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Study of Effect of Different Parameters on the Chassis Space Frame Of Go Kart (Race Car) Vehicle by Using Fea

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Abstract – The concept of Finite Element Analysis of a go-kart chassis space frame has been highlighted in this project. The topic has constrained the study of the chassis space frame. The project was aim to design a go-kart (race car) chassis by the use of catia V5 R20, and perform the static analysis of a go kart chassis consisting of Circular beams by the use of Ansys R15. This project is aimed to develop design of a chassis, and test the different materials at different load, for finding a best material for chassis space frame. Various loading tests like Front Impact, Side Impact, test etc. have been conducted on the chassis, Design of the Go-kart focuses on developing a simple and easily operated vehicle. Aspects of ergonomics, safety, ease of manufacture, and reliability. The chosen project is based on the design and analysis of the chassis of a low ground clearance Go-kart.

Index Terms – Ergonomics, FEA, Go Kart (Race Car) Chassis, Ansys.

1. INTRODUCTION

Chassis frames can also be considered as the structures**.** A carefully weighed arrangement of material that is intended to resist loads is called as structures. Automotive chassis space frame is a skeleton material on which most of the mechanical parts that includes the tires, brakes, and engines are bolted etc. The space frames are basically manufactured with steel or aluminum. The increasing use of aluminum for manufacturing the space frames in present world is what can be observed.

1.2 Different types of chassis frame**:**

. Ladder chassis

. Back bone chassis

. Monocoque chassis

1.2.1 LADDER CHASSIS**:**

This is the earliest kind of chassis. It looks like a ladder, so for that sake it is called a ladder chassis. The construction of this chassis is two longitudinal rail interconnected by many lateral braces. The rigidity to the structure is provided by the cross members and lateral. Most SUV's are still built up on them, though these types of space frames are not much used in the present day.

1.2.2 BACKBONE CHASSIS:

It is simple in structure with a study tubular backbone which joins the front and rear axle and is responsible for most of the mechanical strength of the frame work. At the end of the chassis, the suspension and the drive train are connected. From inside, it resembles the drive shaft tunnel or more conventional front engine vehicles, but the difference is that it was closed in the bottom surface to provide a true tubular section. Still when the torsional stiffness of a chassis is derived from one large central tube running the length of the car, the resistance to twist depends mostly on the cross sectional area of that tube, and it is clearly possible from that cross section to be much larger than that of a typical drive shaft tunnel.

1.2.3 MONOCOQUE CHASSIS:

This type of chassis is used by most of the modern vehicles, as it is a single piece frame work which gives the perfect shape to the car. It is very much different from the ladder and the back bone type chassis when several pieces are welded together, a one-piece chassis is built up. Unlike the above two types of chassis, it is incorporated with the body in a single piece, where as the former only supports the stress members.

1.3 (GO KART VEHICLE):

A Go Cart also spelled as Go Kart is a four wheeled vehicle designed and meant for racing only (though in some countries it is used for fun personal transportation). It is a small four wheeler run by I.C Engine. It is a miniature of a racing car. Go Cart is not a factory made product; it can be made by Automobile engineers. This report documents the process and methodology to produce a low cost go-kart. Simple but innovative, „Go Cart", The chassis are made of steel tube. There is no suspension therefore chassis have to be flexible enough to work as a suspension and stiff enough not to break or give way on a turn.

2. FINITE ELEMENT ANALYSIS (FEM)

Finite element is a method for the approximate solution of partial differential equations that model physical problems such as: Solution of elasticity problems, Determine displacement, stress and strain fields. After finalizing the frame along with its material and cross section, it is very essential to test the rigidity and strength of the frame under severe conditions. The frame should be able to withstand the impact, torsion, roll over conditions and provide utmost safety to the driver without undergoing much deformation. The solution of a general continuum by the finite element method always follows an orderly step by step process. Finite Element Analysis is a powerful tool or technique for analyzing problems over complicated domains (like Automobile, Aerospace, and Pipeline etc.). In mathematics, the finite element method (FEM) is a numerical technique for finding approximate solutions to boundary value problems for partial differential equations. It uses subdivision of a whole problem into smaller parts called finite element.

- History Of Fem/Fea
- Theoretical Measurement Of Stress
- Tensile Or Compressive Stress- Normal Stress

2.1. History of Fem/Fea.

While it is too difficult to quote a date of the invention of the finite element method, the Method originated from the need to solve complex elasticity and structural analysis Problems in civil and aeronautical engineering. It china, in the later 1950s and early 1960s, based on the computation of dam construction, K.Feng proposed a systematic numerical method for solving partial differential equations. The method was called the Finite difference method based on variation principle which was another independent invention of finite element method.

The finite element method obtained its real impetus in the 1960s and 1970s by the development of J.H. Argyris. A rigorous mathematical basis to the finite Element method was provided in 1973 with the publication by Strang and Fix. A variety of specialization under the umbrella of the mechanical engineering discipline (such as Aeronautical, biomechanical, and automotive industries) commonly use integrated FEM in design and development of their products. In structural simulation, FEM helps tremendously in producing stiffness and strength visualizations and also in minimizing weight, material, and cost.

