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SComparision of Aerodynamic Drag and Lift Forces of a Car

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***Abstract:** This paper describes about the CFD analysis on the car body how different shapes and design of the body of car changes the aerodynamic characteristics. The fundamental concerns of automotive aerodynamics are to reduce drag and preventing undesired lift forces at high speeds. The important phase in the study about automobiles is to know about the pressure distribution over the body of the automobile. The pressure differences at the back and the front are not same. At back of the car the pressure is low which creates drag. To design a body of automobile we need to consider the drag and lift forces so that the body aerodynamic efficiency is high.*
***Key Words:** lift, drag, aerodynamic, force, pressure.*

I. INTRODUCTION

The Computational Fluid Dynamics (CFD) has an important part. Keeping in mind the end goal to get a decent execution, the vehicle needs to efficiently productive. The drag drive is the undesirable thing which regularly diminishes the speed of the auto. The down power is valuable to keep up the steadiness of the auto in ground. The capacity of the streamlined designer is to trade-off between down power and drag. We outlined 3 models one is SUV and the other two models are vehicle one with spoiler and the other without spoiler

A. Aerodynamic drag (Cd)

The power on a protest that restricts its movement through a liquid is known as drag. At the point when the liquid is a gas like air, it is known as streamlined drag (or air protection). At the point when the liquid is a fluid like water it is known as hydrodynamic drag. Liquids are portrayed by their capacity to stream. In semi technical dialect, a liquid is any material that can't avoid a shear drive for any considerable time allotment. This makes them difficult to hold yet simple to pour, mix, blend, and spread. Accordingly, liquids have no clear shape however go up against the state of their compartment. Liquids are uncommon in that they yield their space moderately simple to other material things at any rate when contrasted with solids. Liquids may not be strong, but rather they are definitely material. The fundamental property of being material is to have both mass and volume. Material things oppose changes in their speed and no two material things may involve a similar space in the meantime. The segment of the drag compel that is because of the dormancy of the liquid is the protection from change that the liquid needs to being pushed aside so something different can involve its space is known as the weight drag .

$$F_D = ½ \rho v^2 C_D A$$

Where C_D = coefficient drag [dimensionless], A = frontal area [m^2], ρ = density of air [kg/m^3]
v = velocity of vehicle [m/s]

B. Lift

The streamlined drag force is acted on a level plane to the vehicle and there is another segment, coordinated vertically, called streamlined lift. It decreases the frictional powers between the tires and the street, along these lines changing significantly the taking care of qualities of the vehicle. This will influence the handling and stability of the vehicle. The pressure differential from the top to the bottom of vehicle causes a lift drive. These powers are significant concerns in streamlined advancement of a vehicle on account of their impact on driving solidness. The power, LA is evaluated by the condition

$$L_A = ½ \rho v^2 C_L A$$

where L_A = lift force , C_L = coefficient of lift , A = frontal area

Numerous specialists and creators have portrayed distinctive types of drag, conceivable explanations for them and a few methods for limiting the drag. Katz's work was completely dedicated for the racing car optimal design and he portrayed the diverse part of auto outline or streamlining beginning from the original vehicles to latest models, however no numerical or exploratory method was disclosed to quantify the drag. Computational investigation to decrease the drag is performed by Barbut et al. Rouméas et al. on

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street vehicle and by Guilmineau on the improved auto body (Ahmed body). Islam and Mamun performed numerical and trial concentrate to gauge the streamlined drag, however their work was focused on sedan car only and they did not investigated any drag reduction technique.

II. MODELING

A. Introduction to creo

CREO is a one of the world's main excessive-end CAD/CAM/CAE software program applications. CREO (Computer Aided Three dimensional Interactive Application) is a multi-platform PLM/CAD/CAM/CAE industrial software program suite advanced through Dassault Systems.

