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Design and Analysis of Bus Body Structure

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Abstract: *Buses are the foremost mode of road transportation. The design of the bus body depends mainly leading the performance constraint under various types of loading and operating circumstances besides those of the road conditions. the model analysis, linear static analysis and impact analysis of an articulated urban bus body, carried out with the Finite Elements Method. The purpose of this work is to simulate and forecast the structural response of the bus body in terms of stress, strain and displacement, under several loading and constraining conditions Sensitivity analyses about FEM parameters have been run, in order to achieve an adequate trade-off between computational time and results accuracy This project deals with the GFEM modeling, analyzing of important section of the bus body for the standing gravity load, acceleration, breaking load and for the impact case. . Structural modelling is completed with the help of CATIA V5, single component is created in part workbench in CATIAV5, this part is then converted to IGS file. Finite element modelling is completed in ANSYS 14.0.*

Keywords: *Bus body structure, Anysis workbench,*

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I. INTRODUCTION

The bus body structure must be balanced in order to obtain the safety when the bus is running body must be sufficiently strong both the situation of supporting normal loads and accident loads. The bus body can be divided into three parts; the chassis and engine, structural body, interior and exterior parts. The chassis and engine are quite important. They must pass the standard test by domestic and international organization. The chassis consists of frame, which is a box type section and varies longitudinally as per the load and strength required for Body. Numerous Stiffeners are also added at the locations where the effect of Bending is Maximum. The body comprises of six main components; the left frame side, the right frame side, the front frame side, the back frame side, the top frame side and the bottom frame side. The top frame side is sometime called "the roof frame side". The bottom frame side is also called "the floor frame side". The left and the right side are similar but the left side is normally composed of passenger door(s). On the other hand, the right side has two doors; the driver door and the emergency door. The sides are concerned to be critical parts and they must be strong. The static load response of simple structures, such as uniform beams, plates and cylindrical shells, may be obtained by solving their equations of motion. Practical structures consist of an assemblage of components of different types, namely beams, plates, shells and solids. In these situations it is impossible to obtain analytical solutions to the equations of motion. This difficulty is overcome by seeking some form of numerical solutions and finite element methods.

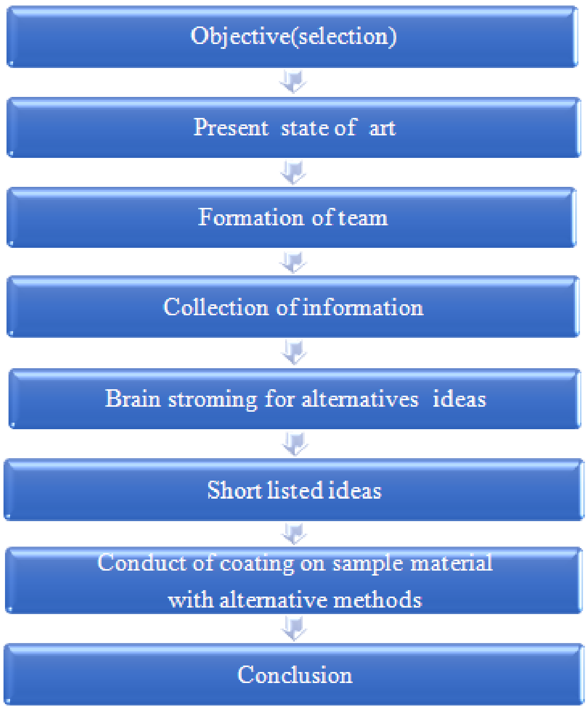
The bus body manufacturing composes of several operation processes. In general, the first step is to prepare drawings after the design is already completely finished. Then, the production process is planned for how to build the bus body step by step, which machine and cutting tools are selected, how much materials are needed, how long time does it take and how much does it cost. Next, the chassis is selected and prepared. Normally, the chassis is combined with its engine The comprises of bus body have six main components the left and right frame side, the front and back frame side, the top and bottom frame side. In that the top frame side is sometime called roof frame side. The bottom frame side is also called floor frame side. The left and right side are similar but the left side is normally composed of two passenger doors. On the other hand, the right side has two doors the driver door and emergency door. In addition, the both frame sides are installed by mirrors and welded with sheet metal. They are concerned to be critical parts. They must be strong. The parts need to be analytical tests by at least simulation or physical test. Torsion and bending tests are widely simulated by FE analysis. However, the strength of this design is affected by the manufacturing.. This part must be sufficiently strong. It must be supported by the total weight from different loads such as interior components, air conditioners passenger carrying loads even the aero dynamic load. Then, the back frame and the front frame are mostly supported and joined with the left and right sides as well as the roof frame and the floor frame. These two parts need to be both strong and beauty style. Therefore the shape is quite become curvature, slop and good aero dynamic. The existing part is further combined by a lot of pieces which is here called trusts. The trusts are can be typed such as straight trusts, angle trusts, diagonal trusts and so on.

