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Modeling, Aerodynamic and Crash Simulation on Car Using Fluient

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ABSTRACT- Aerodynamics plays a crucial role while designing any automobile components. Due to the aerodynamics the entire performance of the automotive will be changed. With an improvement in computer technology, manufacturers are looking toward computational fluid dynamics instead of wind tunnel testing to reduce the testing time and cost. In this paper a car model considered and it is modeled using solid works modeling software. The car material is stainless steel. The lift and drag of production vehicle are determined by the analysis of flow of air around it using Ansys. The aerodynamic analysis of the design parameter of car will be performed by using a suitable turbulence model and to compare the drag coefficient of design of car model by using CFD software result and experimentally result and the results will be validated by CFD analysis/experimental studies. The result of software analysis has agreed excellently with field experimentally results. The aerodynamic and crash analysis on car with of material Al 6061&AISI 4130 with wall and vehicle is considered The given model is tested under frontal collision conditions and the resultant deformation and stresses are determined with respect to a time of 80 Mille sec for ramp loading using ANSYS software. The crash analysis simulation and results can be used to assess both the crashworthiness of current frame and to investigate ways to improve the design. This type of simulation is an integral part of the designcycle and can reduce the need for costly destructive testing program.

KEYWORDS- CAD, CFD, Pro-E, Drag Coefficient, Drag Force, Aerodynamic, ANSYS, Crash

I. INTRODUCTION

All The choice of car is often mode on the basis of fuel efficiency cost & comfort. However, for general purpose fuel efficiency is the most important factor that is responsible for the overall popularity of a car of any make fuel efficiency is depend upon the performance of internal combustion engine & also on the aerodynamic design body of thecar.

In terms of vehicle efficiency, drag is an important factor which is why vehicle aerodynamics is such an active area of research for automobile manufacturers. While wind tunnel testing was the most profound way of testing vehicle aerodynamics in the 20th century, recent growth in the available computational power has led to more and more adaptation of numerical simulations.

Better automotive aerodynamics lead to a reduction in fuel consumption, helping drivers save money and lowering carbon dioxide emissions. One important consideration that modern vehicle engineers take into account while designing a car is aerodynamics. Aerodynamics is the study of both the motion of air and the forces created on an object moving through air. When an automobile is in motion, a large amount of air is displaced and must flow around the vehicle

II. AERODYNAMICS FORCES AND MOMENTS

Among the most important results obtained from wind tunnel experiments supporting design programs are the aerodynamic forces and moment ts acting on the test vehicle in a controlled and repeatable environment. Force and moment measurements are important for all ground vehicles

The drag and lift forces generated on a high-speed train, for instance, are fundamentalin determining its safety, the maximum cruise speed, and all the consequent issues (e.g.,the time of travel and the fuel efficiency)that eventually affect ticket prices.

The lift forces is of extreme importance in determining controllability for performance cars and race cars, becoming more critical as the speed increases. lift is often considered in terms of front lift and real lift. This is equivalent to considering total lift and pitching moment. Other aerodynamic force and moment components also play major roles in the controllability of ground vehicles at high speeds. Side force, yawing moment, and rolling moment under side wind conditioned or due to passing of another vehicle are important determinants of the safety and comfort of a passenger vehicle or the capability of a race carin competition.

III. OBJECTIVES

This paper focuses on the CFD analysis of a production vehicle. The vehicle selection criteriaare:

- Vehicle availability in India.
- Officially provided value of vehicle drag coefficient (as a reference to check the accuracy of the simulation results).
- Availability of vehicle blueprints (necessary to create CAD model).

IV. METHODOLOGY

Crash-testing requires a number of the test vehicle to be destroyed during the course of the tests and is also time consuming and uneconomical. One new recent trend that is gaining vast popularity is computer simulated crash-testing. Here instead of a real vehicle, a FE (Finite Element) model of the vehicle is generated and is used to carry out the different tests that were carried out before using actual vehicles. There are several software packages that are equipped to handle the crash-testing of vehicles, but one of the most popular is ANSYS. We are using ansys software for the crash simulation. A static as well as dynamic analysis is done using the software. A vehicle is designed and is tested by simulation and the results are used to optimize the vehicle in chassis design and safety. The analysis of the vehicle is calculated at a speed of 80 m/sec. The actual speed of the vehicle can vary with the designed speed