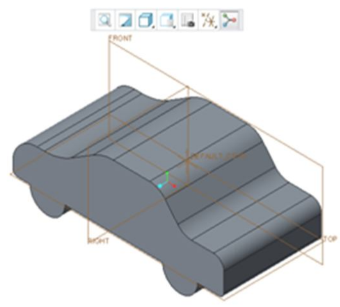

Fig 1. Sedan type model car

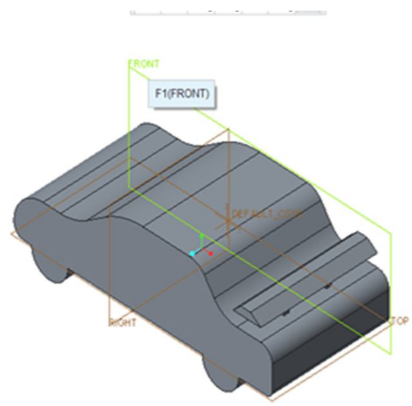

Fig 2: seaden type model car with spoiler

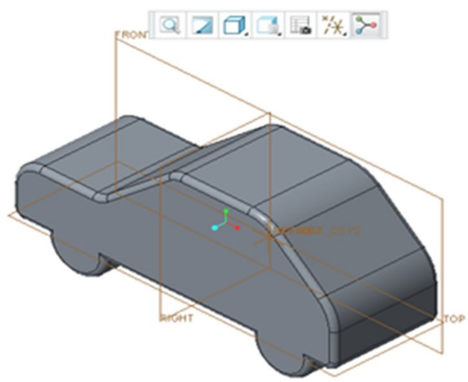

fig 3:SUV type model car

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B. Introduction to Ansys Cfx

Ansys CFX is a fluid simulation software used to determine aerodynamic characteristics of any solid body. Using CFX we can determine these characteristics by giving the boundary conditions and initial conditions. It uses Finite Volume Method to determine the characteristics in the background.

