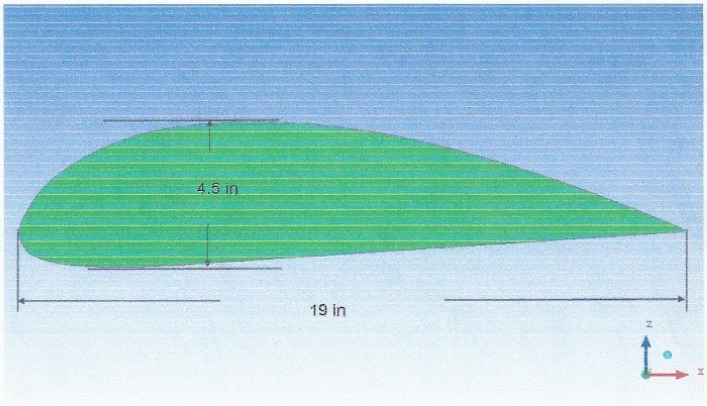
Wing Project

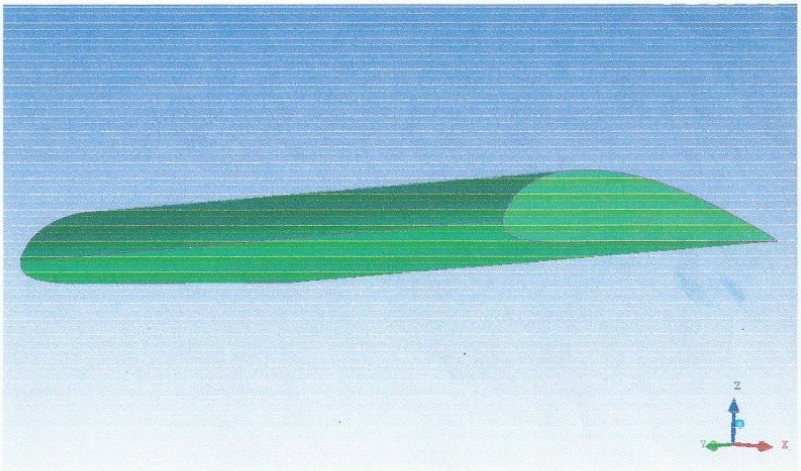
Progress Report 1

1. Geometry of the wing model

The wing model is 19 inch long along the x-axis and 4.5 inch thick at maximum value. Its shape is designed according to the standards of National Advisory Committee of Aeronautics (NACA).



