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Aerodynamic study of LCV(Light Commercial Vehicle) and ways to improve it.

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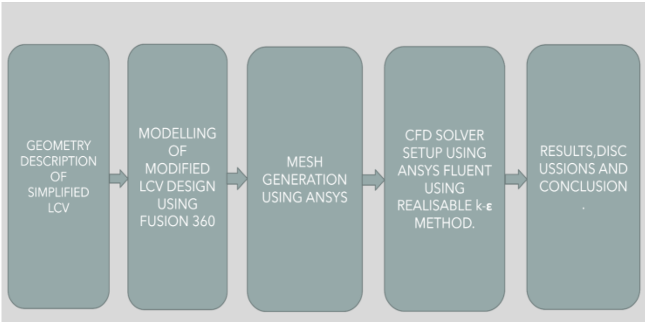
Abstract - Light Commercial Vehicles (LCV) are commercial carrier vehicles with a gross vehicle weight of not more than 3.5 tons. The demand for LCVS is increasing appreciably in recent times due to many reasons, one of which is the increasing trend of home-delivered products encouraged by start-up culture. To date, not much research is done on improving the aerodynamics of these vehicles, as they were only used in heavy traffic zones. But the practice is now changed, LCVs are also used for transporting goods over longer distances. Improving the fuel economy and reducing aerodynamic noise at higher speeds by modifying the aerodynamic design of an LCV is therefore one of the potential areas of research interest. This paper deals with the aerodynamics of LCV and ways to improve it.

Key Words: LCV, Aerodynamics, Fuel economy

1. INTRODUCTION

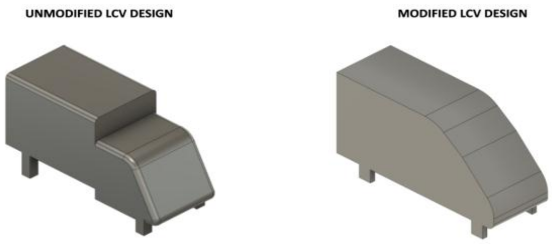
Light commercial vehicles are considered aerodynamically inefficient compared to other passenger vehicles due to their un-streamlined body shapes. A typical light commercial vehicle traveling at 100 km/h consumes about approximately 30% of the total fuel to provide power to overcome the aerodynamic drag rag In contrast, a passenger car under the same driving conditions, consumes approximately two times less to overcome drag. Therefore, any reduction of aerodynamic drag will result in appreciable fuel savings and a reduction in greenhouse gas emissions. At high speeds, wind noises become more pronounced. making it difficult to hear or converse inside the cabin, even causing fatigue failure of vehicle components over long periods. At speeds over 80 km/h, the increase in aerodynamic noise is proportional to the order of V raising to 6 as compared to the increase in other noises which is proportional to the order of V-V^2, where V is the speed of the vehicle. This noise originates from sources at various parts of the vehicle, at different intensities that depend on the external shape of the vehicle. Therefore, it can be predicted that the trailer component of an LCV has a significant contribution in the wind noise generation. Therefore any modification to the trailer reducing the drag would also positively influence the wind noise as there exists an approximately direct correlation between drag coefficient and sound pressure levels.

1.1 Methodology



1.1 Modeling of the LCV

The modeling of the LCV to analyze in ANSYS was done in Autodesk Fusion 360 taking the most common used LCV which is the TATA Ace truck in consideration its dimension where measured and appropriately scaled model was drawn and extruded in the software. To compare the modified LCV and Unmodified LCV design two models with the same dimensions were made.



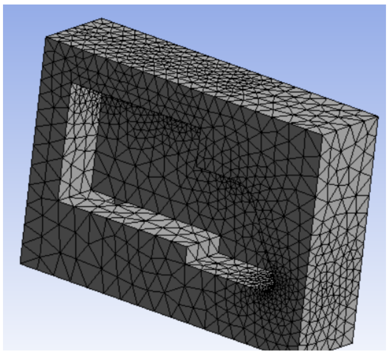
1.2 Equations used

- Standard k-ε turbulence model:

$$\frac{\partial(\rho k)}{\partial t} + \frac{\partial(\rho k u_i)}{\partial x_i} = \frac{\partial}{\partial x_j}\left[\frac{\mu_t}{\sigma_k}\frac{\partial k}{\partial x_j}\right] + 2\mu_t E_{ij} E_{ij} - \rho\varepsilon$$

