ANALYSIS OF ALUMINIUM ALLOY AND CARBON STEEL (AISI 1018) BASED BUS BODY STRUCTURE USING ANSYS

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Abstract: Buses are the most popular mode of road transport. The layout of the bus body is primarily determined by the performance constraints beneathneath distinct forms of loading and operational conditions, further to the road conditions. The model analysis, linear static evaluation and effect a formulated metro bus analysis body, done with the Finite Elements Method. The goal of this project is to visualise and predict structural behavior of the bus body in terms of stress, strain and displacement, in a variety of loading and limiting criteria.In order to maintain the desired trade-off between computational time and outcomes precision, sensitivity tests on FEM parameters have been performed. This work is concerned with the GFEM modeling, analyzing main parts of the bus body for holding gravity load, acceleration, breaking load, andimpact scenarios. Structural layout is completed with the help of CATIA V5, single element is created in part workbench in CATIAV5, After that, the segment is changed to an IGS file. Finite detail modelling is finished in ANSYS 14.0. The element form used for combining was 2D shell elements with QUAD4 in WORKBENCH using the IGS file as geometry. Static analysis done using ANSYS WORKBENCH.

***IndexTerms*:** **Bus body structure, ANSYS workbench, Aluminium alloy, Carbon steel, AISI 1018**

I. INTRODUCTION

The bus body structure should be adjusted in order to achieve safety when the bus is starting to run. The body must be sufficiently powerful in both standard and accident loads situations. The bus body is divided into three parts: the chassis and engine, the structural body, and the interior and exterior. The chassis and engine are crucial. They should transfer the locally and internationally organisations' standard tests. The chassis is made up of a frame, that is a box type section that differs lengthwise depending on the load and strength needed for the body. Various stiffeners are often provided in areas where the impact of bending is greatest.The body is made up of six major parts: the left and right frame sides, the front and rear frame sides, the top and bottom frame sides. The top frame side is sometimes referred to as “the roof frame side”. The lowest part frame side is also known as “the floor frame side”. The left and right sides are equivalent, but the left side is usually made up of traveller doorways (s). The right side, on the other hand, has two doorways: the driver doorway and the emergency doorway. The sides are burden with being critical components and should be strong.Solving the equations of motion of simple structures such as uniform beams, plates, and cylindrical shells yields the static load response.Realistic configurations are made up of various types of materials, such as beams, plates, shells, and solids. Mathematical models to equations of motion are impossible to achieve in such circumstances This challenge is achieved by pursuing analytical results and finite element methods.So many operation methods are involved in the production of a bus body. In general, after the design is complete, the first step is to prepare drawings. The production process is then planned, including how to build the bus body step by step, which machine And slicing tools are used, how plenty cloth is required, how lengthy it takes, and what sort of it costs.The chassis is then selected and prepared. Typically, the chassis is coupled with the engine. A bus in any nation is a type of industry that is specifically linked to the security and stability of that nation. After two years of finalisation of the welfare states' security and social stability, but it was immediately halted in the event of any flaws in the constant.

The internal bus skeleton structure design serves as the foundation for many bus improvements in the bus industry. Based on the design philosophy, it includes a framework of tubes with various cross sections that are assembled within stipulated shapesThe chassis and engine used in this study were purchased from well-known automotive brands such as MAN, BENZ, VOLVO, ISUZU, DAEWOO, HINO, and others.The chassis consists of two main types; the single piece and the three joint combination parts. The one piece chassis is used for the intermediate bus length with one ground, while the three mixture elements are used for the lengthy bus length or ground bus. The next component is the bus body structure. The incorporates of bus frame have six principal additives the left and proper body side, the back and front body side, the top and bottom frame sideIn this case, the top frame side is also known as the roof frame side.

The bottom frame side is also referred to as the floor frame side. The left and right sides are identical, but the left side usually has two rider doorways. The right side, on the other hand, has two doors: the driver door and the emergency doorway. Furthermore, mirrors are installed on both frame sides and welded with sheet metal. They are burden approximately being vital components. They should be powerful. Technical tests, at the very least modelling or physical tests, must be performed on the components. FE analysis is widely used to simulate torsion and bending tests. The manufacturing, however, has an impact on the strength of this design. Special types of welding, such as MIG, TIG, and spot welding, arc much better than the standard arc welding process.