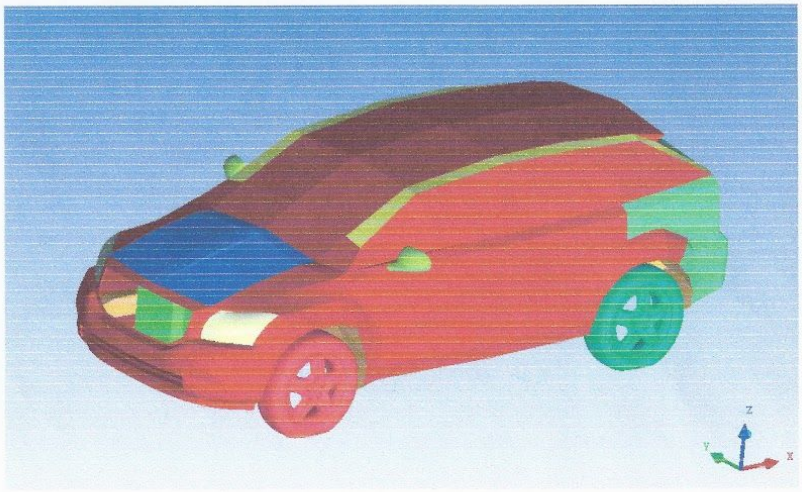
Picture 1: Geometry of wing - side view



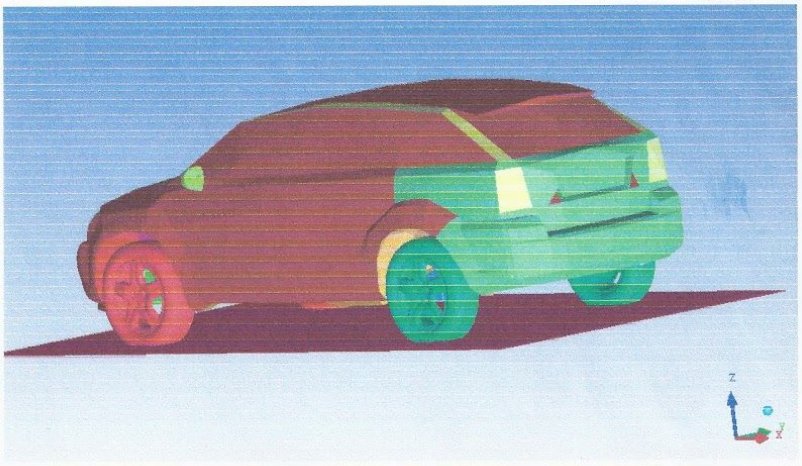
Picture 2: Geometry of wing - isometric view

2. Geometry of the vehicle model

The vehicle model is provided by CFD group. It's a real-size SUV model as shown in the following pictures. The accuracy and quality of this model has been proven and is guaranteed.



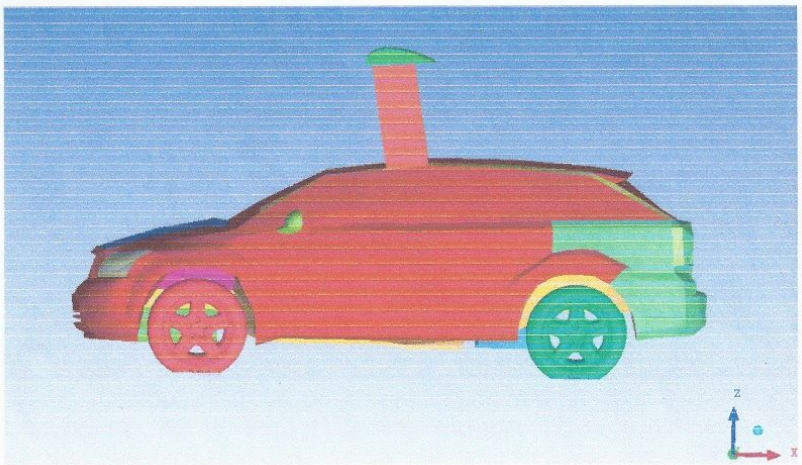
Picture 3: Geometry of vehicle - front view



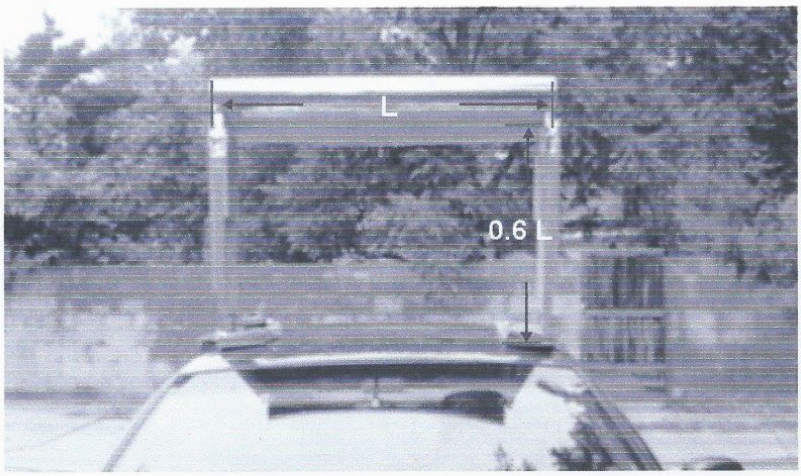
Picture 4: Geometry of vehicle - rear view

3. Combined geometry of vehicle and wing

The wing is placed 12 inches back of the front wind shield and 28 inches in height over the top of the vehicle according to the provided picture (Picture 6). The width of the wing is designed to be 48 inches to fit the width of the ground vehicle.