III. RESULTS

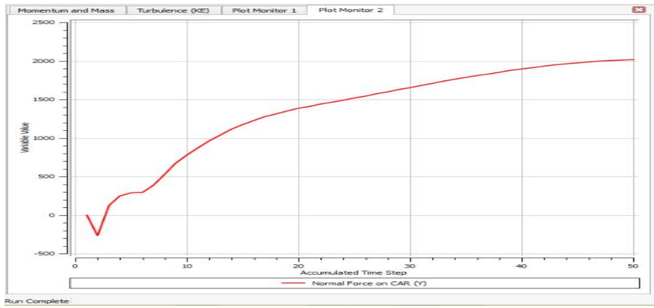

Fig 4: shows lift force of SUV at 25 m/s

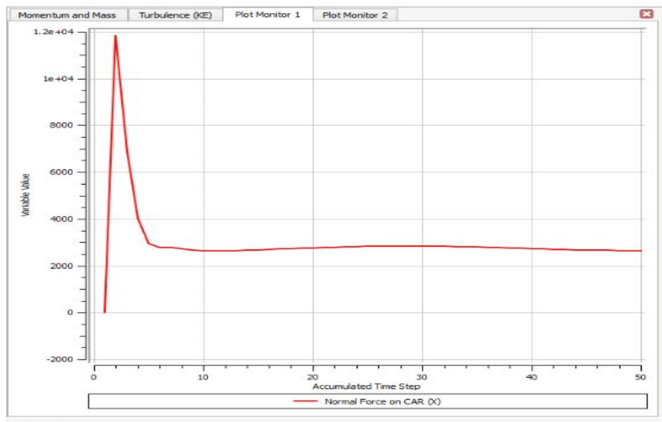

Fig 5: shows drag force of SUV at 25 m/s

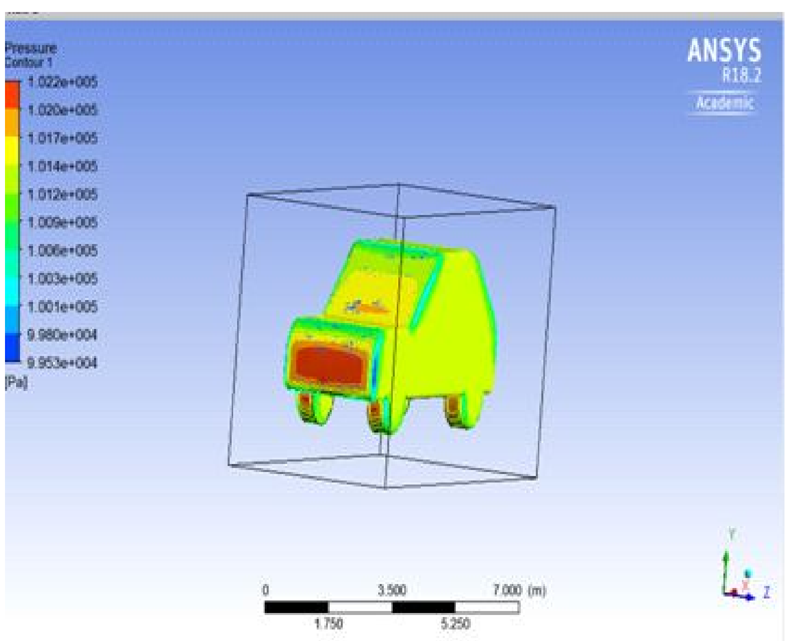

Fig 6:Pressure contour of SUV at 25 m/s

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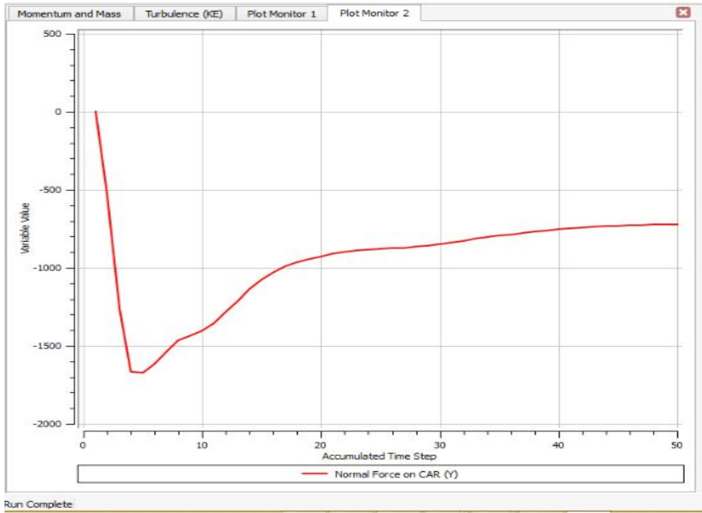