This study, however, is unconcerned with such a production process. The third component, the top frame or roof frame, is regarded as the critical component that must be strong in place to guarantee the safety of the travellers. This element must be sufficiently powerful. It should be defended by the total weight of various loads such as internal design, air conditioning units, traveller carrying loads, and even the aerodynamic load. The back and front frames are then mostly defended and joined to the left and right sides, as well as the floor and roof frames. These two components must be both strong and beautiful in appearance. As a result, the shape has a lot of curvature, slop, and good aerodynamics. The existing part is further combined by a large number of pieces, which are referred to as trusts in this context. Trusts can be classified as straight trusts, angle trusts, diagonal trusts, and so forth

PrasannapriyaChinta, L. V. VenugopalRao [1], New devices are widely being used to optimise the mechanical behavior of automotive and body designs. In general, on the worldwide marketplace for travellersbuses layout techniques can depend upon supercomputing facilities. Nowadays for the passenger buses have many neighborhood manufacturers which assemble motors primarily based totally on neighborhood needs. In the aggressive to live those manufacturers follow the equal necessities and weight loss in their worldwide opposite numbers with out get entry to to modern day computation facilities. This paper proposes a brand new approach for designing a bus frame shape is designed and modelled in three-D modelling software program Pro/Engineer. The authentic frame is redesigned with the aid of using converting the thickness and decreasing the range of factors in order that the full weight of the bus is reduced.The present used material for structure is steel. It is replaced with composite materials Kevlar and S 2 Glass Epoxy. The density of steel is more than that of composite materials, so by replacing with composites, the weight of the structure is reduced. Structural and Dynamic analysis is done on both the structures using three materials to determine the strength of the structure. Analysis is done in Ansys.

In this paper, a bus body structure is designed and modelled in 3D modelling software Pro/Engineer. The dimensions of the frame shape are taken from the magazine specified in literature survey. The authentic frame is redesigned via way of means of converting the thickness and decreasing the range of factors in order that the entire weight of the bus is reduced. The present used fabric for structure is metal. It is changed with composite substances Kevlar and S 2 Glass Epoxy. The density of metal is extra than that of composite substances, so with the aid of using changing with composites, the load of the shape is reduced. Structural and Dynamics analysis is carried out on each the systems the usage of 3 substances to decide the power of the shape.Analysis is done in Ansys [10-11]

II. DESIGN ANALYSIS

Bus frame layout parameters:

The bus frame layout parameters encompass strength, mild weight, manufacturability, adaptability, weld ability.

Technical contradictions, the feasible contradiction most of the parameters were identified. To accomplish this, the reality that development of 1 parameter can get worse any other one has been taken into account.

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

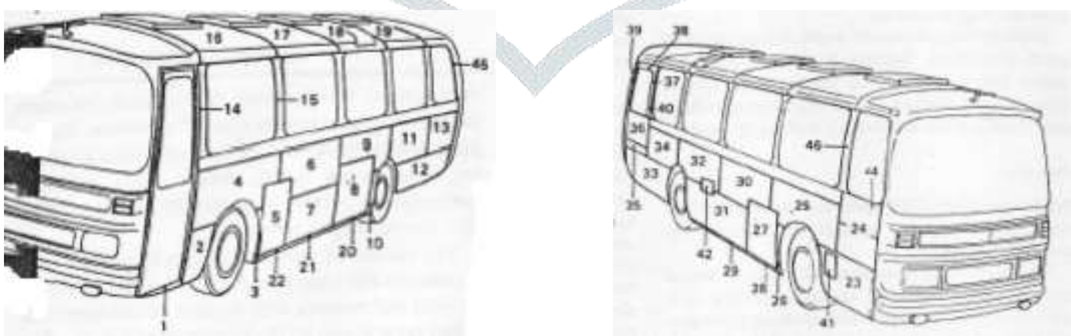
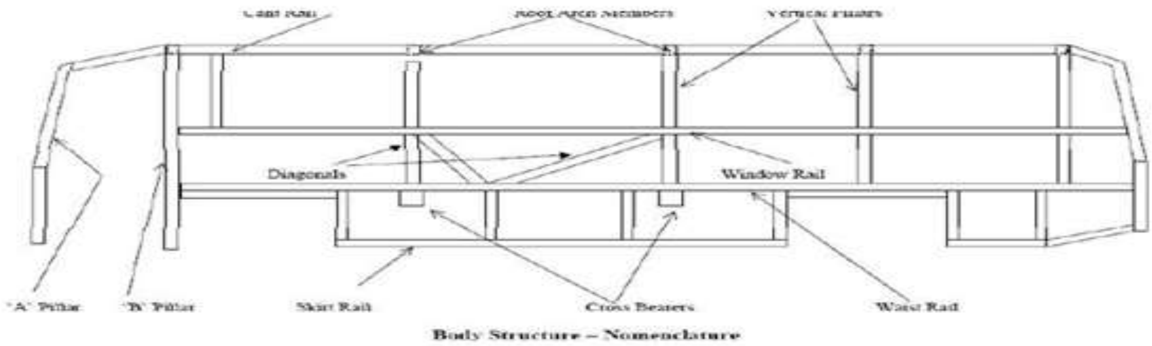


