

DESIGN AND CRASH ANALYSIS OF CAR BODY STRUCTURE USING ANSYS

Submitted in partial fulfilment of the requirements for the award of

Bachelor of Engineering degree in

Automobile Engineering

By

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DEPARTMENT OF AUTOMOBILE ENGINEERING

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SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of KARTHIK. P (Register No.38860008) and JANAKAN. S (Register No.38860006) who carried out the project entitled "**DESIGN AND CRASH ANALYSIS OF CAR BODY STRUCTURE USING ANSYS WORKBENCH**" under my supervision from October 2022 to May 2022.

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We Karthik P (Register Number 38860008), Janakan S (Register Number 38860006) hereby declare that the project report entitled Design and crash analysis of car body structure using ansys workbench done by me under the guidance of Dr. A. Karthikeyan M.E., Ph.D. at Sathyabama institute of science and technology, Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai-600 119 is submitted in partial fulfilment of the requirements for the award of bachelor of Engineering degree in Automobile.

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ABSTRACT

The performance of the vehicle can be optimized by various means, one such method is by reducing the weight to increase its performance. With the recent development in the field of composites it is evident that composite materials can be the best alternative material to reduce the weight but we must also be careful to maintain its strength. The research and development over Composite materials have benefited greatly as they have higher strength and lower weight, more recyclable. In this thesis, a car body structure is designed using CATIA V5 software and a comparative Computer-aided engineering analysis for its crash worthiness is done using ANSYS workbench. The main advantage of CAE is the car body structure can be tested in various fields for optimum performance and durability of the component without actual manufacturing of the original component. The car body structure is implemented with three different materials such as AA7075 T651, Stainless steel, T300 carbon fibre composite and analysed of its crash worthiness. The weight of the car body is being optimized by optimization technique for mass reduction without compromising the stiffness and durability of the structure. The CAE analysis and weight reductions are done in ANSYS workbench software. The results will be compared and discussed with the equivalent stress and total deformation value to find out the better materials that reduces weight and withstands stiffness and durability.

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CHAPTER-1

INTRODUCTION

A Car is the four-wheeled vehicle that often run-on roads, which carries passengers from a place to another. People of the contemporary age have high expectations for automobiles in terms of safety and weight. This analysis is to give justice to passenger safety but at the same time to reduce the weight of the vehicle without comprising its strength. Nowadays, automobile manufacturers are focusing more about the use of light-weight parts such as aluminium, magnesium, plastics, composites, and new sorts of high-tech materials to consider less weight. In the future, composite materials may offer significant benefits over steel in the automotive industry. Vehicles made on composites might be lighter, safer, and more fuel-efficient. A composite is made up of a high-performance fiber (such as carbon or glass) and a matrix material (epoxy polymer), which when combined has better qualities than the separate ingredients. To minimise weight, most automotive manufacturers use lightweight materials such as composites, aluminium, magnesium, or new forms of high strength steels. In the event of a rupture, which is a regular occurrence in a car collision, these materials have limited strength or ductility. Material joining failure is also one of the repercussions of a vehicle's crashworthiness. In a car accident, the front end of the vehicle receives a significant amount of force and suffers plastic deformation. Most automobiles are intended to improve absorption efficiency, passenger safety, and vehicle dependability. Crashworthiness of various sections of a vehicle must be tested only at the beginning stage of vehicle design. Because the dynamic behaviour of a Stainless part differs from its static behaviour, impact analysis may be used to determine the vehicle's crashworthiness. As a result, for both safety and fuel efficiency, it is vital to examine the crash capabilities of the automobile construction. Performing a crash test on a car or modelling the crash analysis of the modelled automobile structure in analysis software are the two methods for assuring safety. Passengers' safety has been investigated at a low cost reduction. When a car crashes, the occupants must be unharmed, and the vehicle must be able to endure impact loads. Crashworthiness refers to the ability of the vehicle structure to absorb energy in the event of a collision.

The vehicle's structure should be built to handle higher speeds while ensuring that occupants do not feel a net slowdown. The occupant and Stainless behaviour in the event of an accident is of particular concern in car design. To forecast the reactions of the structure or the occupant, nonlinear finite element and rigid body analysis are used. Decisions based on these calculations may need considerable design changes. The iterative process of identifying the ideal design is usually led by intuition. It might be difficult to establish essential design changes just based on the study results. Many variants are explored in certain circumstances before an acceptable design is established. In 1889, in New York City, the first motor vehicle death occurred. This event is seen to be the catalyst for the development of vehicle safety as a discipline. Among all the performance characteristics of ground transportation vehicles, occupant safety has been a significant design priority throughout the last century. Before the public embraced the vehicle as a viable mode of transportation, manufacturers recognised the necessity to show occupant protection. In the evolution of car safety, there are three different phases. For optimum ride and handling, the vehicle construction should be sufficiently strong in bending and torsion. It should reduce harshness caused by high frequency fore-aft vibrations. In addition, the structure should produce a deceleration pulse that meets the following standards for both genders over a range of occupant sizes, ages, and crash speeds. Crash and Stainless analysis are the two most significant engineering techniques in designing a high-quality automotive design vehicle. Computer simulation technologies have substantially improved the safety, dependability, and comfort, as well as the environment and the environment's protection. Automobile manufacturing efficiency nowadays. This remarkable feat was made possible thanks to sophisticated software and techniques. In the last two decades, powerful computers have become available. Safety is the foremost priority for both drivers and passengers. Governments have responded by enacting a growing number of legislation in response to this major worry and expectation. Despite the fact that the details Although the standards differ significantly from nation to country, the basic needs are nearly same. The purpose of a vehicle is to offer transportation. In the event of a minor collision, drivers and passengers will be adequately protected. located inside the engine below or adjacent to the engine cylinder.

CHAPTER-2

LITERATURE SURVEY

1. Andrew Hickey, and Shaoping, Finite element modelling and simulation of car crash,

In this study, the primary goal of an accidents investigation is to determine how the vehicles will react in front-end or side-impact collisions. Vehicle body light weighing and crashworthiness are 2 important factors to consider while designing a vehicle.. The main task is to transport the greatest amount of weight under all intended operating conditions.. This method offers an advantage enormous breadth throughout the whole car sector since it reduces the cost of true vehicle crash testing.

2. H Ahmad, A review of carbon fiber materials in automotive industry,

In this study, A composite is made up of a high-performance fibre (such as carbon or glass) and a matrix material (epoxy polymer) that, when combined, outperforms the individual components. Carbon-fiber composites are one-fifth the weight of steel while maintaining the same or better stiffness and strength. They also don't rust or corrode like steel or aluminium, and by reducing vehicle weight by up to 60%, they might enhance fuel economy significantly..

3. J. Santhakumar Design and crash analysis of car body using frp materials adopting fem,

In this study FRP offers exceptionally high fundamental stiffness and strength ratings when compared to metal materials. By reducing the vehicle's bulk, the usage of FRP in current vehicle designs increases structural protection. When compared to other current materials, the use of FRP for BIW indicates the ability to reduce weight of up to 60% to 70%. In compared to metal constructions, FRP offers a far higher ratio of energy absorption per weight, as well as the ability to save weight. As a result, it's an intriguing material for automobile crash constructions.

4. Steven Jones an Analysis of the Effects of Crash Factors and Precrash Actions on Side Impact Crashes at Unsignalized Intersections,

This article is a study that how the behavioral pathways influence the severity of the crashes. Crashes that occurred at unsignalized four-way intersections and T-junctions in Alabama were used for model estimations. Three precrash actions, failed to yield right-of-way at the stop sign, failed to yield right-of-way at a turn, and running stop sign, were considered.

5. Lin C. S, Chou K.D. and Yu C.C, Numerical simulation of vehicle crashes ,

In this study Ansys software's explicit dynamic module is used to analyse an automobile collision at some speed using some materials alternately. As a result, the automobile crashes due to a mechanical collision with a concrete wall on the front surface area of the car body. That is how equivalent stress, equivalent strain, and total deformation will be analysed to find the most suited material with a high strength-to-weight ratio and the highest level of passenger safety in the event of an accident

6. Narender, Bumper beam-longitudinal system subjected to offset impact loading,

In this study, Aluminum alloys are used in modern automobiles' front and rear bumper beams, as well as other safety components including side door impact beams, frames, engine cradles, chassis, and suspension components, which are longitudinally extruded. Although the use of light weight materials reduces fuel consumption and hence CO₂ emissions, another rigorous requirement from society is the passive safety provided when using light weight materials for automotive elements such as bumpers

7. Naga Sai Abhishikt, Challa Balaji, Ramachandran, Balaji, A recent investigation on design aspects of vehicle crash analysis,

In this study, Dummies are subjected to calibration standards to guarantee that their bodies react similarly to humans in the event of an injury or accident, however this does not involve driver slump postures or keeping an upright posture behind the wheel. They run many crash tests, including Frontal Offset,

Side-impact testing, Side-pole testing, Pedestrian Protection testing, Rear Impact testing, and Child Safety Testing.

8. A Muhammad, Simulation of a car crash using Ansys,

In this study, This research uses explicit dynamics in ANSYS workbench to simulate and analyse the impact of an automobile frontal accident on various obstacles. The produced stress and deformation on collision into a steel material wall, both static and moving, are studied using an automobile body made of aluminium materials travelling at 35 m/s..

9. L Praveen and N Sandeep Kumar, Crash analysis of a car body,

In this study, automobile manufacturers are putting greater emphasis on the use of light-weight parts in order to reduce weight. such as aluminium, magnesium, polymers, composites, and novel high-tech materials. Steels with high energy content The majority of Whether these ingredients are restricted power or ductility, rupture is always a serious possibility throughout the process.

10. Byeong Sam , Finite element frontal crash analysis of vehicle's platform with upper and sub frame body,

The study is about LS-DYNA finite element processor is a non-linear finite element processor that can solve any stated problem. In most frontal collisions, the vehicle's front end suffers severe deformations, whereas the middle and back sections suffer only minor deformations. Because these models are designed for frontal collisions, the vehicle's front frame is finely mesh, while the middle and rear frames are coarsely mesh. FMVSS 208 Occupant Crash Protection was applied to the updated standards for non-rigid wall 30mph (48.3km/h) in conflict with the speed limit.

CHAPTER-3

AIM AND SCOPE OF THE PRESENT INVESTIGATION

3.1 AIM

The first phase of this project is to design a car body structure using Catia V5 software. In general, achieving lightweight and rigid automotive constructions is crucial to improve the efficiency of a vehicle. As a result, it must be built in a way that eliminates weight while increasing overall vehicle performance. The three different materials will be implemented into the designed body structure and the crash analysis reports are compared based on the total deformation and equivalent stress value to find out the best material. If the weight has been decreased without disturbing the strength it will be the great advantage to increase the efficiency of the vehicle.

