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Design and Simulate an Aerodynamic Car Body for The Maruti Suzuki 800 With Less Coefficient of Drag

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Abstract - *This paper describes the redesigning and CFD analysis of a Maruti Suzuki 800 car. The focus of the study is to investigate the aerodynamics characteristics of a Maruti Suzuki 800 without using any aerodynamic devices. The aerodynamics study of Maruti Suzuki 800 is made to reduce the drag force. The study was performed using the CFD package. This is a study to design and simulate an aerodynamic urbanconcept exterior body for Maruti Suzuki 800 to attain low coefficient of drag and to help the vehicle attain less fuel consumption. The main goal of this study is to enhance the stability of the vehicle and reduce the drag. With this the resistance of air to the vehicle gets reduced. The CFD analysis is done on full scale model. The aerodynamic study is conducted in the SolidWorks Flow Simulation 2016 software to perform a turbulent stimulation of the air flow on the Maruti Suzuki 800 and modified design. The results are graphically shown with co–efficient of drag, drag force & pressure contour.*

Key Words: CFD Simulation, Drag force, Drag coefficient

1.INTRODUCTION

The Computational Fluid Dynamics(CFD) surely has played important role race cars in the last few years. In order to get a good performance, the vehicle has to aerodynamically efficient. The drag force is the unwanted thing which normally reduces the speed of the car. The down force is useful to maintain the stability of the car in ground. The capability of the aerodynamic engineer is to compromise between down force and drag. Initially the Maruti Suzuki 800 & Modified design of Maruti Suzuki 800 car is analyzed and co – efficient of drag is found.

1.1 Aerodynamic drag (Cd)

The force on an object that opposes its motion through a fluid is known as drag. When the fluid is a gas like air, it is known as aerodynamic drag (or air resistance). When the fluid is a liquid like water it is known as hydrodynamic drag. Fluids are characterized by their ability to flow. In semi-technical language, a fluid is any material that can't resist a shear force for any appreciable length of time. This makes them hard to hold but easy to pour, stir, mix, and spread. As a result, fluids have no definite shape but take on the shape of their container. Fluids are unusual in that they yield their space relatively easy to other material things at least when compared to solids.

Fluids may not be solid, but they are most certainly material. The essential property of being material is to have both mass and volume. Material things resist changes in their velocity and no two material things may occupy the same space at the same time. The portion of the drag force that is due to the inertia of the fluid is the resistance to change that the fluid has to being pushed aside so that something else can occupy its space is called the pressure drag [1].

$$C_d = F_D / 0.5\, \rho\, v^2\, A$$

Where F_D = Drag force C_D = Drag coefficient
ρ = fluid density A = frontal area
v = Velocity

2. METHODOLOGY

The aerodynamic study of the both car is done in SolidWorks Flow Simulation software. The main aim of this aerodynamic study is to reduce the drag and increase the stability of the car. The basic model of Maruti Suzuki 800 car was analyzed in Flow Simulation and it was found that the value for drag co – efficient were on higher side. Appropriate design modification in the basic model of Maruti Suzuki 800 were incorporated and analyze separately. This design modification and its subsequent effects are discussed in the later part of this paper

2.1. Modeling of Car

The main goal of the aerodynamic study is to reduce the drag and increase the stability of car. The decrease in drag will help in increasing the top speed of the car. This is achieved by making the body aerodynamic and air flow should have lesser obstruction in its way. The stability of the car is also very important in the aerodynamic study. In this paper the aerodynamic study two different wind speed test has done on both the car solid models.

2.2. Design Modifications

1. The first solid model is the Maruti Suzuki 800 car model outlining the overall shape with actual dimensions.
2. The second solid model is the modified car model of Maruti Suzuki 800. This will reduce drag and increase the aerodynamic performance of the car.

The first model is the basic model of Maruti Suzuki 800 car. All two cars were modelled in SOLIDWORKS 2016.