Fig 7: shows lift force of sedan at 25 m/s

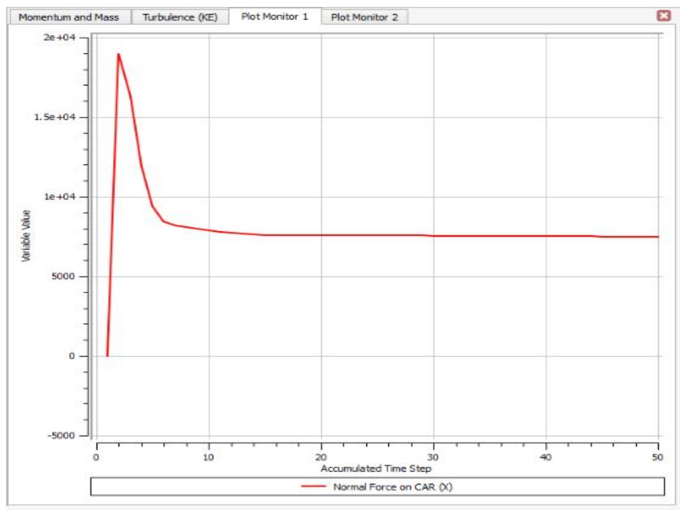

Fig8: shows drag force of sedan at 25 m/s

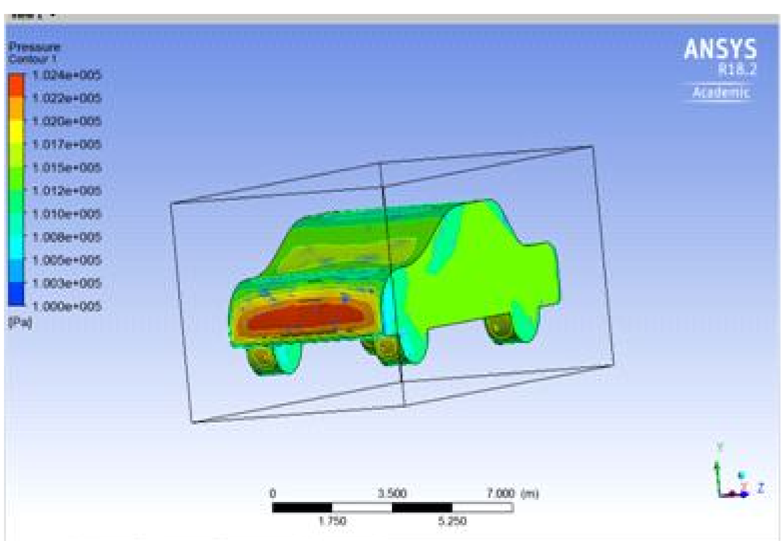

Fig 9: shows the pressure contour of sedan at 25 m/s

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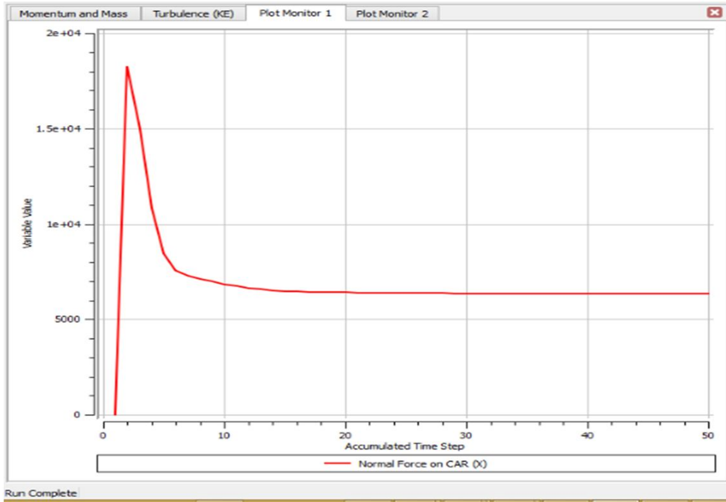

