

## Dynamic Analysis Of A Frameless Chassis

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### ABSTRACT

*In this project we are reducing the impact by modifying the existing design. Presently steel is used for chassis construction. The aim of the project is to analyse the frameless chassis with presently used material steel and replacing with composite materials like steel, E- Glass epoxy. Impact analysis is conducted on chassis for different speeds by varying the materials. We are conducting above analysis for the existing design and for the modified design. Best of the result we will consider for the chassis design. In addition, we are going to reduce weight of the chassis by using composite materials replacing with steel Software used for modelling CATIA and for ANSYS WORKBENCH.*

**Key words:** CATIA, ANSYS Workbench, Composite Material, Speeds

### INTRODUCTION

The chassis forms the main structure of the modern automobile. A large number of designs in pressed-steel frame form a skeleton on which the engine, wheels, axle assemblies, transmission, steering mechanism, brakes, and suspension members are mounted. During the manufacturing process the body is flexibly bolted to the chassis.

This combination of the body and frame performs a variety of functions. It absorbs the reactions from the movements of the engine and axle, receives the reaction forces of the wheels in acceleration and braking, absorbs aerodynamic wind forces and road shocks through the suspension, and absorbs the major energy of impact in the event of an accident.

There has been a gradual shift in modern small car designs. There has been a trend toward combining the chassis frame and the body into a single structural element. In this grouping, the steel body shell is reinforced with braces that make it rigid enough to resist the forces that are applied to it. To achieve better noise isolation characteristics, separate frames are used for other cars. The presence of heavier-gauge steel components in modern separate frame designs also tends to limit intrusion in accidents.

### INTRODUCTION OF CHASSIS FRAME

Chassis is a French term and was initially used to denote the frame parts or Basic Structure of the vehicle. It is the backbone of the vehicle. A vehicle without body is called Chassis. The components of the vehicle like Power plant, Transmission System, Axles, Wheels and Tyres, Suspension, Controlling Systems like Braking, Steering etc., and electrical system parts are mounted on the Chassis frame. It is the main mounting for all the components including the body. Therefore, it is also called as Carrying Unit. In the case of vehicles, the term rolling

chassis means the frame plus the "running gear" like engine, transmission, drive shaft, differential and suspension. An underbody (sometimes referred to as "coachwork"), which is usually not necessary for integrity of the structure, is built on the chassis to complete the vehicle.

For commercial vehicles, a rolling chassis consists of an assembly of all the essential parts of a truck without the body to be ready for operation on the road.[3] A car chassis will be different from one for commercial vehicles because of the heavier loads and constant work use. Commercial vehicle manufacturers sell "chassis only", "cowl and chassis", as well as "chassis cab" versions that can be outfitted with specialized bodies. These include motor homes, fire engines, ambulances, box trucks, etc.

In particular, applications, such as school buses, a government agency like National Highway Traffic Safety Administration (NHTSA) in the U.S. defines the design standards of chassis and body conversions.

A vehicle's hull serves as the chassis and comprises the bottom part of the AFV that includes the tracks, engine, driver's seat, and crew compartment. This describes the lower hull, although common usage might include the upper hull to mean the AFV without the turret. The hull serves as a basis for platforms on tanks, armoured personnel carriers, combat engineering vehicles, etc.



**Frameless chassis of car**

## **LITERATURE REVIEW**

Automotive chassis is a skeletal frame on which various mechanical parts like engine, tires, axle assemblies, brakes, steering etc. are bolted. The chassis is considered to be the most significant component of an automobile. It is the most crucial element that gives strength and stability to the vehicle under different conditions. Bus chassis is the design and quality of bus chassis depends on the capacity of bus. It can be tailor made according to the needs and can be availed with features like transverse mounted engine, air suspension as well as anti-roll bars. A well manufactured bus chassis offers various benefits like high torque from