Fig.1 Bus Body structure

1.Entrance doorway skirt panel
2.Skirt panel the front of the front N/S wheel arch
3.Skirt panel rear of the front N/S wheel arch
4.N/S fundamental aspect panel Bay1.
5.Air clear out out get right of entry to cap.
6.N/S fundamental aspect panel Bay2.
7.Skirt panel.
8.Spare wheel get right of entry to flap.

9.N/S fundamental aspect panel Bay3.
10.Skirt panel the front of rear N/S wheel arch. 11.N/S fundamental aspect panel Bay4.
12.Rear skirt panel, N/S. 13.N/S fundamental aspect panel , Bay 5.
14.Pillar capping among Bay1 & front door. 15.Pillar capping fundamental 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 get right of entry to flap.
21.Valance panel.
22.Valance panel for air clear out out get right of entry to flap. 23.Front skirt panel O/S



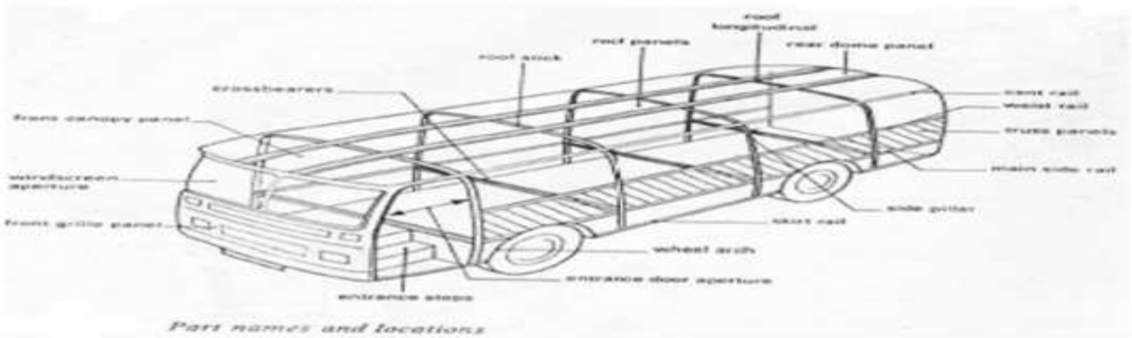


Fig.2parts and its location

III. RESULTS AND DISCUSSION

A. BREAK LOAD ANALYSIS

Table 1 Comparison of Total Deformation

Material	Time[s]	Minimum[mm]	Maximum[mm]
Structural Steel	1	0	3.3236
Aluminium Alloy 6061	1	0	3.2876
Carbon Steel	1	0	3.1654

Table 2 Comparison of Equivalent Elastic Strain

Material	Time[s]	Minimum[mm/mm]	Maximum[mm/mm]
Structural Steel	1	1.8954e-9	2.6866e-4
Aluminium Alloy 6061	1	2.0224e-9	2.6897e-4
Carbon steel	1	1.8051e-9	2.5587e-4

