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A Review on Analysis of a Go-Kart Chassis

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***Abstract*: The aim of this paper is to perform various design analysis on a go-kart chassis to validate the safety of the kart. It also explores the use of various pipe materials other than variants of steel, like aluminum. Methods of joining steel and aluminum pipe is discussed since they can't be welded under normal conditions. Maximum deformation and stress concentration are found out through analysis. 3-D modelling and analysis software like SOLIDWORDS and ANSYS are used. Impact and static loads are applied according to the working conditions of the kart.**

***Keywords*: ANSYS, analysis, chassis, impact load, static load**

1. Introduction

Go-kart is a small four wheeled vehicle which is usually used for racing or recreational purposes. The ground clearance of a go-kart is very less and therefore it is ideal for racing conditions. The various components of a typical go-kart are engine, chassis, steering system, transmission, brakes and aerodynamical body panels. The engine can be two or a four-stroke engine. It can be a combustion engine or an electrical engine. Because of the low ground clearance, it usually doesn't need a suspension system. Although if it is required to have one, it can be installed near the front knuckles. Go-karts can also be used for training amateur drivers in racing since it can provide the driver with all the conditions of a F1 car at a much safer and comprehensible level. The framework of most go-karts is made from a pipe structure welded together. This framework is also called the chassis.

2. Objectives

- To design chassis for go-kart
- To validate material selected for the chassis
- To perform front and rear impact analysis on the chassis
- To perform static load analysis on the chassis

3. Chassis

Chassis is the most basic framework of a go-kart upon which various components of a go-kart are assembled. It is usually made of pipes welded together according to the required dimensions. The basic function of a chassis is to provide framework for the components and to absorb any impact load before it reaches the driver or the critical components without compromising the structural strength. A chassis should be strong but light in weight. We suggest the use of Steel as well as Aluminum pipes for constructing the framework. The recommended thickness is 1.6mm both for round and square pipes, as per preference. The aluminum pipes are used where the force acting on a member is comparatively less. This helps to reduce the overall weight of the frame without compromising structural integrity. A chassis should have good structural rigidity, torsional strength and high degree of flexibility.

4. Material Selection

The material selected for the steel round and box pipes is AISI 4130 and the material for aluminum round and box pipes is 6063-T6. T6 represent tempered aluminum.

[2] AISI or SAE 4130 grade is a low-alloy steel containing chromium and molybdenum as strengthening agents. The steel has good strength and toughness, weldability and machinability. AISI/SAE 4130 grade is a versatile alloy with good atmospheric corrosion resistance and reasonable strength. It shows good overall combinations of strength, toughness. and fatigue strength.

[3] Aluminum alloy 6063 is a medium strength alloy. It has a good surface finish, high corrosion resistance, is readily suited to welding and can be easily anodized. Most commonly available as T6 temper.

Table 1
Properties of AISI 4130 & Al 6063-T6

Property	AISI 4130	Aluminum 6063 T6
Density (kg/m^3)	7850	2700
Poisson's ratio	0.3	0.33
Elastic modulus (GPa)	210	68.9
Ultimate tensile strength (MPa)	560	241
Yield strength (MPa)	460	214
Hardness Brinell	217	73
Thermal conductivity (W/mK)	42.7	200

Aluminum box pipes are used as shown in fig 1. The forces acting on these members is comparatively less and therefore the use of aluminum is justified.

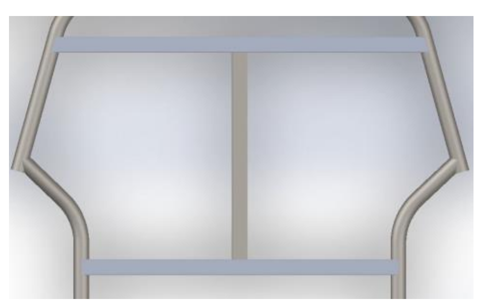

Fig. 1. Aluminum Box pipes

Aluminum round pipe is used for the front bumper. Bumper is a structural member attached in the front and rear of the chassis to absorb impact in collisions. In case of impact collision, the bumper should be able to absorb the maximum impact and transmit minimum to the consecutive members. In case of steel, due to its high rigidity and tensile strength, maximum force will be transmitted which can affect the driver or other components.