Fig 10:Drag force of sedan with spoiler at 25 m/s

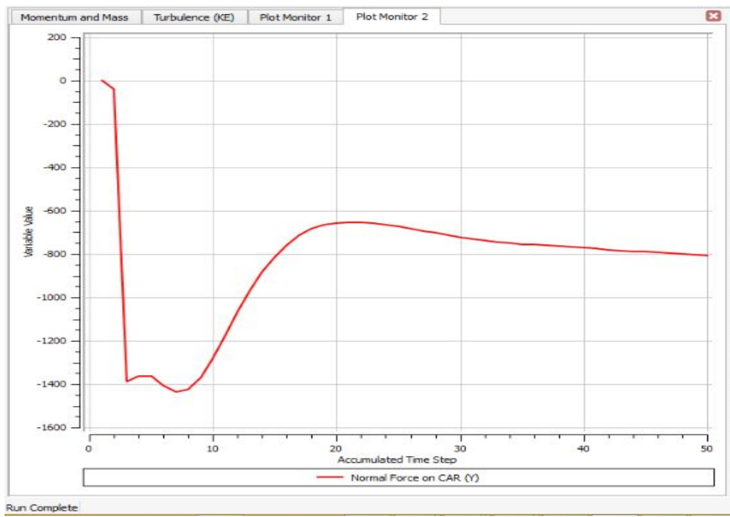

Fig 11:Lift force of sedan with spoiler at 25 m/s

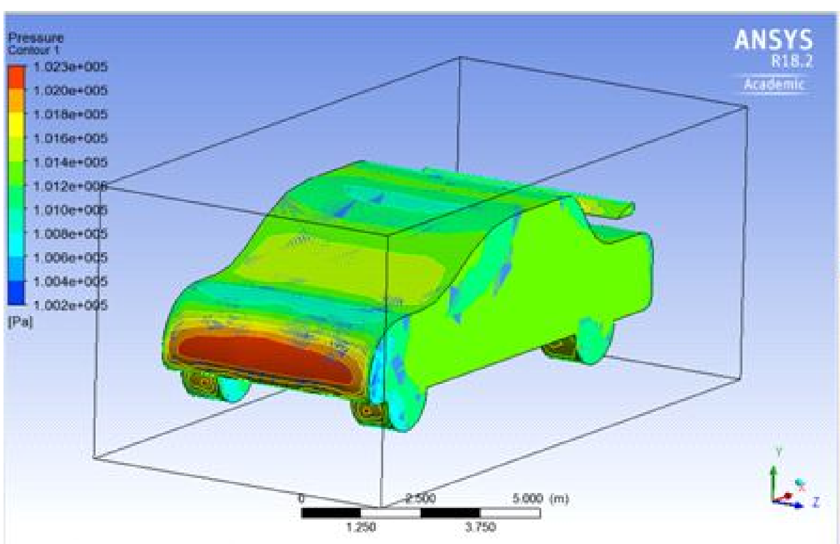

Fig 12:Pressure contour of sedan with spoiler at 25 m/s

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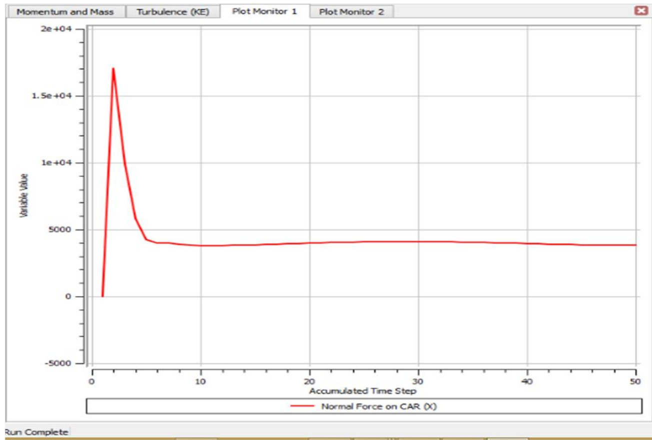