Table 3 Comparison of Equivalent Stress

Material	Time[s]	Minimum [Mpa]	Maximum [Mpa]
Structural Steel	1	2.972e-4	53.63
Aluminium Alloy 6061	1	1.1457e-4	19.059
Carbon Steel	1	2.972e-4	53.63

B. VELOCITY LOAD ANALYSIS

Table 4 Comparison of Total Deformation

Material	Time[s]	Minimum[mm]	Maximum[mm]
Structural Steel	1	99.444	104.22
Aluminium Alloy 6061	1	99.558	104.15
Carbon Steel	1	99.89	104.42

Table 5 Comparison of Equivalent Elastic Strain

Material	Time[s]	Minimum[mm/mm]	Maximum[mm/mm]
Structural Steel	1	1.3285e-7	3.6022e-4
Aluminium Alloy 6061	1	9.067e-8	3.6119e-4
Carbon Steel	1	4.04e-7	3.4575e-4

Table 6 Comparison of Equivalent Stress

Material	Time[s]	Minimum [Mpa]	Maximum [Mpa]
Structural Steel	1	17.397e-3	71.917
Aluminium Alloy 6061	1	4.8692e-3	25.598
Carbon Steel	1	27.385e-3	56.299

C. IMPACT LOAD TEST

Table 7 Comparison of Total Deformation

Material	Time[s]	Minimum[mm]	Maximum[mm]
Structural Steel	1	0	3.8854
Aluminium Alloy 6061	1	0	3.8541
Carbon Steel	1	0	3.7004

Table 8 Comparison of Equivalent Elastic Strain

Material	Time[s]	Minimum[mm/mm]	Maximum[mm/mm]
Structural Steel	1	9.778e-9	2.9243e-4
Aluminium Alloy 6061	1	9.8986e-9	2.936e-4
Carbon Steel	1	9.3118e-9	2.785e-4

Table 9 Comparison of Equivalent Stress

Material	Time[s]	Minimum [Mpa]	Maximum [Mpa]
Structural Steel	1	1.7158e-3	58.374
Aluminium Alloy 6061	1	6.1755e-4	20.804
Carbon Steel	1	1.7157e-3	58.374