3.2 SCOPE OF THE PROJECT

- The primary goal of a crash study is to determine how the vehicle will react in frontal crashes with three different materials, to choose the better materials
- The light weighing of a car's body and its crashworthiness are two significant factors to consider while designing a vehicle.
- Keeping the vehicle's weight down while maintaining its safety.
- To choose the material that reduces weight and withstands strength

CHAPTER-4

MODELING, MESHING, SELECTION OF MATERIALS AND METHODS

4.1 METHODOLOGY

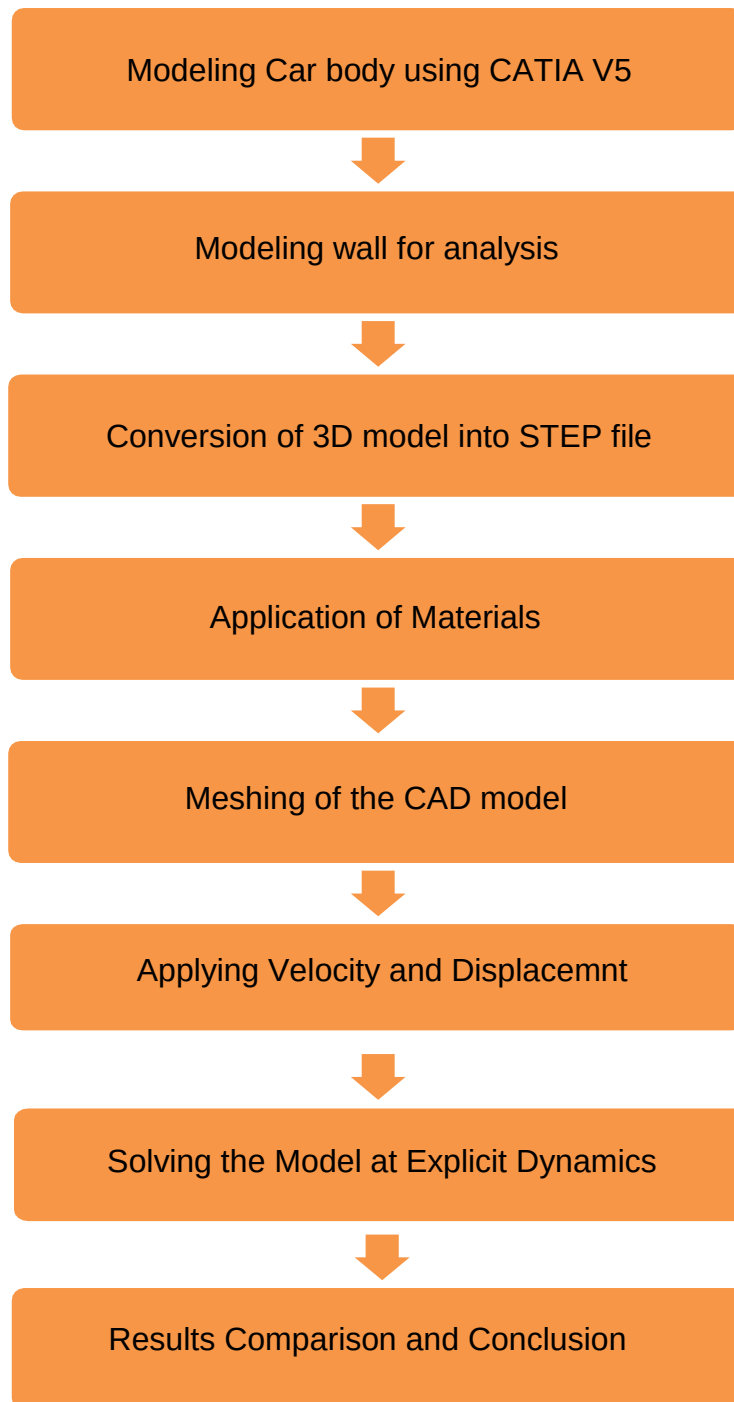


Fig: 4.1 Methodologies of design and analysis of car body structure

4.2 DESIGN AND DEVELOPMENT

The design of the car body structure is carried out in CATIA V5 software. The design parameters were very essential for 3d modeling of the car body by giving the specification to the designs by how much velocity acts on the body, and an wall is created in front of the car with a specific dimensions so that to perform with further crash analysis

4.3 MATERIAL SELECTION

Steel and Aluminium are used as material for the production of car body structure because of its material properties like stiffness, strength, hardness, availability, Non-corrosive, easily machined and cast, Lightweight yet durable and low cost of the material. The properties required for the manufacturing of car body are

- The material should have high strength.
- The material should have high fatigue resistance.
- The material can be easily available for manufacturing
- The material can be easily manufactured into complex shapes to match the design of the designer.

4.3.1 *Stainless steel*

Table 4.1 Stainless steel material properties

	Stainless steel	
Properties	METRIC	UNIT
Density	8000	kg / m ³
Young's Modulus	190	GPa
Poisson's Ratio	0.265	no unit
Yield Strength	250	MPa
Ultimate Tensile Strength	510	MPa

Stainless steel is one of the most commonly and traditionally used steel in the automotive industry. It is an alloy that consists of iron, carbon, manganese, chromium, nickel and other alloy materials. It was originally called as rust less steel. The properties such as heat resistance, lower electric conductivity and anti-corrosion are the main reasons for automobile industries to select stainless steel for their application. 40% is used in the body structure, panels, doors and trunk closures for high-strength and energy absorption in case of a crash 23% is in the drive train, consisting of cast iron for the engine block and achinable carbon steel for the wear resistant gears.12% is in the suspension, using rolled high-strength steel strip. The remainder is found in the wheels, fuel tank, steering and breaking systems.

4.3.2 AA 7075 T651

Table 4.2 AA 7075 T651 material properties

	AA 7075 T651	
PROPERTIES	METRIC	UNITS
Density	2810	kg / m ³
Young's Modulus	70	GPa
Poisson's Ratio	0.32	no unit
Yield Strength	510	MPa
Ultimate Tensile Strength	590	MPa

The aluminium alloy 7075-T651 is a popular 7-series aluminium alloy. It is known to have the highest strength among various Aluminum alloys, making it an ideal choice for high-strength applications. The alloy's major components are zinc and magnesium, with a minimal amount of copper mixed in it. In the automotive and aviation industries, this alloy is commonly used. 7075 aluminium alloy (AA7075) is a zinc-based aluminium alloy. It has exceptional mechanical qualities, including high

ductility, strength, toughness, and fatigue resistance. Because of micro segregation, it is more prone to embrittlement than many other aluminium alloys, but it has much greater corrosion resistance than the alloys from the 2000 series. It's one of the most popular aluminium alloys for high-stress structural applications, and it's been utilised widely in aircraft structural parts. Due to their high specific strength, 7000 series alloys like 7075 are frequently utilised in transportation applications like as marine, automotive, and aviation.

4.3.3 T300 Carbon fibre composite

Table 4.3 T300 carbon fibre composite material properties

	T300 carbon fibre composite	
PROPERTIES	METRIC	UNIT
Density	1400	kg / m ³
Young's Modulus	57	GPa
Poisson's Ratio	0.005	No unit
Yield Strength	530	MPa
Ultimate Tensile Strength	570	MPa

T300 Carbon Fibre is a Fibre Reinforced Plastic (FRP), and the adoption of FRPs over traditional materials is increasing due to its superior qualities over other engineering materials. Properties such as High strength-to-weight ratio, exceptional corrosion resistance, thermal resistance, and high fracture toughness make it desirable. Because of their extremely low weight and excellent strength characteristics, they are ideal choice for vehicle body.

4.4 CAD MODELING

Computer-aided design is the use of computer technology to help in the development, change, analysis, or optimization of a design (CAD). CAD software is used to improve the designer's productivity, design uniformity, cooperation through reporting, and the creation of a production database. Popular CAD outputs include electronic files for printing, machining, and other industrial tasks.

CAD is a significant technological art that is utilised in a wide range of industries, including automotive, shipbuilding, and aerospace, as well as industrial and architectural architecture.

Three-dimensional solid modeling can be divided into two categories.

1. Parametric modelling enables the usage of "template purpose" by the operator. Objects and features that can be changed have been created. Any future adjustments can be made by adjusting the original portion's construction method. If a feature was required to be put from the centre of the component, the operator might find it from the centre of the model. To find the element, any geometric object currently existent in the component might be utilised, but this would undermine the design goal. If the operator develops the component as it operates, the parametric modeller will enhance it while maintaining geometric and functional linkages.

2. Using direct or explicit modelling, you may update geometry without having to go via a history tree. If a drawing is used to produce geometry while utilising direct modelling, the sketch is incorporated into the present geometry, and the artist simply needs to make small modifications to the geometry. Relationships between selected geometry may exist in direct modelling, including parametric modelling (e.g., tangency, concentricity). Direct modelling allows you to quickly construct and record geometry without ignoring features, restrictions, and the original design purpose. Working with modelling clay is a common comparison. Simply push and pull the geometry until you have the desired shape.

4.4.1 Car body structure modeling

The design of the car body structure is designed using CATIA V5 Software. The design has been modelled based on the reference dimension of a SUV type car vehicle. The below vehicle body design has a length of 4385mm, height of 1398mm and the width of 1890 mm.

