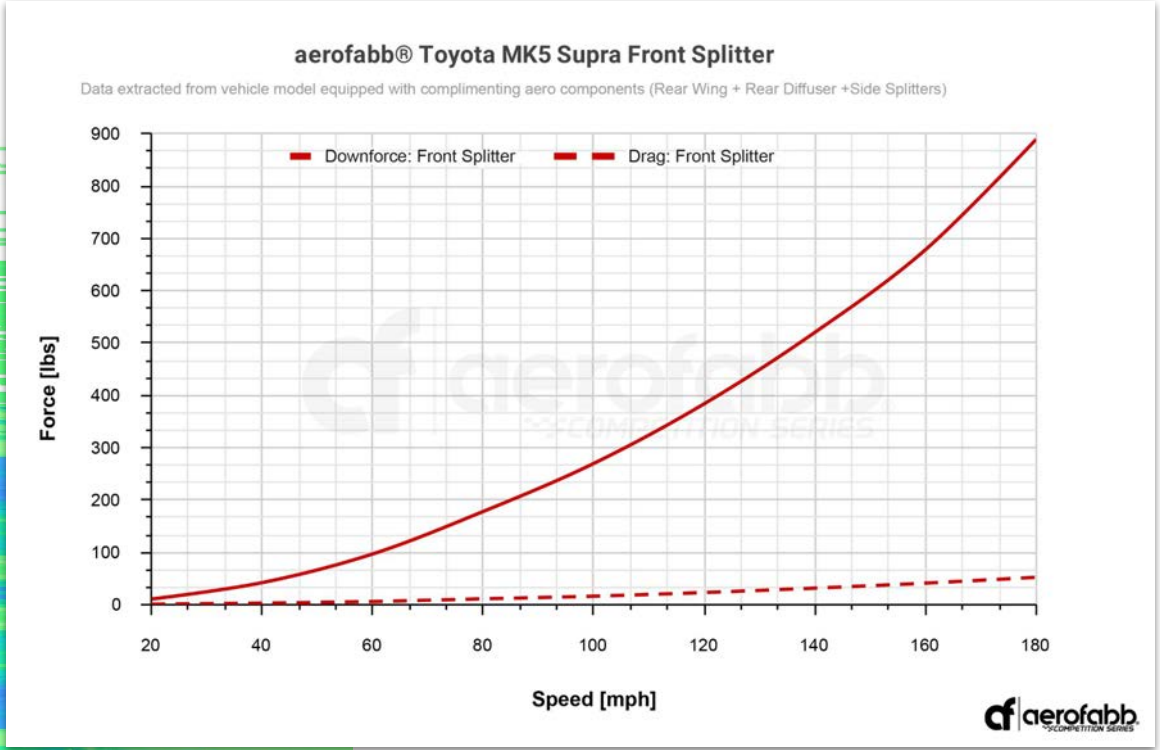
Fig 2.



DATA - FRONT SPLITTER

This graph compares total downforce vs. total drag produced by the Competition Series Front Splitter at various speeds. Rear Wing at 9° AoA.

