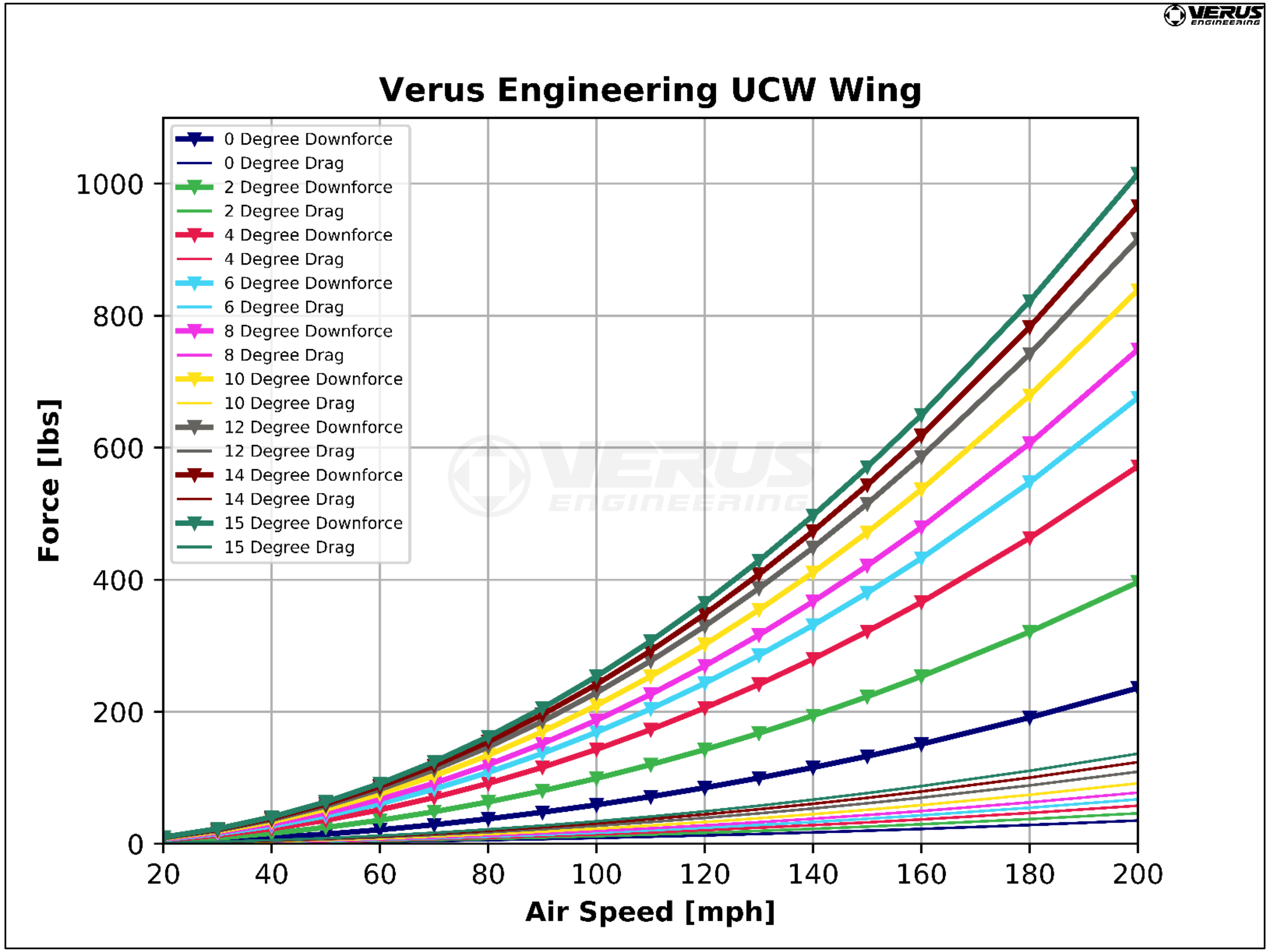
UCW REAR WING

INFORMATION AND DEVELOPMENT

OVERVIEW

SUMMARY : AERODYNAMIC FORCES

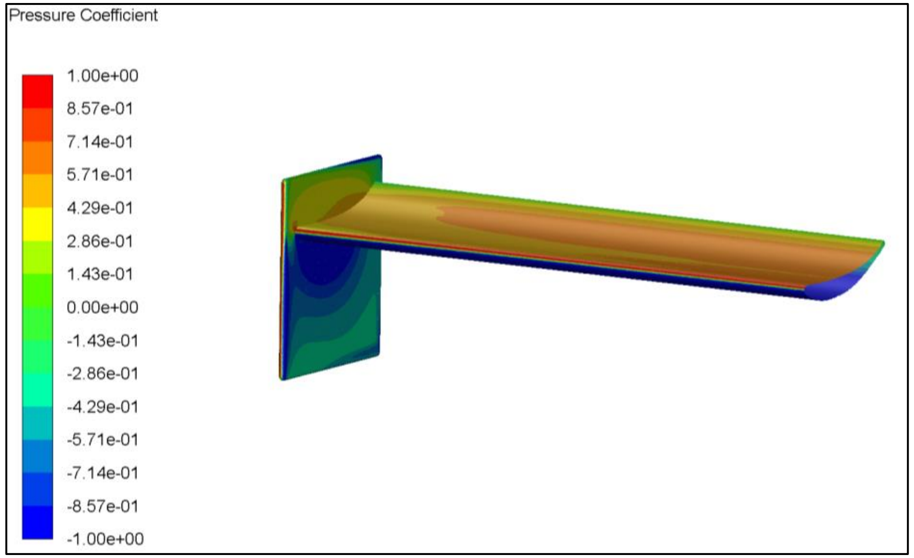


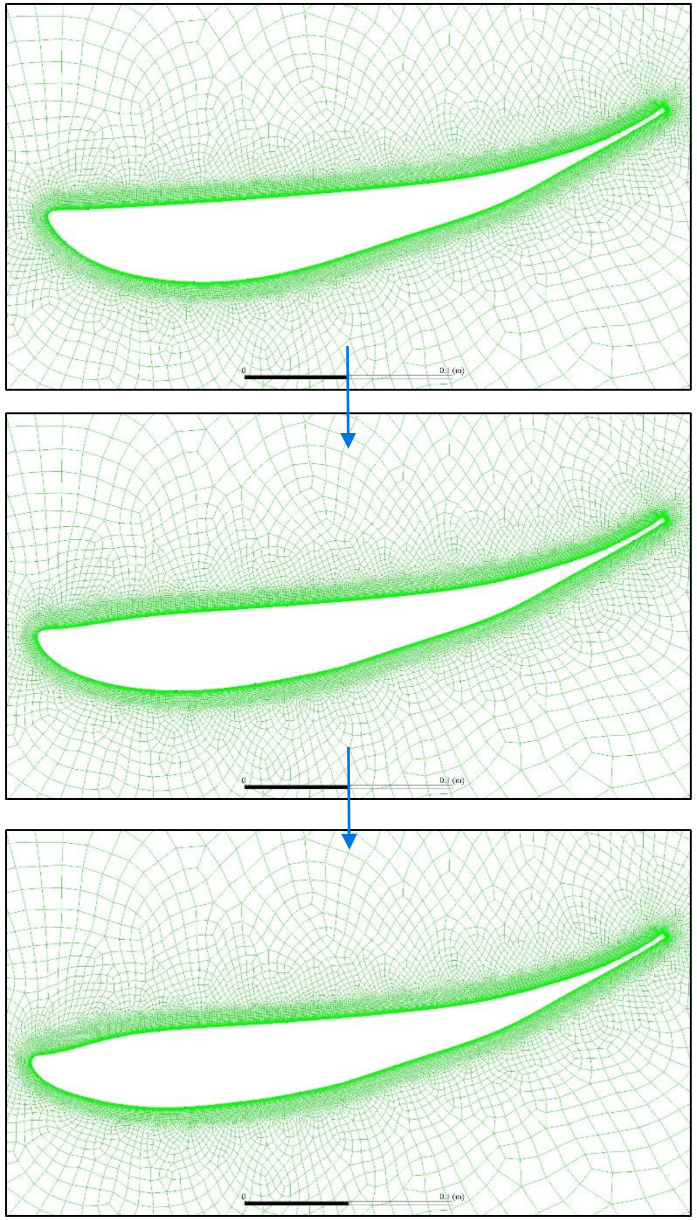
DEFINITIONS

1. **Coefficient of Pressure (Cp)** = This is a dimensionless number which describes relative pressure to atmospheric pressure. A Cp of 0 equates to atmospheric pressure while a number below 0 represents low pressure and a number above 0 represents high pressure.
2. **CpX** = This is a dimensionless number which describes Cp normal to the x-direction. This helps us visualize locations which create drag. Red represents locations which are creating drag, while blue represents locations where thrust is created.