Table 4.4 Dimensions of the car body structure

Length	4385	mm
Height	1398	mm
Width	1890	mm

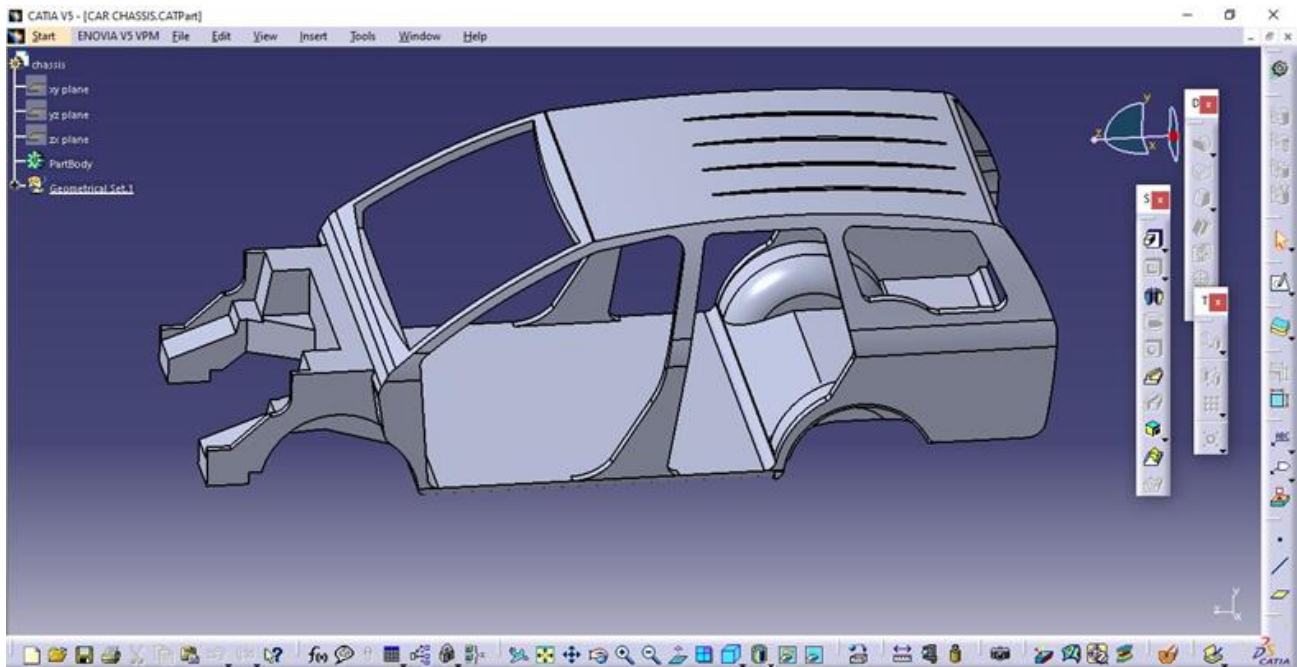


Fig: 4.2 Modellings of the car body structure

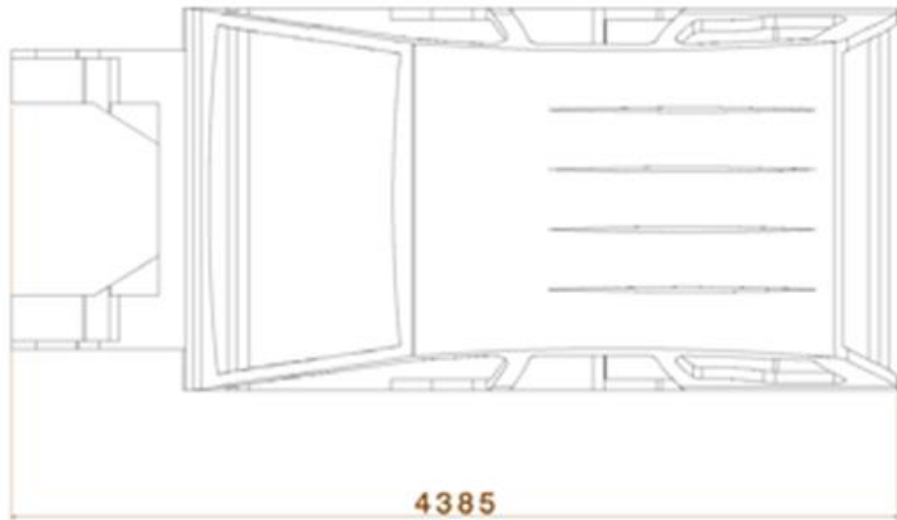


Fig: 4.3 Detailed drawings of the car body

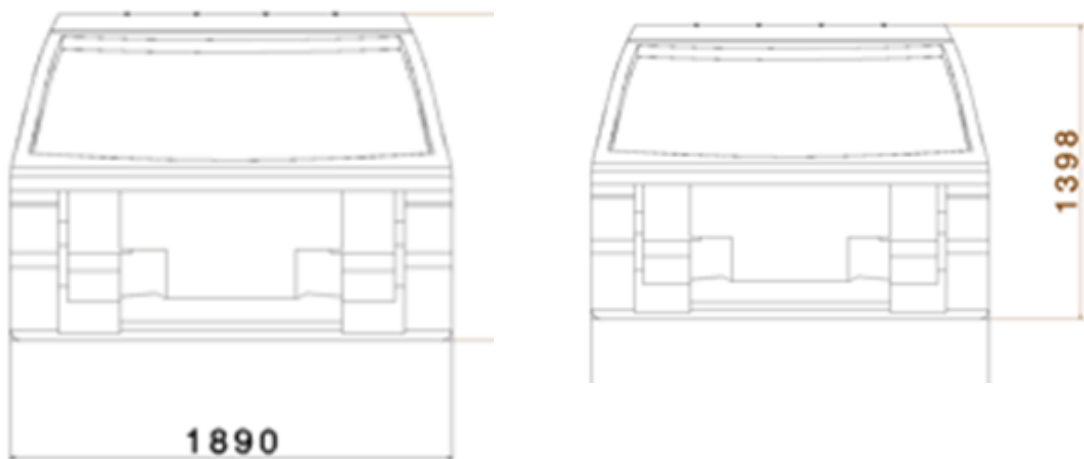


Fig: 4.4 Detailed drawings of the car body

4.4.2 Creating a wall for analysis

A wall is created in front of the body with a length of 3000 mm height of 2000 mm and with a thickness of 200mm, in which the impact of the body structure will be analysed.

Table 4.5 Dimensions of the wall

Length	3000	mm
Height	2000	mm
Thickness	200	mm

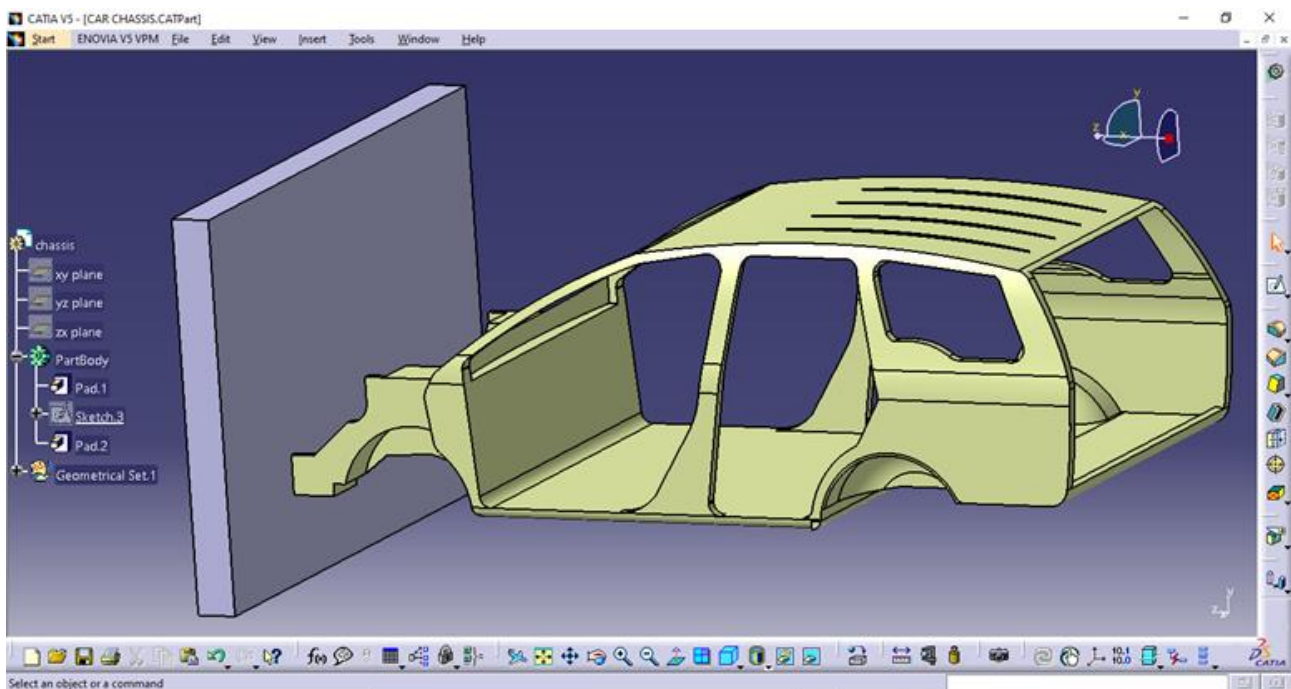


Fig: 4.5 Modellings of wall

4.5 Ansys Introduction and Analysis

Ansys, Inc. is a Canonsburg, Pennsylvania-based American corporation. It creates and sells CAE/multi-physics engineering simulation software for product design, testing, and operation. It serves customers all around the world. ANSYS A frequent platform for tackling engineering challenges is the workbench. Workbench may be used for a variety of activities, including: Models may be imported from a number of CAD programs. The Design Modeler is used to condition models for design simulations. ANSYS is the only engineering simulation generating firm with the depth and breadth of equipment required for real-world Multiphysics. The ANSYS Workbench platform provides the foundation for producing integrated Multiphysics simulations with a high level of automation and a user-friendly interface in a single environment.

Customers may use ANSYS Workbench to construct parametric models in physics and geometry, as well as conduct sensitivity research and layout optimization using coupled-physics solutions. This, in turn, provides the highest level of consistency in digital modelling, whereas physical testing is either too expensive, impractical, or impossible. The benefits of digital prototyping and the Simulation Driven Product are most useful when simulation comprises more than one physics totally connected, included, and unified. The development process may be fully utilised in the search for cutting-edge products.

ANSYS has built its generation and equipment from the ground up with a flexible foundation that is carefully engineered for scalability. As a customer's commitment to simulation grows, ANSYS supports that goal by providing 21 feature degrees that address the various conversion scenarios. The ultimate result is a ROI route that doesn't have a dead end.

The goal is to provide products that are compatible with and easily integrated into a wide range of customer organisations, methodologies, and issues, not just now but also in the future.

4.5.1 Explicit Dynamics

If a product must withstand impacts or short-duration high-pressure loadings, Ansys explicit dynamics can help you enhance its design. Advanced analytic methods are required for specialised challenges in order to effectively forecast the influence of design factors on product or process behaviour. When physical testing is too expensive or impossible to do, gaining insight into such a complicated reality is extremely vital. With Ansys, you can see how a structure reacts when it is subjected to extreme loads. Complex reactions, such as massive material deformations and failure, are reliably predicted using algorithms based on fundamental principles interactions between bodies and fluids on surfaces that are constantly changing.

A crash simulation is a digital attempt at a negative crash examination of a vehicle using a computer simulation in order to determine the amount of protection of the vehicle and its occupants. Automakers use crash simulations as part of their Computer-Aided Engineering (CAE) evaluation for crashworthiness as part of the Computer-Aided Design (CAD) process for modelling new automobiles.

Deformations (for example, guidance wheel intrusions) of the occupant area (motive force, passengers) and decelerations (for example, head acceleration) felt while using them are significant effects that must be kept below Neath threshold values constant in criminal automobile protection regulations.

Modern crash simulations include computerised models of crash test dummies as well as passive safety devices to simulate genuine crash testing (seat belts, airbags, surprise soaking up sprint boards, etc.).

4.5.2 Meshing

The geometry given by the element serves as a meshing template. The element types are generally categorised into four categories based on the region declared in a domain:

- Shell elements
- Solid elements
- Line elements

Shell elements are commonly utilised in modal structures where one of the parameters, thickness, is much less than the other ones. By specifying the geometry at a reference surface of the model, conventional shell elements apply the condition to discretize the body of a 3d model. Shell elements in the continuum discretize a full three-dimensional body, whereas conventional shell elements have both displacement and rotational degrees of freedom. The thickness is determined by the nodal geometry of the element. Continuum shell elements, on the other hand, have transposition degrees of freedom exclusively in the material's thickness attribute. In terms of modelling, continuum shell elements appear to be a three-dimensional continuous solid, yet their kinetic and constitutive behaviour is similar to that of ordinary shell elements.