1.1 Bus body design parameters:

The bus body design parameters consist of strength, light weight, manufacturability, adaptability, weld ability. Technical contradictions, the possible contradiction among the parameters have been identified. To accomplish this, the fact that improvement of one parameter can worsen another one has been taken into account.

- Weight of the moving object,
- Length of the moving object,
- Area of the moving object,
- Column of the moving object,
- Durability of the moving object,
- Stability object, Strength.

II. METHADOLOGY



III. MATERIAL USED FOR BUS BODY STRUCTURE MANUFACTURING

Traditionally, the most common material selection for manufacturing bus body structure would be steel, in various forms. Some time, other materials have come into use, the majority of which have been covered here.

3.1 Structural steel :

The main factors of selecting material especially for body is wide variety of characteristics such as thermal, chemical or mechanical resistance, ease of manufacture and durability. So if we want to choose a material with these characteristics, Steel is the first choice. re was many developments in irons and steels over the past couple decades that made the steel more light-weight, stronger, stiffer and improving other performance characteristics. Applications include not only vehicle bodies, but also engine, chassis, wheels and many other parts. Iron and steel form the critical elements of structure for the vast majority of vehicles, and are low-cost materials. The prime reason for using steel in the body structure is its inherent capability to absorb impact energy in a crash situation. The prime reason for using steel in the body structure is its inherent capability to absorb impact energy in a crash situation.

3.2 Aluminium Alloys :

There are a wide variety of aluminum alloy usage in automotive powertrain, chassis and body structure. Use of aluminum alloy can potentially reduce the weight of the vehicle body. Its low density and high specific energy absorption performance and good specific strength are its most important properties. Aluminum alloy is also resistance to corrosion. But according to its low modulus of elasticity, it cannot substitute steel parts and therefore those parts need to be re-engineered to achieve the same mechanical strength, but still aluminum alloy offers weight reduction. Recent developments have shown that up to 50% weight saving for the body in white (BIW) can be achieved by the substitution of steel by aluminum alloy. This can result in a 20-30% total vehicle weight reduction. The cost of aluminum alloy and price stability is its biggest obstacle for its application.

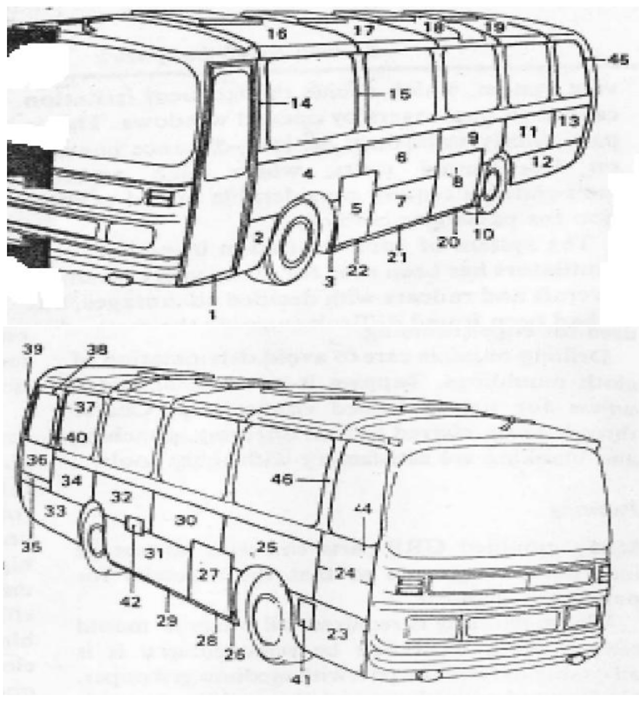
3.3 Kevlar :

Kevlar is simply a super-strong plastic. If that sounds unimpressive, remember that there are plastics- and there are plastics. There are literally hundreds of synthetic plastics made by polymerization(joining together long chain molecules) and they have widely different properties. Kevlar's amazing properties are partly due to its internal structure(how its molecules are naturally arranged in regular, parallel lines) and partly due to the way it's made into fibers that are knitted tightly together.