V. MATERIAL

Al 6061
Density = 2.7g/cc

- Ultimate tensile strength = 310 MPa
- Tensile yield strength = 276 MPa
- Young's modulus = 68.9 GPa
- Poisons ratio = 0.33
- Major application – Aircraft fitting, camera lens mount, coupling, marine fitting, brakepistons, hydraulic pistons, bike frame etc
- AISI 4130
- Density = 7.85g/cc
- Ultimate tensile strength = 560 Mpa
- Tensile yield strength = 460 Mpa
- Young's modulus = 190-210 GPa
- Poisons ratio = 0.27-0.3
- Major application – Aircraft engine mounts, welding tubing etc.

VI. INTRODUCTION TO COMPUTATIONAL FLIUD DYNAMICS

CFD or Computational fluid dynamics is a branch of fluid mechanics that, with the help of computers, uses numerical methods to solve and analyze problems involving fluid flows. Computers are used to carry out calculations using an iterative procedure wherein the solution accuracy improves with every iteration. The underlying equations that are solved in CFD problems are the Naiver-Stokes equations(figure 1).

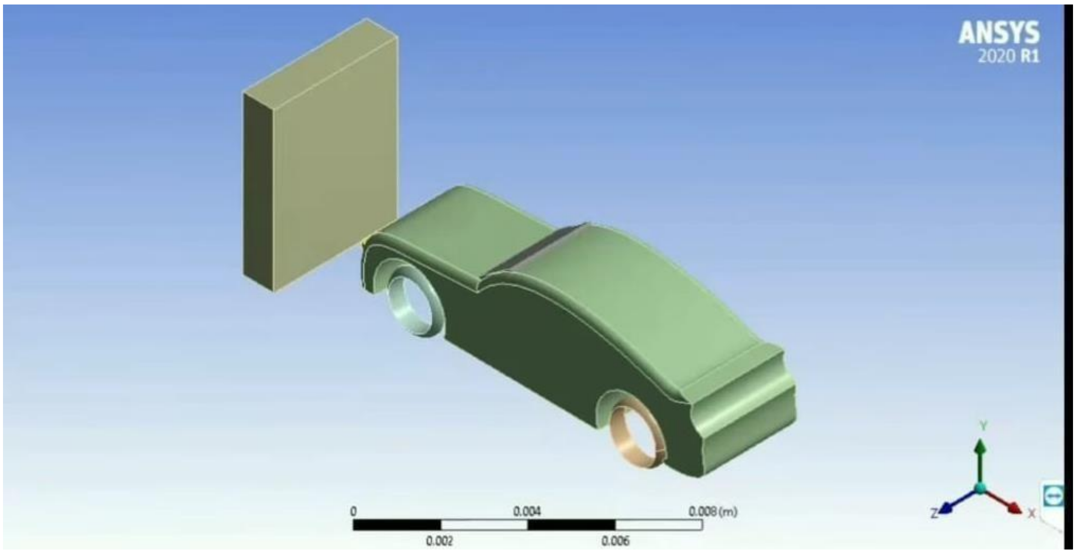

Figure 1: Model component for crash analysis with wall

In the laminar regime, the flow of the fluid can be completely predicted by solving the steady-state Navier-Stokes equations, which predict the velocity and the pressure fields. As the flow begins its transition to turbulence, it is no longer possible to assume that the flow is invariant with time(figure 2-4).