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low revs, superior brake performance and more. Bus chassis designed for urban routes differs from the one manufactured for suburban routes. For bus frameless chassis construction is used. In this frame less chassis type all the components is attached to the body. All the functions of the frame carried out by the body itself. Due to elimination of long frame it is cheaper and due to less weight most economical also. Only Disadvantage is repairing is difficult. This type of frames will affect more in collision of vehicle. In this project we are reducing the impact by changing the existing design materials. Data is collected from the Body construction work shape in Vijayawada. Presently steel is used for chassis construction. The aim of the project is to analyze the frameless chassis with presently used material steel and replacing with composite materials like Carbon Epoxy, E- Glass epoxy. Impact analysis is conducted on chassis for different speeds by varying the materials. We are conducting above analysis for the existing design and for the modified design. Best of the result we will consider for the chassis design. Also we are going to reduce weight of the chassis by using composite materials replacing with steel.

## INTRODUCTION TO ANSYS WORKBENCH

### Project Objective

In this chapter, we will be able to define:

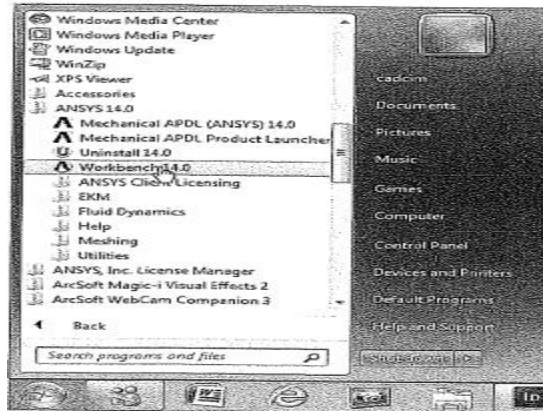
- Understand the types of system
- Understand different types of cells
- Understand the graphic user interface of the workbench window
- Start a new project in ansys workbench windows
- Add the first and subsequent analysis system to a project
- Set units for the project

In ansys workbench this are the list of analysis can be determined:

- Modal analysis
- Static structural analysis
- Transient structural analysis
- Steady state thermal analysis
- Transient thermal analysis
- Fluid flow (cfd)

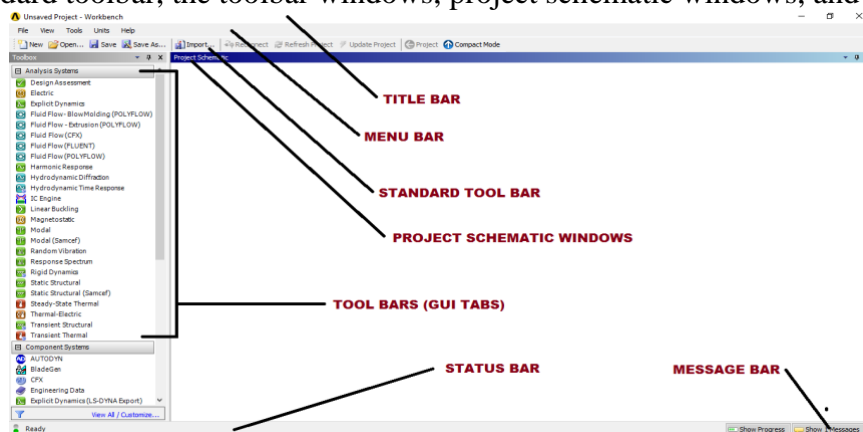
### Starting Ansys Workbench 16.0

To start ansys workbench 16.0 , choose start- programs/ all programs- ansys 16.0 - workbench 16.0 from the taskbar. Alternatively, we can start ansys workbench by double click on the workbench 16.0 .



**Figure 5. 1 Starting Of Ansys Workbench Using Taskbar**

The workbench windows help streamline an entire project to be carried out in ansys workbench 16.0 . In this window, one can create, manage, and view the workflow of the entire project create by using standard analysis system. The workbench windows mainly consist of the menu bar, standard toolbar, the toolbar windows, project schematic windows, and the status bar.