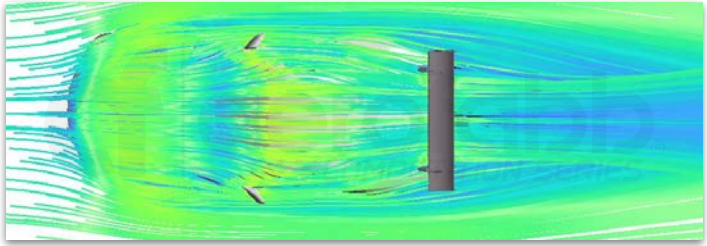


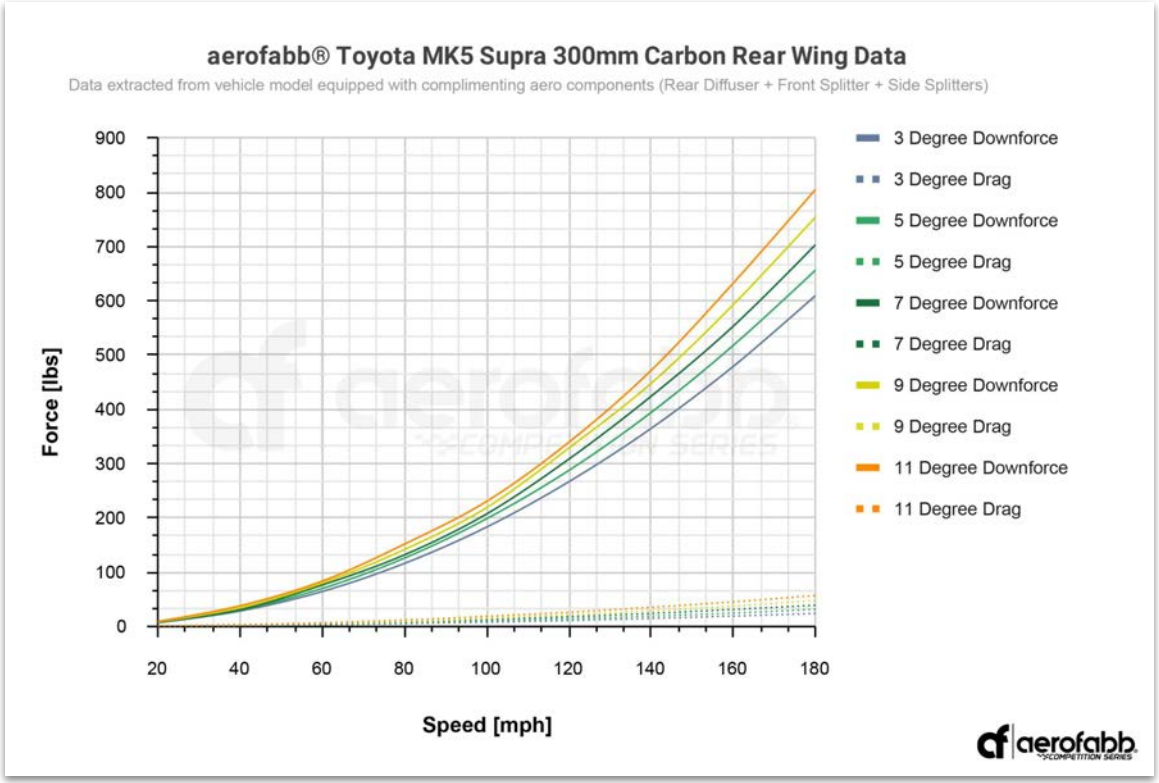


DATA - REAR WING KIT

This graph compares total downforce vs. total drag produced by the Competition Series Rear Wing Kit by AoA at various speeds.

- The Competition Series Rear Wing Kit allows for the user to adjust AoA and shift the balance to what fits best within their needs.
- An aero balance of approximately 48F/52R compared to factory is the result of 9° AoA.