FEM allows detailed visualization of where structures bend or twist, and indicates the distribution of stresses and displacements. FEM software provides a wide range of simulation options for controlling the complexity of both modelling and analysis of system. FEM allows entire designs to be constructed, refined, and optimized before the design is manufactured. [3].

2.2. Theoretical measurement of stress

Stress is “force per unit area” – the ratio of applied force F and cross section A. Engineering stress is categories as:

(1) Tensile stress- stress that tends to stretch or lengthen the material acts normal to the stressed area.

(2) Compressive stress- stresses that tent to compress or shorten the material acts normal to the stressed area.

(3) Shearing stress: stress that tends to shear the material acts in plane to the stressed area at right angles to compressive or tensile stress. . [4, 5].

2.3. Tensile or compressive stress-normal stress

It can be expressed as $\sigma = F_n / A$

Where=normal stress (Pa),F_n= normal component force(N),A=area(m^2)

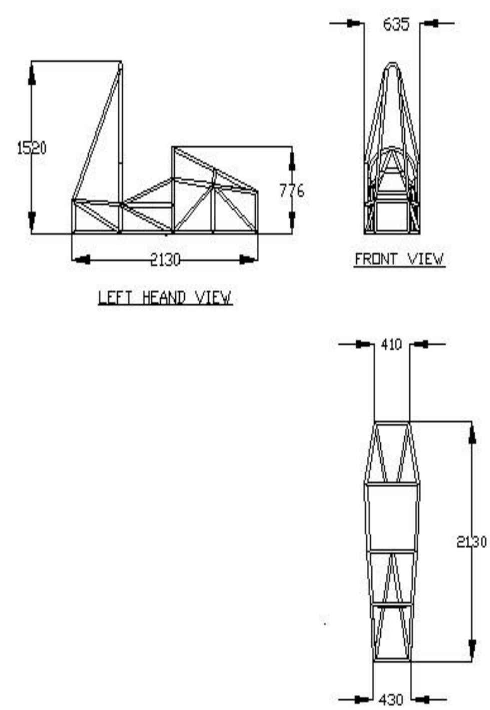
3. PORPOSED MODELLING

3.1 Parameters used for designing of chassis frame:

Outer diameter of hollow pipes = 25.4 mm

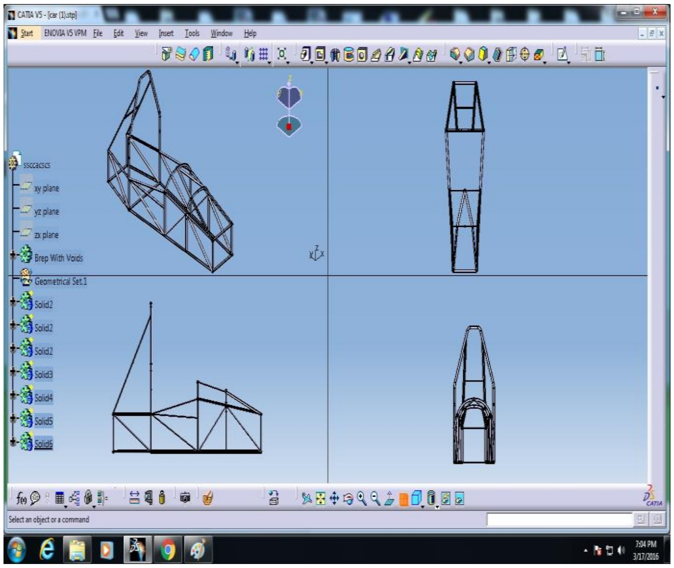
Inner diameter of hollow pipes = 21.7 mm

3.1.1 Dimension of pipes used for designing.



3.1 Dimension of the chassis space frame

3.2 Model designing by CATIA V5 R20



4. RESULTS AND DISCUSSIONS

4.1 Analysis of chassis frame for material – AISI 1018

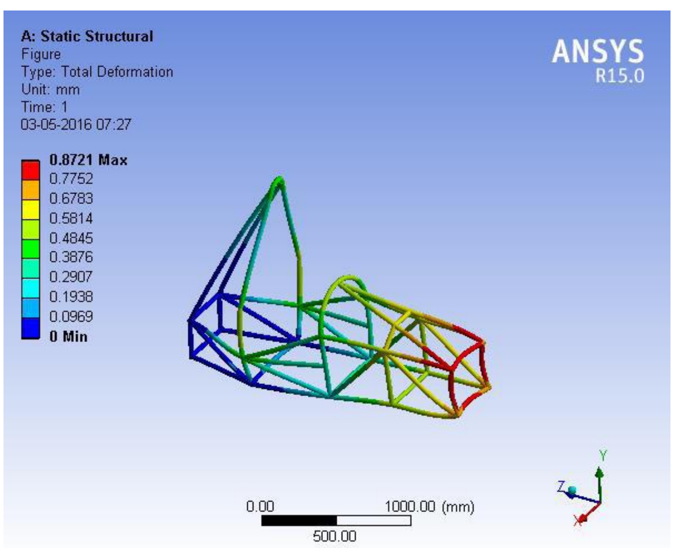
In this work front and side impact has been tested on the chassis frame. In both front and side impact total deformation.