3.1 Break Load Analysis

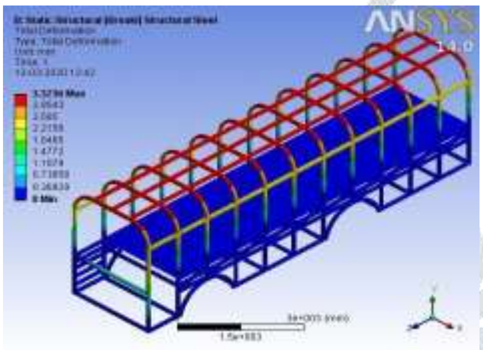


Fig3 Total Deformation

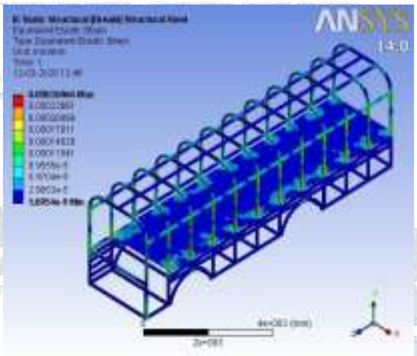


Fig 4 Equivalent Elastic Strain

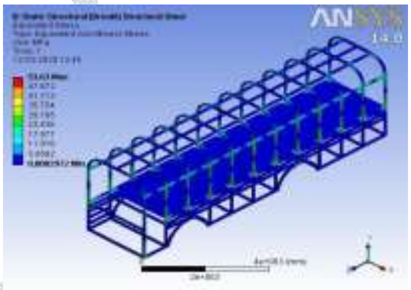


Fig 5 Equivalent Stress

3.2 VELOCITY LOAD ANALYSIS

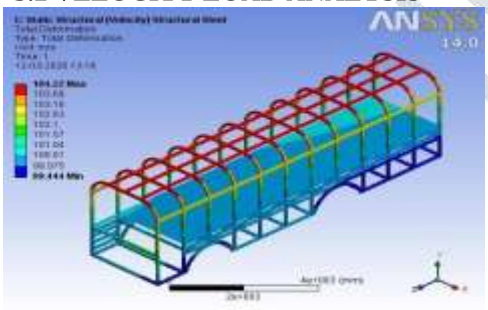


Fig 6 Total Deformation

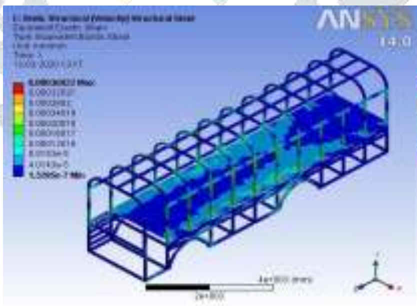


Fig 7 Equivalent Elastic Strain

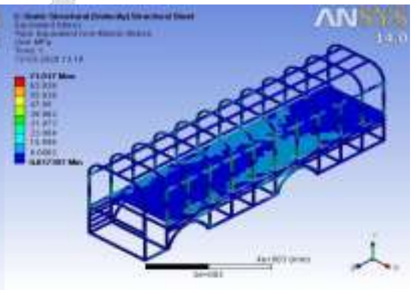
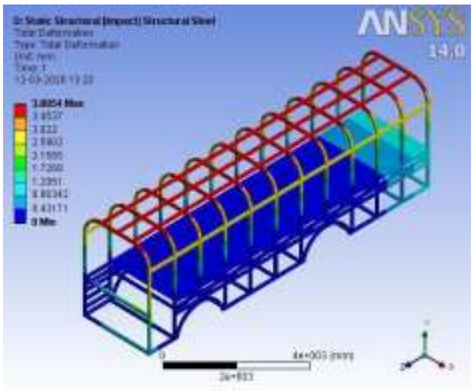
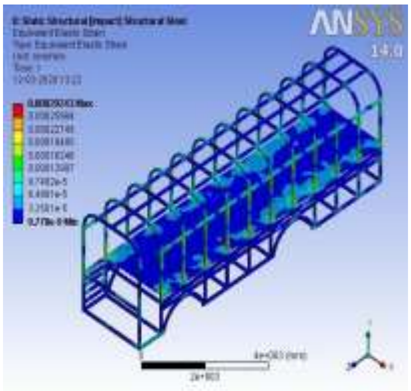


Fig 8 Equivalent Stress

3.3 IMPACT LOAD ANALYSIS





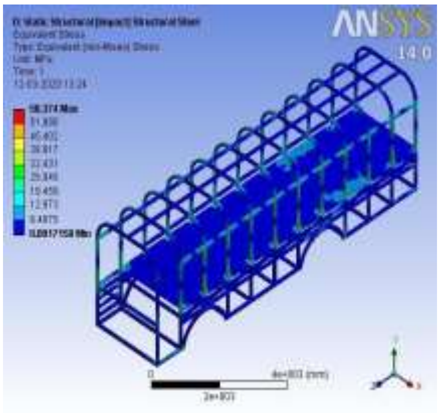


Fig 9 Total Deformation Fig 10 Equivalent Elastic Strain Fig 11 Equivalent Stress

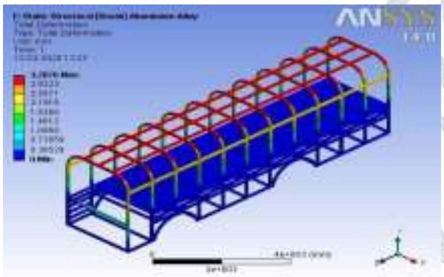
3.4 ANALYSIS WITH PROPOSED MATERIALS

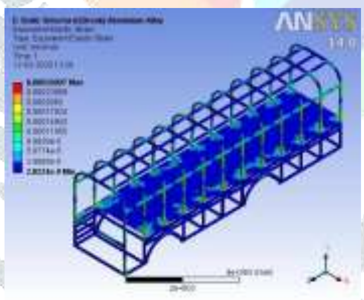
3.4.1 ALUMINIUM ALLOY

Table 10The material properties of the Aluminium Alloy

DENSITY	2770 Kg/m^3
YOUNG"S MODULUS	7.1 x 10^{10} Pa
POISSON"S RATIO	0.33
TENSILE YIELD STRENGTH	2.8 x 10^8 Pa
TENSILE ULTIMATE STRENGTH	3.1 x 10^8 Pa