3. **CpZ** = This is a dimensionless number which describes Cp normal to the z-direction. This helps us visualize location which create downforce or lift. Red represents locations which are creating lift, while blue represents locations where downforce is created.
4. **Total Pressure Coefficient (CpT)** = This is a dimensionless number which describes total energy of the airstream. It is the sum of static pressure and dynamic pressure.
5. **Wall Shear** = This is a force per unit area due to fluid friction on the wall. This is used to visualize areas of separation and rapid changes on the surface.
6. **LIC Plot** = Line integral convolution (LIC) is used to visualize “oil” flow on the surface. It is a great way to correlate to flow vis testing and to study the flow on the surface of the vehicle.
7. **Streamline** = These are fluid tracers which are used to visualize where the air is going or coming from. These are normally colored as velocity where red is high-velocity and blue is low-velocity.
8. **Points** = One point is considered 0.001 of a coefficient. This is used in coefficient of drag (Cd) and coefficient of lift (Cl).

DEVELOPMENT – EARLY CFD

In the early development, CFD was used to develop and refine wing shapes with the goal of creating another convex recovery (trailing edge stall) wing. This is the best type of wing for a motorsports or automotive application as more adjustment is possible with a slow stall. This ensures no major loss in downforce or large increase in drag with minor wing change.



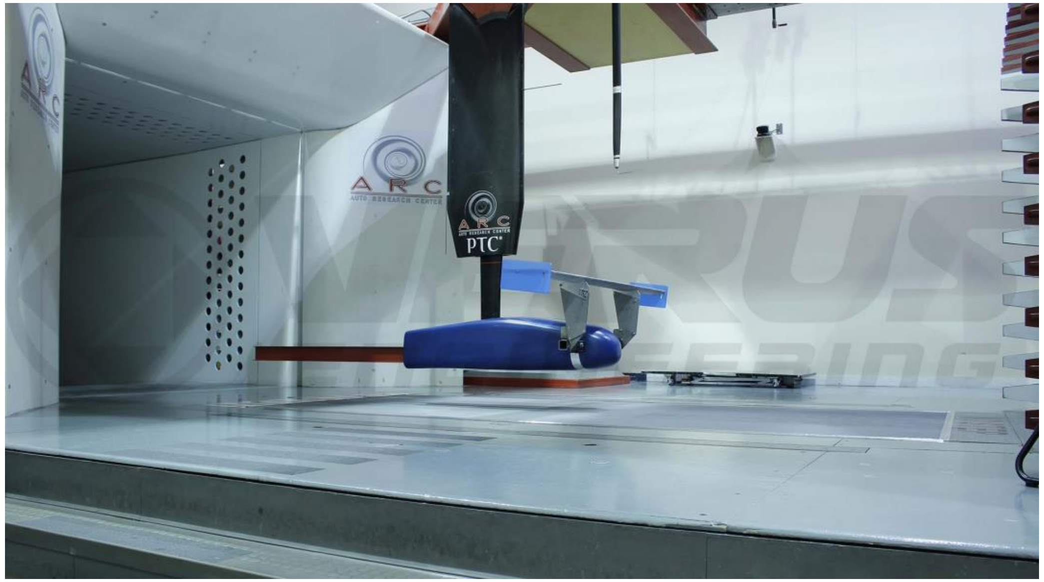


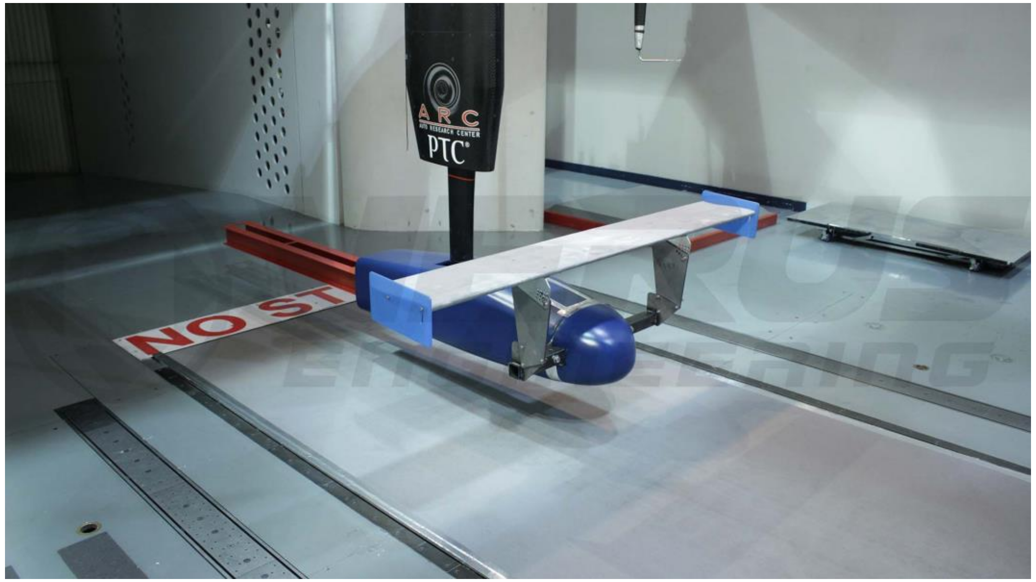
DEVELOPMENT – WIND TUNNEL

Wind tunnel testing was used in the development of the UCW. The wind tunnel was used to validate our CFD on various wing designs from the early CFD.