The cad model geometry describes the whole geometry of Solid Elements. Tetrahedrons are the element type for solid meshes that are three-dimensional. The four corner nodes of a linear tetrahedral element are linked by straight edges. Four corner nodes, six mid-side nodes, four corner nodes, and six edges make up the parabolic tetrahedral element. Because they express curved boundaries more precisely and provide superior mathematical approximations, parabolic tetrahedral elements outperform linear elements for the same mesh density for multiple elements. The computing resources required by parabolic tetrahedral elements are more than those required by linear elements.

Table 4.6 Mesh settings

Use Adaptive Sizing	Yes
Resolution	Default (4)
Mesh Defeaturing	Yes
Defeature Size	Default
Transition	Slow
Span Angle Center	Coarse
Initial Size Seed	Assembly
Bounding Box Diagonal	5832.9 mm
Average Surface Area	1.5434e+005 mm ²
Minimum Edge Length	0.46341 mm
Nodes	37741
Elements	161798

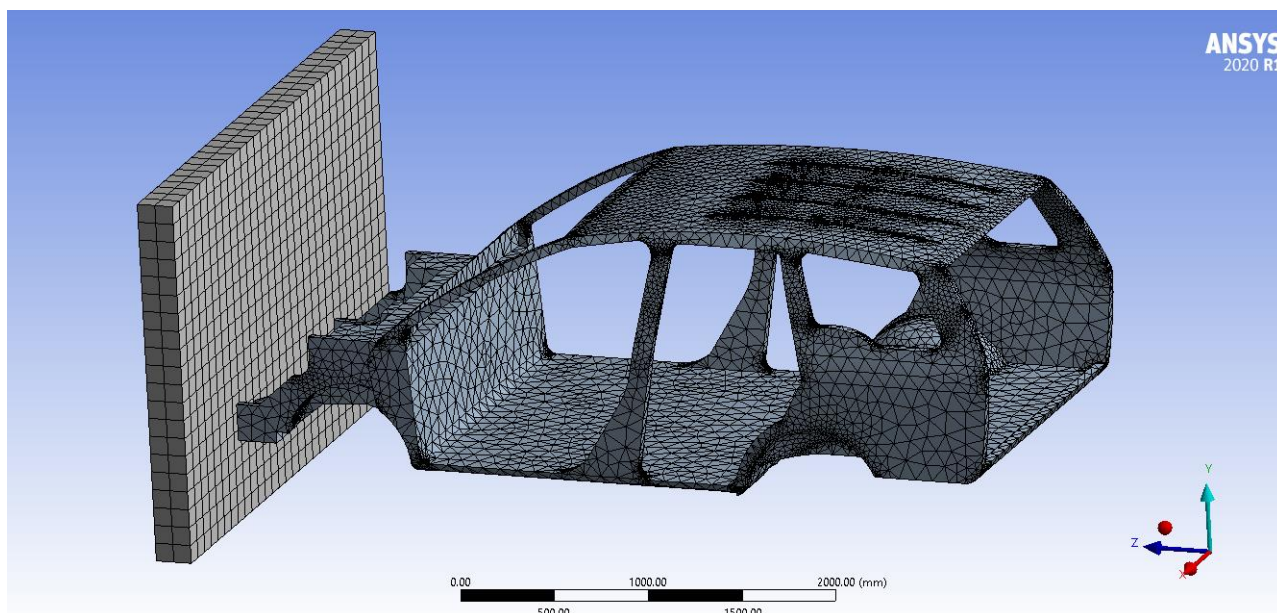


Fig: 4.6 Meshed 3D model

4.5.3 Boundary Conditions

These describe the current state of a few nodes in the finite detail mesh. This is a way of describing how a lot of the nodes in the version are limited. It is critical to describe adequate boundary conditions or limitations in order to compensate for impacts. Each node inside the structural device has six degrees of freedom: translational, three-square coordinate axes, and three rotating axes around each of the square axes.

The velocity of 100kmph that is 27778 mm/s is given to the car body structure to crash into the wall for analysis. The velocity 27778 mm/s is given in the positive z axis direction.

Table 4.7 Velocity settings

Input type	Velocity
Define by	Components
Coordinate system	Global Coordinate system
X Component	0 mm/s
Y Component	0 mm/s
Z Component	27778 mm/s

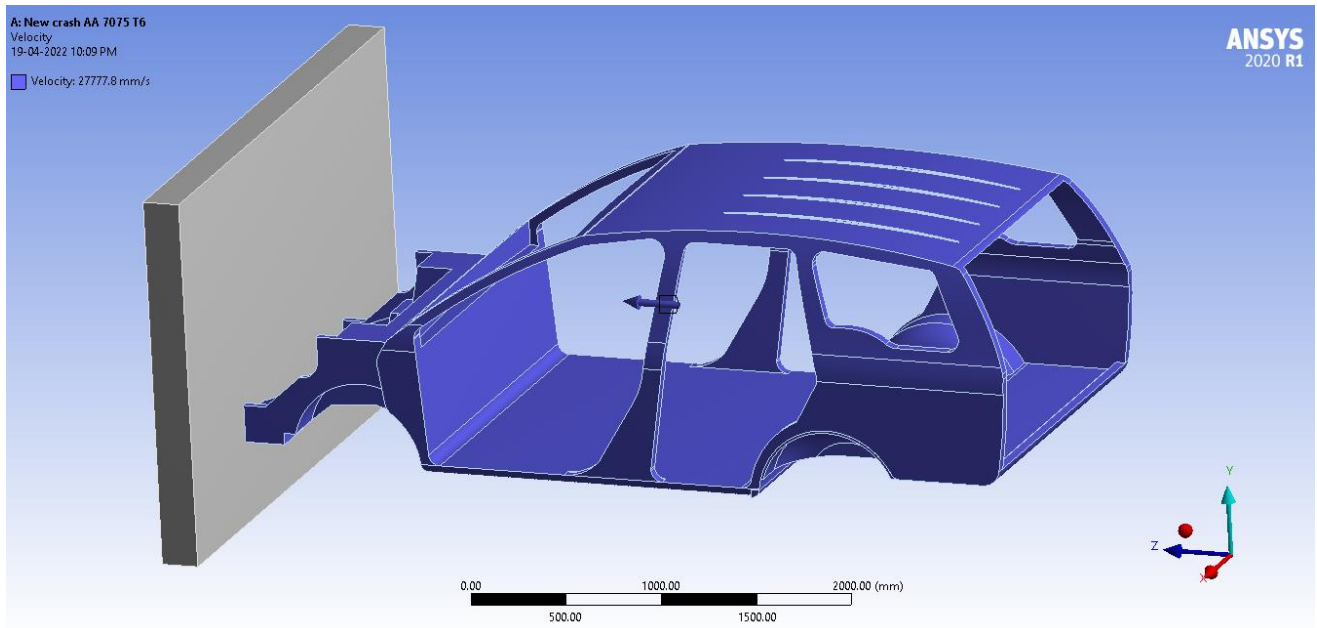


Fig: 4.7 Velocity setting for analysis

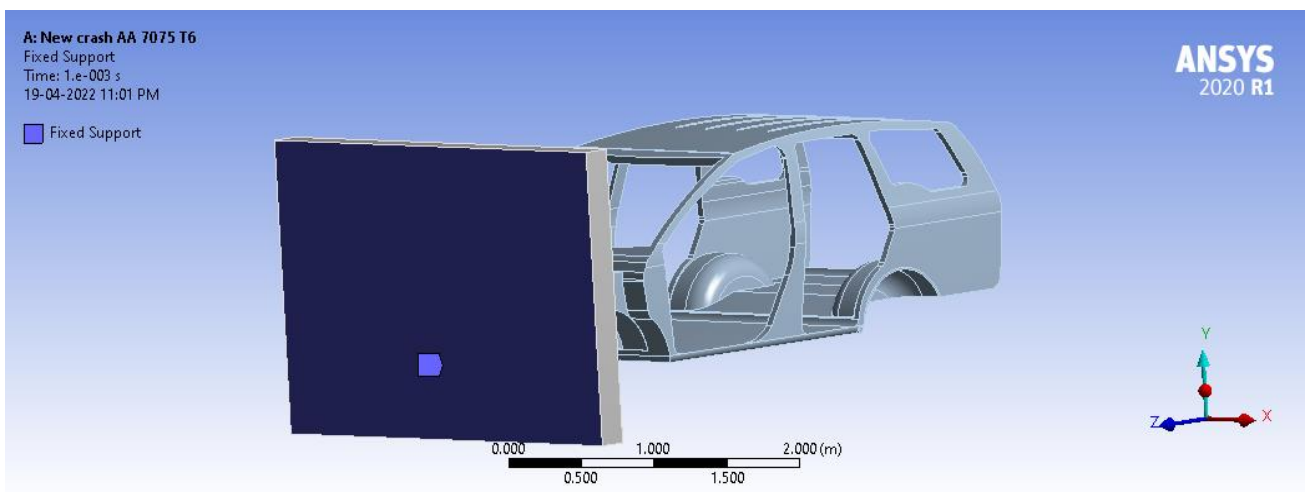


Fig: 4.8 Fixed support setting for wall

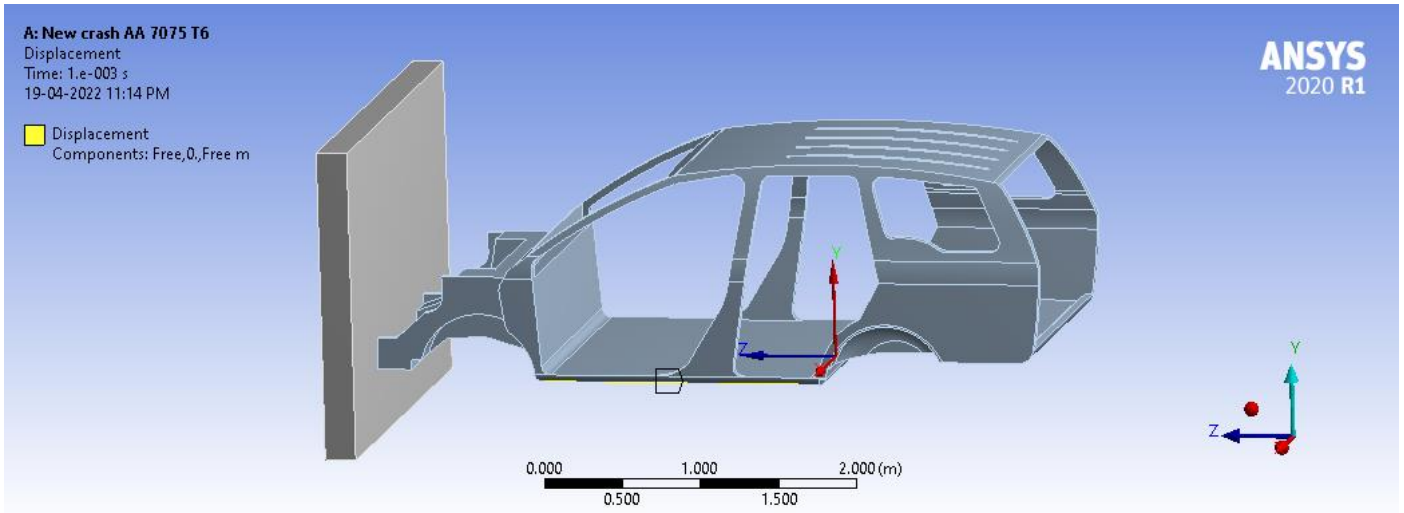


Fig: 4.9 Displacement settings

A displacement constraint produces an imposed translational or rotational displacement in a given direction for a selected reference. Applying a displacement constraint is comparable to applying a load on a reference.