**Figure 5. 2 The Component Of The Workbench Windows**

**Toolbox Windows**

The toolbox windows are located on the left in the workbench windows. The toolbox windows list the standard and customised templates or the individual analysis components that are used to create a project. To create a project, drag a particular analysis or component system from the toolbox window and drop into the project schematic windows or double click on gui table it will add it into project schematic windows and to create the project



**Figure 5. 3 The Analysis System Displaying Various Analysis System In It.**

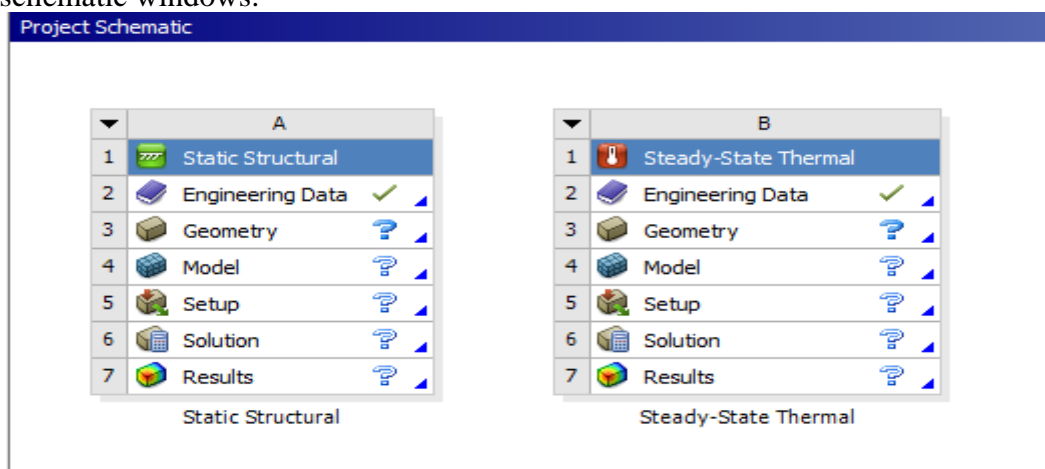
Table Of Analysis And Definitions

Name of analysis	Application of loads	Solution determines
Explicit dynamics	Loads with respect to time	Total deformation or impact deformation
Fluid flow (cfx)	Compressible or incompressible of air or gases	Heat transfer or flow of air
Fluid flow (cfd)	Compressible or incompressible of fluid	Heat transfer fluid
Harmonic response	Periodic or sinusoidal loads	Resonance, fatigue, and effect of forced vibration.
Rigid dynamics	Constraints and motion loads	Forces or direction analysis
Static structural	Static load conditions	Deformation, stresses and strains, fatigue tool, life, damages, safety factor
Steady state thermal	Temperature or thermal loads	Heat flux or temperatures
Transient structural	Varying of load conditions with changing of times	Deformation, stresses and strains, fatigue tool, life, damages, safety factor
Transient thermal	Varying of temperature or thermal loads with changing of times	Heat flux or temperatures

**Table 4. 1 Table Of Analysis And Definitions**

#### 5.5. Project Schematic Windows

The project schematics windows help manage an entire project. It displays the workflow of entire analysis project. To add an analysis system to the project schematic windows, drag the analysis system from toolbox windows and drop into the green coloured box displayed in the project schematic windows.



**Figure5.4 Static And Thermal Analysis Imported Into Project Schematic**

### 5.6. Custom System Analysis.

By default, the custom system toolbox is also displayed in collapsed state in the toolbox. To expand this node, click on + on a custom system. The system in the customs system toolbox is used to carry out the standard coupled analysis like static and thermal analysis (the combination of more than single or multiple of gui tab). In every guitabs, we can drag more gui tabs makes the links analysis.