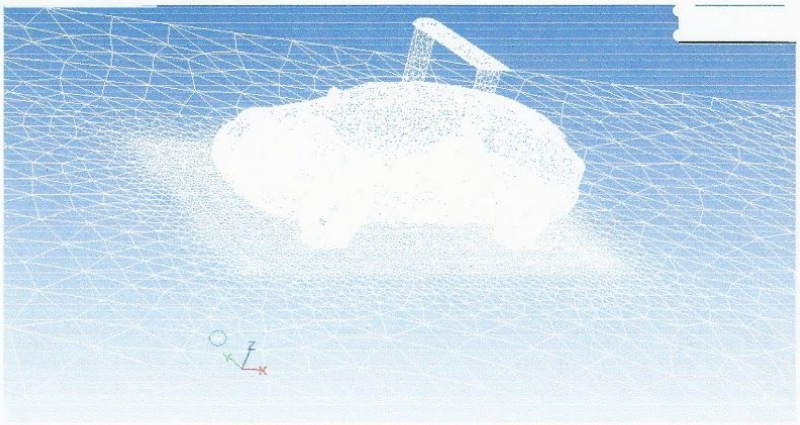
Picture 5: Combined geometry of vehicle and wing



Picture 6: Dimension of the wing

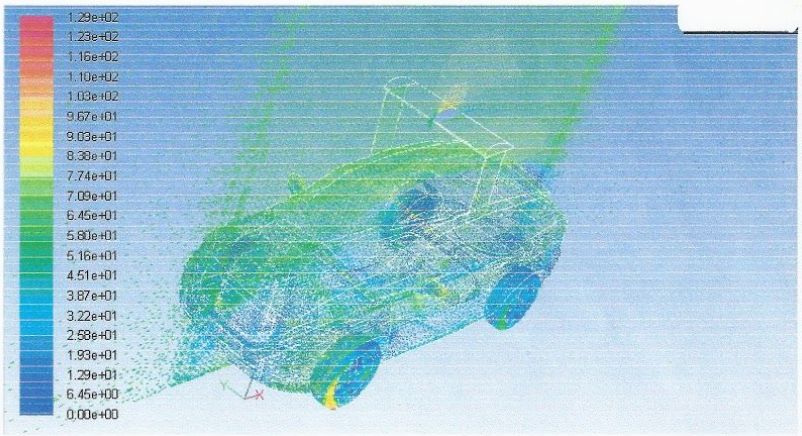
4. Pre-processing and Results of simulation

The whole domain of simulation is divided into 3.8 million of tetrahedral volume cells. The mesh density close to the wing surface is enhanced with extra care, which ensures the quality and accuracy of the simulation.