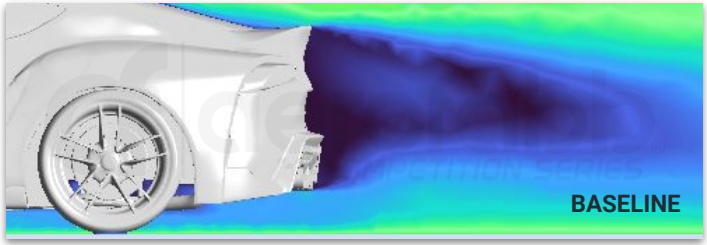


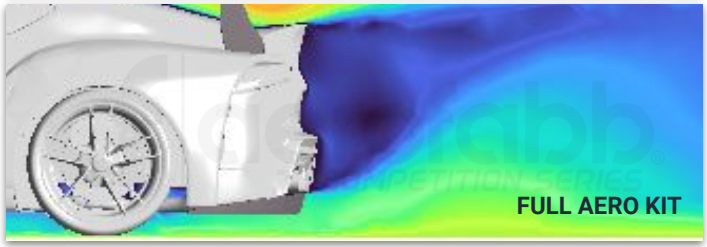


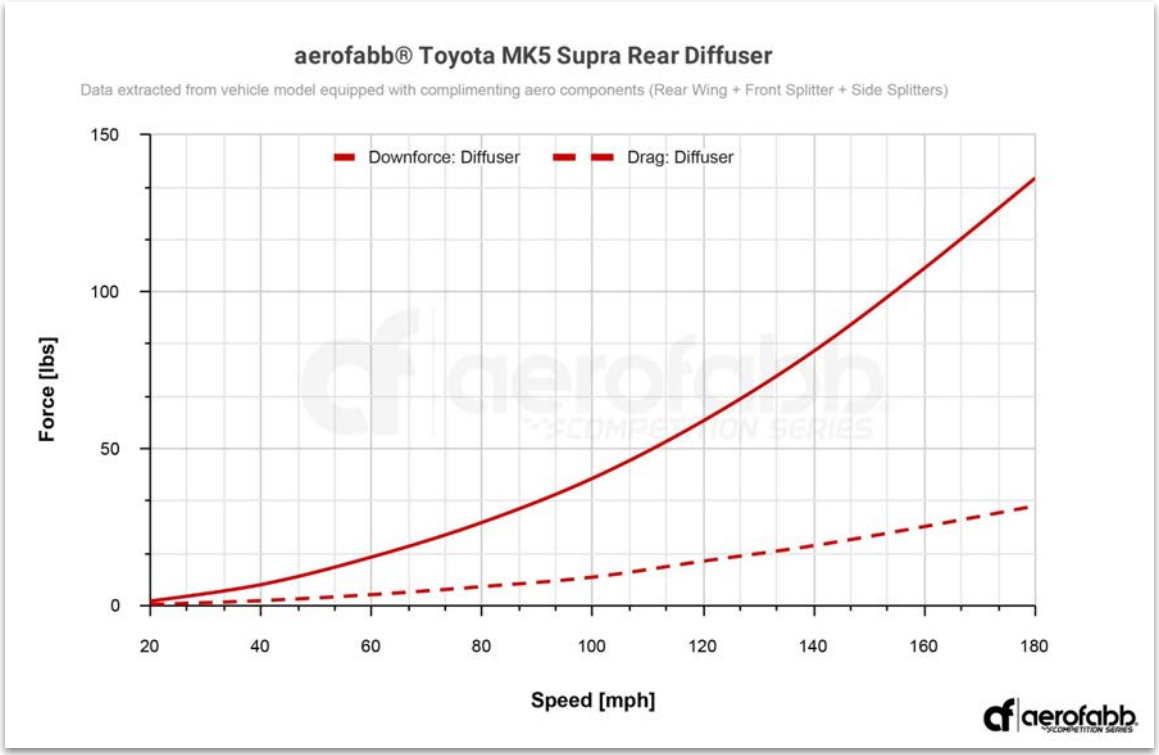
DATA - REAR DIFFUSER

This graph compares total downforce vs. total drag produced by the Competition Series Rear Diffuser at various speeds. Rear Wing at 9deg AoA.

- While this component alone may induce minor drag (<13lbs @120mph) the overall drag is reduced significantly by feeding the low pressure area at the rear of the car with higher velocity air from its underside which is represented in the figures below. Less flow separation = less drag.

