EXTERNAL AERODYNAMIC ANALYSIS OF A RACING CAR

Objective

To assess the changes in aerodynamic drag force of a racing car w.r.t. different shapes of side view mirror.

Challenges

- Suitable meshing scheme and flow model required to predict the flow characteristics accurately
- Capturing complex geometrical features in areas of interest during mesh generation

CFD Model

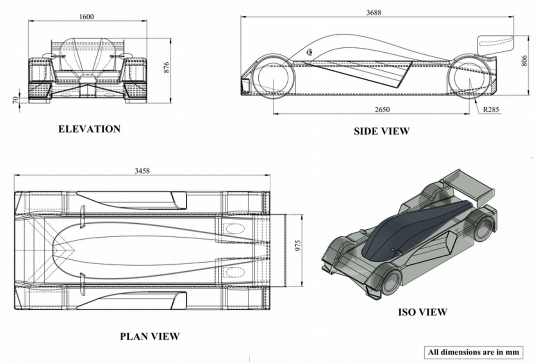

Fig 1: Geometry – Racing car

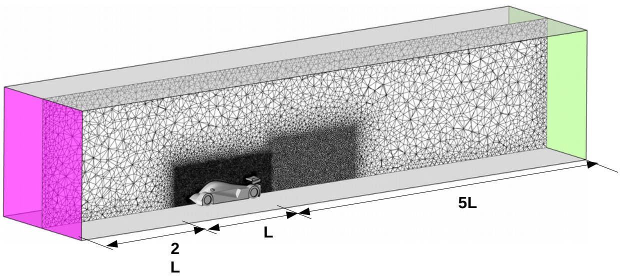

Fig 2: CFD Domain with mesh

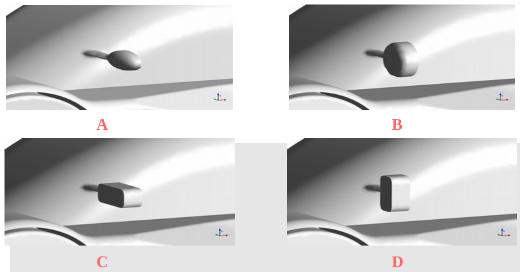

Fig 3: Side view mirror configurations

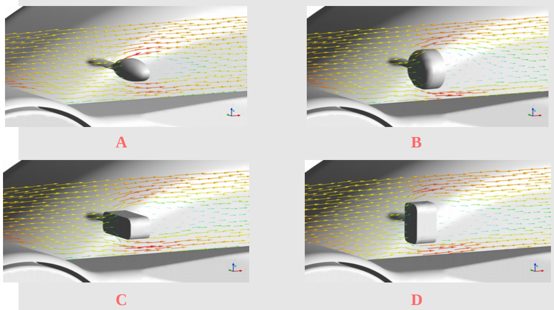

Fig 4: Velocity vectors near the mirror

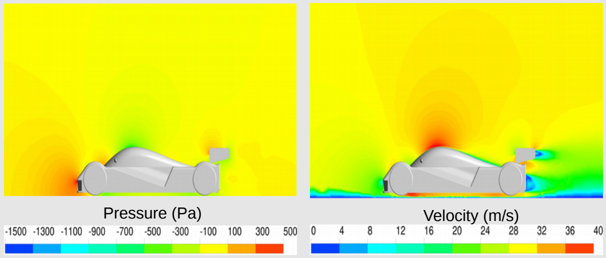

Fig 5: Pressure and Velocity Contour

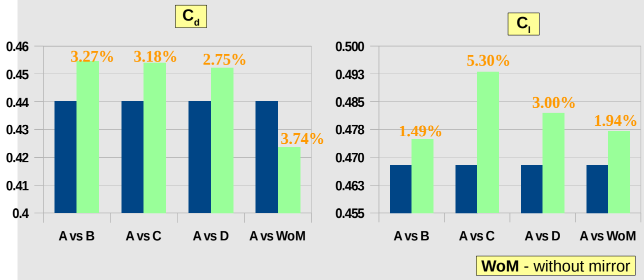

Fig 6: Comparison of Drag (C_d) and Lift (C_l) Coefficient

Approach

Aerodynamic Drag is one of the major factor affecting the performance and manoeuvrability of high speed cars. Targeting optimal drag that would improve the manoeuvrability, stability, traction control and reduce fuel consumption at high speeds are prime concerns during the design of racing cars. Shape of the vehicle and wind/vehicle speed are the major factors that determines the drag induced on the car. In this case study, the effect of the shape of side view mirrors onto the overall drag of a racing car (Fig 1) has been evaluated. In Fig 3, original design of the side view mirror (A) is of elliptical shape, other geometries considered are B, C & D. Suitable domain length were considered to capture the flow separation phenomenon over the mirrors and car body. To capture the near wall physics appropriately, finer meshing was adopted near the wall with wall y+ values nearly equal to 1. RANS based SST-K-ω turbulence model was used to resolve the flow field over the car and the resulting drag and lift coefficients were calculated.

Conclusion

The results obtained indicates that the change in shape of side view mirror does influence the overall drag force (Cd) generated on the car body. In this case study it was observed for the mirror geometries B, C & D the Cd value increases by 2-3%. This may be due to formation of large wake regions at the rear end of the mirror. Further it was observed that the drag reduces ~3.5% when there is no side view mirror. Lift force was highest for modified mirror geometry D whereas the original design (A) had the least lift force among the given configurations.

Benefits

- Predicting the drag and lift coefficients for a given car geometry with any external modifications.
- Optimize the shape and geometries of the vehicles external mountings to improve the high speed vehicle performance ensuring its stability and manoeuvrability.

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