Fig13:Drag force of SUV at 30 m/s

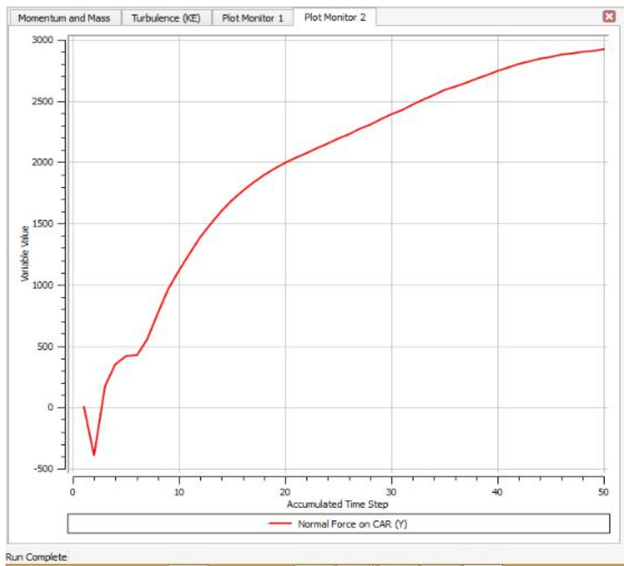

fig 14:Lift force of SUV at 30 m/s

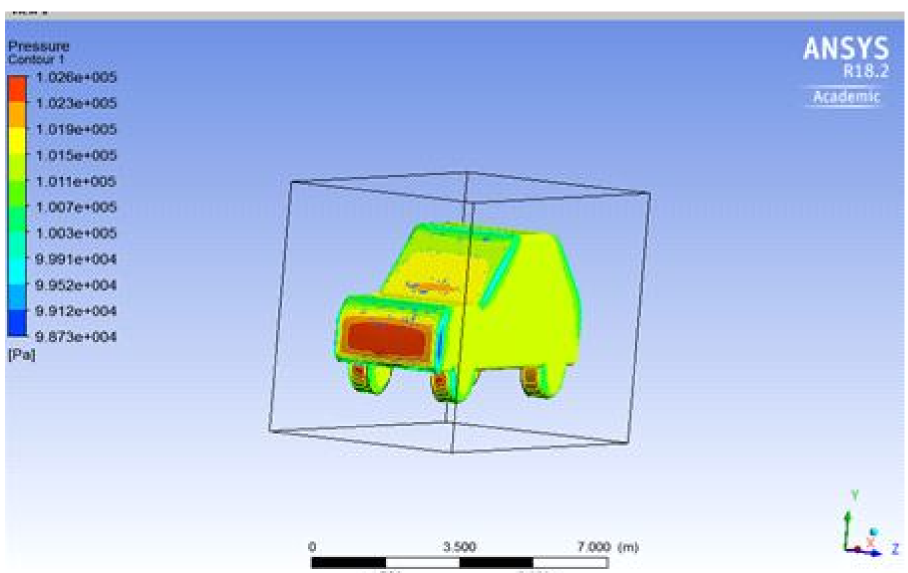

Fig 15: Pressure contour of SUV at 30 m/s

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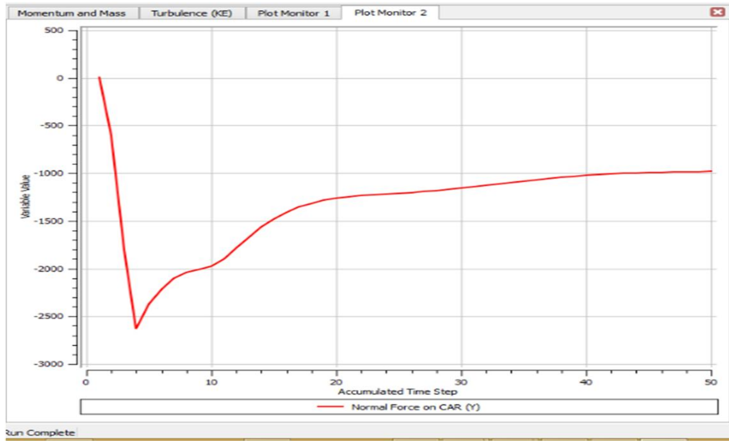