The wind tunnel models tested were 3D printed plastic wings at full-scale. The plastic was reinforced with aluminum structure on the inside of the airfoil. The airfoil was tested at multiple air speeds up to 100mph and multiple angles of attack.

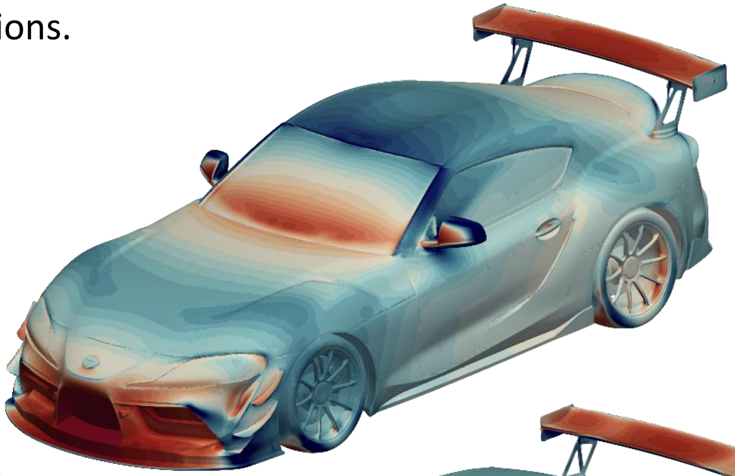
Testing in the wind tunnel helped narrow down a path for further refinement. With validating our CFD in the wind tunnel, confidence in wing profile or shape would be accurately captured.





DEVELOPMENT – CFD WING REFINEMENT

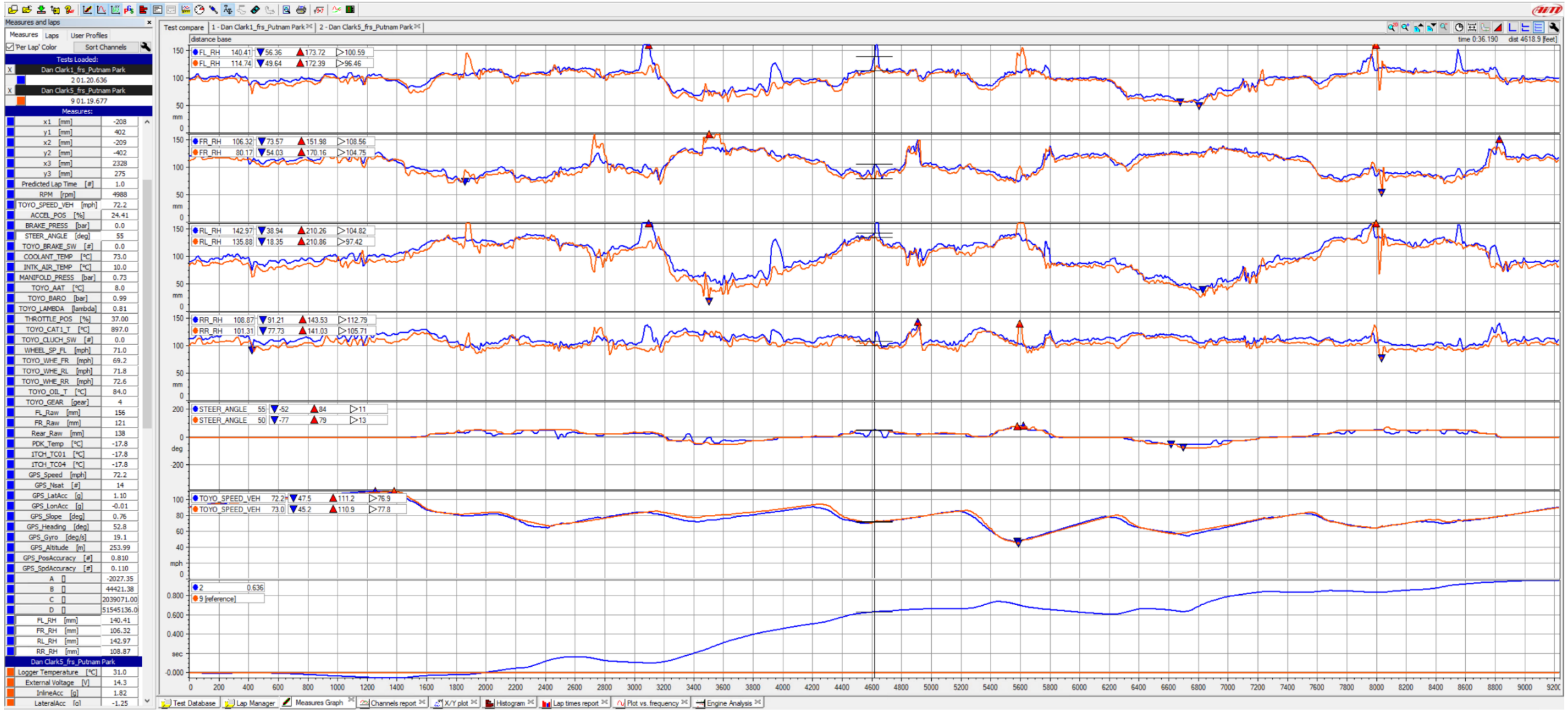
The UCW was optimized on multiple different platforms. This ensures the best performance possible when installing a Verus Engineering UCW package. The final UCW design has a slight curve and a more camber than wind tunnel models. The UCW is a high downforce slow stalling wing. This is perfect for motorsports applications.



