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Aerodynamics Study of Race Cars

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ABSTRACT

If objects move through air, forces are generated by the relative motion between the surfaces and air of the object, Aerodynamics is the study of these forces, generated by the motion of air, This work deals with the study of race car prototype and its flow conditions, prototype study is economical, the final aim of this paper is to reduce the drag and lift of the car. Also to increase the speed of the car and reduce fuel consumption.

Keywords— Drag, Lift, Race car, Solid Works.

I. INTRODUCTION

When objects move through air, forces are generated by the relative motion between air and surfaces of the body, study of these forces generated by air is called aerodynamics. There are two types of aerodynamics, they are external aerodynamics and internal aerodynamics; external aerodynamics is the flow around solid objects of various shapes, where as internal aerodynamics is the flow through passages in solid objects, they are two parameters having huge effect on race car performance they are.

A.LIFT

It is the sum of all fluid dynamic forces on a body normal to the direction of external flow around the body. Lift is caused by Bernoulli's effect, it states that air must flow over a long path in order to cover the same displacement in the same amount of time. This creates a low pressure area over the long edge of object as a result a low pressure region is formed over the aerofoil and a high pressure region is formed below the aerofoil, it is this difference in pressure that creates the object to rise.

B.DRAG

It is the sum of all external forces in the direction of fluid flow, so it acts opposite to the direction of the object. In other words Force caused by turbulent airflow around an object that opposes the forward motion of the object through a gas or fluid.

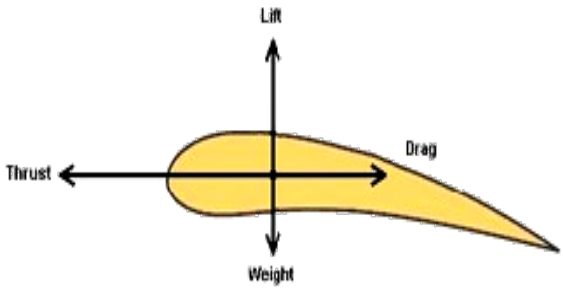

Figure.1. Smooth forces on body

II. METHODOLOGY

In this paper first process is selecting a race car of preferable prototype model, and made the design changes to the prototype, like changing flat surfaces to curved surfaces. After this by using Solid Works software complete the flow simulation by applying boundary conditions, Then both drag and lift are reduced hence it increases the speed of the car.

III. PRIOR APPROACH

since the first car was manufactured in early 20th century the attempt has been to travel at faster speeds, in the earlier times aerodynamics was not a factor as the cars where traveling at very slow speeds there were not any aerodynamic problems but with increase of speeds the necessity for cars to become more streamlined resulted in

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structural invention such as the introduction of the windscreen, incorporation of wheels into the body and the insetting of the headlamps into the front of the car. This was probably the fastest developing time in automobiles history as the majority of the work was to try and reduce the aerodynamic drag. This happened up to the early 1950's, where by this time the aerodynamic dray had been cut by about 45% from the early cars such as the Silver Ghost. However, after this the levels of drag found on cars began to slowly increase. This was due to the way that the designing was thought about. Before1950, designers were trying to make cars as streamlined as possible to make it easier for the engine, yet they were restricting the layout of the interior for the car. After 1950, the levels of aerodynamic drag went up because cars were becoming more family friendly and so as a consequence the shapes available to choose were more limited and so it was not possible to keep the low level of aerodynamic drag. The rectangular shape made cars more purposeful for the family and so it is fair to say that after 1950 the designing of cars.

IV. OUR APPROACH

The initial design of the car having flat surfaces, in this study we are changing in to curved surfaces. The old design for aerodynamic study is shown in figure 2. And new design is shown in figure 3.

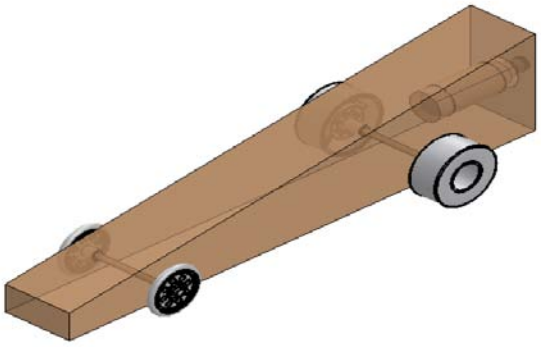

Fig .2 Old Design Flow Simulation Race Car Design

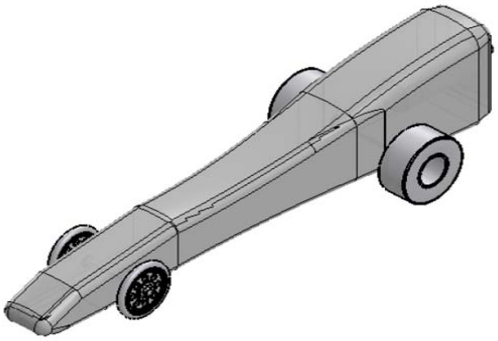

Fig. 3 New Design Flow Simulation Race Car Design

A. Analysis Results

Analysis can be carried out buy using solid works software, the figure 4. Shows the aerodynamic flow on the surface of the cars running of cars at 55mph.

