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Design and Analysis of Bus Body Right Side Frame

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ABSTRACT

Conventional designs of bus bodies have more weight and which will affect the carrying capacity, performance and resulting higher fuel consumption. This project describes a new approach and specific design procedure for more lightweight bus body design. The purpose of this project is to redesign the parameters like gauges, materials, geometry/shapes, topology variables, weld pitch, joints for improving the structure so that the total weight of the bus is reduced. A light weight design of bus body structure is designed and structural analysis of the body structure under different load conditions is done. The modeling will be done on solidworks 2014 and analysis part will be done on ANSYS 14.

Keywords— Carrying Capacity, Light Weight, Structure, Topology Variables.

1. INTRODUCTION

The bus body structure must be balanced in directive to obtain the protection when the bus is running, body must be suitably strong in both the condition of associate normal loads and accident loads. 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 left and the right side are related but the left side is normally composed of passenger doors. On the other side, 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. The cross section that is commonly used in making the bus body frames is tubular sections (square and rectangular). The C-channel sections are also for providing strength and stiffness. Among the materials used for the frames GI tubular and structural steels are commonly used. Since the stiffness is the main criterion for minimizing deflection and improving strength, studies are conducted on the properties of materials. It is found that the young’s modulus, which is a measure of stiffness, is high for structural steel. Also the load bearing capacity is higher for structural steel. Hence structural steel is selected as the material for analysis. The behavior of the structure under different load conditions like static, cornering etc. are also analyzed. The scope of this project is to provide a light weight design which will reduce the weight as well as improve the stability under all the driving conditions. The shear stress acting on the frames is also evaluated.

2. DESIGN AND ANALYSIS

2.1. Design parameters

The design parameters were selected from reference papers and from Original Equipment Manufacturing. The design modifications are done by reducing number of elements and thickness without compromising the structural strength. The dimensions are made according to the bus body regulations by automotive industry standards AIS052. The existing frame section is tubular section with number of supporting members. Here two models, one with less number of supporting elements are compared with existing model. This reducing the materials used and there by reduces the weight also. The length, width, track and wheel base are kept constant and only the frame elements and their dimensions are modified. Also at the point where more shear force and bending moments are acting stiffeners are provided. More iteration must be done for finding which all elements have to be redesigned or avoided. Edge fillets are provided to avoid stress concentration. The simple structural surface method is used to check the continuity of load path. This method is used while modifying the design.

2.2. Modeling using solidworks

The three dimensional model is modeled using Solidworks. The two different models were modeled. The model 1 having a number of supporting members and model 2 with less number of supports. The dimensions obtained from the design analysis are used to model the sections. During Design and Analysis of a Bus Body Side Frame modeling the structure, weight reduction is the prime objective. Redundant structures are identified and avoided. These helps in reducing the weight and offers better load path continuity. It also helps to reduce the volume of material used in making the bus body. This makes the frame more economical. The same tubular sections are used for both designs.

Table 1 Design Parameters

S.N	PARAMETERS	DIMENSIONS (mm)
1.	Length	11500
2.	Height	2890
3.	Wheel Base	5840
4.	Tubular sections-size	40*40 and 60*40

Table 2 Different loads acting on the right side frame in the analysis

S.N	LOAD	WEIGHT (N)
1.	40% of weight on Rear frame	120
2.	40% of weight on Front frame	50
3.	40% of weight on Top frame	130
4.	Cornering load	12000
5.	Luggage	250

2.3 Analysis Using ANSYS

The analysis of the modeled structure is carried out by using ANSYS 14.0 software. Before going into the analysis the ideal mesh size that will provide the correct mesh size is found out by the method of mesh convergence. For doing mesh convergence, the structure is selected and the size of the element is varied from course to fine and the deflections formed are detected. It is found that optimum result is obtained when the element size is 7mm. The meshing adopted for analysis is quadrilateral meshing and element selected is solid 85. Since the quadrilateral meshing have lower skewers and it improves mesh quality and convergence. It has 114956 nodes and 55656 elements. The analysis is carried out by giving the different loads acting on the right side frame. The weight of front, top and rear frames are shared by side frames and bottom frames from which chassis takes the loading. So the portions of load due to frame weights are given as homogeneously distributed load. The luggage weight is given on the particular frame member as uniformly distributed load. In addition to these loads, a cornering load is given during the analysis while cornering. Both the Von-Mises stress and shear stress are calculated and compared.

