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Design and Computational Fluid Dynamics Analysis of Aerodynamic Package of a Formula Student Car

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Abstract : In the past few decades there has been great advancement in use of aerodynamics in cars. Now its use has been evident from commercial cars to race cars for achieving higher speeds, stability and efficiency. This paper focusses on studying the effects of aerodynamics in Formula Student car. These cars weigh around 200kgs with an average speed of 60kmph. With increasing competition every year, developing a competitive car is a herculean task. The race track comprises mostly of tight corners and little or no straights thus testing the car's cornering capabilities. Higher cornering speeds can be achieved by increasing traction at the tires. Studying the aerodynamics helps in achieving higher traction without much addition in overall weight of car. The main focus is to develop an aerodynamic package involving front wing, under tray and body to obtain an optimum value of down force. The initial process involves the detail study of geometrical constraints mentioned in the rule book and calculating the limiting value of drag as per the engine specifications. The successive steps involve conduction of various iterations in ANSYS for selection of airfoils, deciding the number of elements, designing the nose for low drag, channelizing the flow under the body and obtain an optimum value of down force within the limits defined in the initial process. The final step involves design of model using these results in Virtual environment called OptimumLap® for detailed study of performance with and without the presence of aerodynamics. The CFD analysis results showed an overall down force of 377.44N with a drag of 164.08N. The corresponding parameters of the last model were applied in OptimumLap® and an improvement of 3.5 seconds in lap times was observed.

Keywords : aerodynamics, formula student, traction, front wing, undertray, body, rule book, drag, down force, virtual environment, computational fluid dynamics (CFD)
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