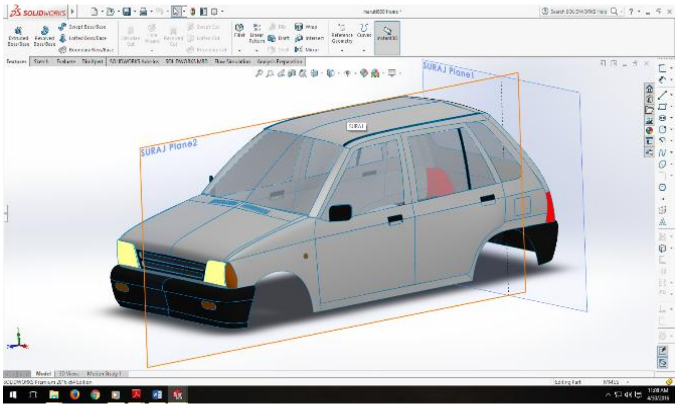

Fig -1: Maruti Suzuki 800 model

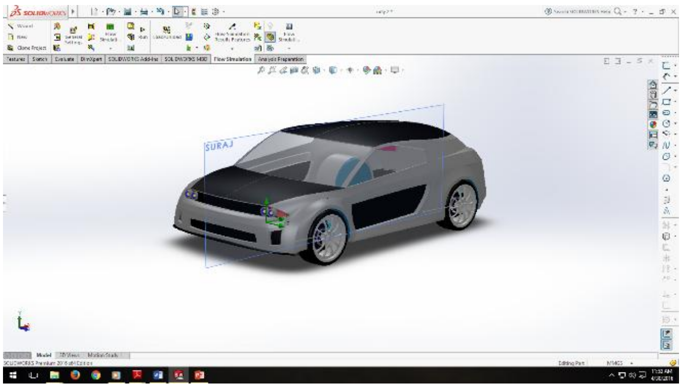

Fig -2: Maruti Suzuki 800 modified design

2.3. Boundary Conditions for Simulations

Analysis has been done to simulate the car model in the wind tunnel [2]. The inlet velocity is given 30 & 35 m/s. The model used was imported from SolidWorks 2016, any CAD program can also be imported, orientation of the model can also be changed, and different view of the wind is also available.

2.4.CFD Methodology

For analysis purpose, CFD solver FLOW SIMULATION is used for calculations. The simulation is using air with the following properties: temperature of 293.2 K, density of 1 kg/m^3 and pressure of 101325 Pa. Simulation will be run in different parameters where the inlet velocity of air used are 30 & 35 m/s in X- direction.

3.RESULTS

CFD analysis of flow over the car is carried for speed of 30 & 35 m/s, for all two models. Results are obtained the two models and graphs are plotted.

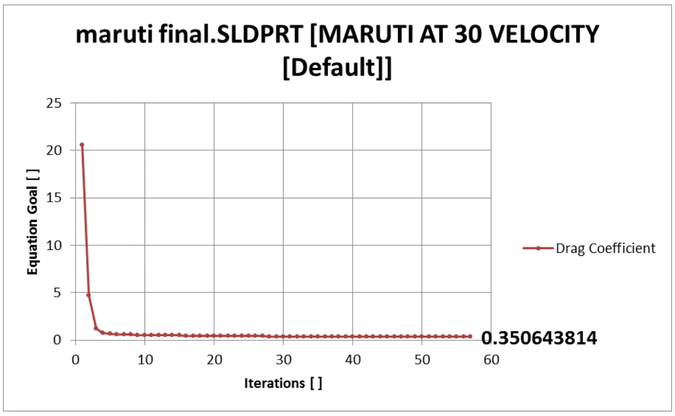

Chart -1: Drag coefficient of Maruti Suzuki 800 at 30 m/s wind speed

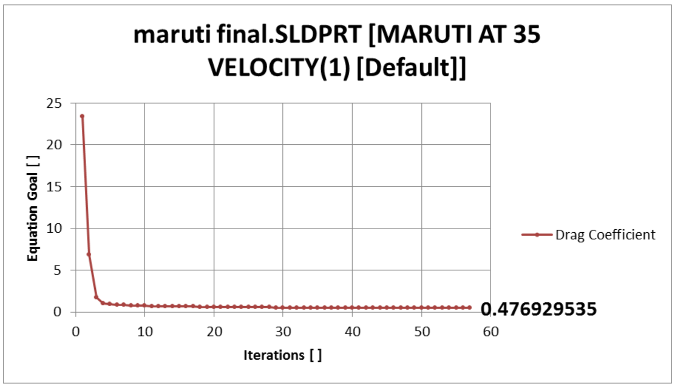

Chart -2: Drag coefficient of Maruti Suzuki 800 at 35 m/s wind speed

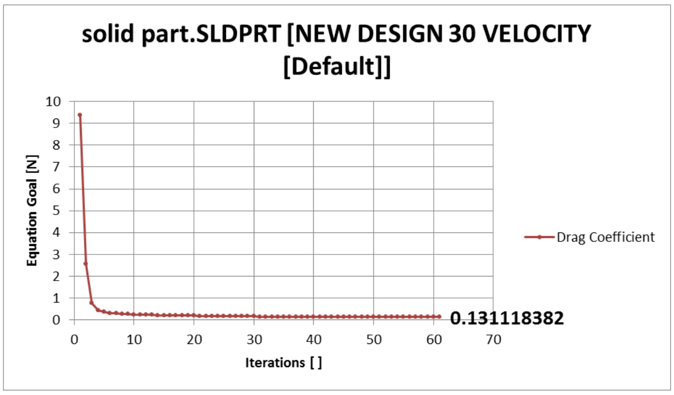

Chart -3: Drag coefficient of modified design of Maruti Suzuki 800 at 30 m/s wind speed

