Evolution and Optimization in Aerodynamic Performance of Grand Turismo Type

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Abstract- Sport car having high speed engine, so it's having its aerodynamic and its effects. Here main objective is to improve its aerodynamic efficiency by certain modification as well as also improve in aerodynamic braking and stability at higher speed. By doing aerodynamic analysis get better performance, increase fuel efficiency, Decrease fuel economy, better aerodynamic efficiency, less pollution due to less usage of fuel, improve in road holding capabilities and decrease in wind noise.

Keywords- aerodynamic, car, optimization, performance, analysis.

I. INTRODUCTION

Touring cars is car which are using in racing competition. In this car which highly modification in road going cars. It is population many countries like Argentina, Australia, Brazil, Britten, America etc. According to information it’s not fast like but it having equal fans compare to f1 racing. These vehicles are used for entertaining as well as well support to the racing. A grand tourer is luxury automobile with high speed with high performance and capable for long distance travelling.

Grand tourer cars having low aerodynamic efficiency in the past. But in present it will improve but something will remaining. So I trying to find them and try to find something new concept. Most sports cars to increase aerodynamic effects and aerodynamic efficiency manufacturer using spoilers, flaps, ducts, diffuser etc. All component use in front side as well as rear side of the car.

II. OBJECTIVES

Objective of this paper is using and modification in front spoiler, front diffuser, front flaps and ducts, rear spoiler, rear diffuser, rear ducts and flaps etc. All modification for better control at high speed driving, increasing braking and automatic supporting this kind of driving with help of sensors and computerized. Everything will control by computer and as per setting which selected by driver. Aim of modification are create high traction control and down force at corners of the road. Better acceleration and top speed, to create maximum down force or increase down force and braking force when brake paddle fully pressed.

III. LITERATURE SURVEY

MatleoCorno, Stefano Bottelli and ManraTanelli study on working and investigation about using of active aerodynamic surface in sports car for getting require lift forces. For controlling vertical acceleration as well as decrease upward direction force. Everything done for getting comfort riding and better road holding. They requires controller like sensors and air foils, spoiler and diffuser etc. They want to increase ride comfort without and disadvantage or disaffect of road holding at high speed and other capabilities.

Rzdhwan and Bin CheZake studied on aerodynamic spoilers to gain more down force and better traction and road holding capabilities. They study on every fundamentals of aerodynamic. Its equation and derivatives and study on modal of car and analysis on the car. They experiment different types of aftermarket spoiler take better performance of spoiler for specific modal. They measure co efficient of drag force (cd) and co-efficient of lift force (cl). Also measure co-efficient of friction of body. All forces with its reaction.

Mond Nizam Sudin, Mohd Azman Abdullah and Shamsul Anuarb Shamusddin studied on drag reduction on vehicle. They telling us flow control of air will affect 50% of car performance. That means if proper air flow control it will reduce in fuel usage as well as increase efficiency of vehicle and reduce in emission. They are focused rear side of car in segregation air recirculate air in rear side of car.In conventional passive control techniques is allowed to modification shape of body of car for drag reduction by attaching new device and parts. But it will using for particular application. But preferable is flow control. But both method are able to reduce drag of vehicle and improve in fuel efficiency and consumption.

Keisuke Nisugi, Toshiyaki Hyase And Atusushi Shirai study on using of feedback flow control for aerodynamic drag reduction for vehicle. They start with two dimensional modal of car and calculation for it. They find the location which side drag is most effectively. They find place based on physical consideration of drag reduction and velocity measurement place. In bluff body we can applicable feed buck flow control. The drag is generated with same mechanism of two dimension vertex shedding. They experiment on car’s body in 2-d dimensions and calculations are performed for flow around the body. As per analysis they got that the flow same time they reduction in 20% drag without any modification with modified it will more reduction of drag.
IV. TERMINOLOGY