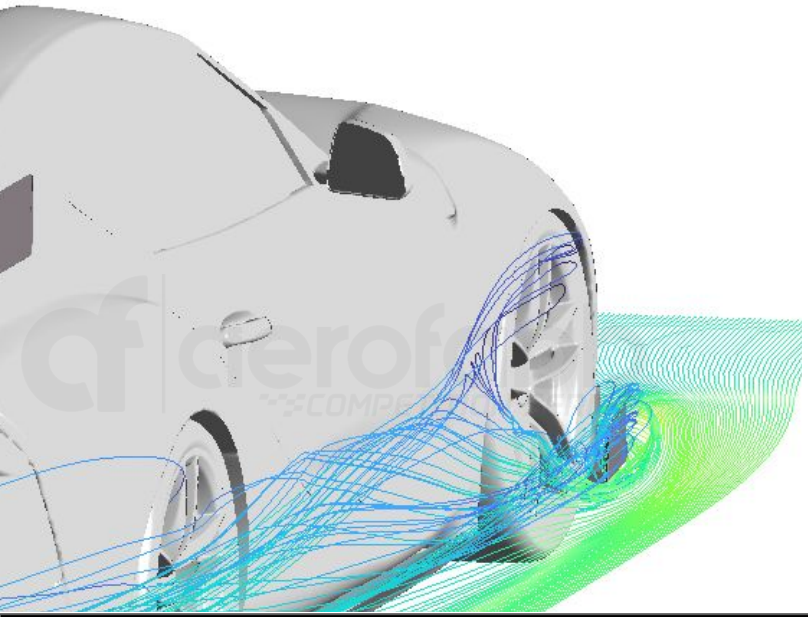


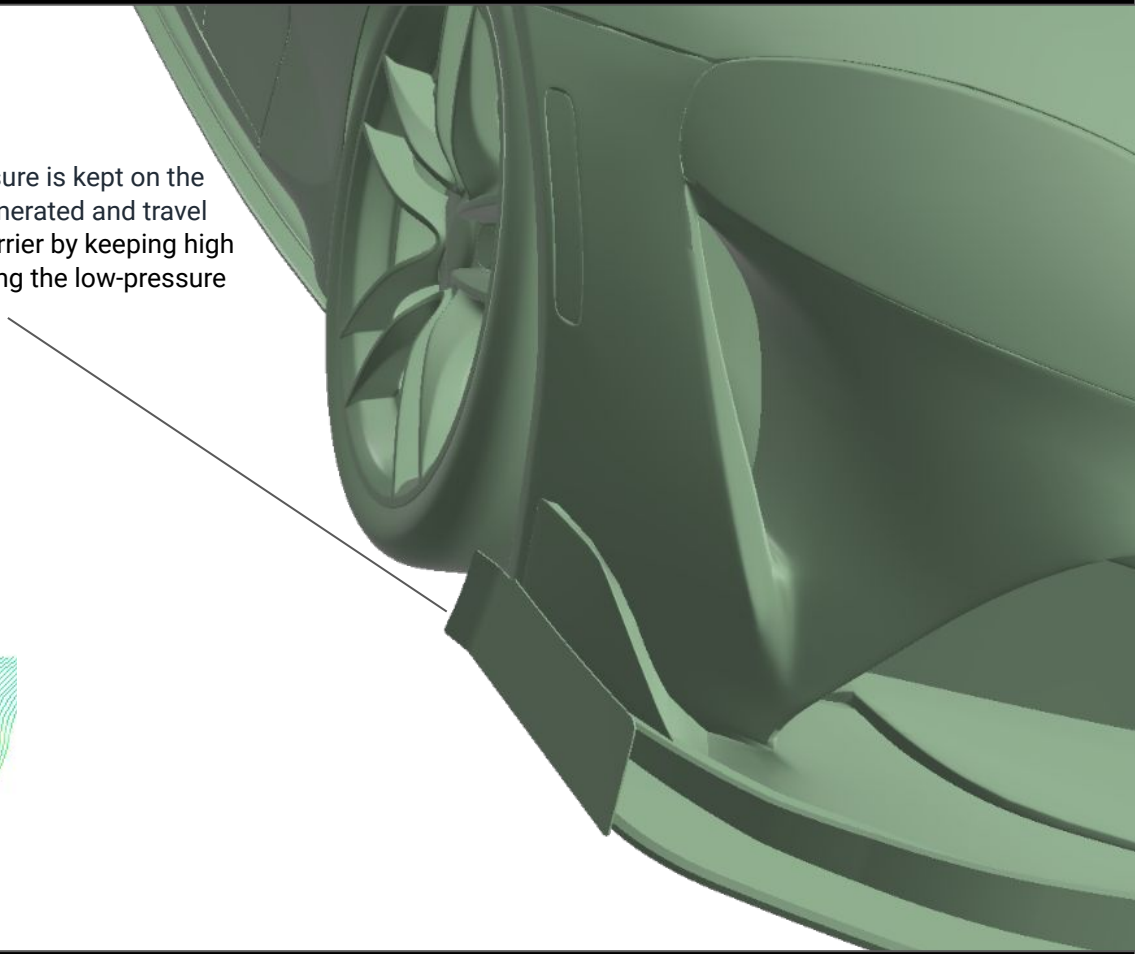




DETAILS - SPLITTER END PLATES

With a minimal drag penalty, high pressure is kept on the topside of your splitter. Vortices are generated and travel down the side of the car acting as a barrier by keeping high pressure air around the car from entering the low-pressure region under the car.

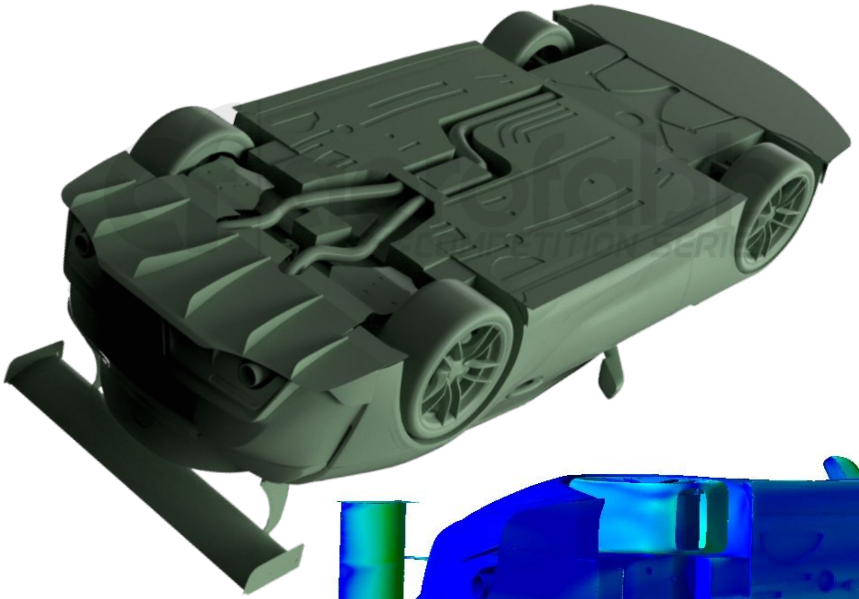




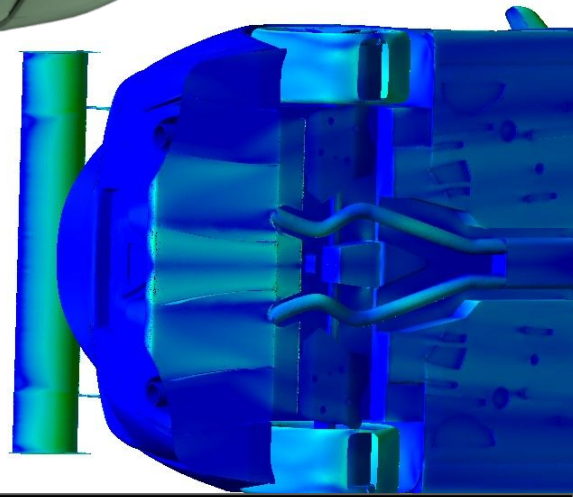
SETUP - GEOMETRY

The final run geometry consisted of a Toyota Supra A90 equipped with aerofabb® Competition Series aero components:

- Front Splitter
- Rear Diffuser
- Rear Wing Kit
- Side Splitters



Many OEM areas of detail were modeled on the underside of the car which include exhaust, suspension components, and valleys where air could be disrupted/trapped in order in to simulate behaviors of turbulent airflow more accurately. Some simplifying of higher complex geometry was made to keep computing power at a reasonable level. All aero components were modeled with bracketry in place.