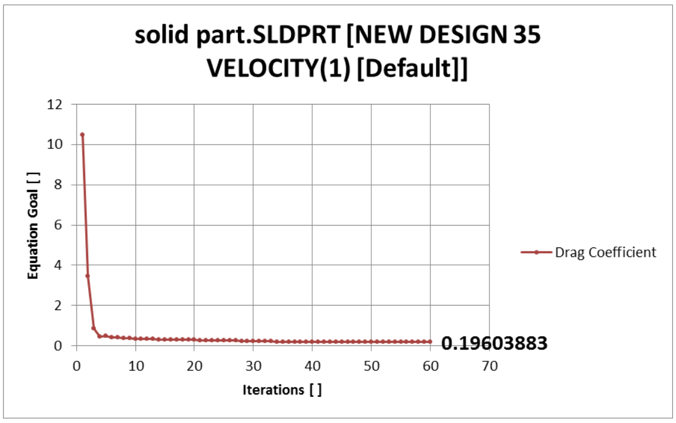

Chart -4: Drag coefficient of modified design of Maruti Suzuki 800 at 35m/s wind speed

Co-efficient of drag always depends on shape of the vehicle body. In this study, shape of the car is modified. From the above charts it can be observed that Cd for the modified car is lower, compared to the Maruti Suzuki 800 car. Cd for the modified car is found to 0.13 to 0.19, whereas Maruti Suzuki 800 car have Cd of 0.35 to 0.47 at two different wind speeds.