3. RESULTS AND DISCUSSION

3.1 Static Analysis

From the analysis, it is clear that for the equal loading condition, the model 2 design with less number of elements are have less stress developed. The shear stress is also lower for model 2 design. From the above figure 1 and 2, it is clear that in both the cases the maximum stress is developed at the linkages above the wheel arches. The minimum stress is developed at mid points of the middle frame members.

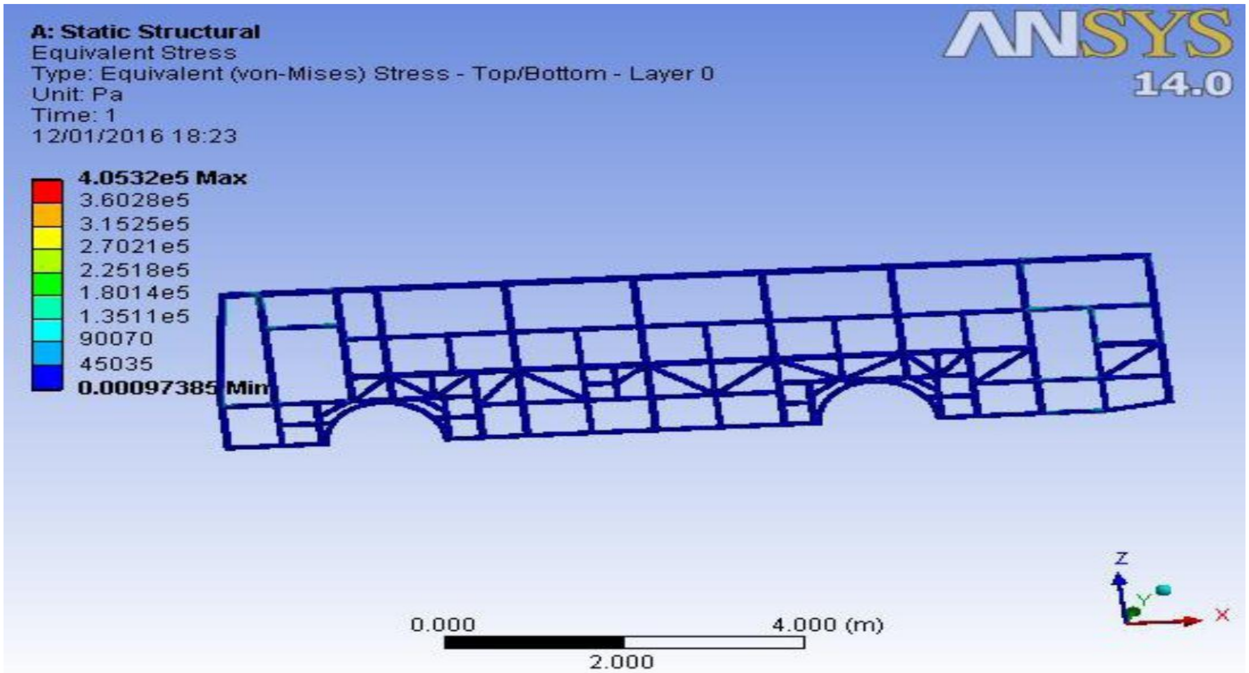

Fig. 1 Equivalent stress developed for model 1

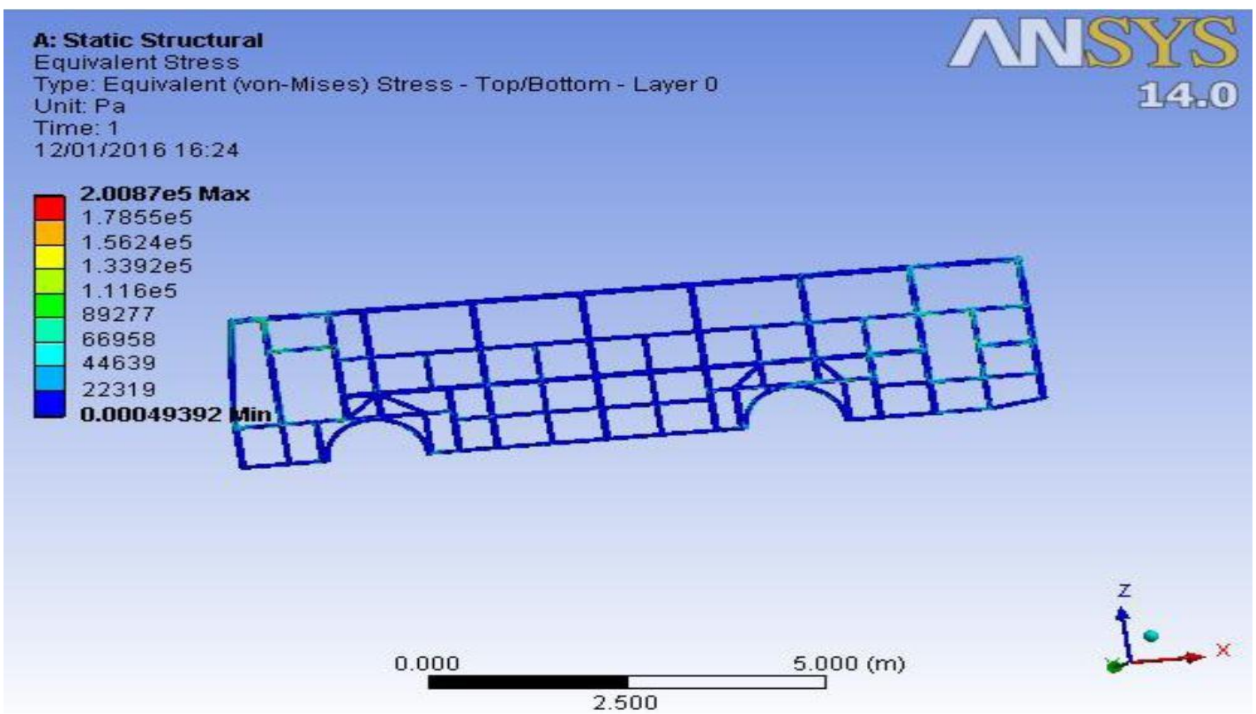

Fig. 2 Equivalent stress developed for model 2

3.2. Cornering

In case of cornering, the main part of cornering load is substitute on the side frames. When the vehicle turns a left turn most of the weight shifts to the right side in lateral direction. Hence a portion of load is applied on to the right side frame and Von-Mises stresses are evaluated.