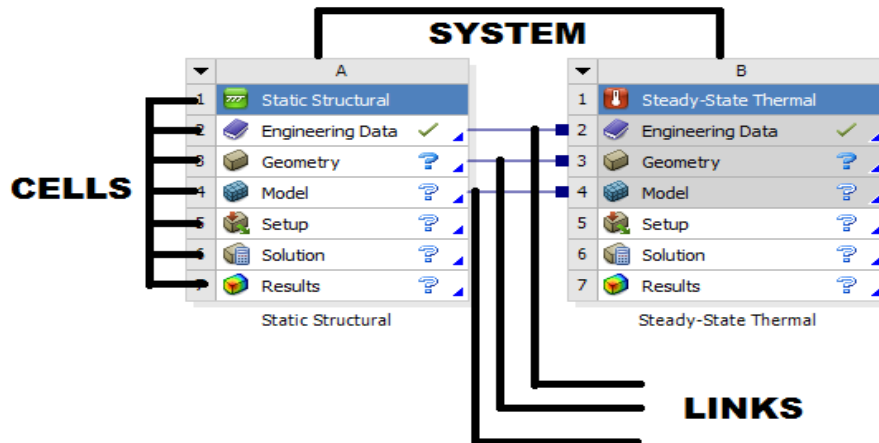


Figure 5.5 Project Schematic Showing Engineering Data, Geometry And Model

### 5.7. Component Of The System:

An item that is added from the toolbox window to the project schematic windows is known as a system and the constituent elements of the system are known as cells. Each cell of a system plays an important role in carrying out a project and are discussed next

### Engineering Data Cell

The engineering data cell is used to define the material to used in the analysis. To define the materials, double click on the engineering data cell, the workbench corresponding to this the engineering data cell will e displayed.

Engineering cell-double click-click on the shell system (engineering data book)-select general materials in the outline of the engineering data sources- select materials in the outline of general materials

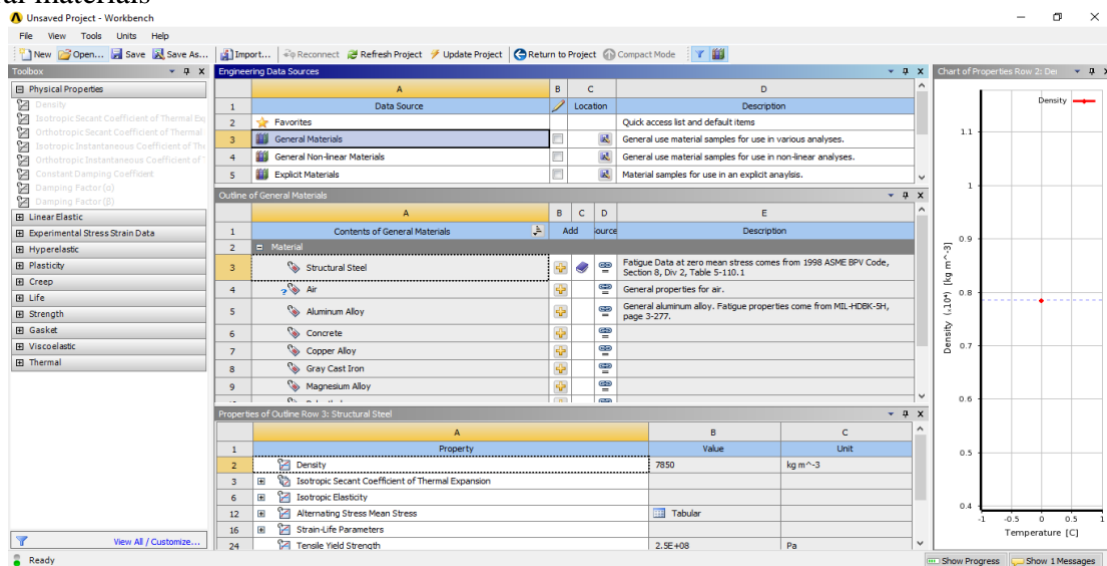
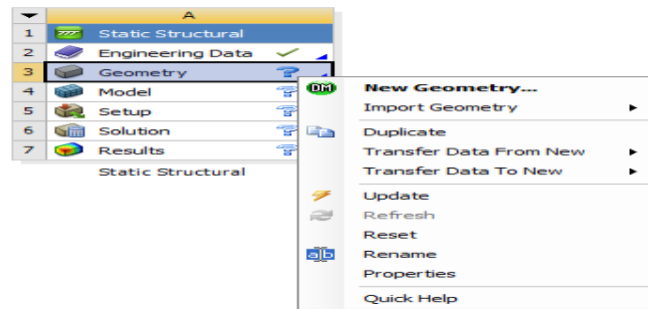