The solution for the Equivalent stress and total deformation for the materials is calculated

4.5.4 Analysis of stainless steel

The maximum equivalent stress value when steel is implemented in the car body is 1105 mpa whereas the total deformation value noted is 36.301mm and these values will be compared with the other two materials.

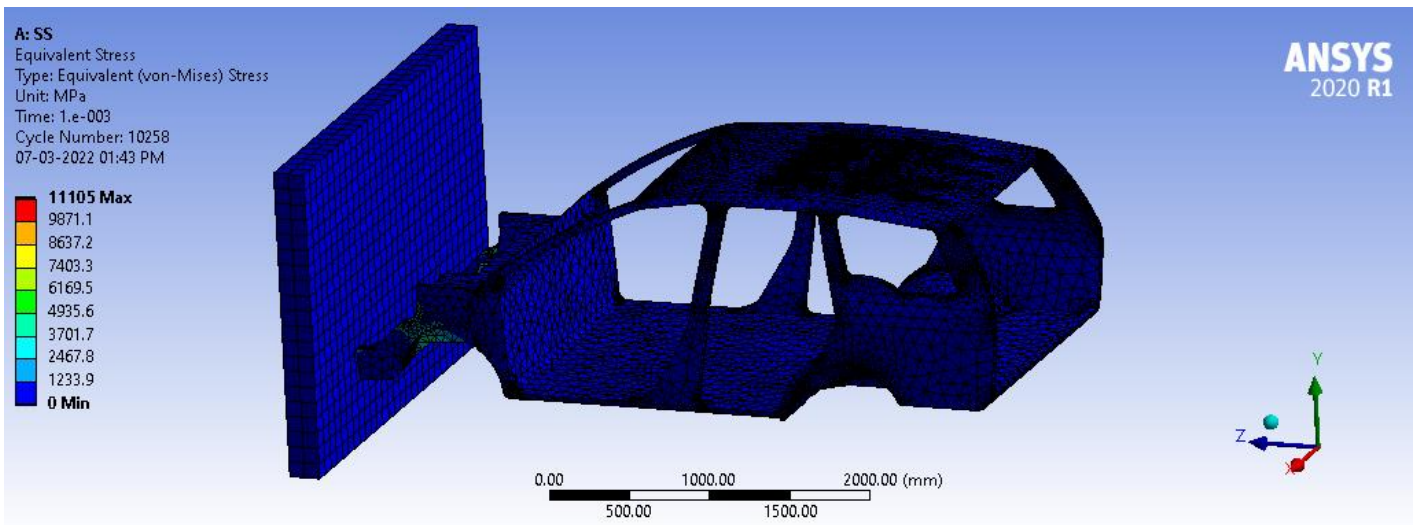


Fig: 4.10 Equivalent stress value for steel

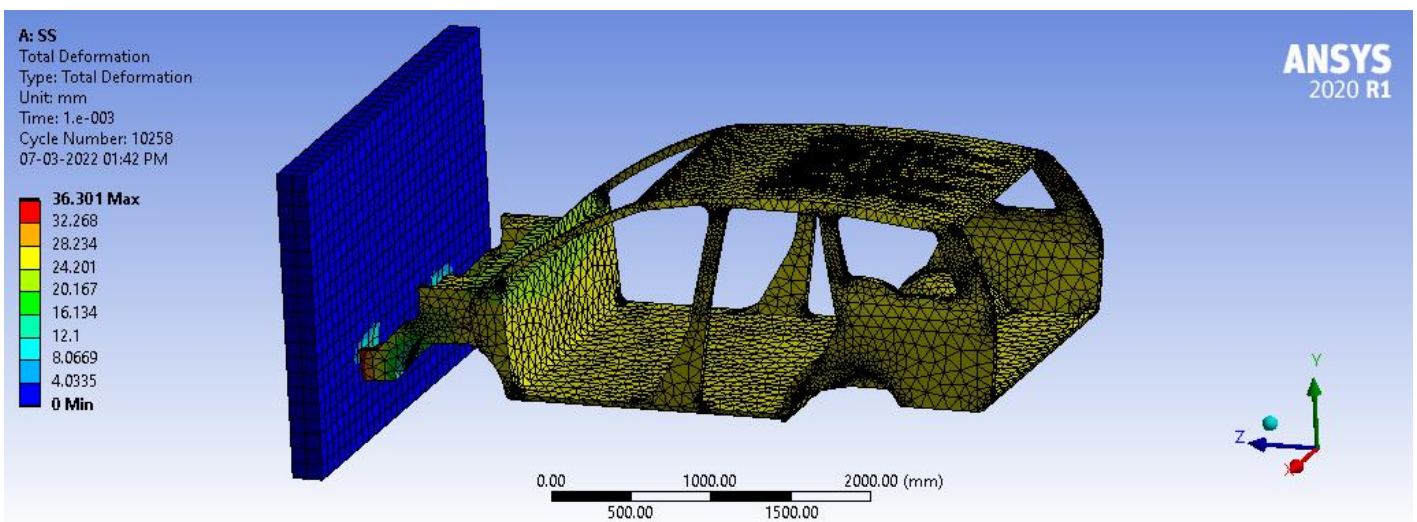
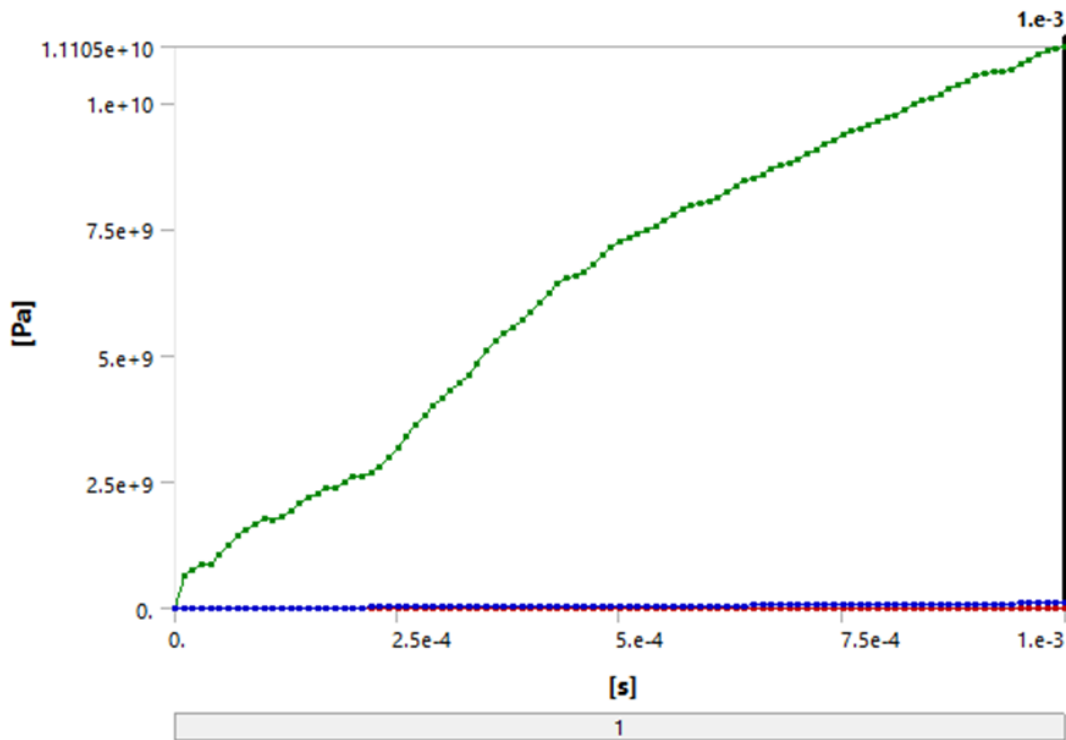
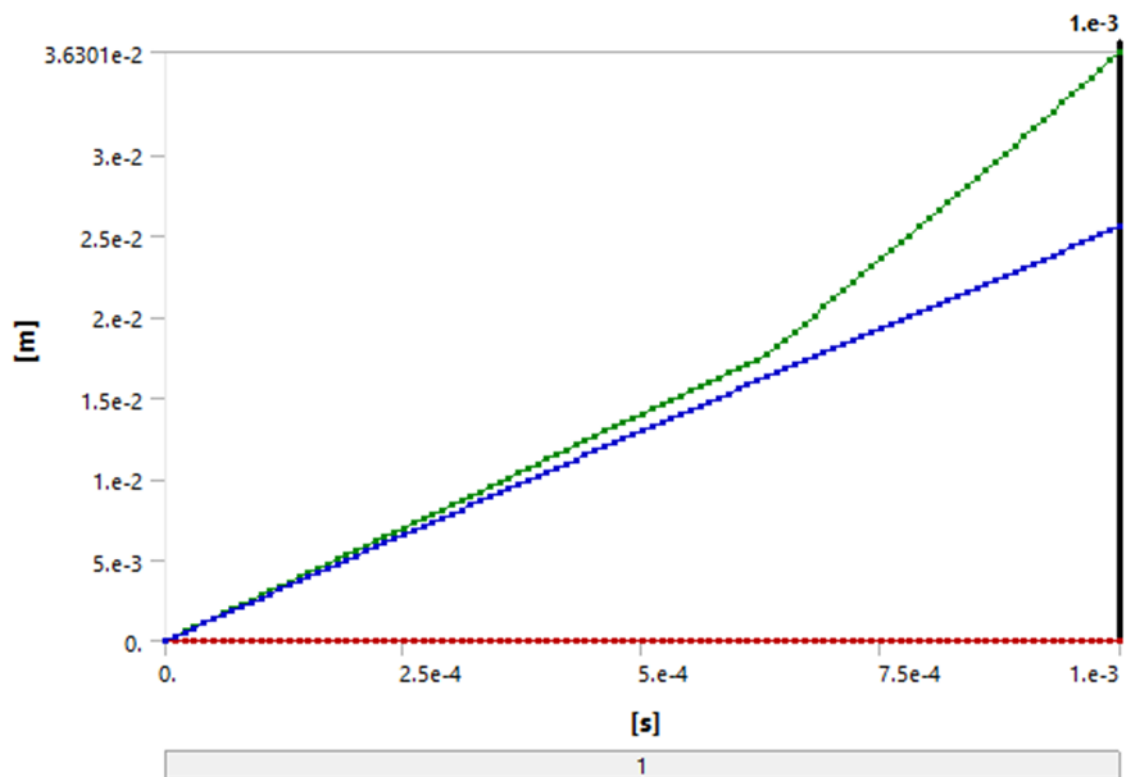


Fig: 4.11 Total deformation value for steel



Graph: 4.1 Equivalent stress graph for steel



Graph: 4.2 Total deformation graph of steel

4.5.5 Analysis of AA 7075 T651

The car body structure is performed for analysis with Aluminium alloy 7 series that is 7075 T651 in which the equivalent stress value is 5277.8 Mpa which is less than steel and the deformation value is 47.305 mm which is higher than steel.