- Wheel size of 18x9.5 F and 18x10.5 R. The wheels and tires were modeled nearly "flush" to the outer wheel arches of the car with a front camber of -1.5° and a rear camber of -.5°.
- The ride height was set to 634mm Front and 648mm Rear. Our ride height is measured from the most center of the fender arch to the ground.
- The center leading edge of our front splitter measures a distance of 74.1mm from the ground with an AoA of .75°.
- The rear diffuser forward floor measures at a distance of 107.5mm from the ground. The diffuser planes are at their standard fixed angle of 9° (vehicle rake dependent).

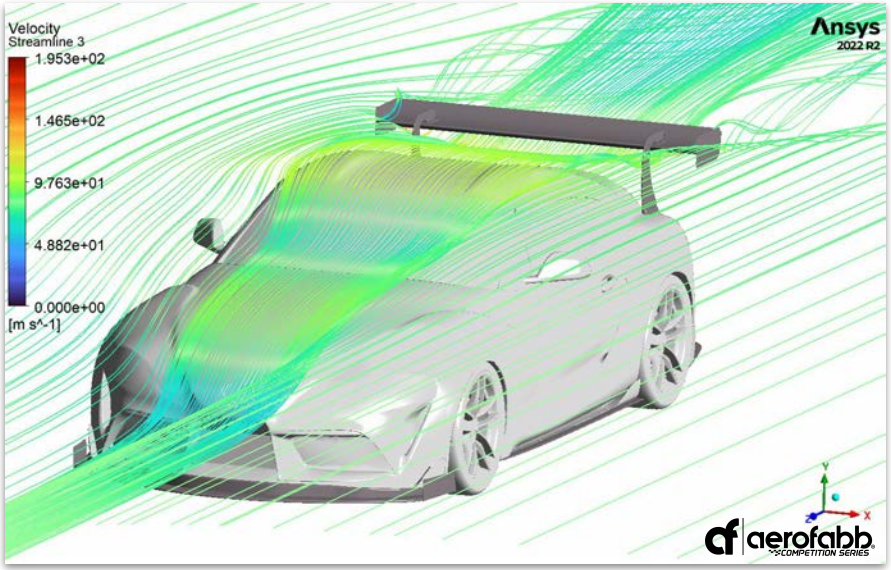
SIMULATION - GENERAL

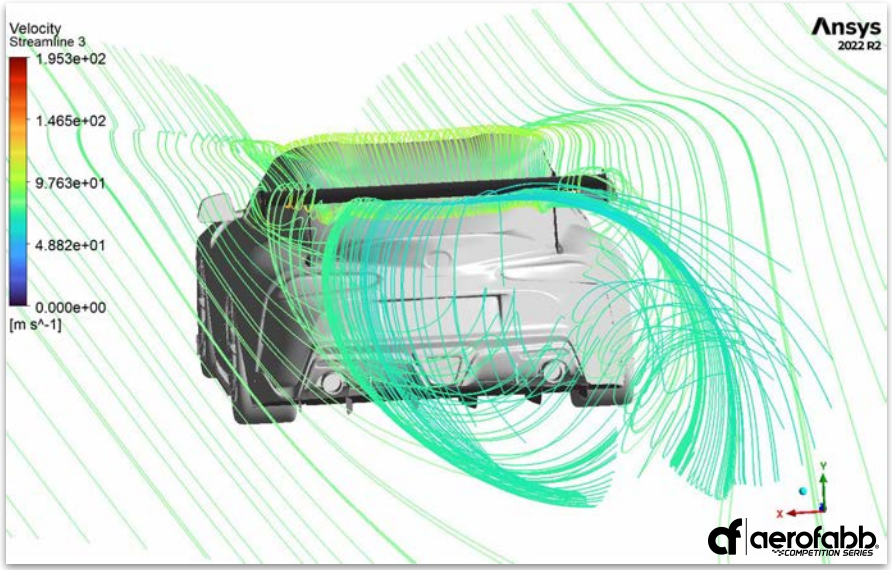
The simulation involved the calculation of downforce and drag on various components of the car (Front Splitter, Rear Wing, Rear Diffuser, Side Splitters). These calculations were conducted in Ansys software, which allowed for a comprehensive analysis of the car's overall performance.