3.4.1.1 BREAK LOAD ANALYSIS





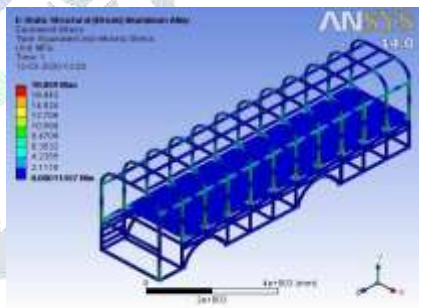
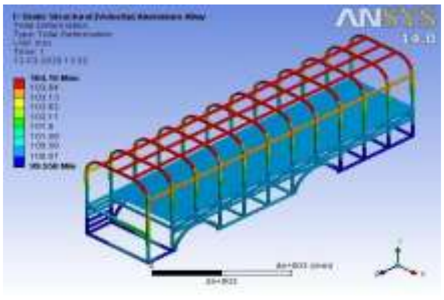
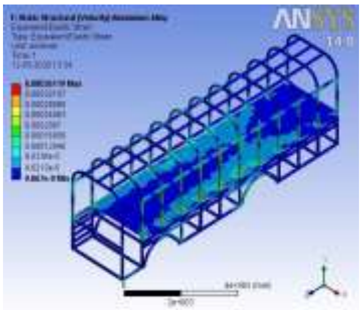


Fig 12 Total Deformation Fig 13 Equivalent Elastic Strain Fig 14 Equivalent Stress

3.4.1.2 VELOVITY LOAD ANALYSIS





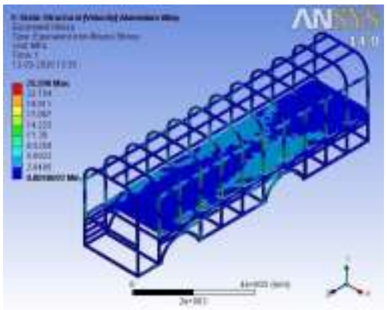


Fig 15 Total Deformation Fig 16 Equivalent Elastic Strain Fig 17 Equivalent Stress

3.4.1.3 IMPACT LOAD ANALYSIS

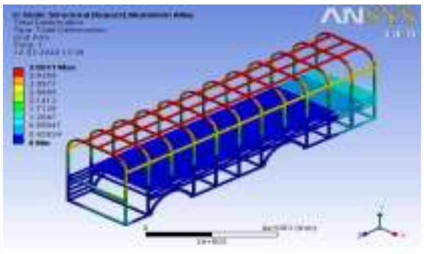


Fig 18 Total Deformation

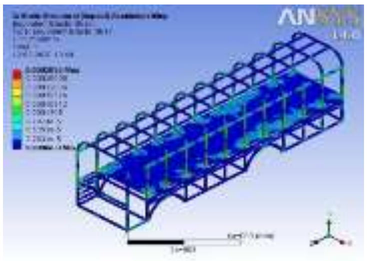


Fig 19Equivalent Elastic Strain

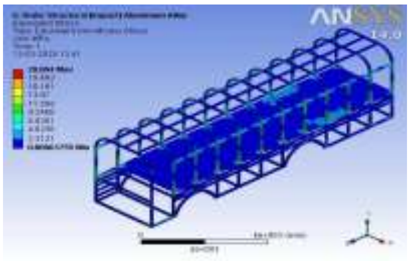


Fig20 Equivalent Stress

3.4.2 CARBON STEEL (AISI 1018)

Table 11 The material properties of Carbon Steel (AISI 1018),

DENSITY	7850 Kg/m^3
YOUNG‟S MODULUS	2.1 x 10^{11} Pa
POISSON‟S RATIO	0.3
TENSILE YIELD STRENGTH	2.15 x 10^8 Pa
TENSILE ULTIMATE STRENGTH	5.05 x 10^8 Pa