Figure 4.6 The Engineering Data Workspace

### 4.7.2 Geometry Cell

5eate a geometry for analysis, double click on geometry cell, the design modeller windows will be displayed.



**Figure 5. 7 The Menu Displayed On Right Clicking On The Geometry Cell**

The new geometry option in the menu is used to get into design modeller windows, where you can create geometry or import the geometry from the existing geometry file create in another cad software packages.

### Model Cell

The model cell will be displayed for mechanical analysis system and is used to discredited geometry into small elements, apply boundary and load conditions, solve the analysis, and so on.

### Mesh Cell

The mesh cell will be displayed for fluid flow analysis and is used to mesh the geometry, on double clicking on this cell, the meshing windows will be displayed . In other words, this cell is associated with the meshing windows.

### Setup Cell

The setup cell is used to define the boundary conditions of an analysis system, such as loads and constraints. This cell is also associated with the mechanical workspace.

### Solution Cell

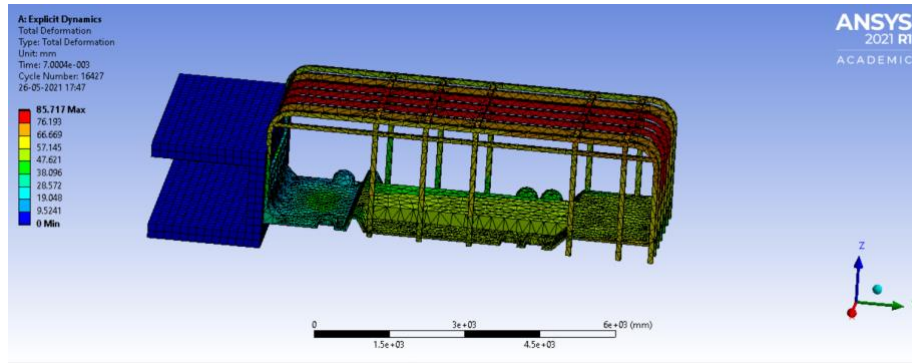
The solution cell is used to solve the analysis problem based on the conditions defined in the cells above the solution cell. The cell is also associated with the mechanical workspace.

### Results Cell

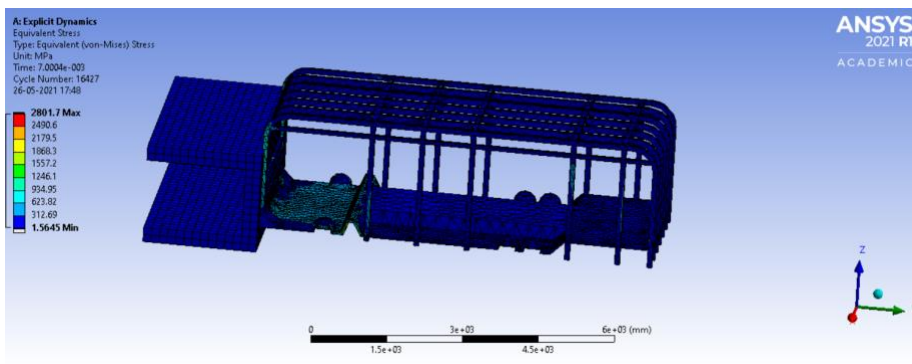
The results cell is used to display the results of the analysis in the user specified formats, this cell is also associated with the mechanical workspace.