By assessing the downforce and drag on individual components, the simulation was able to provide insights into the car's aerodynamics and its ability to generate downforce for improved stability at high speeds. These insights informed design decisions and optimizations aimed at improving the car's performance on the track.

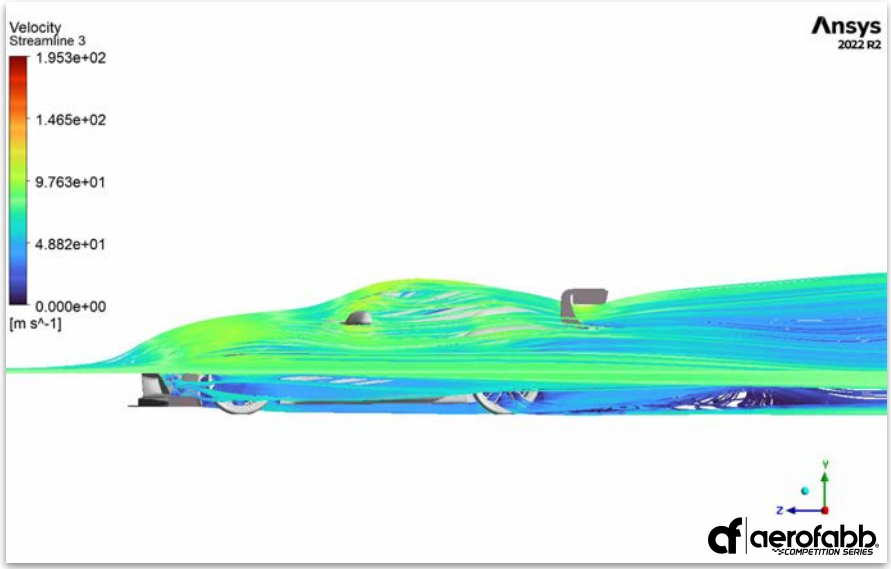
Overall, the simulation's assessment of downforce and drag, in conjunction with its comprehensive analysis of the car's overall performance, provides valuable insights for the design and optimization of the Toyota Supra MK5 chassis.