4.1 General Aerodynamic Concepts

The Bernoulli’s equation, which is can be obtained by integrating $F = ma$ is derived using the assumptions that the air density does not change with pressure, viscous effects are assumed negligible, the flow is assumed to be steady, the flow is assumed to be compressible and the equation is applicable along a streamline. Therefore, the formula can be applied along any point on a streamline where the relation between the local static pressure ($p$), density ($\rho$), and the velocity ($v$) is:

$$p + \frac{1}{2} \rho v^2 + \gamma z = \text{constant along streamline}$$

or

$$\frac{p}{\rho} + \frac{1}{2} v^2 = \text{constant.}$$

From the equation, this indicates an increase in pressure will cause a decrease in velocity and vice versa.

![Fig. 1 Pressure and velocity gradient in the air flow over body](image)

This moment of the air flow near the body creates a velocity distribution which in turn creates the aerodynamics loads acting on the vehicle. These loads, in general, can be divided into two major contributions. The first is the shear (skin friction) force, resulting from the viscous boundary layer, which acts tangentially to the surface and contributes to drag. The second force is pressure, which acts normally (perpendicular) to the surface and contributes to both lift and drag meaning that “the vehicle down force is really the added effect of the pressure distribution”.

4.2 Drag and Lift concept

There are two basics categories of aerodynamic forces acting on the vehicle. Shear stress, which an act parallel to the body surface and contributes only to drag. Pressure, which acts normally (perpendicular) to the surface and is responsible for a vehicle’s lift and part of drag.

![Fig. 2 Aerodynamic force effect](image)

4.3 Pressure distribution

Most of the lift comes from the surface pressure distribution. A typical pressure distribution on a moving car is shown in figure.

![Fig. 3 Pressure distribution along the center line of a car](image)

The distribution for the most part with simple Bernoulli equation analysis. Location with high speed flow (i.e. over the roof and hood) has low pressure while location with low speed flow (i.e. on the grill and windshield) has high pressure. It is easy to believe that the integrated effect of this pressure distribution would provide a net upward force. This force is negative force, meaning that the force that no need to enhance the stability of a vehicle. The opposite force of upward force is down force.

V. ANALYSIS

In aerodynamic components in including front and rear spoiler, front and rear diffuser, and front and rear. There are many material such as ABS plastic, Fibber plastic and Carbon fiber for that spoiler and other component.

5.1 Experiment on carbon fiber duel spoiler

In this case used duel spoiler attached with rear side and it shows bending when more drag force impacting on the rear spoiler.

![Fig. 4 rear spoiler analysis](image)

VI. RESULT

Analysis results are given below.
TABLE I

<table>
<thead>
<tr>
<th>Velocity (KM/H)</th>
<th>Drag force (N/mm²)</th>
<th>Lift Force (N/mm²)</th>
<th>C_d</th>
<th>C_a</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>147.431</td>
<td>49.646</td>
<td>0.3326</td>
<td>0.112</td>
</tr>
<tr>
<td>90</td>
<td>244.137</td>
<td>80.663</td>
<td>0.3333</td>
<td>0.110</td>
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<tr>
<td>110</td>
<td>369.157</td>
<td>125.973</td>
<td>0.3343</td>
<td>0.115</td>
</tr>
<tr>
<td>130</td>
<td>512.359</td>
<td>172.825</td>
<td>0.3355</td>
<td>0.113</td>
</tr>
<tr>
<td>150</td>
<td>684.323</td>
<td>224.034</td>
<td>0.3363</td>
<td>0.110</td>
</tr>
</tbody>
</table>

VII. CONCLUSION

According to all data, methodology and terminology conclude that according to working model, we can modify according to observation data and that help to increase aerodynamic efficiency of car as well as stability at higher speed and gain more traction control. As we decided in modification in include car has its front diffuser and rear diffuser, under body vents and air guide vents, rear diffuser with modified active ram, front and rear flaps and dual spoiler. We sure about this kind of modification helps to improve aero dynamic efficiency.

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