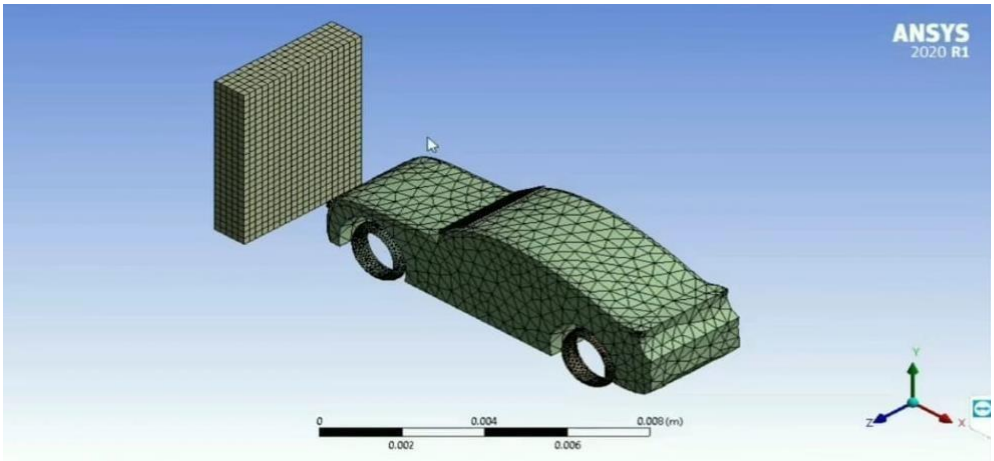

Figure 2: Meshed model for wall and car

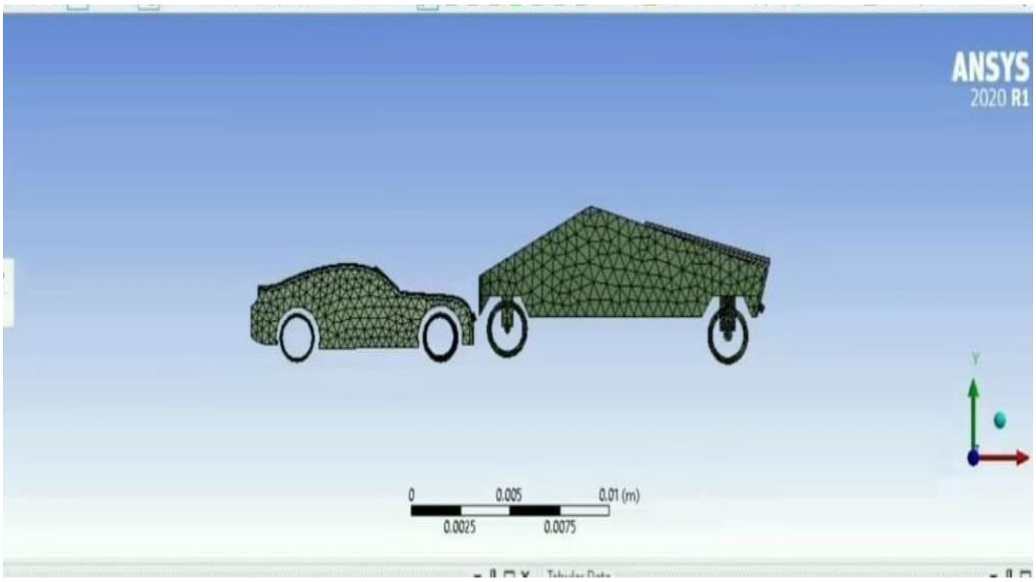

Figure 3: Model component for car and vehicle

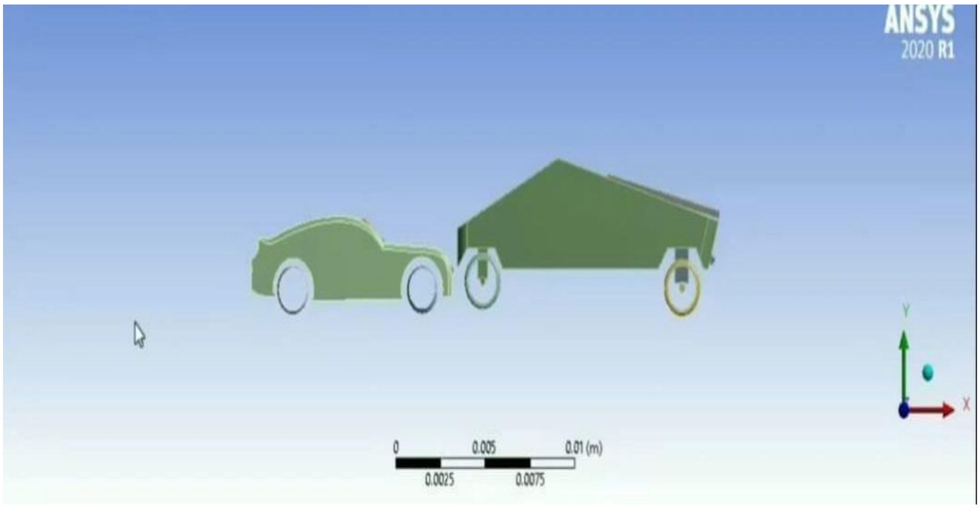

Figure 4: Meshed model for car and vehicle

VII. RESULTS & DISCUSSION

At speed of 80m/sec. the vehicle is crashed to a fixed rigid wall and front vehicle alongwith aerodynamic forces analyzed accordingly. The results of the analysis are shown in following figure 5, 6 and 7.