**RESULT AND CONCLUSION**

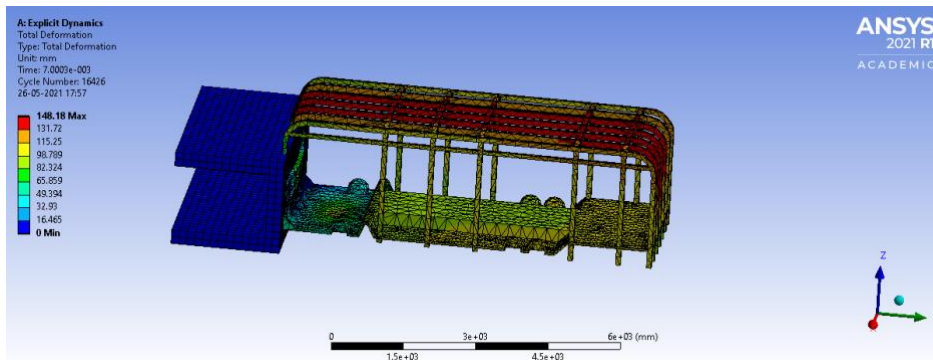
**RESULT**  
**E-GLASS**  
**70KMPH**  
**DEFORMATION**  
**75kmph**



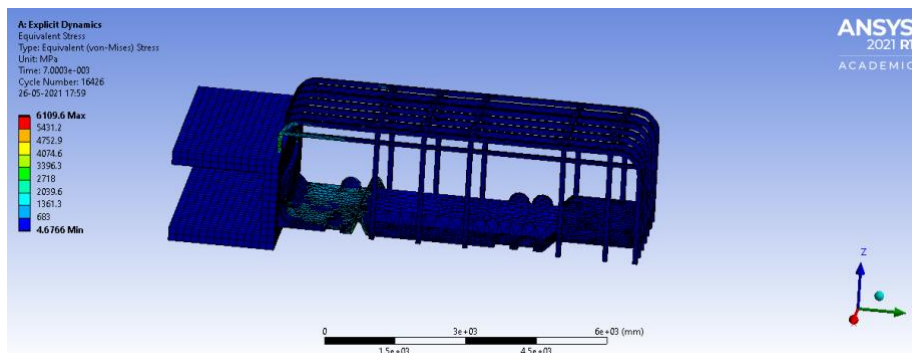
**Stress**



**150kmph**



**STRESS**





# International Journal of Research (IJR)

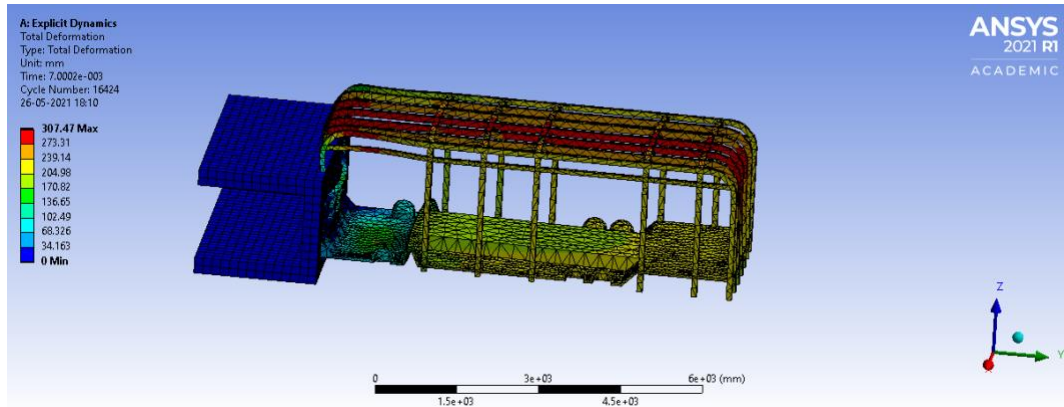