3.1. Drag Force

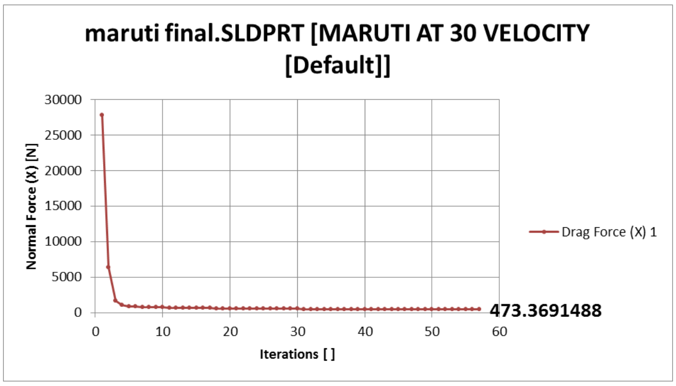

Chart -5: Drag force of Maruti Suzuki 800 at 30 m/s wind speed

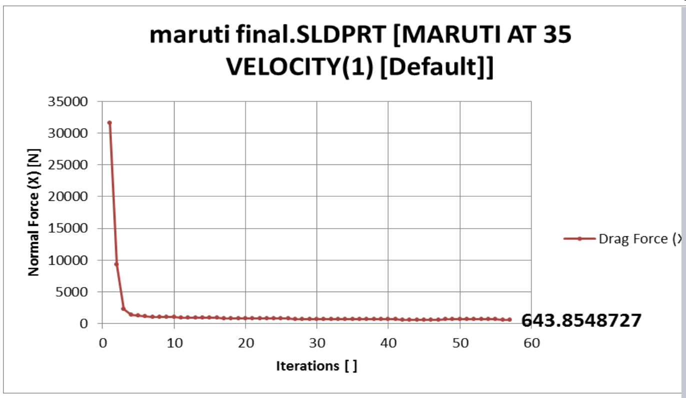

Chart -6: Drag force of Maruti Suzuki 800 at 35 m/s wind speed

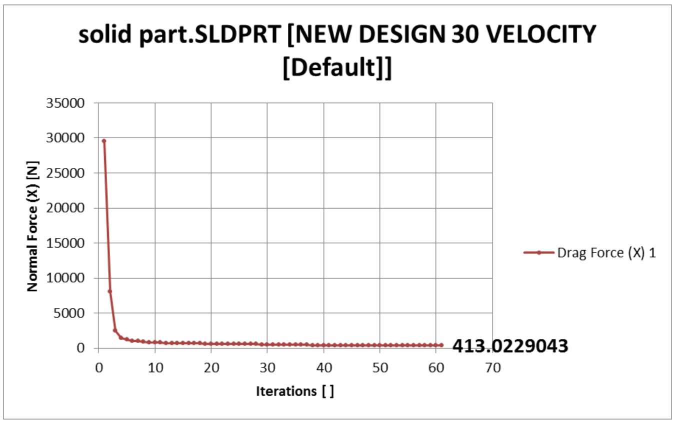

Chart -7: Drag force of modified design of Maruti Suzuki 800 at 30 m/s wind speed

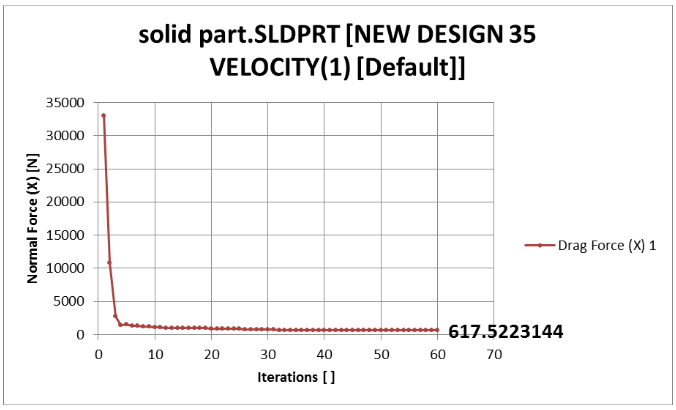

Chart -8: Drag force of modified design of Maruti Suzuki 800 at 35 m/s wind speed

From the above charts, it can be observed that drag force is reduced from the modified design as compared to Maruti Suzuki 800. It is because the shape modification of the vehicle affecting drag force, which is comparatively lower than Maruti Suzuki 800. Reducing the drag ultimately assists to achieve vehicle speed.