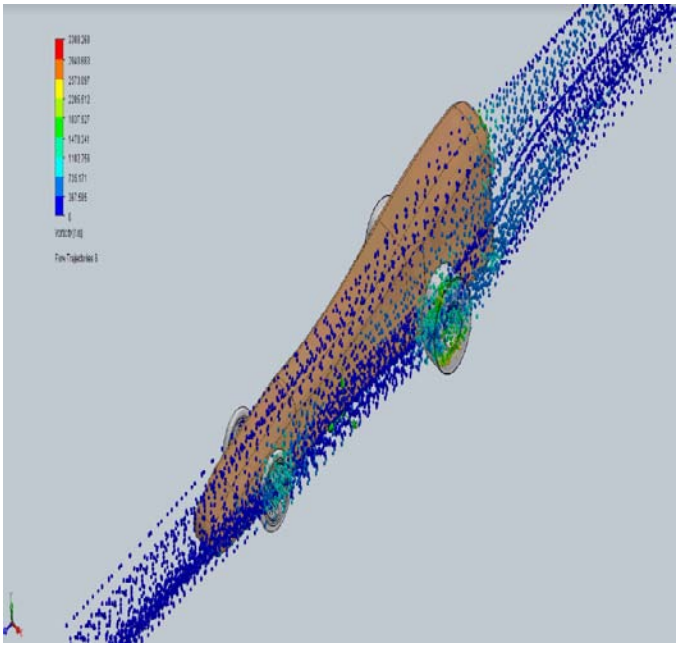

Fig .4 Aerodynamic flow simulation of car

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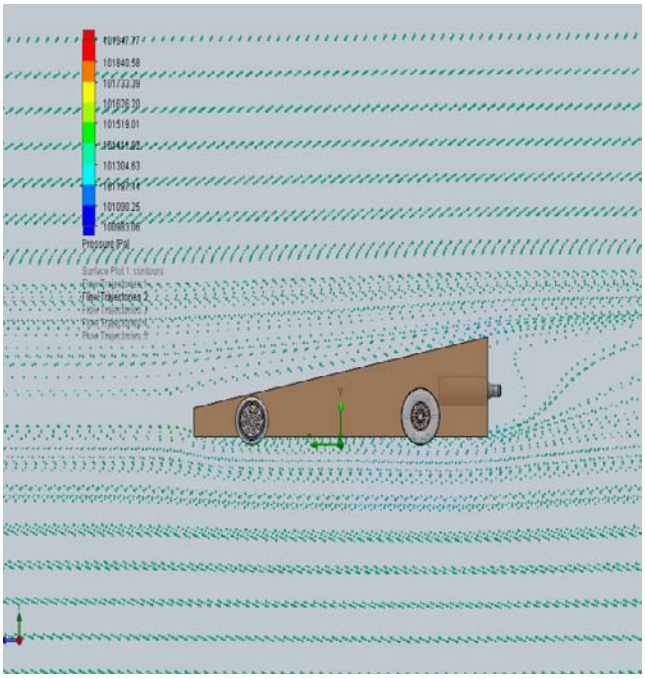

FIG .5 flow simulation of old design

Fig 5 shows the flow simulation of old design, the cavity is creating on the outside surfaces is as shown in the above figure.