IV. PROBLEM DESCRIPTION

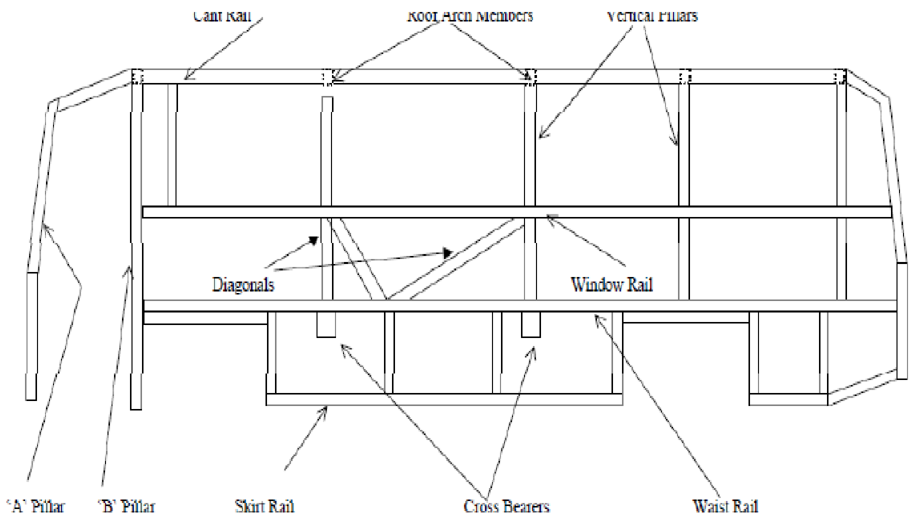
Now days there is demand on buses, not only on the cost, weight and shape aspects but also on the improved entire vehicle features and overall work performance. In addition to this number of variants that are possible due to different types of designs and modulation, all for several design iterations to arrive at appropriate combination. For optimized bus body design, newly developed models are chosen whose specifications are taken from the local industry.

4.1 Busbody layout.



1. Entrance doorway skirt panel
2. Skirt panel front of front N/S wheel arch
3. Skirt panel rear of front N/S wheel arch
4. N/S main side panel Bay1.
5. Air filter access cap.
6. N/S main side panel Bay2.
7. Skirt panel.
8. Spare wheel access flap.
9. N/S main side panel Bay3.
10. Skirt panel front of rear N/S wheel arch.

11. N/S main side panel Bay4.
12. Rear skirt panel, N/S.
13. N/S main side panel , Bay 5.
14. Pillar capping between Bay1 & entrance door.
15. Pillar capping main pillars.
16. Roof panel Bay1.
17. Roof panel Bay 2.
18. Roof panel Bay 3.
19. Roof panel Bay 4.
20. Valance panel for spare wheel access flap.
21. Valance panel.
22. Valance panel for air filter access flap.
23. Front skirt panel O/S.
24. Main side panel below driver's signaling window O/S.
25. O/S main side panel Bay 1.
26. Skirt panel rear of front O/S wheel arch.
27. O/S brake gear access flap.
28. Valance panel for O/S brake gear access flap.
29. Valance panel.
30. O/S main side panel Bay 2.
31. Skirt panel front of rear O/S wheel arch.
32. O/S main side panel Bay 3.
33. O/S rear skirt panel.
34. O/S main side panel Bay 4.
35. Main side panel below emergency door.
36. Emergency door main side panel.
37. Pillar capping between emergency door and
Bay 4.
38. Emergency door, top rail capping.
39. Emergency door, shut pillar capping.
40. Emergency door, hinge pillar capping.
41. Water bottle flap.
42. Fuel filter flap.
43. Header tank flap.
44. Electrical flap.
45. N/S rear pillar capping.
46. O/S No 1 pillar capping.



Body Structure – Nomenclature

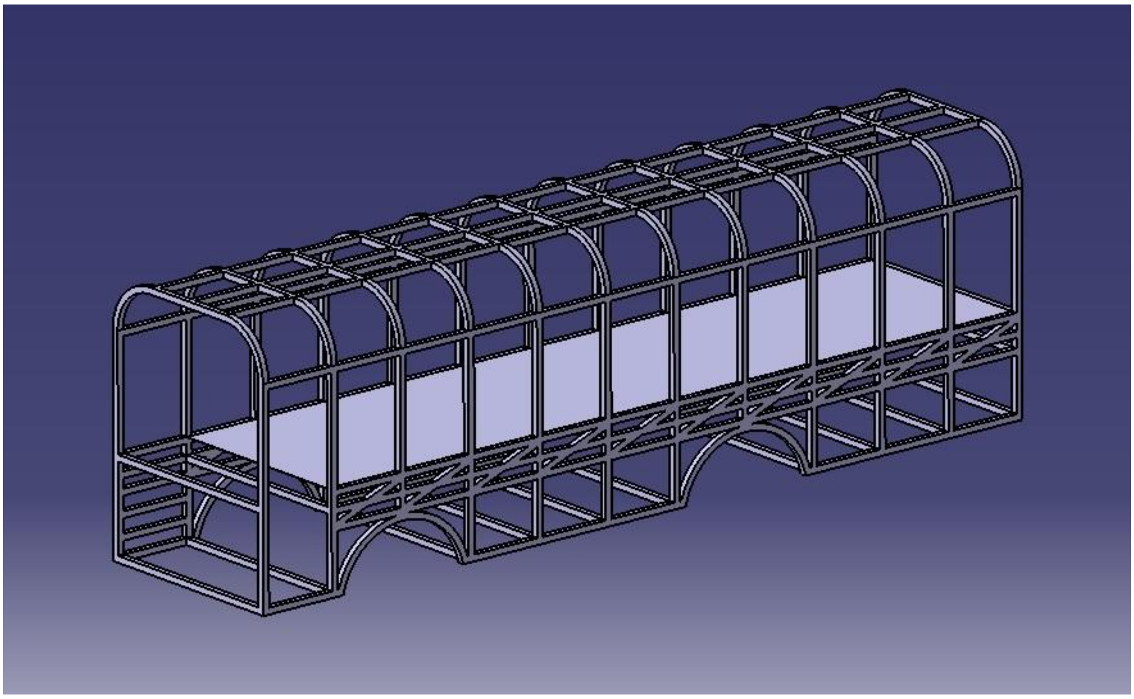
'Cant rails' are structural members that connect two body sections above the window section. 'Waist Rails' are structural members that connect two body sections below the window section. 'Seat Rails' are structural members running along the lateral walls and provide support for seat mounting.