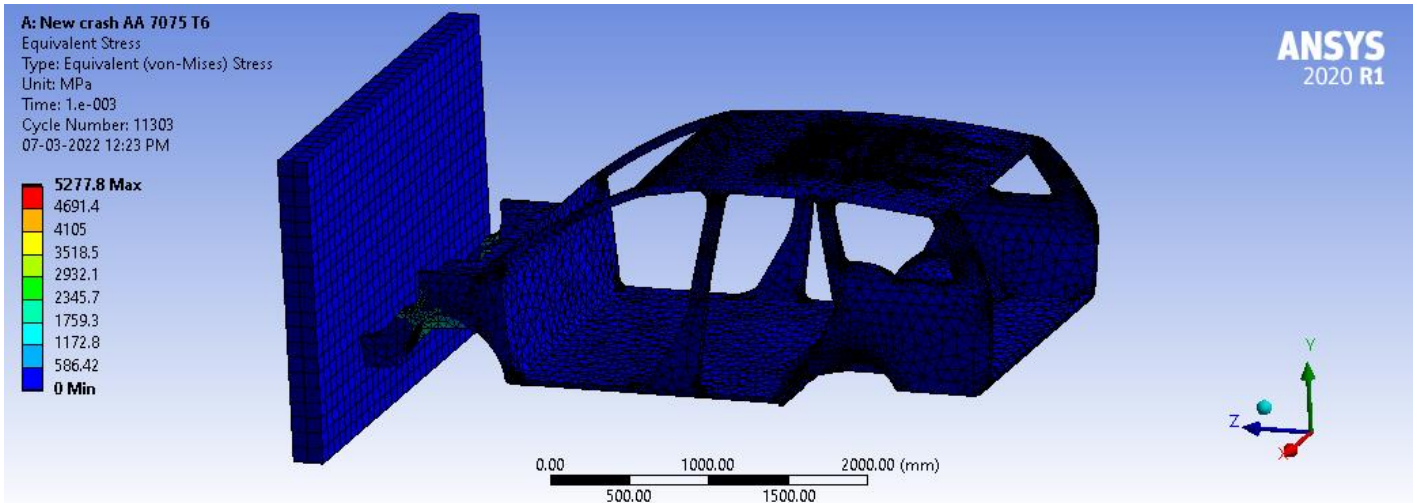


Fig: 4.12 Equivalent stress value for AA 7075 T651

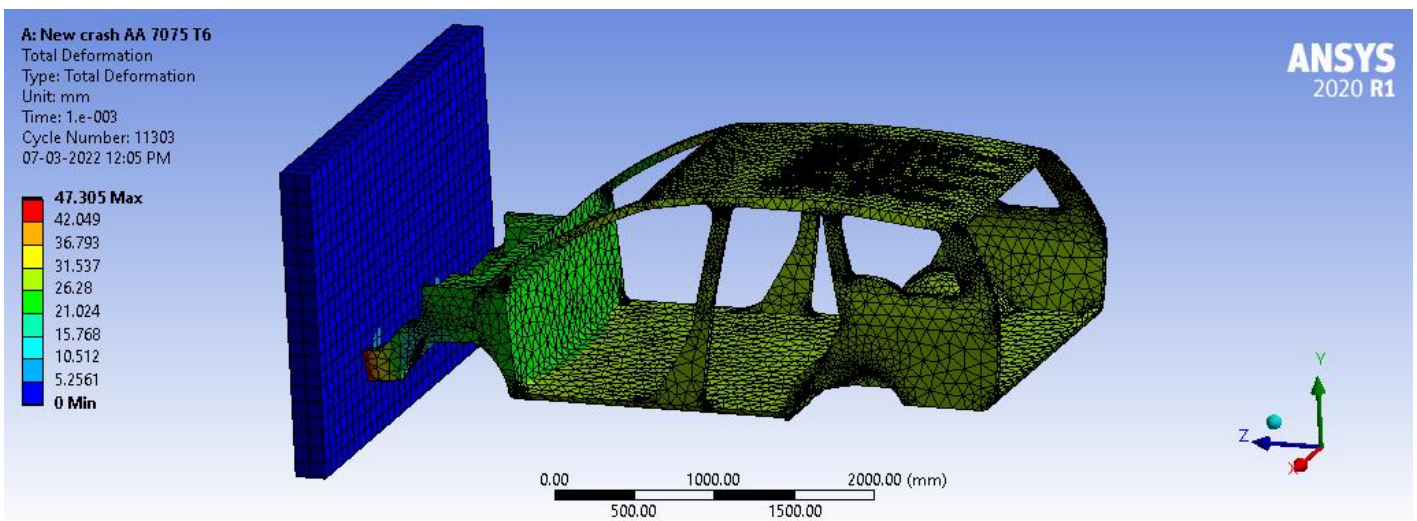
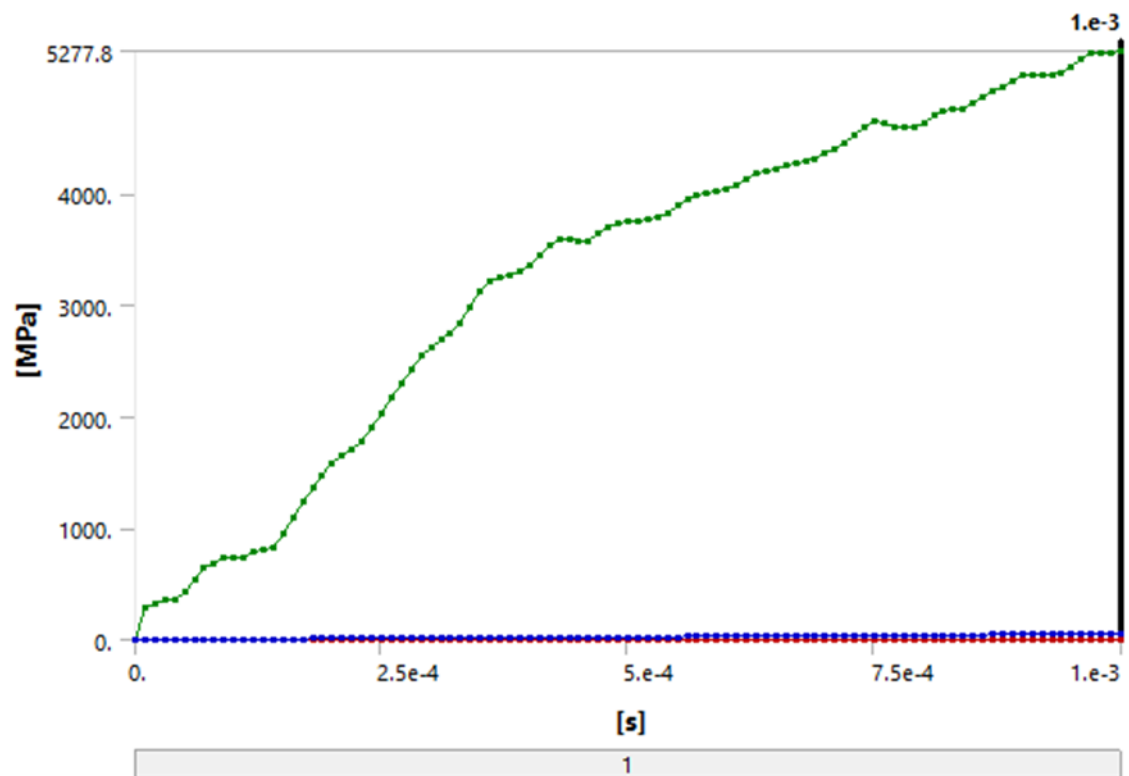
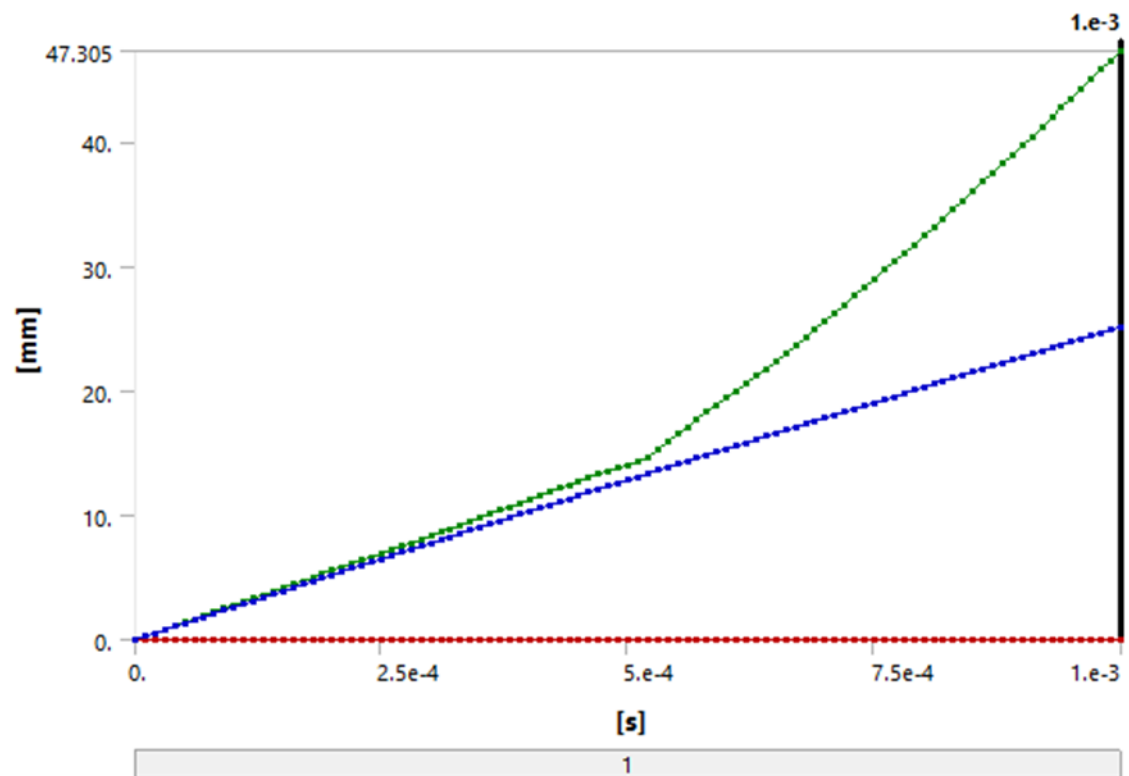


Fig: 4.13 Total deformation value for AA 7075 T651



Graph: 4.3 Equivalent stress graph of AA7075 T651



Graph: 4.4 Total deformation graph of AA 7075 T651

4.5.6 Analysis of T300 carbon fibre composite

The material that is compared with aluminium and steel is the carbon fibre composite material T300 which is imported to the car body with a constant velocity of 100kmph in which the stress value is 4561 Mpa and deformation value is 53811 mm.