DEVELOPMENT – UCW TRACK TESTING

After CFD refinement, we manufactured tooling and a prototype. This prototype was then tested on track at Putnam Park. AIM data acquisition with laser ride height sensors were used to collect the data to analyze car performance with UCW added. The test was performed with professional driver Dan Clarke.

DEVELOPMENT – UCW TRACK TESTING



The orange lap is with Verus aero & UCW and blue is no aero. At the end of the straight, we are calculating around 420 lbs of downforce at 110 mph with wing angle of 1 degrees. The average downforce increased compared to no aero throughout the lap is 329 lbs.

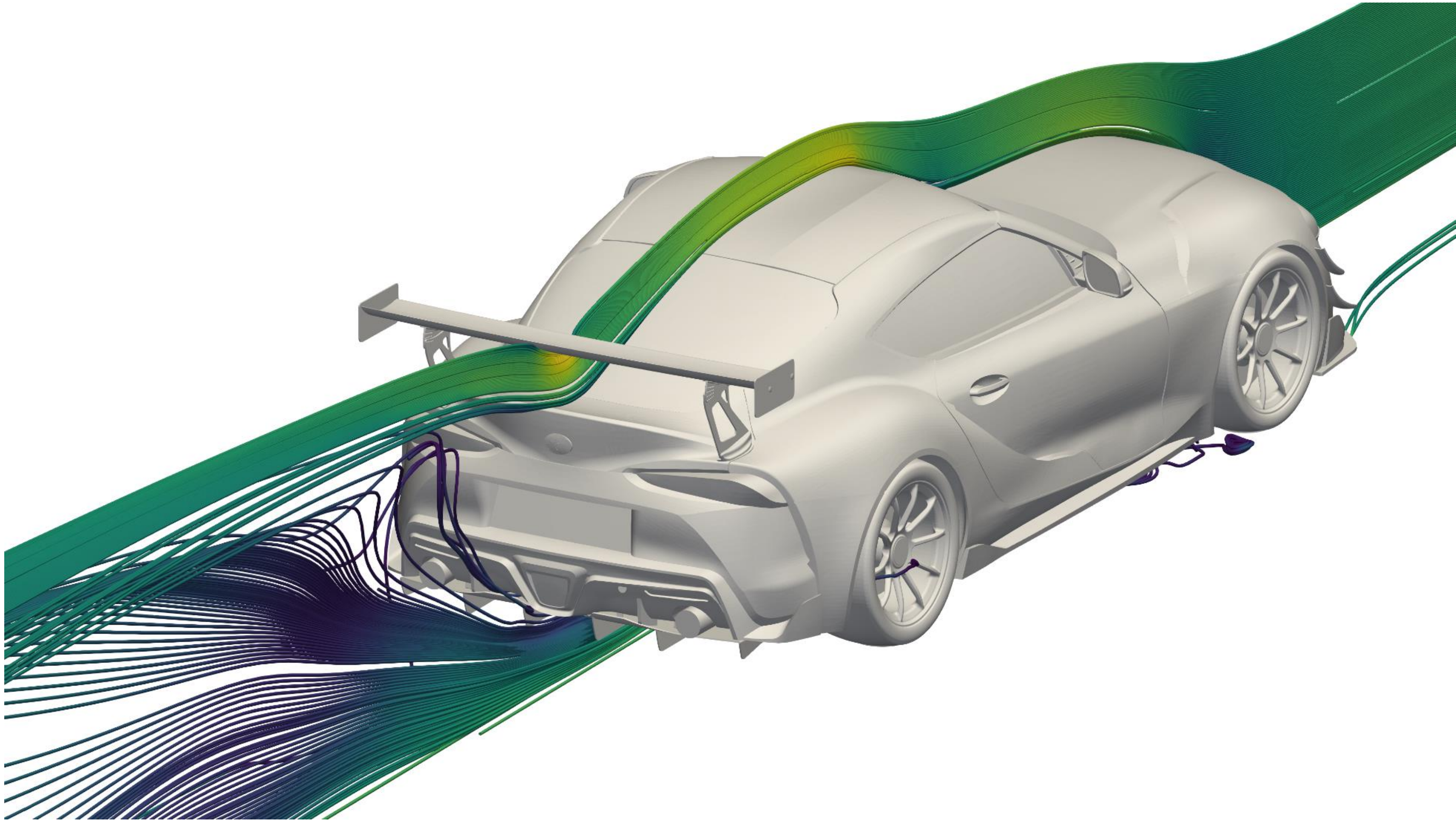