V. DESIGN OF BUS BODY STRUCTURE

5.1 Modeling Of Bus Body Structure Using CAD System.

There are some good reasons for using a CAD system to support the mechanical design function:

- To increase in the productivity.
- To get better the quality of the mechanical design.
- To uniform design standards. To create a manufacturing data base.
- To remove inaccuracies due to hand-copying of drawings and irregularity between Drawings.
- It is a document that includes the specifications for a part's production. Generally the part drawings are drawn to have a clear idea of the model to be produced. The part drawing of the entire frame is drawn with all the views in CATIA V5 R20.The components that are generated in part module are imported to assembly module and by using 'insert components' command and all these components are mated together to form the required assembly. The different views of assembly and the drawing generated in CATIA V5 R20 are as shown below.



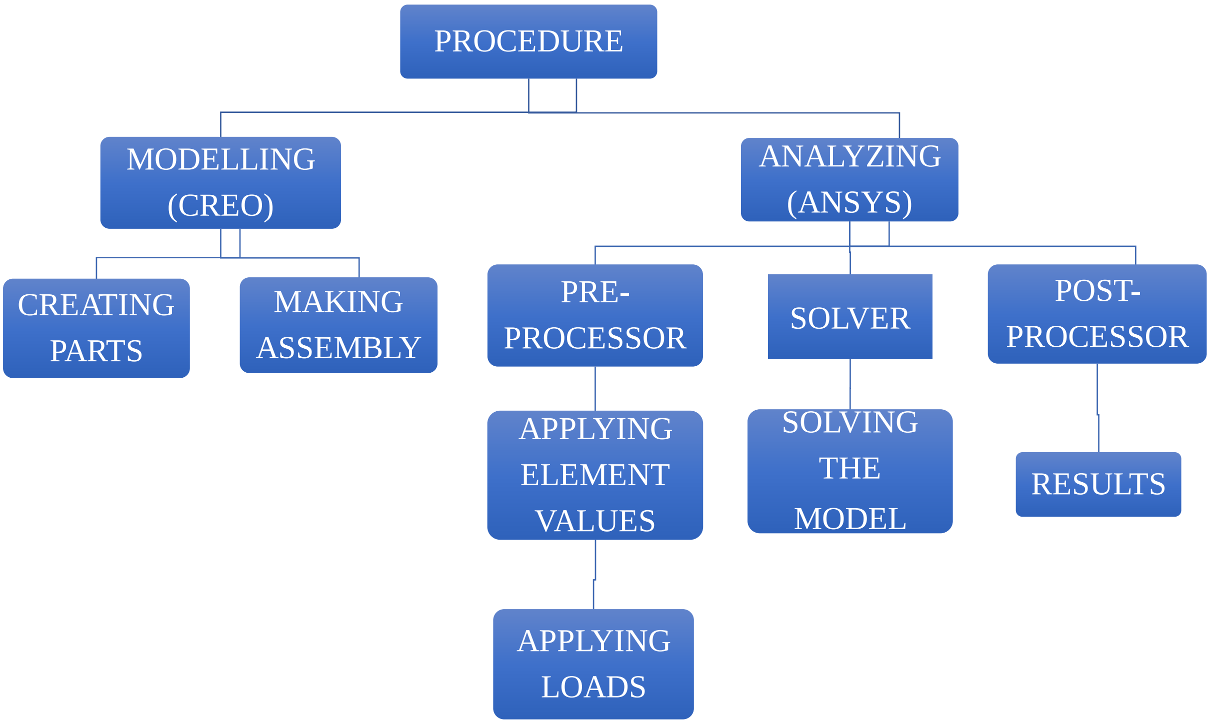
VI. ANALYSIS OF THE BUS BODY STRUCTURE

6.1 Software Explanation.

ANSYS Mechanical is a finite element analysis tool for structural analysis, including linear, nonlinear and dynamic studies. This computer simulation product provides finite elements to model behaviour, and supports material models and equation solvers for a wide range of mechanical design problems. ANSYS Mechanical also includes thermal analysis and coupled-physics capabilities involving acoustics, piezoelectric, thermal–structural and thermo-electric analysis. ANSYS offers a comprehensive software suit that the spans the entire range of physics, providing access to virtually any field of engineering simulation that a design process requires. Organizations around the world trust ANSYS to deliver the best value for their engineering simulation software investment. The software used for analysis is ANSYS 14.0.

6.2 Software Overview.

ANSYS as a software is made to be user friendly and simplified as much as possible to keep the user as much as possible from the hectic side of programming. The ansys software provide us to give any types of load to any types of component and to see the types of stresses and strain acting at every points of the solid component .It also shows the maximum load which a solid component can carry. By analyzing the given solid model diagram which is drawn using creo, the stresses and strain acting in that model was identified.