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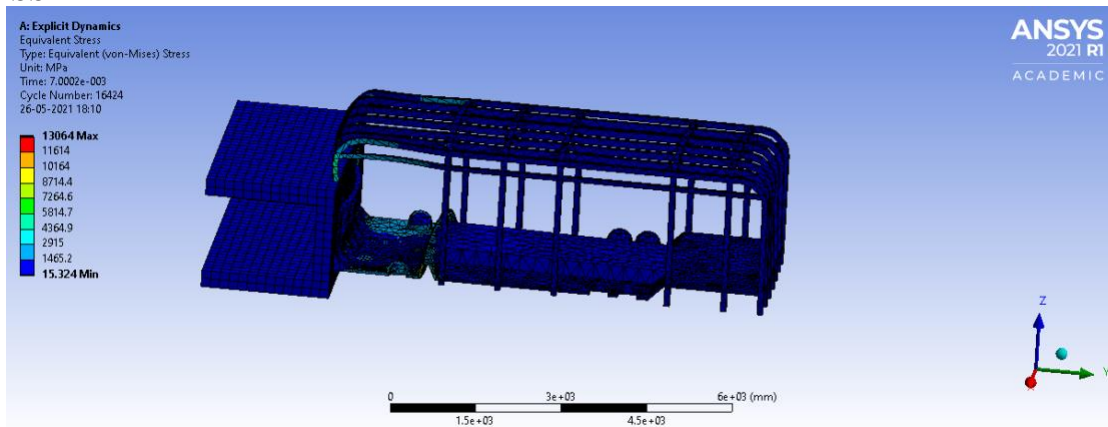
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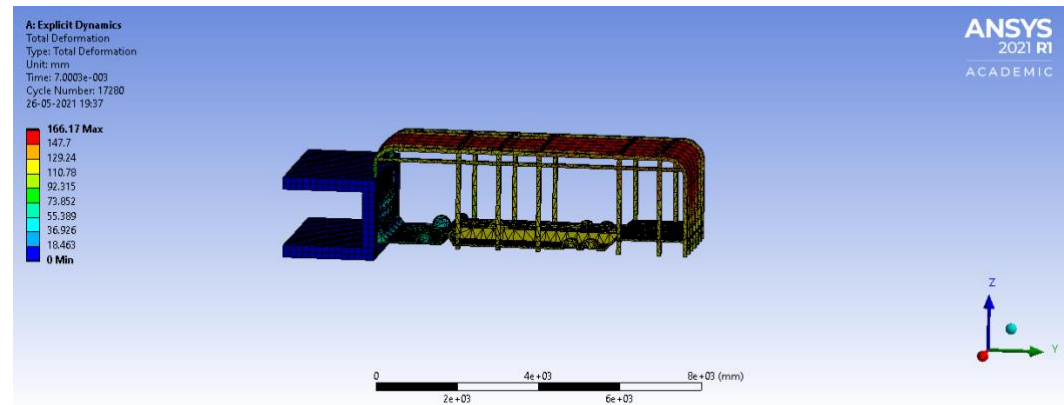
**ALLOY STEEL  
300KMPH  
DEFORMATION**