SUMMARY

The Verus Engineering UCW wing increases downforce efficiently. The UCW decreased lap times by increasing performance all while keeping factory warranty. The research and development of he package was done using cutting edge technology in CFD , wind tunnel testing, track testing with professional driver, and proven designs from previous wing designs.

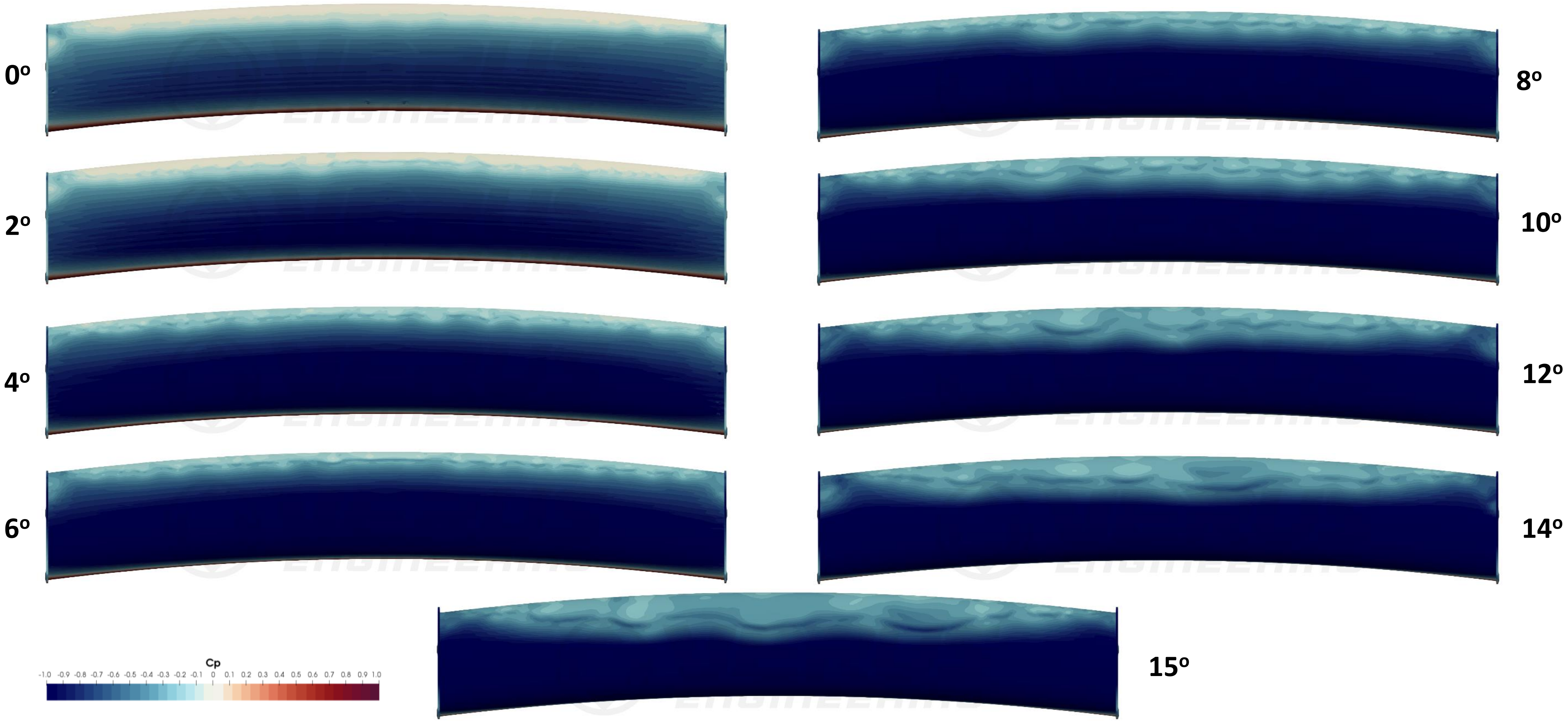
The UCW is available in specific vehicles applications or in universal applications. The specific vehicle applications will be OEM level fit and finish. The universal applications will be a DIY install where the user will make their own uprights/brackets to the UCW with mounts.