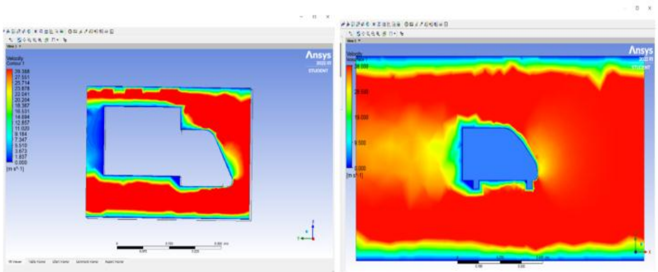
2. Mesh Generation

After 3D modeling of both the modified and unmodified LCV was done its meshing is done using Ansys Workbench software. Meshing uses different algorithms for different types of 3D modeling. A 3D mesh was made for the odject and its surroundings



2.1 Velocity Contours

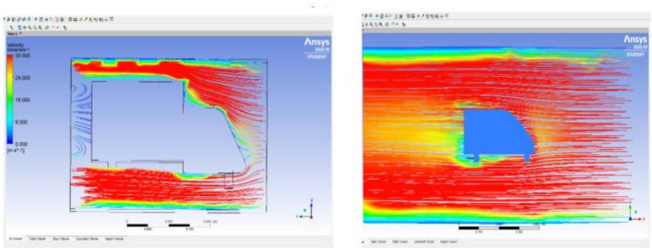
After getting the velocity contour from Ansys we can see that more velocity of air is observed in the modified design at the cutting out section. Also more velocity is observed under the stagnation point in the modified design.



UNMODIFIED LCV MODIFIED LCV

2.2 Velocity Streamline

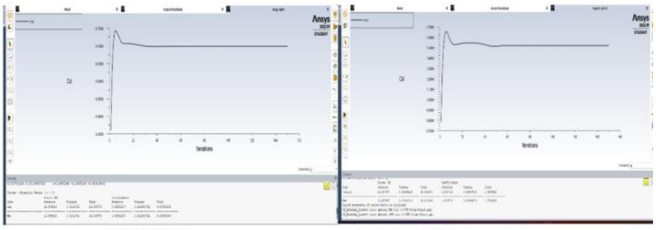
After calculating the velocity streamline we can see that in the modified design the air is more streamline and delfects the vehicle more easily and decreasing the wind resistance of the car.



UNMODIFIED LCV MODIFIED LCV

3.Results

CFD analysis of flow over the LCV is carried for speed of 38 m/s for both the unmodified and modified model. Results are obtained and the graph is plotted as follows for 160 iterations.



MODIFIED LCV UNMODIFIED LCV

Coefficient of drag always depends on the shape of the vehicle body. In this study, shape of the vehicle is modified by adding a wind deflector and providing skirts at the sides. From the above graphs, it can be observed that Cd for t**he modified vehicle is 0.649** which is lower, compared to **1.520 of unmodified vehicle design**

Conclusion

To improve the aerodynamic performance of the light commercial vehicle (Tata Ace), an attempt is made to modify the design of its trailer design. Comparative study is done on two simplified vehicle models by carrying out CFD Analysis. Addition of wind deflector and miniskirts are the modifications done to the design. Drag co-efficient is found to get reduced from 1.520 for the standard race car to 0.649 for the modified car with the modifications incorporated. The pressure above driver's cabin found to be reduced for the modified light commercial vehicle design due to provision of smooth flow of air through wind deflector, where flow remains attached and helps to decrease the drag.

References

1) Harun Chowdhury, Hazim Moria, Abdulkadir Ali. Iftekhar Khan, Firoz Alam and Simon Watkins A study on aerodynamic drag of a semi-trailer truck. Procedia Engineering 56 (2013) 201-205

2) Rajkumar Vishnu Ganesh, Yagnavalkya Mukkamala, Karan Raul Viegas, S. Venkatraghavan Computational Aero-acoustic Analysis of a Simplified Vehicle Model at Various Rear Slant angles ISSN 0973-4562 Volume 10, Number 23 (2015)

3) Subrata Roy and Pradeep Srinivasan External Flow Analysis of a Truck for Drag Reduction SAE 2000

4) Marco Lanfrit Best practice guidelines for handling Automotive External Aerodynamics with FLUENT.

5) P.E. Waters Commercial road vehicle noise.

6) B. Lokhande. S. Sovani, J. Xu, Computational Aeroacoustic Analysis of a Generic Side View Mirror,SAE 2003-01-1698. 2003.