3.2. Static Pressure Contours

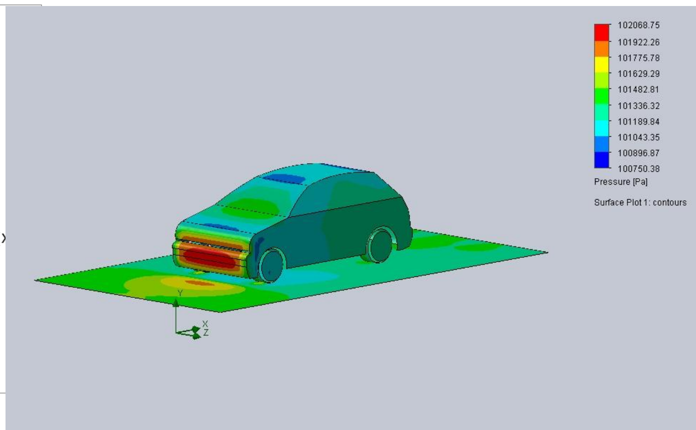

Fig -3: Pressure contour on surface of Maruti Suzuki at 30 m/s wind speed

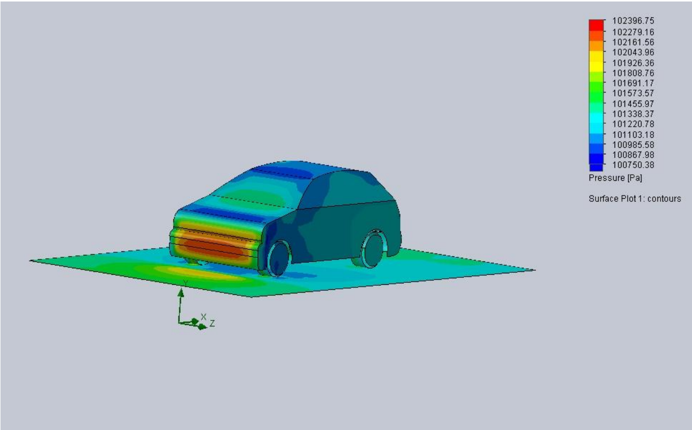

Fig -4: Pressure contour on surface of Maruti Suzuki at 35 m/s wind speed

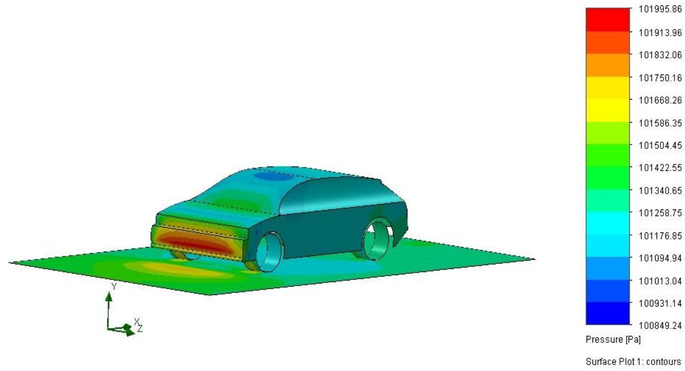

Fig -5: Pressure contour on surface of modified design of Maruti Suzuki at 30 m/s wind speed

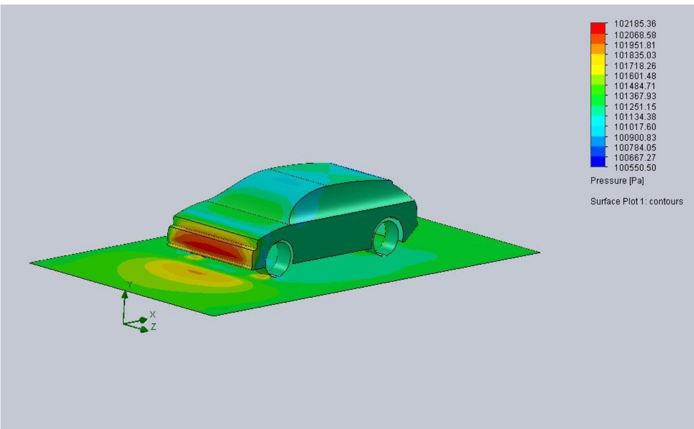

Fig -6: Pressure contour on surface of modified design of Maruti Suzuki at 35 m/s wind speed

Rounded edges at the front surface accelerates the air flow. From the above figures total pressure found to be less in modified design as compared to Marauti Suzuki 800. The red color indicates high dynamic pressure area that also presents the high-speed airflow. According to Bernoulli's effect, compared to the low velocity underneath of the vehicle, it generates the lift. Figure above shows that the blue section represents the low pressure on the top of vehicle. The pressure difference between the top and underneath of the vehicle generates lift [4].

Table-1: Aerodynamic Characteristics of Maruti Suzuki 800

Trial	Wind Speed (m/s)	Coefficient of Drag	Drag Force (N)	Highest Front pressure (Pa)
1	30	0.35	473.36	102068.75
2	35	0.47	643.85	102396.75

Table-2: Aerodynamic characteristics of Modified Design of Maruti Suzuki 800

Trial	Wind Speed (m/s)	Coefficient of Drag	Drag Force (N)	Highest Front Pressure (Pa)
1	30	0.13	413.02	101995.86
2	35	0.19	617.52	102185.36

3. CONCLUSIONS

The shape of an object affects the numerical value of the coefficient of drag. The frontal area of the vehicle body is the reference in the simulation of the coefficient of drag. The calculated coefficient of drag of modified design via simulation is less as compared to Maruti Suzuki 800. Although drag coefficient is determined by an object shape, drag force can still change depending on the numerical value of the velocity. From the data results, it is clear that increasing velocity will yield increasing value of the drag force.

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REFERENCES

[1] S Mohd Shaifullah. (2009) "Aerodynamics behaviour of Persona car using computational fluid dynamics",
[2] R.H. Barnard, Road Vehicle Aerodynamics, Third edition.
[3] W.H. Hucho, "Aerodynamics of Road Vehicles"

[4]] Inchul Kim, Hualei Chen and Roger C. Shulze, “A Rear Spoiler of a New Type that Reduces the Aerodynamic Forces on a Mini-Van”, 2006-01-1631.

[5] Angel Huminic and Gabriela Huminic, “On the Aerodynamics of the Racing Cars”, 2008-01-0099.

[6] Wael A. Mokhtar and Jonathan Lane, “Racecar Front Wing Aerodynamics”, 2008-01-2988.

[7] Douglas Gogel and Hiroshi Sakurai, “The Effects of End Plates on Downforce in Yaw”, 2006-01-3647.

BIOGRAPHIES

Suraj Pal Singh received the B.Tech degree in Mechanical Engineering from Desh Bhagat Engineering College in 2014 and is currently perusing M.tech in Machine Design from Desh Bhagat University.