Fig 16: Lift force of sedan without spoiler at 30 m/s

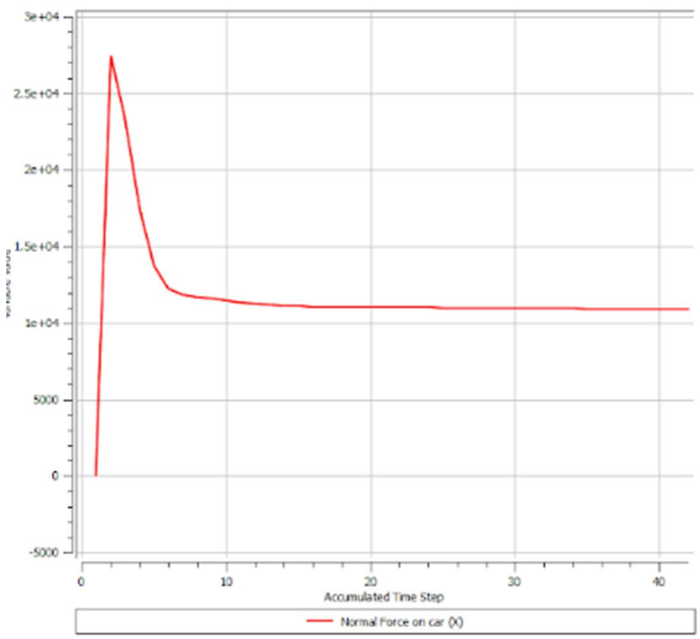

Fig 17: shows drag force for the sedan

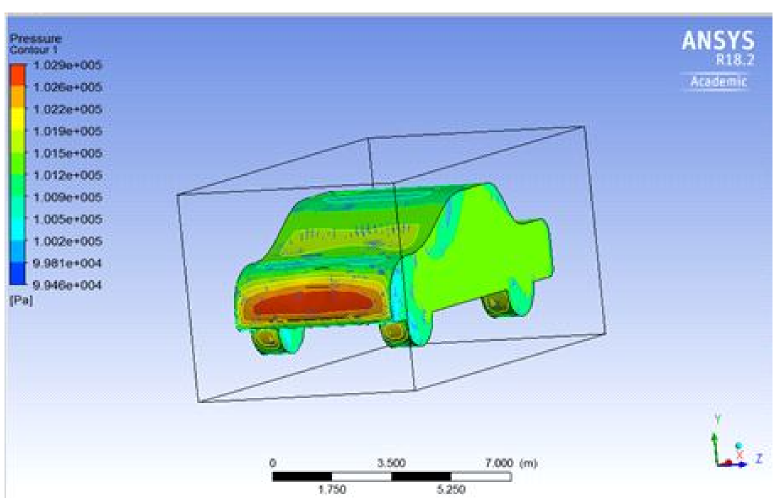

Fig 18:Pressure contours of sedan without spoiler at 30 m/s

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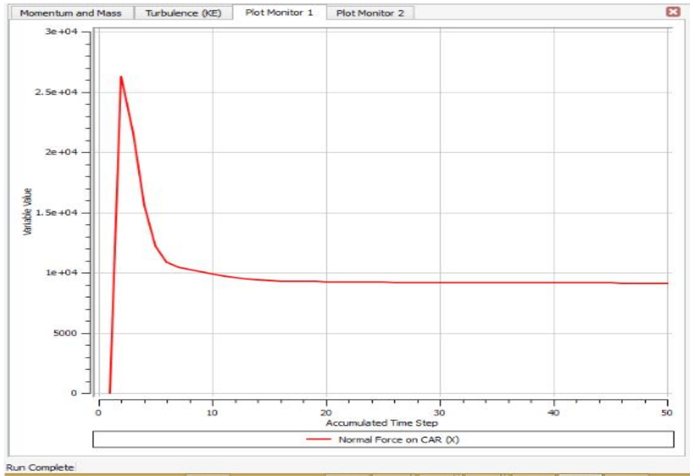

Fig 19:Drag force of sedan with spoiler at 30 m/s

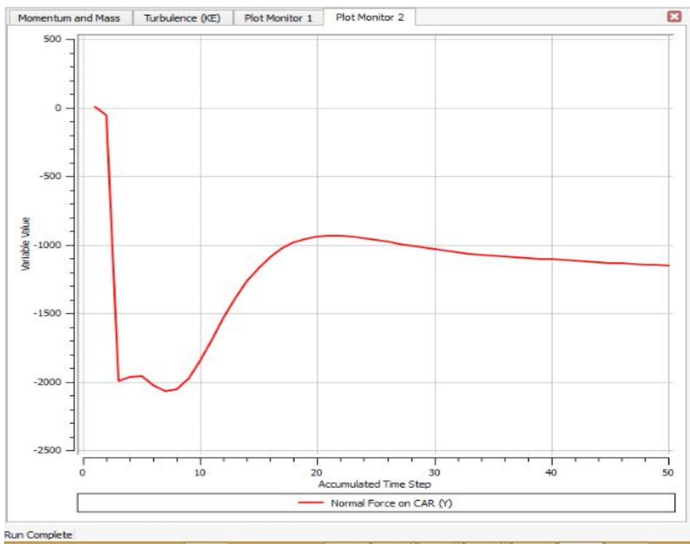

Fig 20:Lift force of sedan with spoiler at 30 m/s

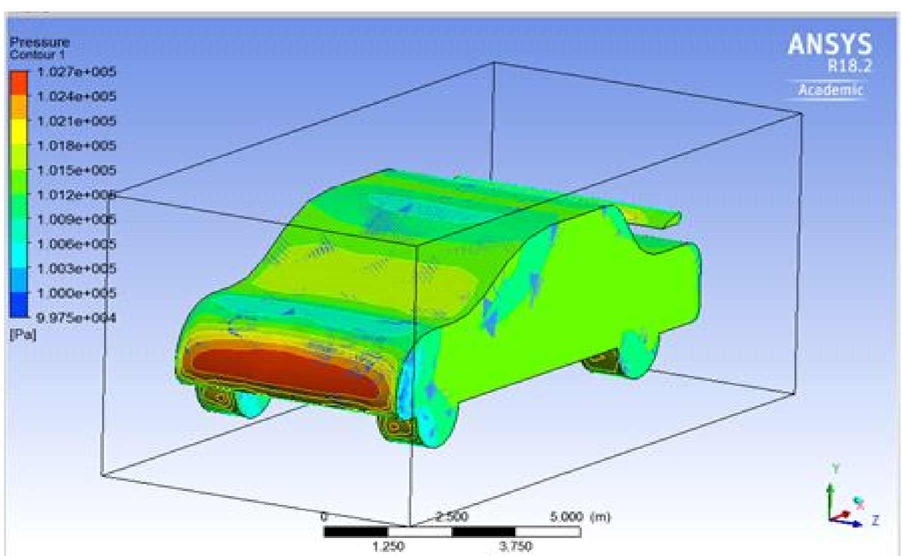

Fig 21:Pressure Contours of sedan with spoiler at 30 m/s

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IV. CONCLUSION

The results obtained shows the difference in forces act on the car. Forces act on the car depend on the shape and the frontal area. Difference in the forces act on the car may slightly differ from each other. There may be small difference but it is considerable for the aerodynamics point of view