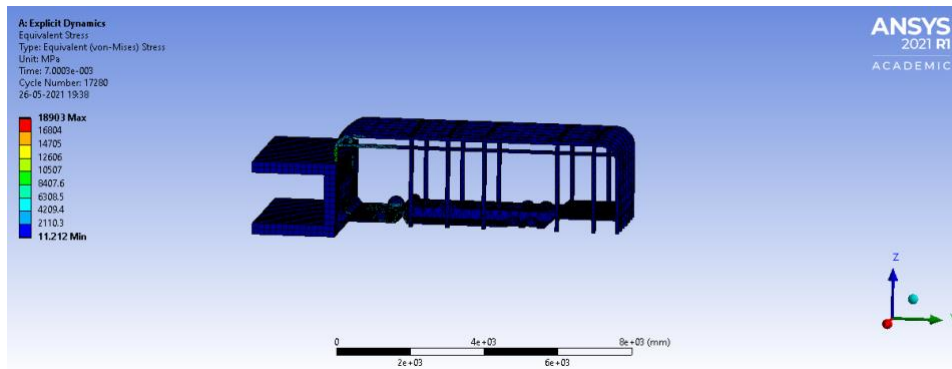
**STRESS**



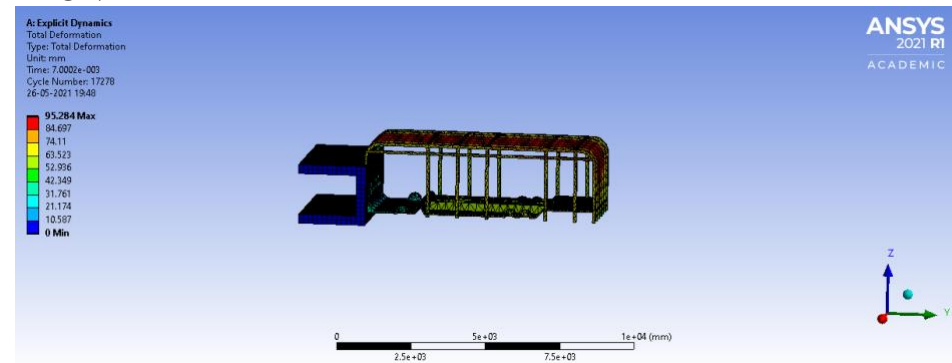
**150KMPH**



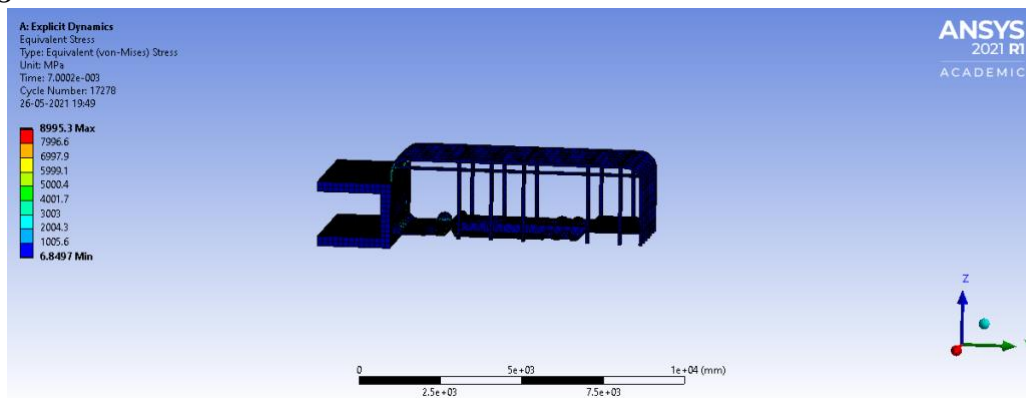
## STRESS



## 75KMPH DEFORMATION



## STRESS



## TABLE OF OBSERVATION

	ALLOY STEEL		E-GLASS	
	DEFORMATION (MM)	STRESS (MPA)	DEFORMATION (MM)	STRESS (MPA)
75KMPH	95.284	8995.3	85.7	2801.7
150KMPH	166.17	18903.4	148.18	6109.6
300KMPH	332.78	42158.2	307.47	13064.5

## CONCLUSION

In our project we have designed a frameless chassis used in a bus collecting data from Body construction . Present used material for frameless chassis is Steel. We are replacing the steel with composite materials E – Glass Epoxy. By replacing with composites, the weight of the frameless chassis is reduced by almost 4 times. Impact analysis is done on the chassis at different speeds 75km/hr, 150 km/hr and 300 km/hr. By observing the results, the displacement and stress values are less for E – Glass epoxy than Steel . We have also modified the design of frameless chassis by adding ribs at the top and bottom at the front side of the chassis. By observing the impact analysis on modified design the displacement and stress values are reduced than the present design. So we can conclude that E – Glass epoxy is better material for frameless chassis and by modifying the design some advantages can be found (i.e) decrease of stress and displacement values.

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