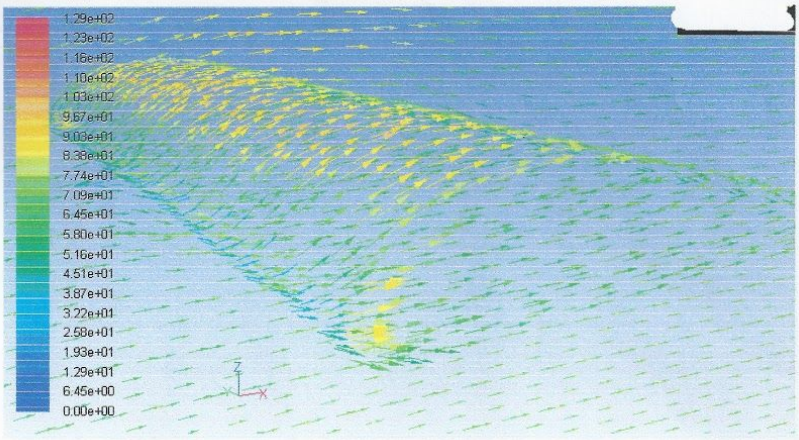


Picture 7: Mesh of the simulation domain

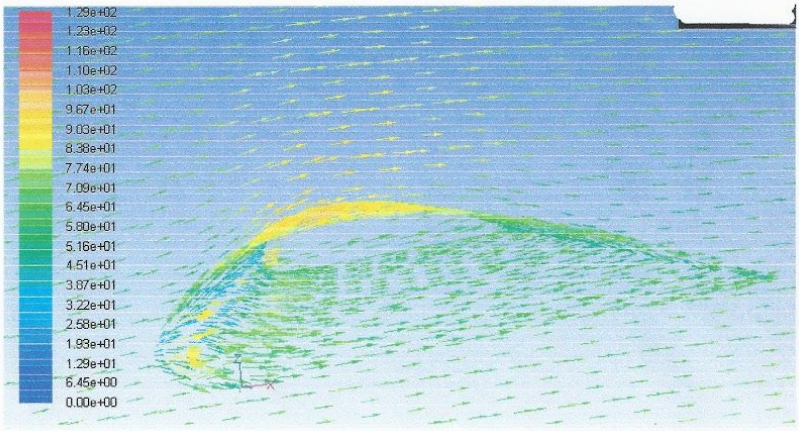
Two simulations have been conducted for the purpose of comparison. The first one is the aerodynamic simulation for the ground vehicle itself only without the wing and the second one is the aerodynamic simulation for the vehicle-wing combined case. The flow field plots which include the plots of flow velocity vector near the vehicle and wing surfaces and the plots of air pressure distribution near the vehicle and wing surfaces are achieved and provided below.



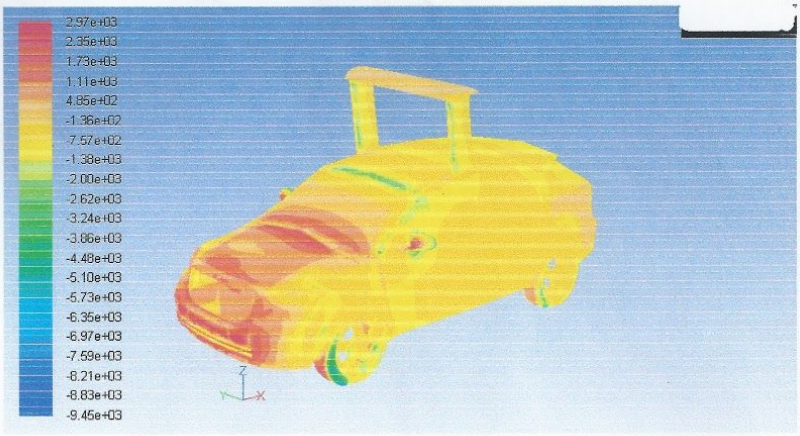
Picture 8: Flow velocity distribution near the vehicle and wing surfaces



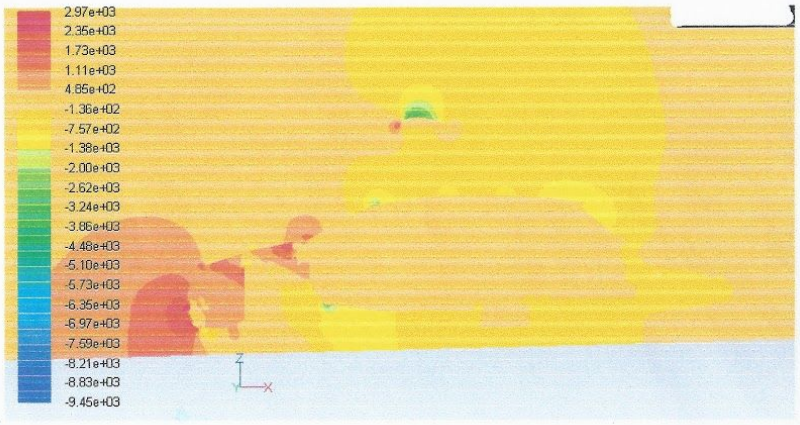
Picture 9: Flow velocity distribution near the wing surface – isometric view



Picture 10: Flow velocity distribution near the wing surface – side view



Picture 11: Air pressure distribution near the vehicle and wing surfaces – isometric view



Picture 12: Air pressure distribution near the vehicle and wing surfaces – central cut plane

5. Conclusion

Table 1: Comparison of the cases with and without wing

	Drag force (Newton)	Lift force (Newton)	Drag coefficient	Lift coefficient
W/O Wing	3510.9241	1824.8344	0.455	0.236
W/ Wing	3764.0954	2265.0349	0.465	0.280

From the table above, it is clear that adding the wing to the ground vehicle slightly increases the drag force by 7.21%. However, the lift force is increased by 24.12%. This means adding the wing contributes 2.2% increase to the aerodynamic drag coefficient, which means barely any influence on the vehicle performance; and 18.6% increase to the aerodynamic lift coefficient, which could imply a huge improvement on the fuel efficiency and vehicle performance.