

Roll Cage Analysis and Fabrication (All-Terrain Vehicle)

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Abstract— The paper over here deals with analysis and fabrication of a roll cage. The roll cage is just a skeleton of an automobile. It also plays a very important role as a protestant for the driver and the vehicle. Here, analysis and fabrication of a roll cage has been done with respect of various loading tests conducted like front, torsion and rear. The main focus has been done on the roll cage for improving the performance of vehicle without any failure with the help of analysis and Rulebook of SAE-BAJA 2015.

Key words: Roll cage, front analysis, rear analysis, torsional analysis, fabrication

I. INTRODUCTION

The roll cage (frame) is supporting component of automobile vehicle. It is the foundation for carrying the engine, transmission system and steering by means of spring, axles, rubber pads etc. The frame are made of box, tubular channels or U-shaped section, welded or riveted together. A roll cage is a safety feature installed in a vehicle used in environments where there is a high danger of rolling, such as race car driving as well as military and police use. Some cars are specifically designed with this feature installed, while others have had this device installed during a retrofit. The points which were considered while designing the roll cage were safety, ergonomics, market availability, cost of the components and standardization.

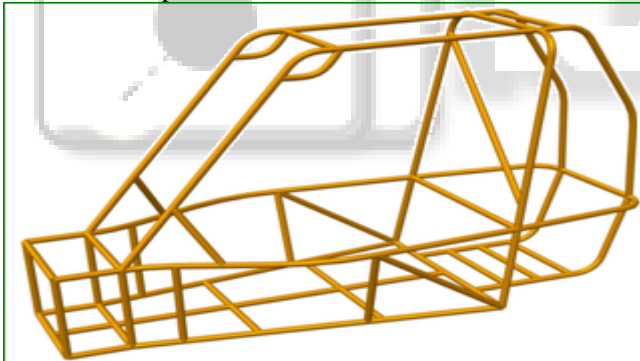


Fig. 1: Roll Cage Model

II. METHODOLOGY

A. Analysis and Fabrication:

Analysis and fabrication of the roll cage includes many factors like material selection, cross section and frame design. Material selection is one of the important factors while designing the roll cage as it ensures safety, reliability and performance.

B. Material Selection:

The frame of the roll cage will be built by using a bent tube construction using pipe bending machine and welded joints. The material used for the frame of the roll cage is structural mild steel. Structural mild steel is chosen as it gives high strength, high toughness, high stiffness, etc.

C. Roll Cage Function:

The main function of the roll cage frame is to provide the mechanical support to different parts of vehicle like engine, tires, suspension systems etc. It provides dynamic stability, strength, strength against vertical bending, safety of driver against accidents and also acts as a vibration harness agent.

D. Roll Cage Analysis:

The whole analysis of the design is done by using ANSYS R15.0. By using this software we sorted out various failures with respect to the deformation of the roll cage model. The analysis of the roll cage is done according to the selected parameters such as front analysis, rear analysis and torsion analysis. Following are the results of various analysis performed while keeping in mind the resultant of failures.

III. ANALYSIS REPORT

The analysis report shown below satisfies each and every parameter followed while fabricating the roll cage.

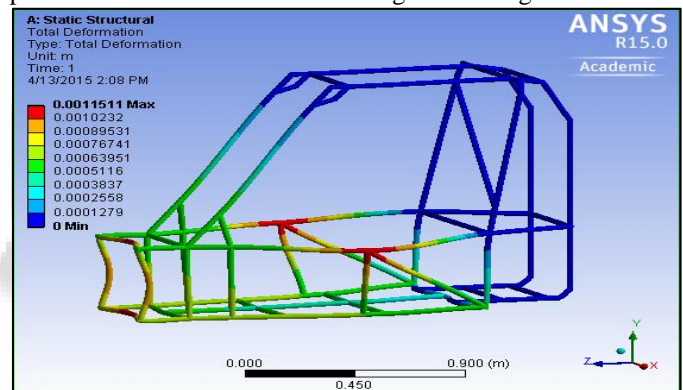


Fig. 2: Deformation of Front Analysis

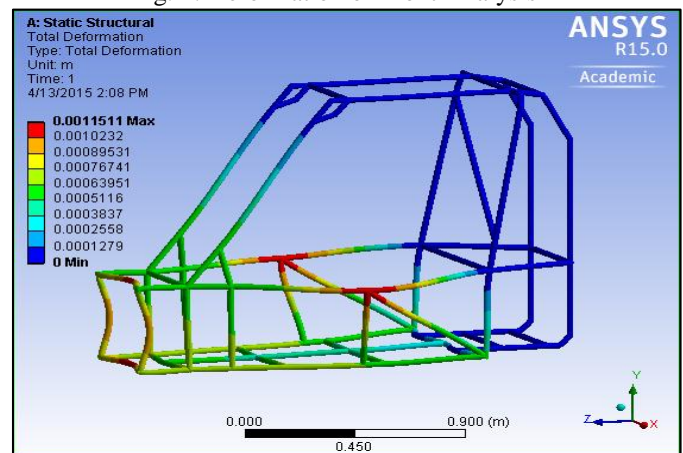


Fig. 3: Deformation of Rear Analysis

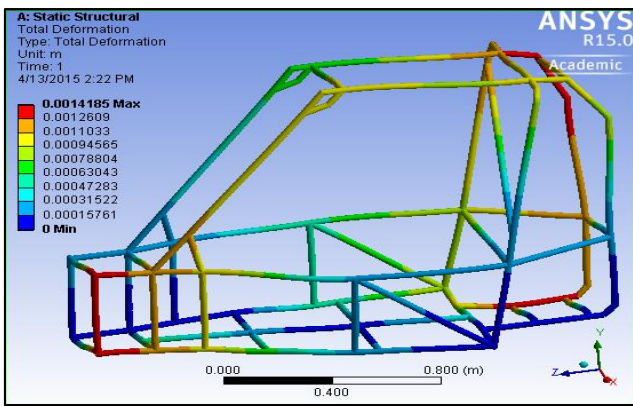


Fig. 4: Deformation of Torsion Analysis

From the above analysis report it has been concluded that deformation takes place at different parts of the roll cage. The deformations here in the analysis are categorized as:

- Blue colour indicates the starting stage of deformation.
- Green and yellow colour indicates the medium stages of deformation.
- Red colour finally results into the total deformation.

Out of all these stages mentioned in the analysis as categorized in colours the red colour portions indicates the total failure resultant of the component.

IV. Analysis result of impact tests

TYPES OF IMPACT TEST	FORCE (KN)	VON-MISES STRESS (Pa)	MAX. DEFOR - MATION (m)	NO. OF NODES	F.O. S
Front	12	1.9145×10^8	1.1511	4	2.44
Rear	12	2.1698×10^8	3.3685	4	2.86
Torsion	6	1.4875×10^8	1.4118	2	3.53

V. FABRICATION

1) Tube Sizes:

- Outer Diameter: 25.4 mm (1.00")
- Wall Thickness: 2 mm (0.078")
- Welding Process: Metal Arc Welding
- Joints: Crossed Butt Joint



Fig. 5: Fabrication of Roll Cage Structure

VI. CONCLUSION

Finally after having lots of study, efforts and observations we came to the conclusion that this paper results into light weight compared to other roll cages, reduced space requirements, reduction in material wastage, reduction in cost, multiple usage, easy for implementation, survival in un-ground surfaces and gives safety to the driver for smooth driving.

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