Two loads have been considered for front impact testing – Load 1- 8500 N

Load 2- 14000N

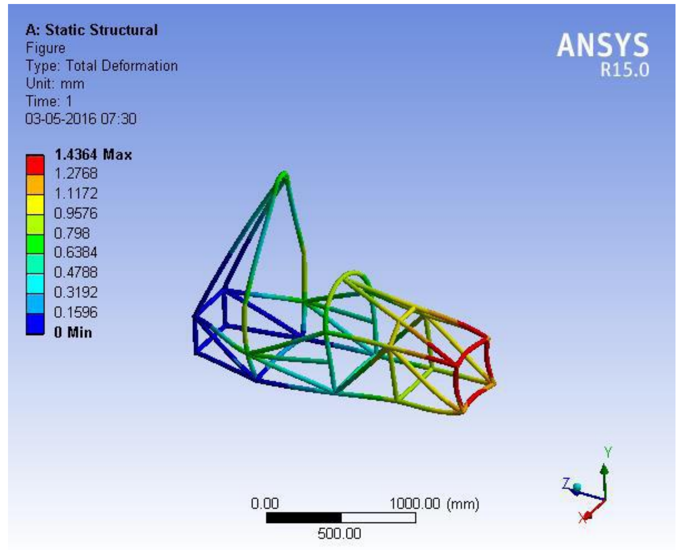
4.1.1 Front impact testing of chassis frame with load1- 8500N

4.1.2 Total deformation of chassis frame



4.2 Front impact testing of chassis frame with load2- 14000N

4.2.1 Total deformation of chassis frame

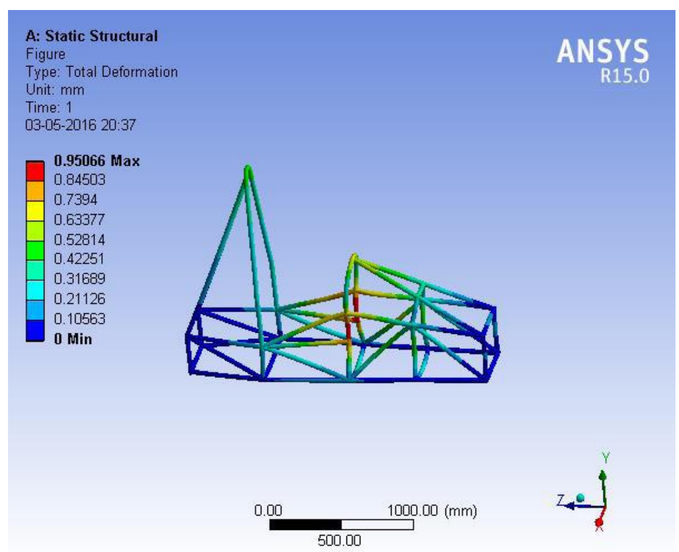


Total deformation calculated in the chassis frame is 1.4364 mm

4.3 Side impact testing of chassis frame with load- 8500N

Single load has been considered for side impact testing – Load - 8500 N

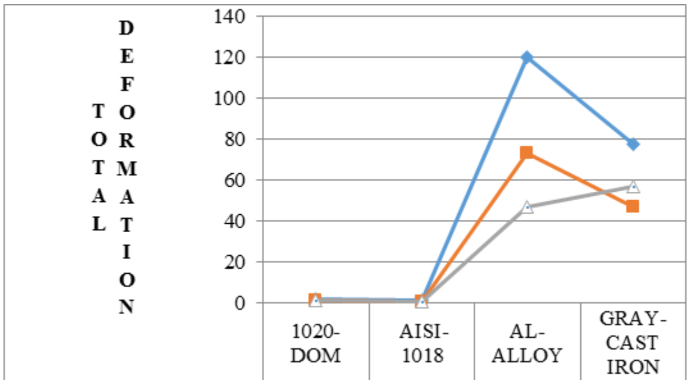
4.3.1 Total deformation of chassis frame



Total deformation calculated in the chassis frame is 0.95066 mm

5. Graph plotted for deformation of different materials in following condition:

Load 14000N, 8500N front impact and 8500N side impact



	1020-DOM	AISI-1018	AL-ALLOY	GRAY-CAST IRON
FRONT IMPACT 14000N	2.2448	1.4364	120.06	77.52
FRONT IMPACT 8500N	1.3311	0.8721	72.895	47.066
SIDE IMPACT 8500N	1.446	0.95066	46.978	57.237

5. CONCLUSION

The chassis design is tested for different materials and all the four materials which are tested in different loading conditions have given different results but from the above graph it can be seen that the material AISI 1018 shows great performance and gives comparatively better results in terms of deflection, stress and strain. So, the material AISI 1018 steel alloy is best among all the four materials for this tubular design of the chassis for a go-cart vehicle. The go-kart used in the design offers easy operation and maintenance. Multiple unique design features provide easy adjustability that gives the owner more control over the vehicle.

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