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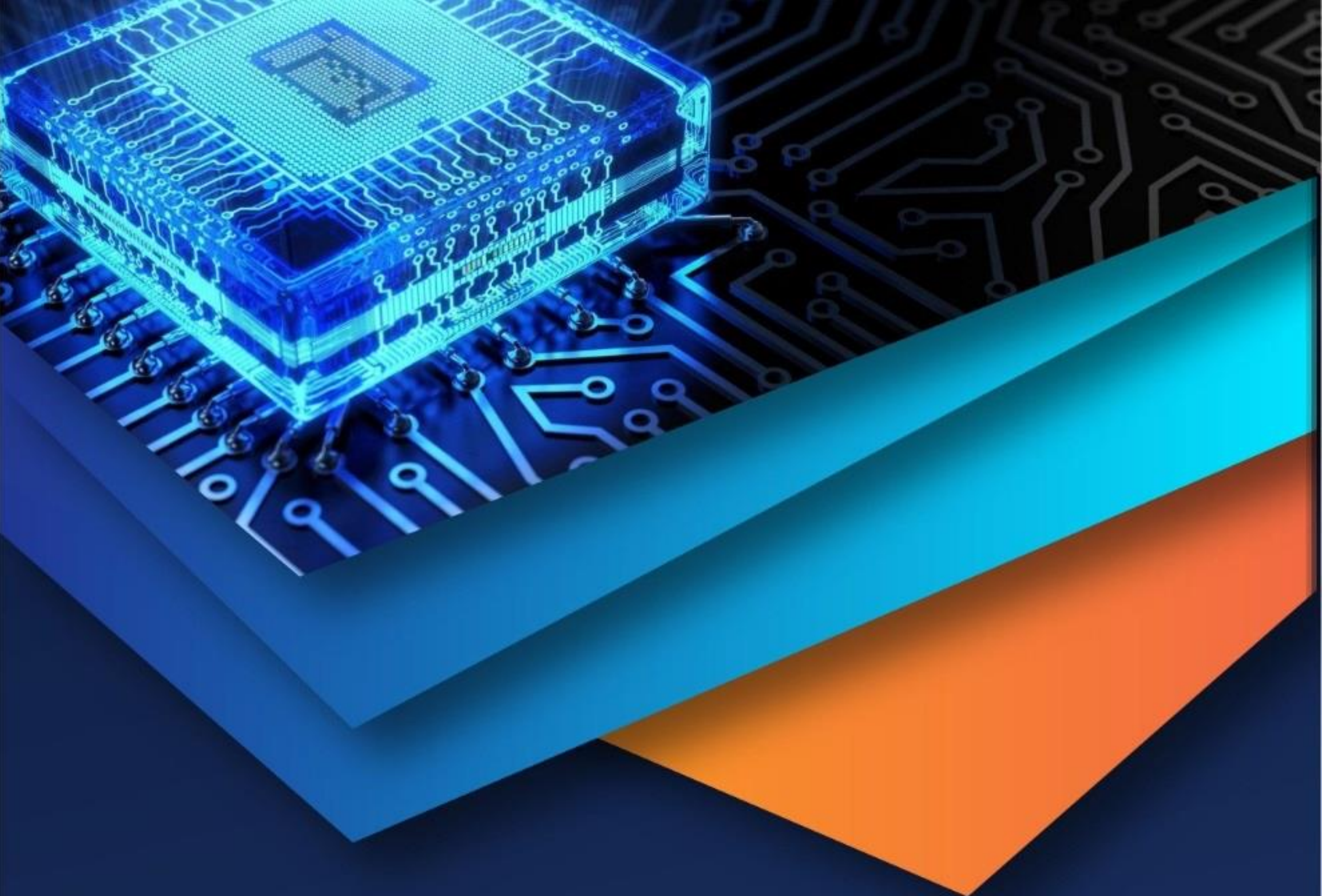

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