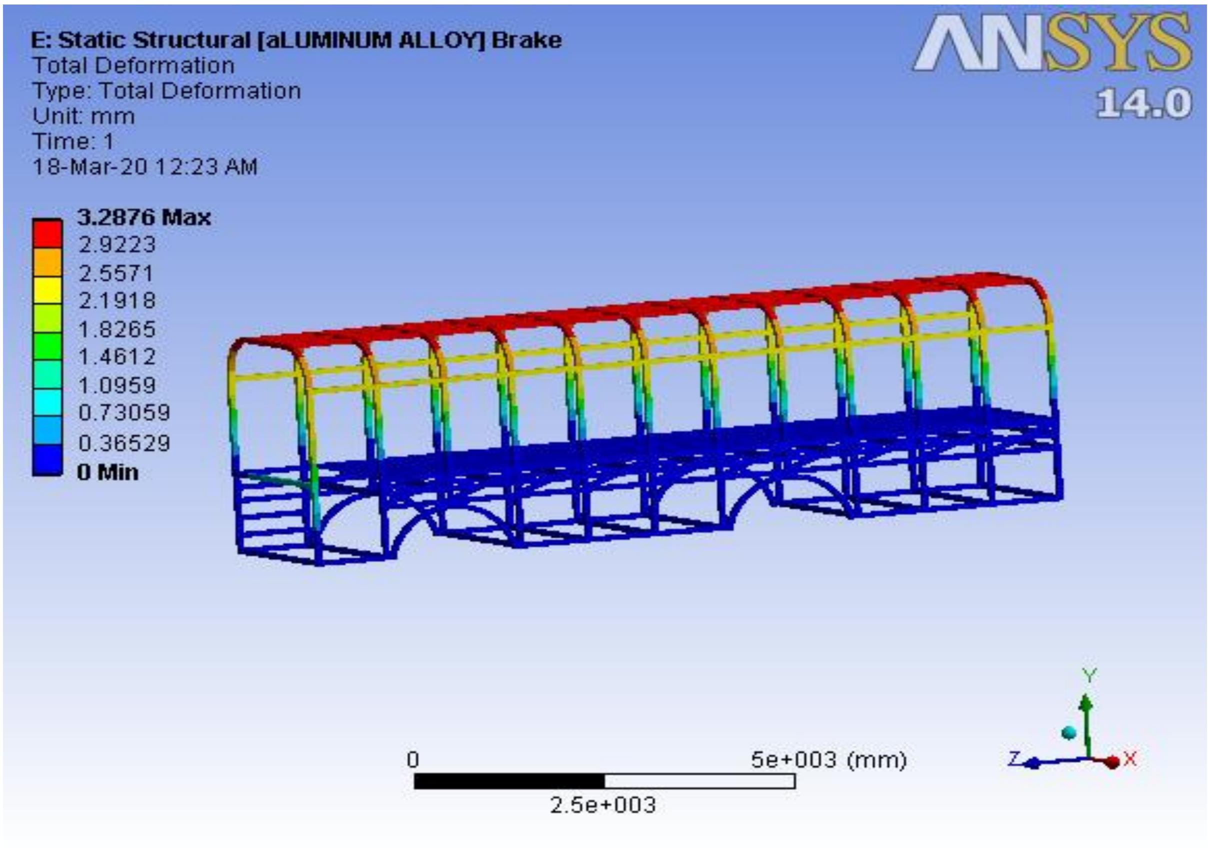
VII. RESULTS AND DISCUSSIONS