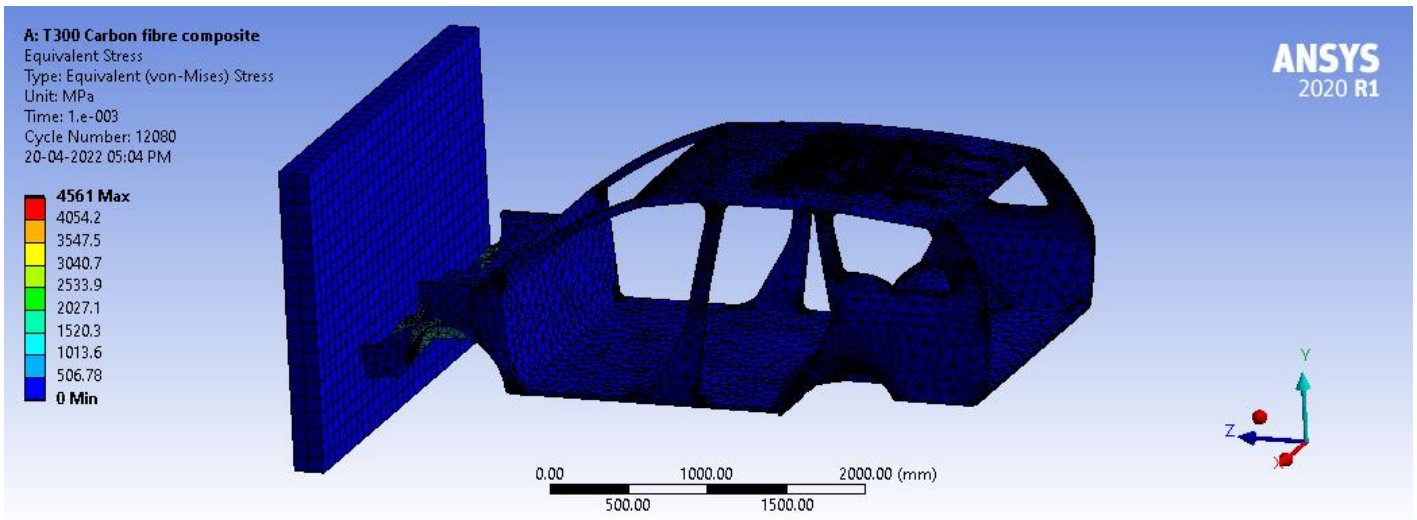


Fig: 4.14 Equivalent stress value for T300 carbon fibre composite

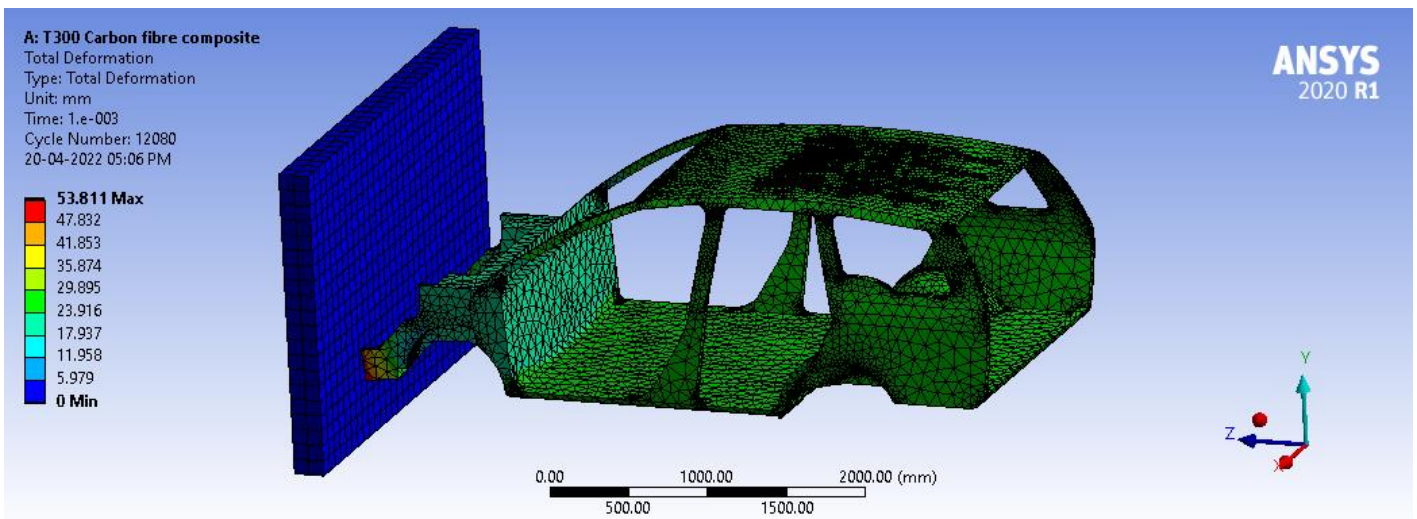
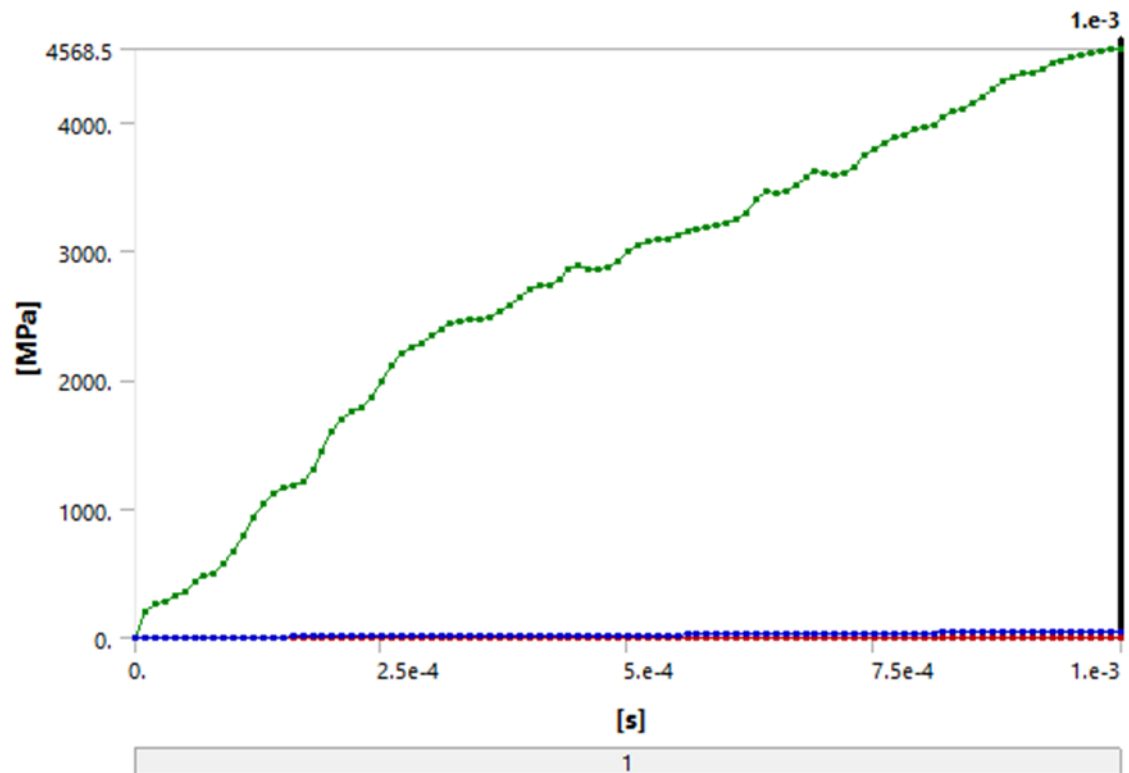
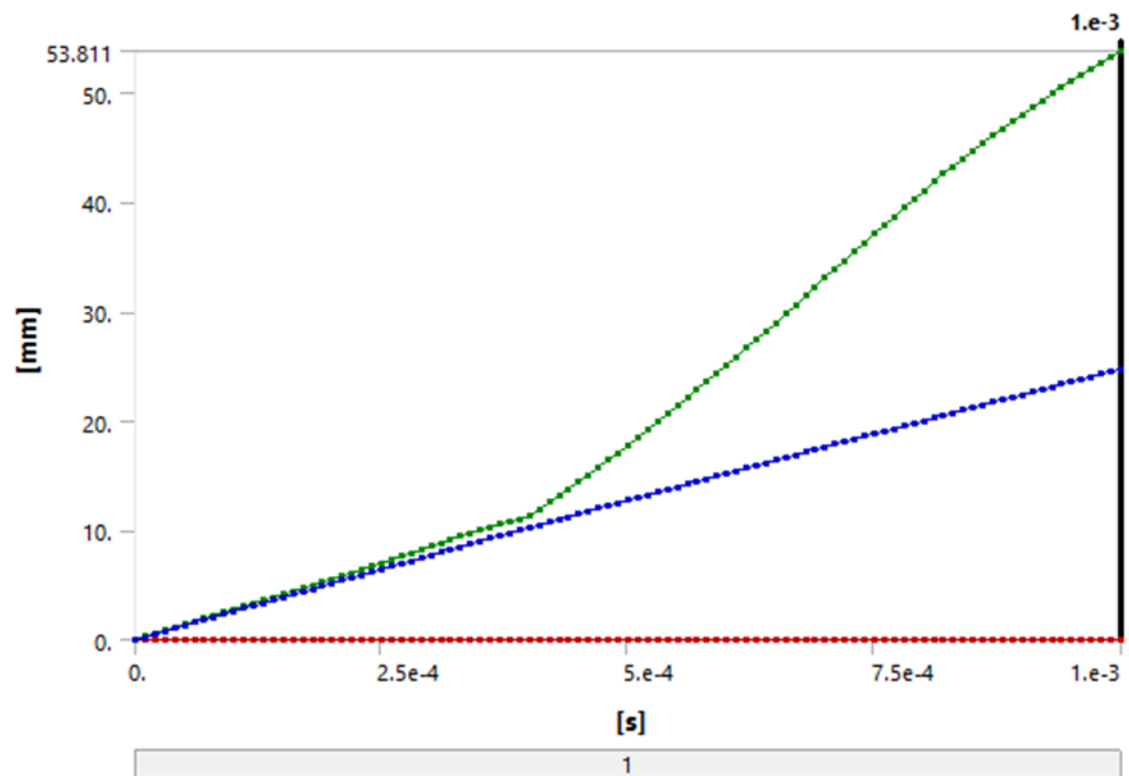