THE SCIENCE

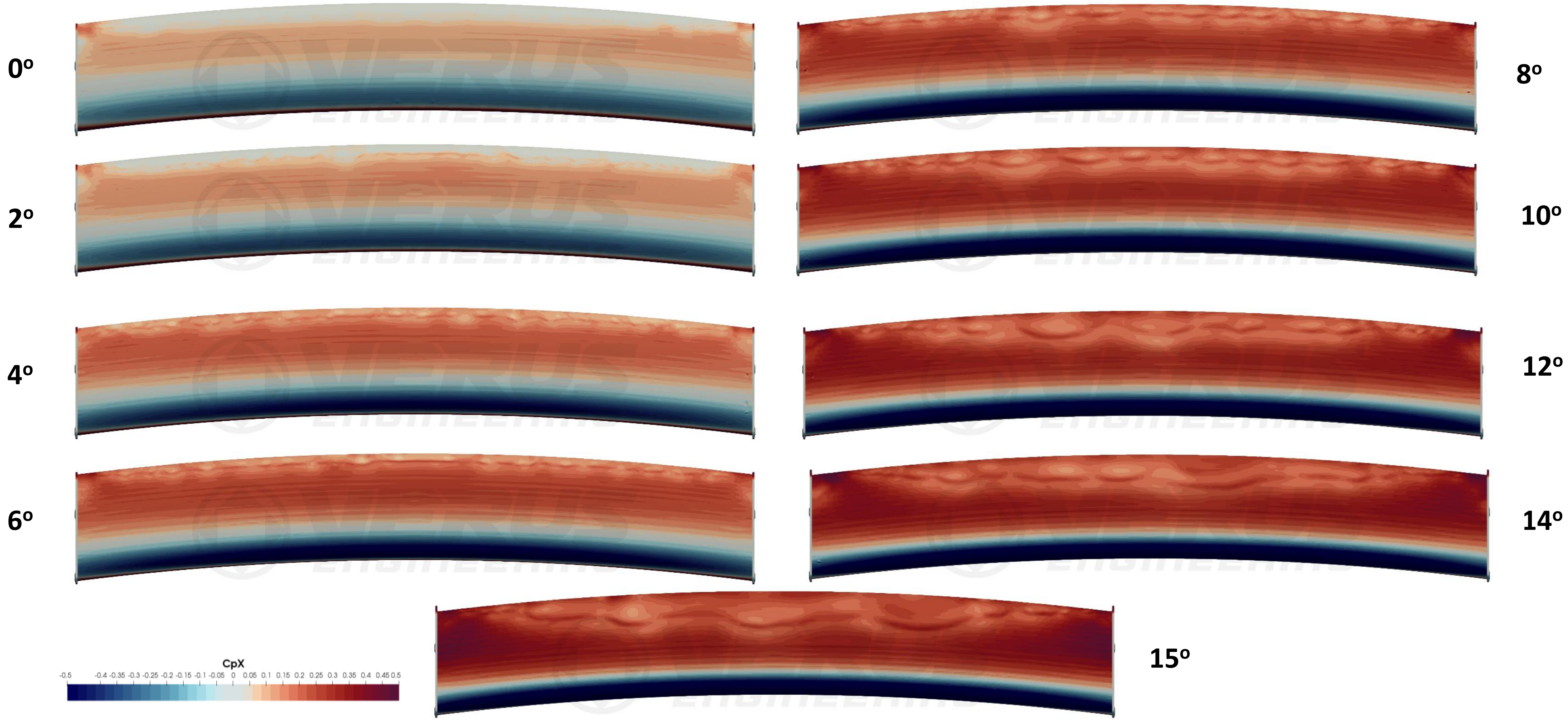
This analysis was done using ANSYS Fluent & OpenFOAM V6 which are finite volume CFD software. The solver was SIMPLE and the turbulence model was K-Omega SST using standard wall conditions. We used standard automotive arrangement when setting up boundary conditions and running a full-car. The case for full-car and wing refinement was simulated using slight yawed airflow of 0.5 degrees. This yawed airflow is to ensure we are not analyzing a condition the car will almost never see which is perfectly straight airflow down the length of the car or wing.