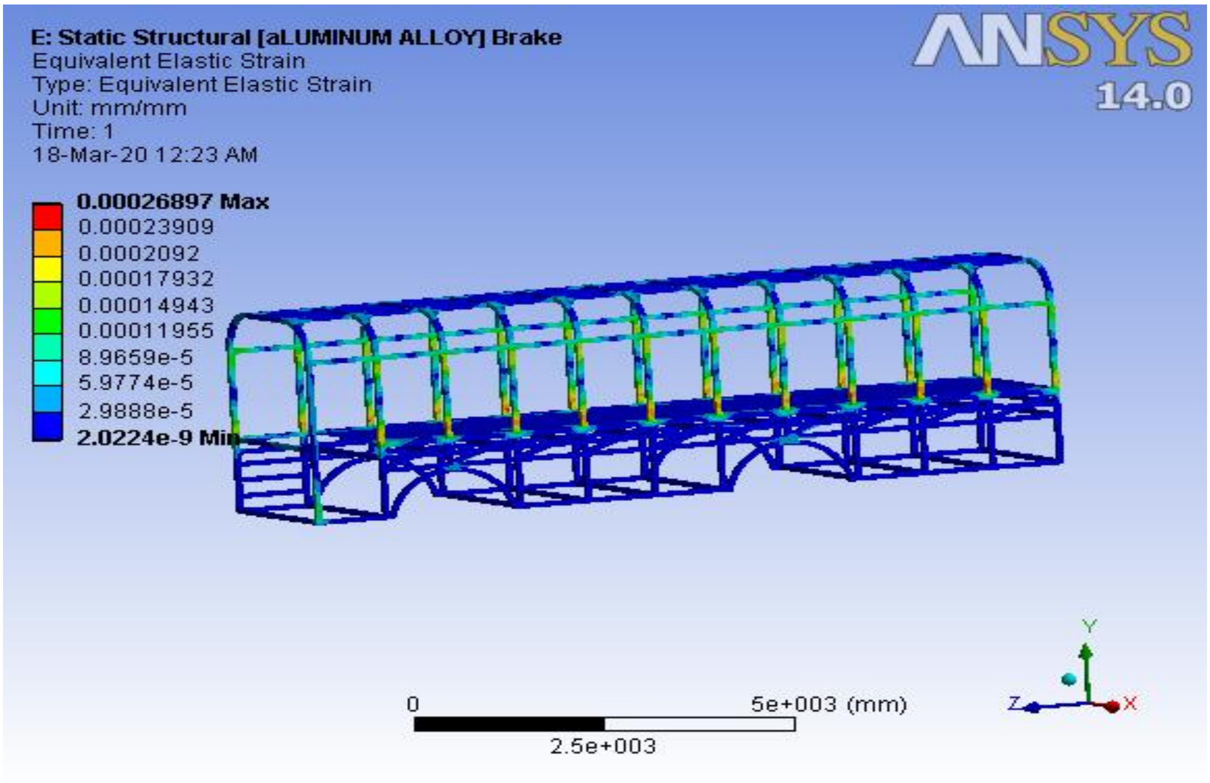
7.1 Loading calculation:

Loading calculation for acceleration,

1 km/hr = 277.77 m/s²

For 100 km/hr = 100x277.77= 27777.78 mm/s²

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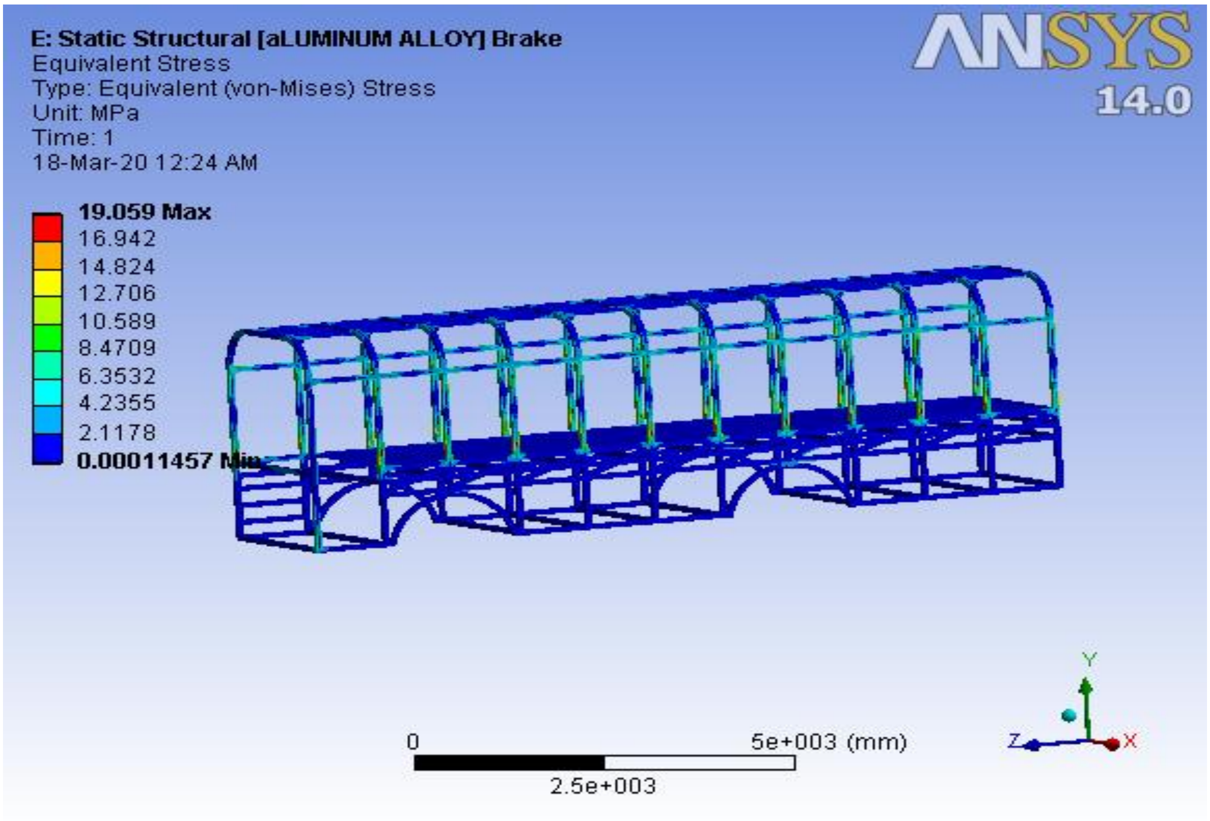
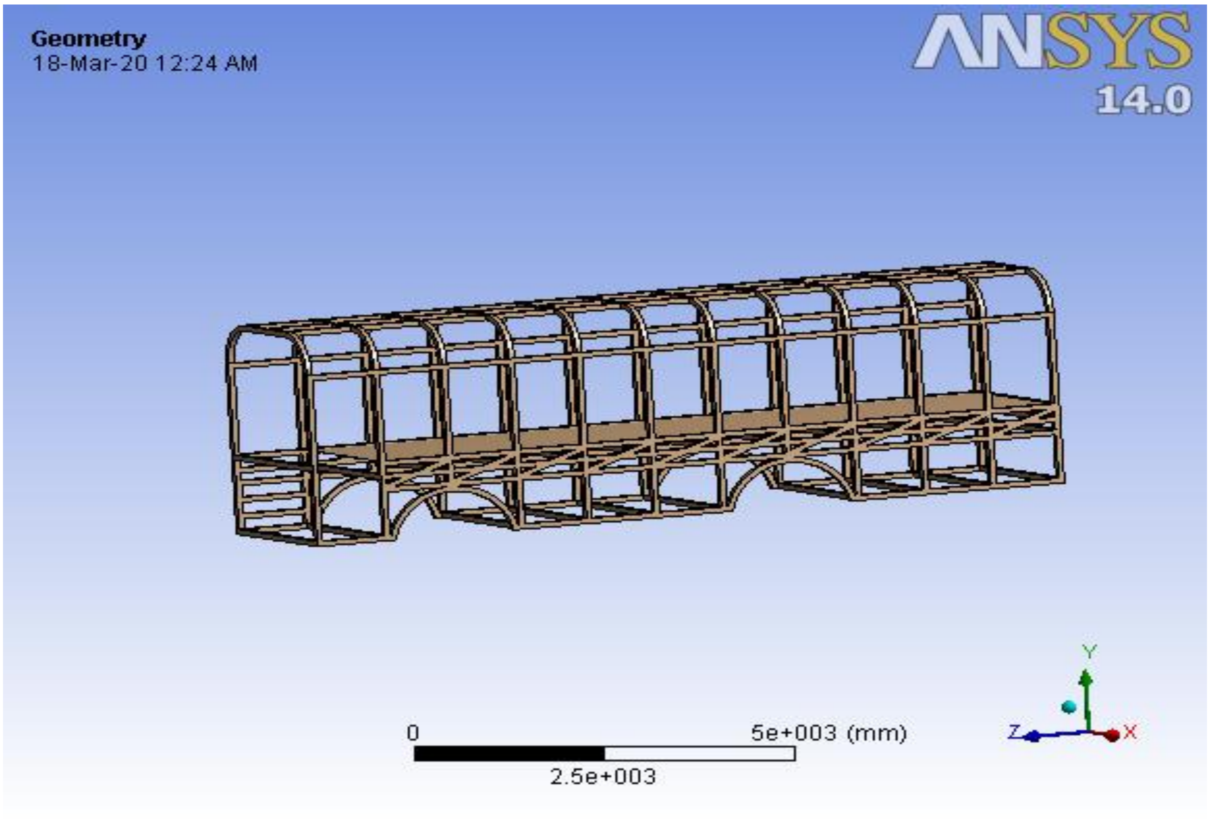
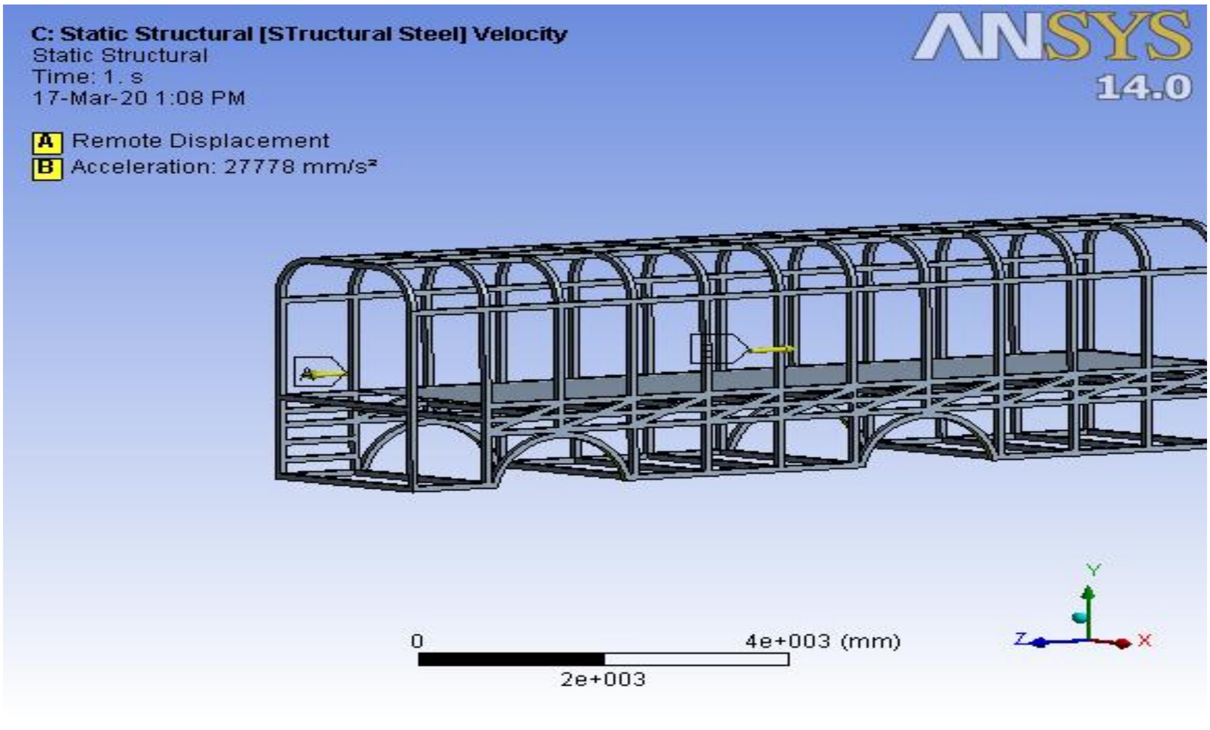
Equivalent Elastic Strain
Type: Equivalent Elastic Strain
Unit: mm/mm
Time: 1
18-Mar-20 12:23 AM
0.00026897 Max
0.00023909
0.0002092
0.00017932
0.00014943
0.00011955
8.9659e-5
5.9774e-5
2.9888e-5
2.0224e-9 Min
ANSYS
14.0
0
5e+003 (mm)
2.5e+003
Y
Z
X


E: Static Structural [aLUMINUM ALLOY] Brake
Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: MPa
Time: 1
18-Mar-20 12:24 AM
19.059 Max
16.942
14.824
12.706
10.589
8.4709
6.3532
4.2355
2.1178
0.00011457 Min
ANSYS
14.0
0
5e+003 (mm)
2.5e+003
Y
Z
X





VIII. CONCLUSION

The bus body structure was analyzed for static Impact load of 180N with respect to three different materials viz Titanium, Aluminium and E-Glass respectively by using ANSYS 14.5 software. As per the results, it indicates that the structure made of Titanium Material produces more stress and deformation of 316.82 Mpa and 2.8263 mm respectively while E-Glass material produces less stress and deformation of 28.9 Mpa and 0.78398mm respectively. Hence, predication of results shows that a structure made of E-Glass which develops less stress and deformation compared other two materials is recommended for construction of bus body in our project work.When three different materials are compared with their self weights, E-glass material was found to have a less weight with better mechanical properties. As we know that, the reduction in the weight of the structure will improve the mileage of the vehicle. Hence, this work recommends E- Glass for construction of bus body structure as a better material.

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