SIMULATION - GENERAL

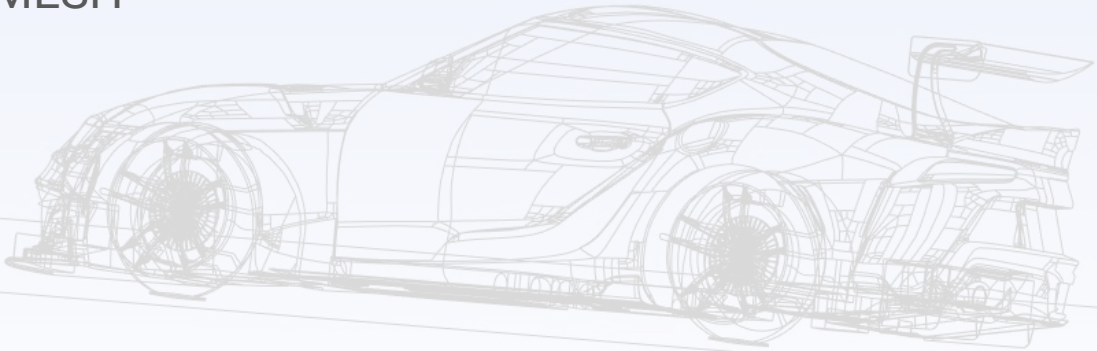


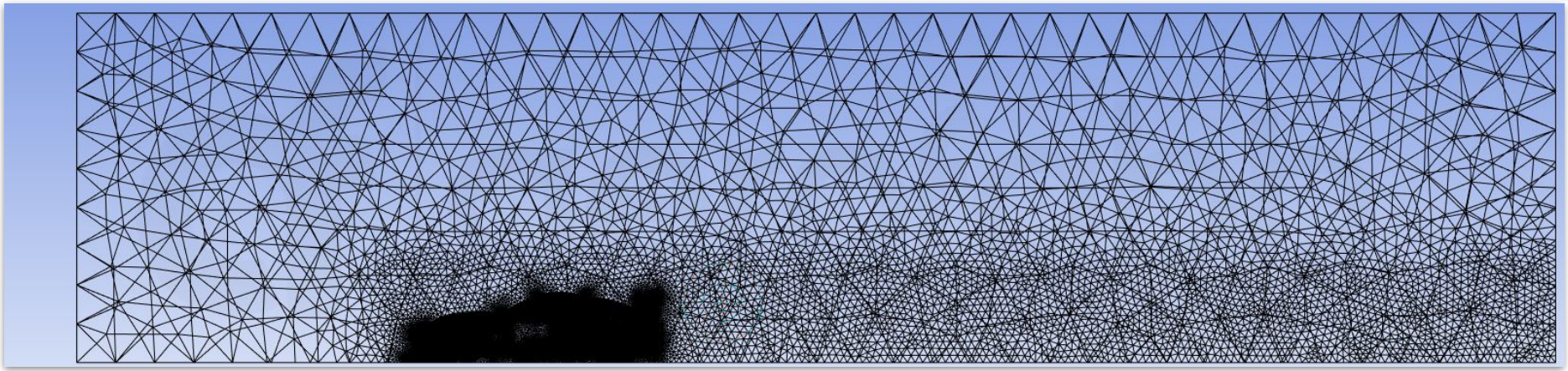


SIMULATION - GENERAL



SIMULATION - MESH

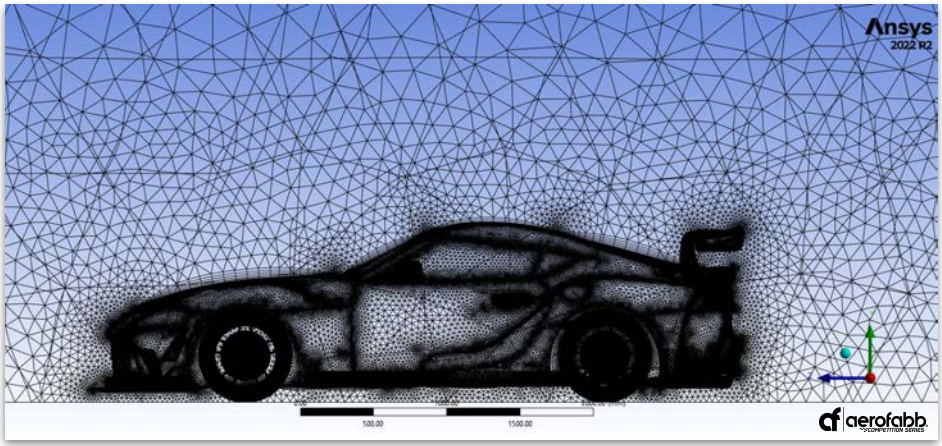




SIMULATION - MESH

Mesh is generated by using the Fluent workbench meshing tool. The with a quality of 2513581 Nodes and 8998187 Elements.

Results are shown in the figures to the right.



SUMMARY

The aerofabb Competition Series Aero Kit for the Toyota Supra MK5 chassis was developed in pursuance of increasing the cars overall aerodynamic efficiency. We wanted to accomplish this while still remaining within the "aero rulesets" for the most commonly entered competitive classes. This did pose limitations for us during the development phase when it came to the total heights and widths of each component, but we quickly learned that “bigger” isn't always “better”, especially if the end user is unable to participate in an event due to aero restrictions.

Individual components from the full aero kit can be installed by themselves however, we recommend that the entire kit be installed in order to maintain a safe aerobalance whether on or off the track. The behavior of each component changes without the presence of the other complementary components.

CFD, FEA, and real world testing on track were utilized during the R&D stages in order to refine our designs and validate their functionality.