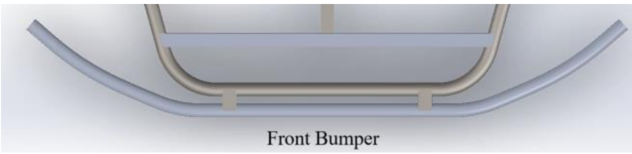

Fig. 2. Aluminum front bumper

5. Steel Aluminum Sleeve

We have used both aluminum and steel pipes in the framework but steel and aluminum cannot be welded under normal circumstances. A sleeve is introduced to connect the aluminum and steel pipes. In this case, there are two types of sleeves-

- Inner sleeve – A hollow box stepped pipe whose material is the same steel used for chassis pipe. It is welded on one side to the frame and the aluminum pipe is press fitted from the other side. The step facilitates in obstructing the aluminum pipe on one side.

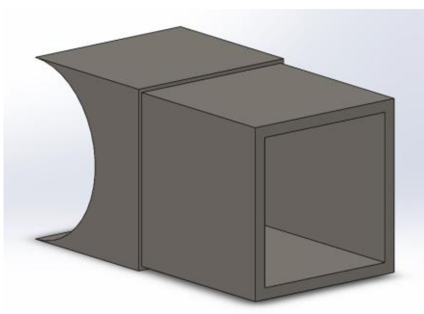
Fig. 3. Inner Sleeve

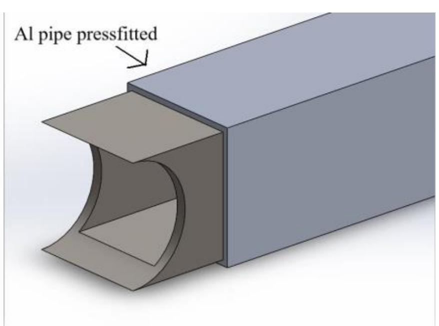

Fig. 4. Inner sleeve assembled with an aluminum pipe

- Outer sleeve – A T-section component with a cylindrical horizontal round pipe and a vertical round pipe. The vertical pipe is welded to the chassis and the aluminum pipe is press fitted inside the steel horizontal round pipe.

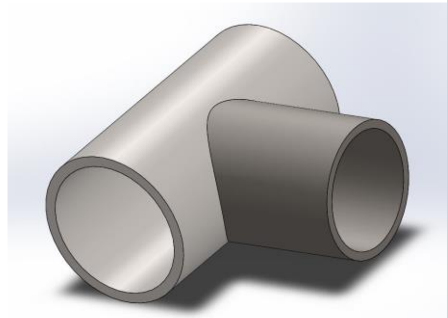
Fig. 5. Outer Sleeve

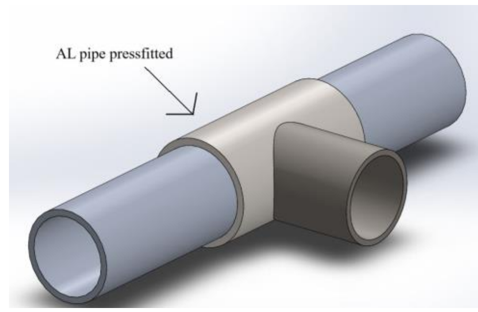

Fig. 6. Outer sleeve assembled with aluminum pipe

6. Modelling

The CAD model of the chassis is designed in SOLIDWORKS 2017.

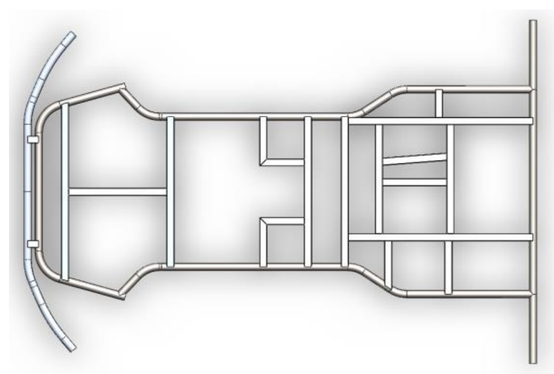
Fig. 7. Chassis modelled in SOLIDWORKS

7. Impact force Calculations

[4] During an impact, the energy of a moving object is converted into work, and force plays an important role. To create an equation for the force of any impact, you can set the equations for energy and work equal to each other and solve for force.