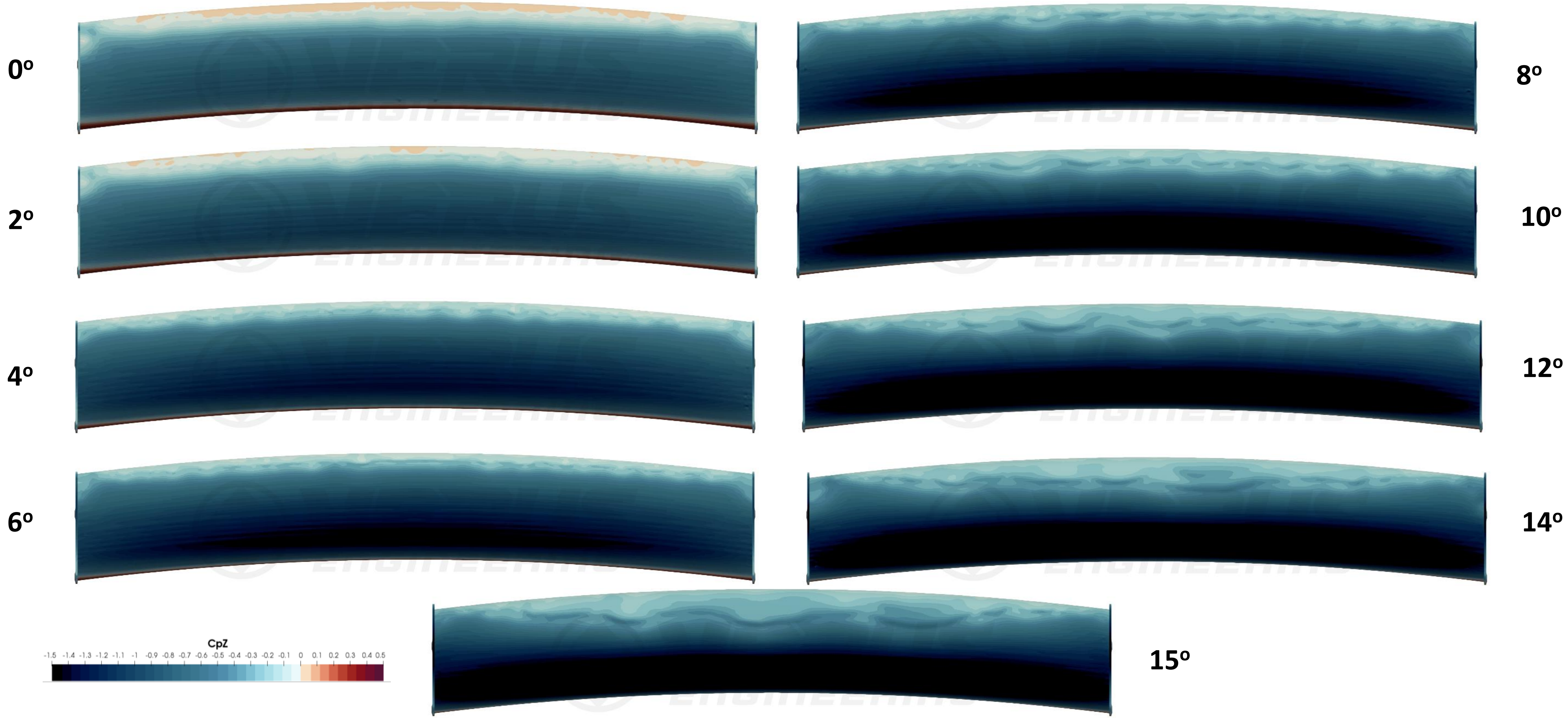
Cp PLOTS – BOTTOM SURFACE OF WING



CpX PLOTS – BOTTOM SURFACE OF WING



CpZ PLOTS – BOTTOM SURFACE OF WING



WallShear PLOTS – BOTTOM SURFACE OF WING