Chapter 6

Investigation Study of Bus Body Structure Analysis

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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 work 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 modeling is completed with the help of CATIA V5, single component is created in part workbench in CATIAV5, and this part is then converted to IGS file. Finite element modelling is completed in ANSYS 14.0. WORKBENCH using the IGS file as geometry, the element type used for meshing was 2D shell elements with QUAD4.

Keywords: CATIA, FEM, ANSYS, road transportation, chassis.

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1. 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 [1]. 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.

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. For example the

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special type of welding such as MIG, TIG, and spot welding arc much better than the normal arc welding process. However, such manufacturing process is not concerned in this study [2-3]. The third part, the top frame or the roof frame is considered as the critical part that is needed to be a strength part in order to be ensured safety for the passengers. 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 [4].

2. Materials Used

2.1 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. The material with these characteristics, Steel is the first choice [5]. 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.

2.2 Carbon fiber

Carbon fibers or carbon fibers (alternatively CF, graphite fiber or graphite fiber) are fibers about 5 to 10 micrometers (0.00020–0.00039 in) in diameter and composed mostly of carbon atoms. Carbon fibers have several advantages including high stiffness, high tensile strength, low weight, high chemical resistance, high temperature tolerance and low thermal expansion [6]. These properties have made carbon fiber very popular in aerospace, civil engineering, military, and motorsports, along with other competition sports.

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However, they are relatively expensive when compared with similar fibers, such as glass fibers or plastic fibers.

2.3 Kevlar

Kevlar is simply a super-strong plastic. The 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 [7-8]. 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.

3. Design of Bus Body Structure

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.

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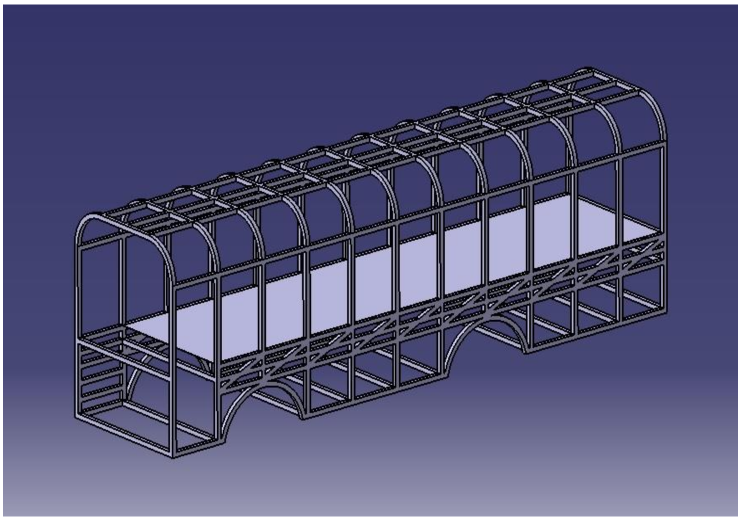

Figure. 1: Assembled view

4. Analysis of Bus Body Structure

In this work the static structural and modal analysis has been done on the bus body structure. The boundary condition for the static structural analysis is loads are applied at the tip of the tooth and all DOF condition at the top.

4.1 Loading calculation

Loading calculation for acceleration,

1 km/hr = 277.77 m/s^2

For 60 km/hr = 60 x 277.77=16666.7 mm/s^2

Remote displacement as 60 mm in Z-axis

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4.2 Analysis of Bus Body Structure

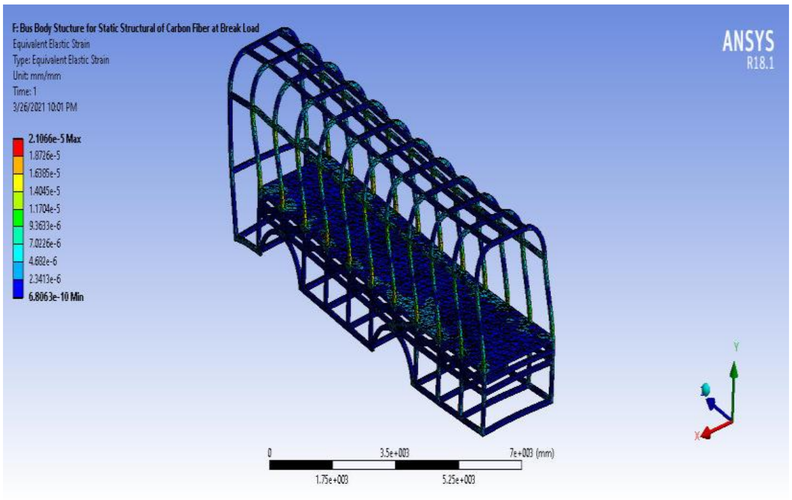

Figure. 2: Equivalent Stress at break Load

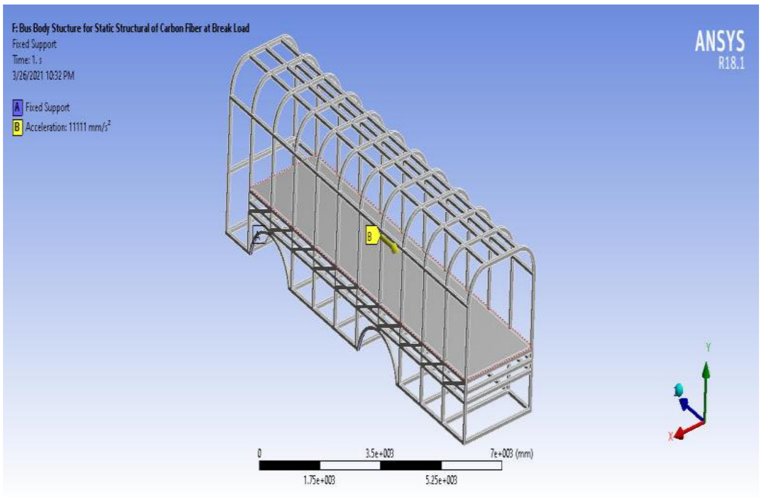

Figure. 3: Total Deformation at break Load

5. Conclusion

The design and analysis of the bus body structure presented in this project has demonstrated significant advancements in ensuring both functionality and safety. The meticulously planned design not only met the project's specific requirements but also incorporated innovative features that enhance passenger comfort and overall performance. The structural analysis results

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highlighted the structure's robustness, with even stress distribution and adequate load-bearing capacity, ensuring passenger safety and structural integrity. Complying with rigorous safety standards and regulations has been a cornerstone of this project, guaranteeing that the bus body structure not only meets but exceeds industry safety requirements. This research sets the stage for the development of safer, more efficient, and environmentally friendly bus body structures that can potentially revolutionize the public transportation sector.

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