WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Fuel Performance Improvement by Changing Coefficient of Drag

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ABSTRACT

The auto industry is extremely competitive. Hundreds of businesses invest billions of dollars in R&D to give their goods the competitive edge they need to succeed in the market. The Indian market is arguably the most competitive in the world, and the biggest brands in the world now die there. Ford, MAN Trucks, Harley Davidson, and General Motors have all ceased operations. Volkswagen, the market leader in the world, and its affiliate Skoda have a market share of less than 1%. The amount of fuel used determines whether the vehicle is successful or not. Across the board, this is the situation. Cars, two-wheelers, or commercial vehicles all qualify. Actually, this becomes the most important in commercial vehicles.

In this study, we took a Volvo bus and attempted to make improvements to it in order to lessen aerodynamic drag and increase fuel efficiency.

Keywords- CFD (Computational Fluid Dynamics), Automotive Sector, Fuel Efficiency etc. Aerodynamics, Drag

1. INTRODUCTION

The fuel efficiency of a vehicle is critical in determining whether or not the vehicle will be successful in the marketplace. There are two reasons for this. To begin with, the cost of fuel in India is very high in dollar terms when compared to several other countries. Second, our currency is weaker, so we pay much more in purchasing power parity terms as Indians. As a result, our market is extremely sensitive to fuel costs per kilometre. We've all heard of Maruti Suzuki's "Kitna Deti Hai" campaign.It was a successful campaign that aided in increasing their sales. That is one of the reasons they have nearly a 50% market share in a market with more than 12 players.

A vehicle's engine (or electric motor) generates power, which is then used to generate tractive effort, which moves the vehicle. Assume the vehicle is moving at a constant speed. This tractive effort is required to overcome the following obstacles:

• Resistance to rolling

• Resistance to climbing

• Drag (Aerodynamic)

2. OBJECTIVES

The main objectives in this research work are

- **Improve fuel efficiency of a bus by reducing aerodynamic drag.**
- **Improve the profitability of bus operators**
- **Improve the comfort for passengers**
- **Reduce green-house emission.**

3. METHODOLOGY

In this research methodology, we first examine previous research and attempt to identify the problem on which we can work or explore a solution. We looked at a real Volvo bus design, ran a CFD analysis, and calculated the drag force. Then we changed the design and calculated the drag force once more. Then we went through several iterations until we found the lowest drag force. The drag force for each iteration was also calculated mathematically (analytically). The CFD results were compared to the mathematical results to see if both methods produced similar results, validating the values. The design with the lowest drag values would be chosen and recommended to the manufacturer.

4. DESIGN CALCULATION

The Drag force is a force on an object by a fluid to resist motion is called drag force and if fluid is air is named as aerodynamic drag force and the fluid is water than it hydrodynamic drag. The drag force acts in opposite direction to the motion of the object. The drag force is directly depending on density of fluid, velocity, drag coefficient and cross section area. It can be expressed using Bernoulli theorem, is a relation between pressure, kinetic energy and gravitational potential energy of the fluid, it states that in increase in the speed of fluid occurs simultaneously decrees in static

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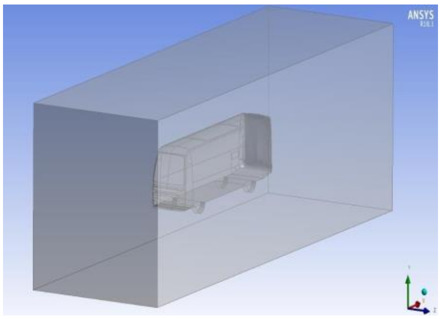

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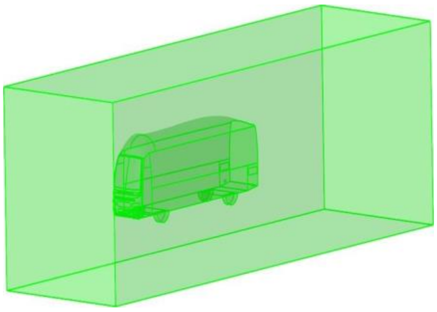

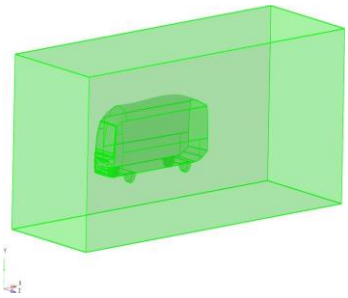

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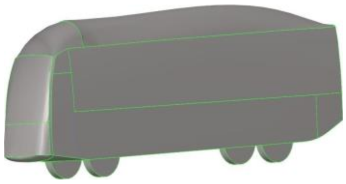

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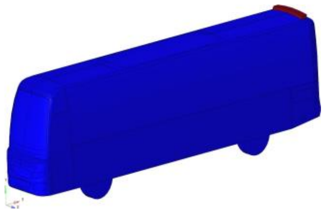

DESIGN 5

5. VALIDATION OF RESULT

To validate the results of some experiments, we must compute the values using two or more methods. Then compare the results of the two experiments to see if they match. If they are, we can be certain of the values and accept them as true.

In this study, we calculated Drag values using two different methods. First, CFD analysis was used, followed by analytical calculations. The outcomes of the two experiments are shown in the table below.

Table5.1

Comparison of the Results Obtained with Two Methods				
Concept	**Cd**	**Dag CFD**	**Drag Analytical**	**Diff CFD & Analytical**
D1	0.35904	2.0105494	2.0177861	0.0072367
D2	0.38193	2.5262781	2.5353774	0.0090993
D3	0.38360	2.5231310	2.5322158	0.0090848
D4	0.36514	2.4011301	2.4097795	0.0086494
D5	0.32900	1.8467764	1.8489643	0.0021880

The values of drag obtained with analytical method and those from CFD are very close to each other and thus are in good agreement with each other. Hence, we can safely assume that the results are validated.

6. CONCLUSION

The goal of this study was to improve an automobile's efficiency by lowering the drag force generated by aerodynamic forces. as speeds increase, aerodynamics become more important. This is because drag is proportional to the square of velocity, whereas other factors such as area, Cd, and air density only have a linear relationship. We can easily predict drag coefficient and lift value in computational fluid dynamics analysis, which aids the engineering team in designing the aerodynamic shape of the vehicle. Thus, various shapes were tried to find the most optimum one which will reduce the aerodynamic drag to a bare minimum.

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