3.4.2.1 BREAK LOAD ANALYSIS

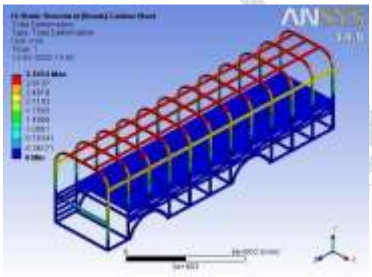


Fig 21Total Deformation

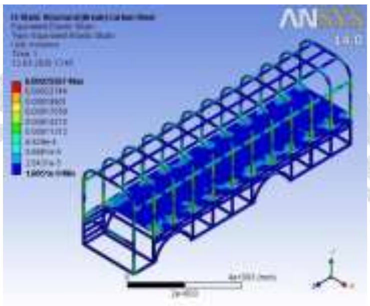


Fig 22 Equivalent Elastic Strain

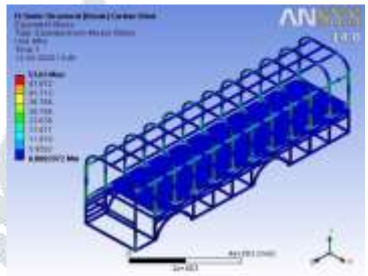


Fig 23 Equivalent Stress

3.4.2.2 **VELOVITY LOAD ANALYSIS**

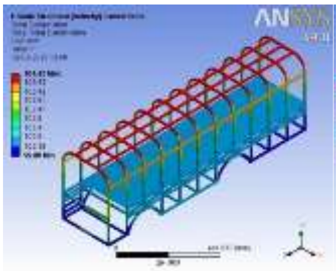


Fig 24 Total Deformation

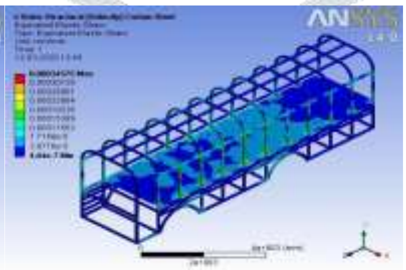


Fig 25 Equivalent Elastic Strain

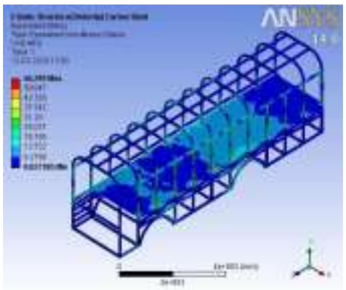


Fig 26 Equivalent Stress

3.4.2.3 IMPACT LOAD ANALYSIS

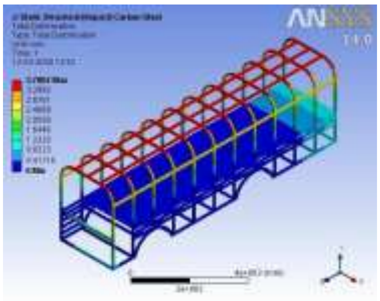


Fig 27 Total Deformation

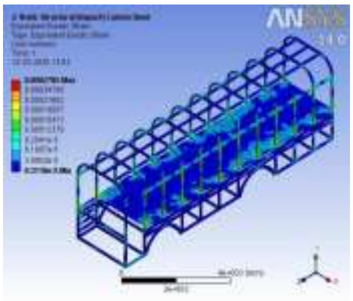


Fig 28 Equivalent Elastic Strain

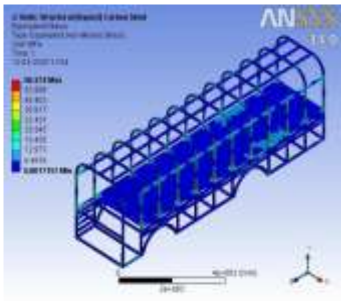


Fig 29 Equivalent Stress

IV. CONCLUSION:

The break load analysis, the impact load analysis and the velocity load analysis has been done for the existing and the proposed materials and the results are tabulated. According to the result, we conclude that the material Carbon Steel (AISI 1018) has the capacity and it gives minimum deformation when subjected to break load and impact load analysis, which increases the factor of safety of the bus model. The another advantage of Carbon Steel (AISI 1018) is low cost compared to Aluminium Alloy and Structural Steel, it is better to opt for Carbon Steel (AISI 1018) due to its load withstanding capacity and its factor of safety.

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