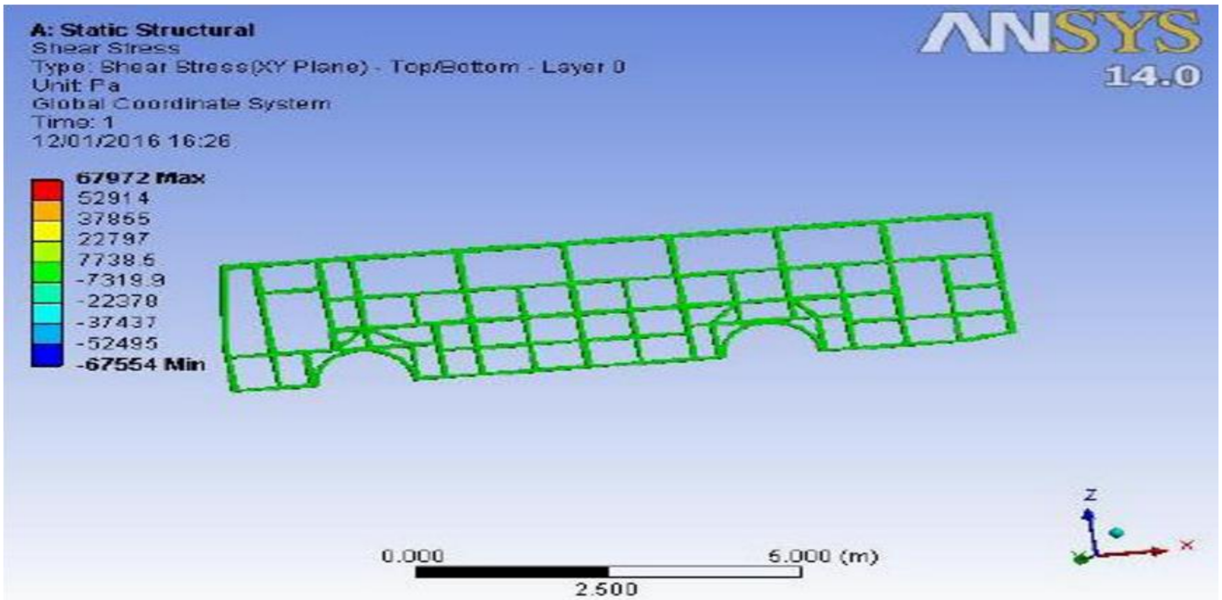

Fig. 3 Shear stress developed for model 1

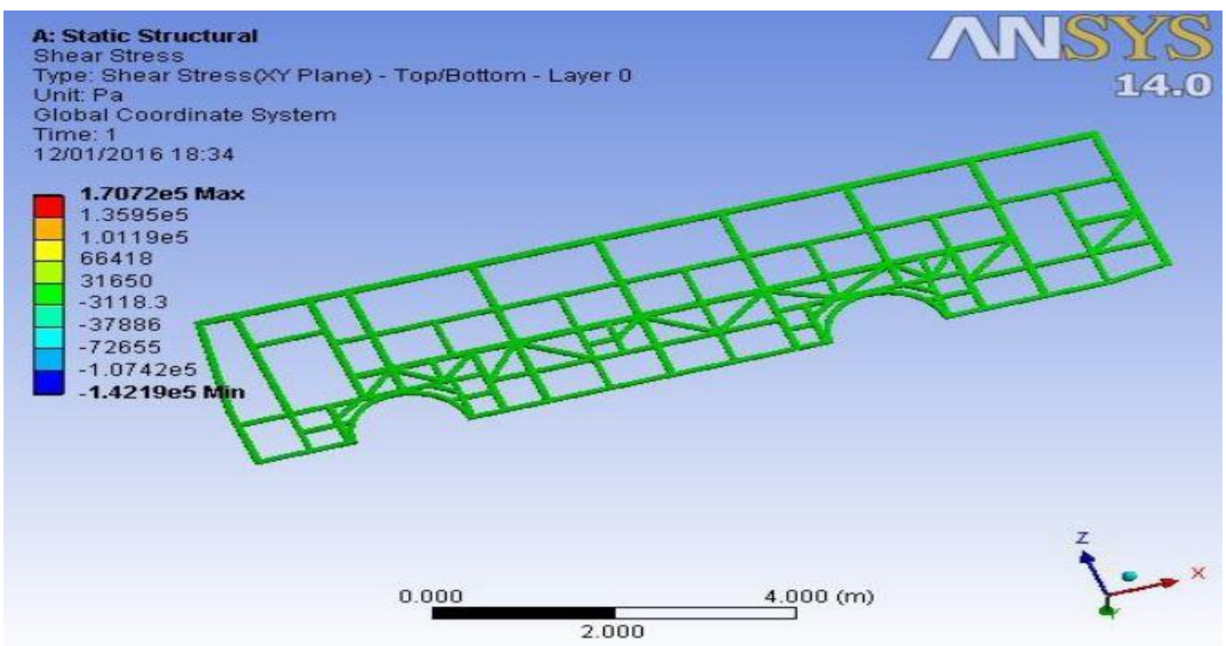

Fig. 4 Shear stress developed for model 2

4. CONCLUSIONS

The conventional bus body is modeled and the factors affecting the weight of the bus bodies were studied. The light weight approach for a bus body influences the manufacturing cost, vehicle handling and stability as well as the overall performance. The two methods adopted for the light weight design are by reducing the number of frames elements and supporting frames elements and secondly the topology (thickness, gauges etc.) optimization. The analysis part is done on two different model 1 and model 2 (with less supporting elements) develops less stress in both static structural analysis and in case of cornering condition.

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