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Study of Drag Around the Nosecone of FSAE Vehicle

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Abstract - *This paper presents a review of recent research that has been carried out on the effect of drag on FSAE vehicle's nosecone. Drag plays an important role in overall performance of the vehicle and it can be reduced by using different aerodynamic shapes for nosecone. Since the beginning of the racecar events, aerodynamic drag has been extensively studied with primary purpose of reducing drag and improving performance. FSAE vehicles are the prototype models of F1 cars, so they has to perform well as they compete in dynamic events. Not only in performance but also in safety point of view, the nosecone should satisfy all the requirements as to clear the technical inspection. Here, we use computer model analysis to investigate the effects of drag on the nosecone. Using two different designs for analysis shows the behaviour of airflow around the nosecone of the vehicle.*

Key Words: Aerodynamic drag, FSAE, nosecone, CFD analysis, airflow, drag coefficient, etc

1. INTRODUCTION

Aerodynamic is the study of behaviour of the air, particularly when affected by solid object, such as racecar, airplane wings, etc. It is primarily concerned with drag and lift force caused by passing air around the body. Drag is considered as the important force in aerodynamic, most of the racecar manufacturers consider it as a challenge. Racecars are meant to be fast on the track and aerodynamic drag is like a stepping stone on that track. Drag is responsible for the loss of power of the vehicle. It also affects the fuel consumption rate which decreases the overall performance of it. It is the most undesirable thing when designing the body of the vehicle. Number of researchers have worked on this topic from years and some of them have provided us effective solutions to reduce the drag. Racecar manufacturers are intended to use these solutions or manipulate it in their own ways.

The nosecone or the frontal part of the vehicle is the first part that comes in contact with the air wall. When the vehicle comes in contact with air, the nosecone splits the air and it flows around the body. We can say that the shape of the nosecone decides the airflow around the vehicle. As the racecars moves in speed, they experience some lift at the front side because most of the weight of the vehicle is concentrated behind the C.G. of the vehicle. To avoid that, lowered nosecone and weight of the vehicle must generate some downforce to reduce the lift. Also in accident cases, it should protect driver from any injuries. That signifies the importance of the nosecone. Downforce is important for racecars while traveling faster through a corner as most of the FSAE competition tracks consists of tight corners with no longer straights. But, increase in downforce will also increase the drag. So, we have to consider all these things while designing the vehicles for racing.

2. PROBLEM STATEMENT:

Just like other teams, we ultimately focused on reducing drag and increasing stability of the car. Most of the FSAE competition tracks are consists of tight corners to test vehicles dynamics thoroughly. Also, the Dynamic events in such competitions are time-based, for that vehicle must have sufficient downforce to travel fast at a corner. Our problem statement is as follows:

1. To set target for different parameters like drag and lift coefficients, downforce, drad force, etc.
2. To choose designs that can satisfies the requirements.
3. Design should not be complicated which can lead to consume more time in fabrication process.
4. Choose the best option for further analysis.

3. ABOUT THE COMPETITION:

Formula SAE (FSAE) may be a student style competition organized by SAE International (Society of Automotive Engineers). The competition was started in 1980 by the SAE student branch at the University of American state at capital of Texas. The thought behind Formula SAE is that a fictional producing company has contracted a student style team to develop atiny low Formula-style racecar. Groups battle the idea that their example are going to be evaluated for production and a bunch of developers have an interest in investment in their project. The supposed sales market is that the non-professional weekend autocrosser. Therefore, the automotive should have terribly high performance in terms of acceleration, braking and handling qualities. The automotive should be low in price, straightforward to keep up and reliable. Additionally, the cars marketability is increased by different factors like aesthetics, comfort and use of common components.

The challenge to the look team is to style and fabricate a example that best meets these goals and intents. Over the

course of five day competition, a jury of consultants from the Motorsport, automotive and provider industries choose the look, price and business designing of all the groups to see the simplest team and vehicle; additionally the team's on-track performance scores can demonstrate however well they hindrance beneath real world conditions.

4. OVERVIEW

4.1 Drag force:

Drag force acts opposite to the vehicle's motion and provides resistance. In simple words, drag reduces the speed of the car. To find drag force, we require the drag coefficient and the cross-section area on which the drag is acting. For every type of vehicle, there is some drag coefficient, in case of F1 cars, Cd should be around 0.7- 0.8. Most of the student teams assume this value for their calculation. By using CFD analysis, we can find the value of drag force and Cd for a particular nosecone design.

4.2 Ways to reduce drag:

As there are lot of ways to reduce the drag, we'll focus on some prime ways which FSAE student teams follow:

1. Keep the frontal area of nosecone small:

Coefficient of drag is directly proportional to the frontal cross-section area. To reduce that, we should keep the frontal area of nosecone as small as possible. Some teams design box-like nosecone which doesn't perform as per their intents. Nosecone with small front area and sleek design will be the best option as it will cut the air wall effectively.

2. Keep the vehicle low:

To avoid lifting of vehicle, we must keep our vehicle close to the ground. According to FSAE competition's rulebook, the minimum ground clearance must be 30 mm. If not mentioned, keep it around 30-50 mm.

3. Streamlined body:

Making streamlined body vehicle is quite difficult when you are a FSAE student team, working with a tight budget, but it can be achieved. Using CFD analysis and some designing softwares, we can make body of vehicle streamlined.

Fig -1: Nose Cone Design

4. Use of composite materials:

While fabricating the bodyworks, use of composite materials is become like a trend in FSAE competitions. From fiberglass, carbon fibre to the materials used in F1 like Zylon, these materials gives smooth surface finish and strength as well to body panels.

5. Avoid unwanted openings:

The body panels must not possess any unwanted openings, gaps and cracks between the body panels. This causes uneven passage of air in the vehicle and it affects the airflow around that region. Venting holes should be created as per the competition rulebook(2 mm in diameter).

5. CONCLUSIONS

Aerodynamics of the vehicle improved by using the nosecone with sleek design with small frontal area and streamlined in nature. Nosecone improves the air flow around the vehicle and it boosts up the speed which will help the driver to complete the racing events of the competition under their planned timings.

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