Fig: 4.15 Total deformation value for T300 carbon fibre composite



Graph 4.5 Equivalent stress graph of T300 carbon fibre composite



Graph 4.6 Total deformation graph of T300 carbon fibre composite

CHAPTER-5

RESULTS AND DISCUSSION

5.1 TABULATION OF RESULTS

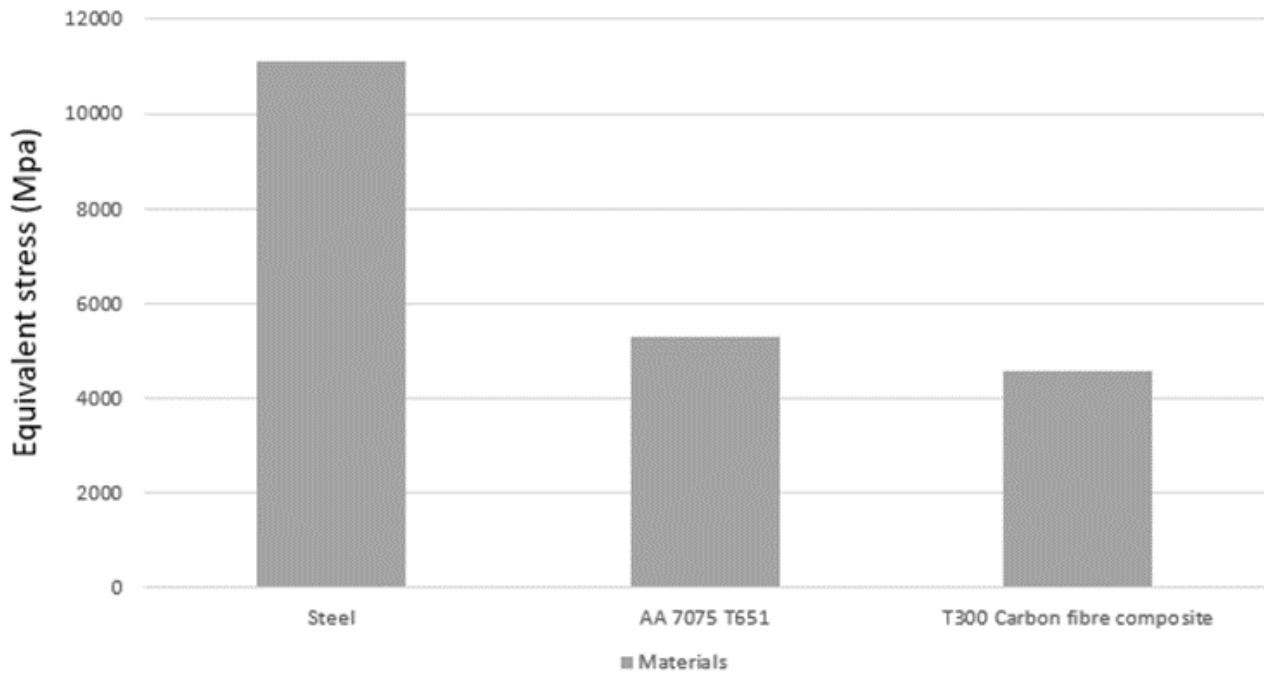
Materials	Velocity (m/s)	Equivalent stress (mpa)	Total deformation (mm)
Steel	27.7778	11105	36.301
AA 7075 T651	27.7778	5277.8	47.305
T300 carbon fibre composite	27.7778	4561	53.811

Table 4.8 Tabulation of results

5.2 COMPARISON OF WORK DONE

The analysis done for the car body structure for three different material such as steel, aluminium AA7075 T651 and T300 carbon fibre composite by crashing the car body structure into an wall with an velocity of 100kmph that is 27778 mm/s. The equivalent stress value and total deformation value for the three different materials is noted and each material value will be compared with the other two materials to find out the alternate material.

5.2.1 Equivalent stress for three materials

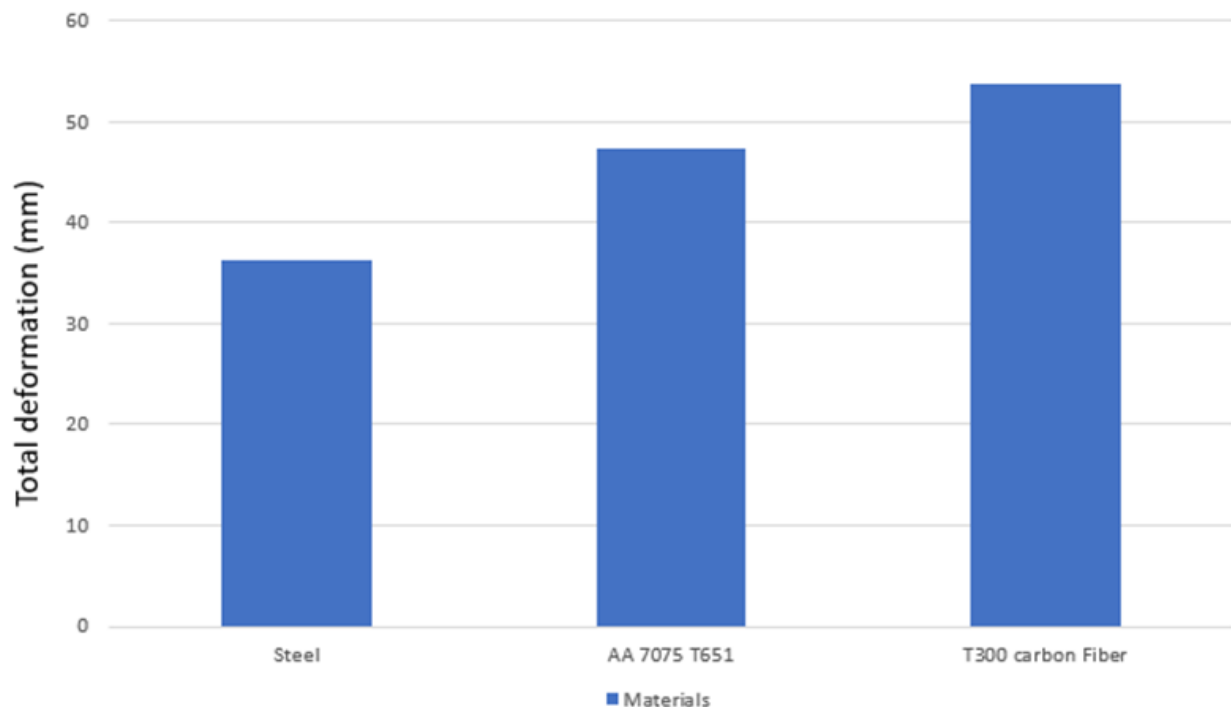


Graph 5.1 Equivalent stress for three materials

By comparing the results from analysis of three materials, the equivalent stress value of steel is higher when compared with aluminium and carbon fibre composite. The composite material T300 Carbon fibre has the least stress value which conveys its higher strength and hence according to the analysis results on equivalent stress of three materials T300 carbon fibre is the better alternate for other two materials.

5.2.2 Total deformation of three materials

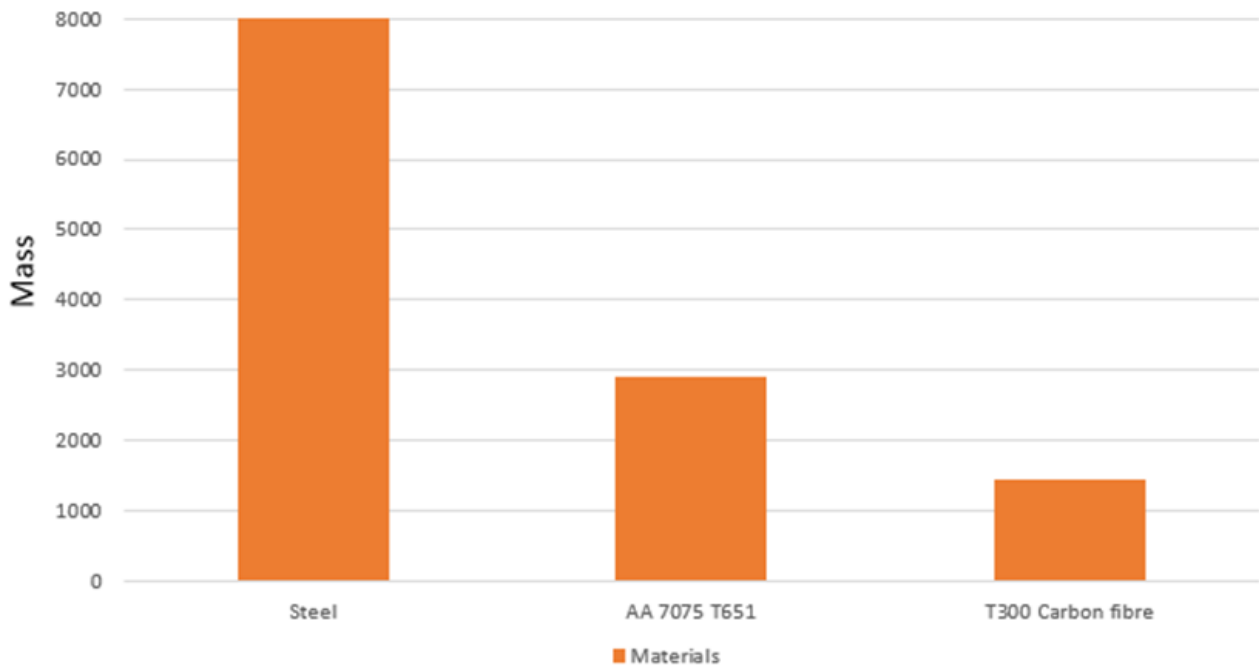
Total deformation is a deformation option that allows you to see all of your model's deformation results in three coordinates (X, Y, and Z). You can select a coordinate (X, Y, or Z) in directional deformation to see the deformation result of your physical model in that direction.



Graph 5.2 Total deformation for three materials

From the above analysis of three materials, the comparison of the total deformation value between three materials, T300 carbon fibre has the highest deformation value, whereas aluminium has less deformation value when compared with T300 carbon fibre composite and Steel has the lowest deformation value from the other two materials but it couldn't be used due to its mass.

5.2.3 Mass of the structure for three materials



Graph 5.3 Mass of the structure for three materials

From the above analysis results of mass of the three materials for the car body structure is compared. From the comparison the T300 carbon fibre composite material has the least weight when compared with the other three materials. Aluminium AA7075 T651 has slightly higher mass when compared with T300 carbon fibre composite. Among the three materials steel has the highest mass. So from this comparison T300 carbon fibre composite 81 % lesser and an better alternate material.

CHAPTER-6

CONCLUSION

According to the results of equivalent stress value for the different materials, T300 carbon fibre composite has the least stress value but it has a higher deformation value, and this material has the optimized weight when compared to other materials. Steel has high mass and stress value but the least deformation value, it couldn't be used due to its stress and higher mass. Aluminium alloy 7075 T651 has less weight and stress value when compared with steel. But the weight of T300 carbon fibre composite is less than AA7075 T651. From the results compared, AA 7075 T651 and T300 carbon fibre composite could be used in the Car body structure. Due to its mass Steel couldn't be used. The weight of AA 7075 T651 is 63.76 % lesser than the traditional steel. The weight of T300 carbon fibre composite is 81% lesser to the steel and 50.18% lesser than AA 7075 T651, hence weight is also optimized

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PLAGIARISM REPORT

SS

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