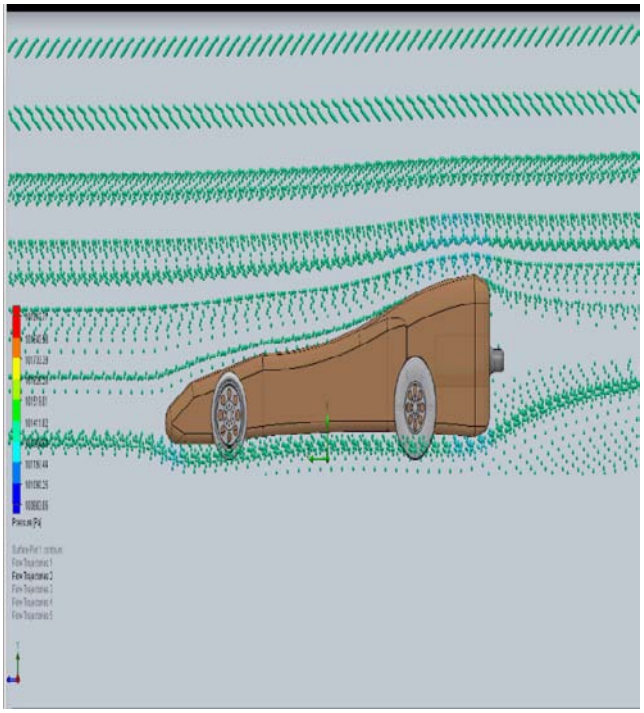

Fig .6 Flow Simulation of new design

Figure 6 shows the flow simulation of new design, there is no cavity on the surface of the car. Figure 6. shows the surface pressure acting on surface of the race car

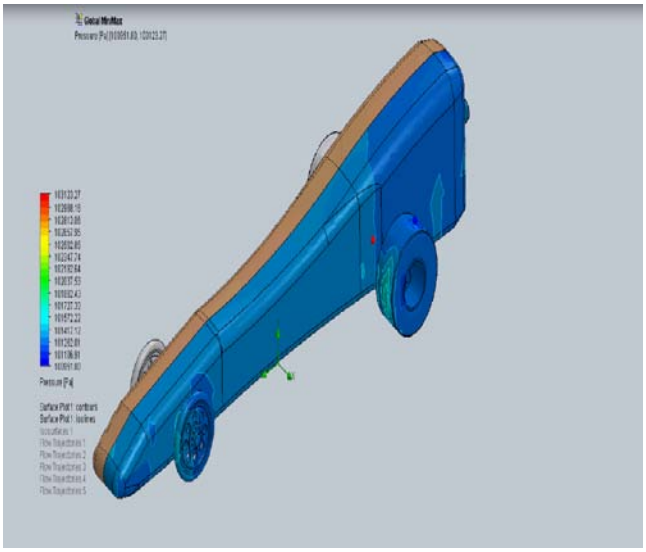

Fig. 7 Surface Pressure

Goal Name	Unit	Value	Averaged Value	Minimum Value	Maximum Value	Progress [%]	Use In Convergence	Delta	Criteria
Drag	[g]	-26.596197	-26.507765	-26.596197	-26.423983	100	Yes	0.172213	4.659701
Lift	[g]	-3.916894	-4.792347	-5.714588	-3.905294	100	Yes	0.700894	0.760634

Table .1 Drag & lift criteria of car for 55mph

Drag and lift values for the race car is as shown in Table 1.

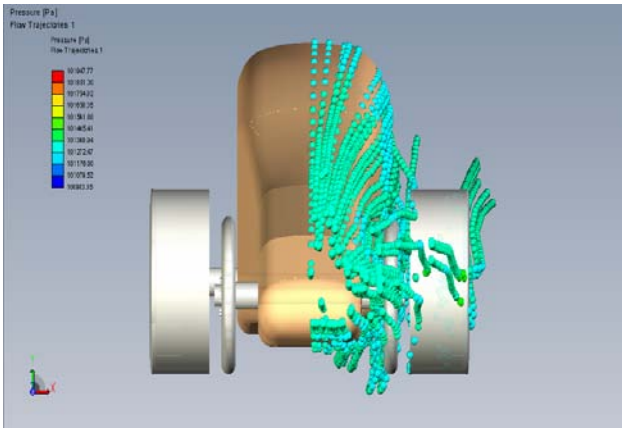

Fig .8 Flow Pressure

Name	Unit	Value	Progress	Use in convergence	Delta	Criteria
Drag	p	-26.529	100	On	0.115377466	4.63969964
Lift	p	-3.822	100	On	0.702104028	0.760638123

Table 2 maximum refinement level of new design

B. COMPARISION

Comparision of old and new design of car running at 55mph.

OLD DESIGN

Goal Name	Unit	Value
Drag	[p]	-32.82427016
Lift	[p]	-12.04345615

NEW DESIGN

Goal Name	Unit	Value
Drag	[p]	-26.596193725
Lift	[p]	-3.9160284302

V. CONCLUSION

After the modifications in design of race cars, drag and lift is reduced, it induces the increase in its speed and cause less fuel consumption. The drag and lift are considerably reduced in our new approach. Additionally more design modifications can be carried out to obtain better results. And also by selecting different materials to the prototype model to control the aerodynamic effects.

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