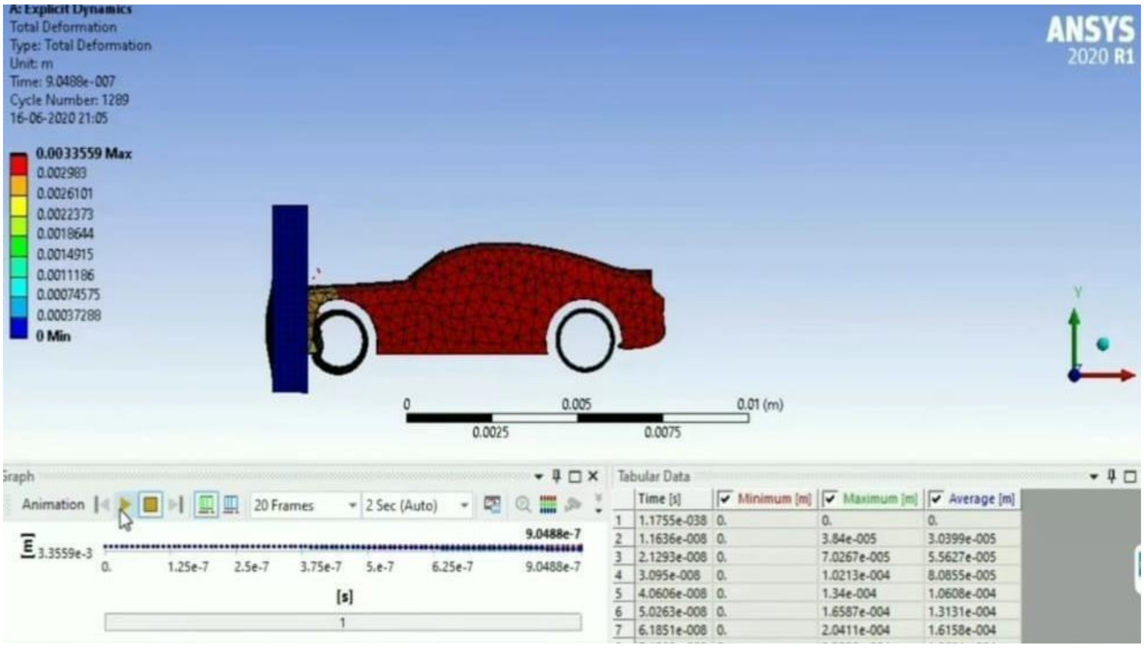

Figure 5: Deformation of car after crashing for material Al 6061

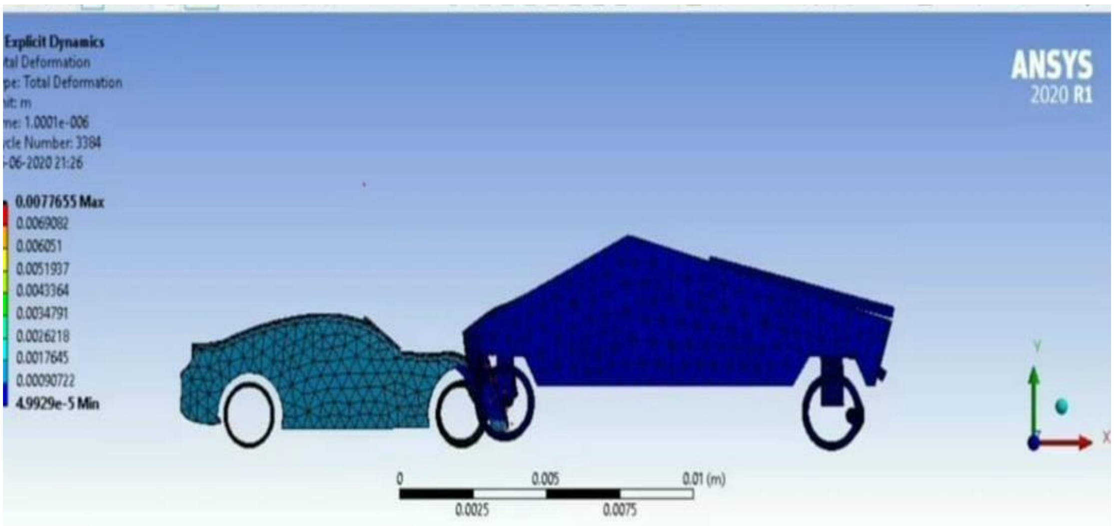

Figure 6: Deformation of car after crashing with front vehicle for material AISI 4130

VIII. CONCLUSION

In day-to-day life, the lives of human beings are of utmost importance. For the safety of human beings, the vehicle should be safer against the various impacts on the vehicle. The chassis is the backbone of the vehicle. The main purpose of the chassis is to withstand the designed load and provide support for the mounting of different systems on the vehicle.

The aim of this project was to design a safer, lighter and economical chassis using iterations for the safety of the vehicle in analysis software.

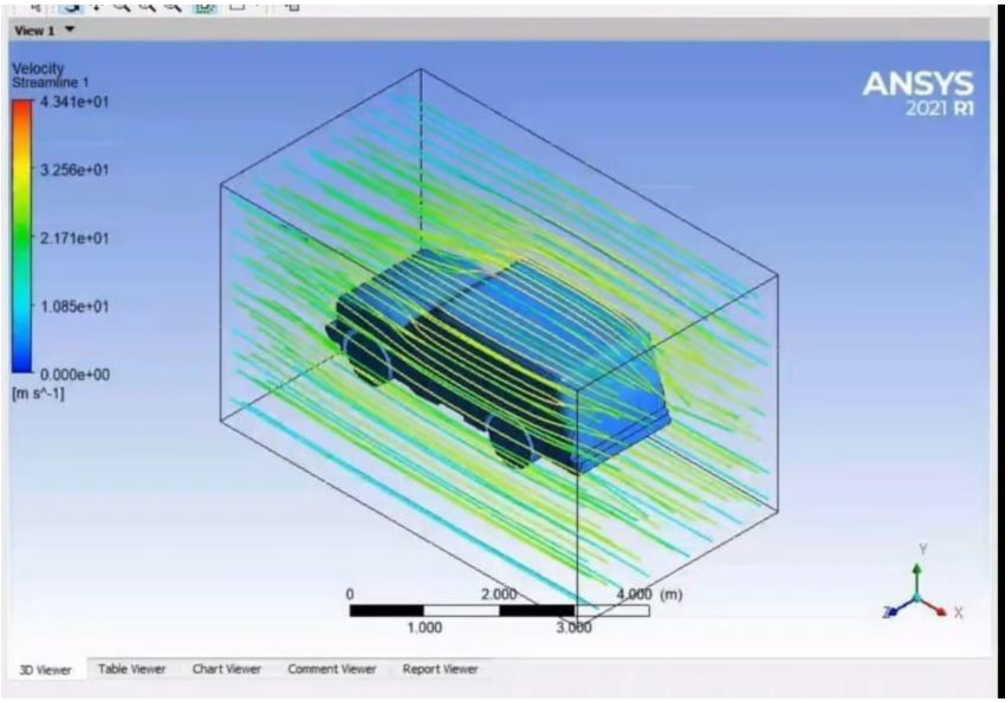

Figure 7: Aerodynamic analysis on car

The design is optimized and the weight factor along with the safety consideration is kept in view while designing the chassis. The material is selected based on the desired properties for the chassis. The actual cost for the crash testing of the vehicle is saved.in crash analysis with wall and front vehicle on car , the results gives the AISI4130 is best material for manufacturing Hence, the overall cost of the vehicle is also reduced. the machine is prepared by designing and manufacturing the components.

The drag coefficient vehicle has average value about 0.0950 and reach lower than

0.1 as targeting point. The lift coefficient vehicle has the average value is 0.19. For designing the vehicle form streamline which has bigger shape in the front and behind as the opposites can decrease the drag force that through the vehicles. Due to faster velocity produce the lift force coefficient increase along.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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