Mass of the vehicle with driver = 150kg
Velocity of the vehicle = 50kmph
For horizontal motion,
Kinetic energy = Work done
$(0.5*m*v^2) = (F*d)$
$F = (0.5*m*v^2)/d$
Taking d = 4m, we get
F = 3417.5 N

8. Analysis

Once the design of the chassis is modelled in a CAD software, the analysis is performed in ANSYS 18.1. It is used to determine stresses and deformation of the model under the action of various impact forces acting on it under static and dynamic conditions. By performing such analysis, safety of the driver can be ensured and the design can be modified in case of Inconvenient results.

The types of analysis performed are –

- Static Structural for front impact
- Static Structural for rear impact
- Static Load analysis for weight of the driver and engine

A. Meshing

It is a process of discretizing the model into a number of elements. The software uses numerical methods to solve the problem and obtain results. A fine mesh provides with better results.

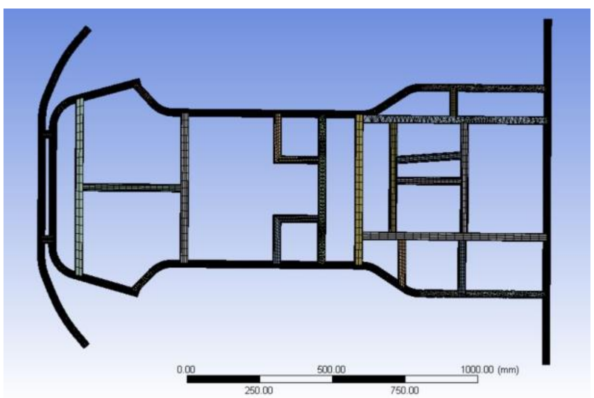

Fig. 8. Meshed model of chassis

B. Boundary Conditions

- Fixed supports
  The fixed supports at applied at 4 points, that is, front supports at the knuckle mounting points and rear at the rear axle bearing housing support member.

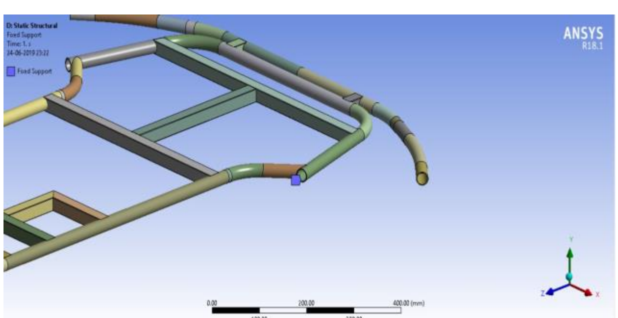

Fig. 9. Front fixed supports

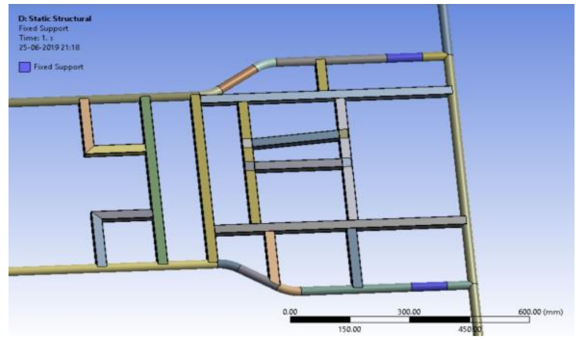

Fig. 10. Rear fixed supports

- Forces
  The forces applied on different analysis performed is as follows:
  - Front and rear impact = 3417.5 N
  - Static load
    Force acting on Seat mounting members = 500N
    Force acting on Engine mounting members = 200N

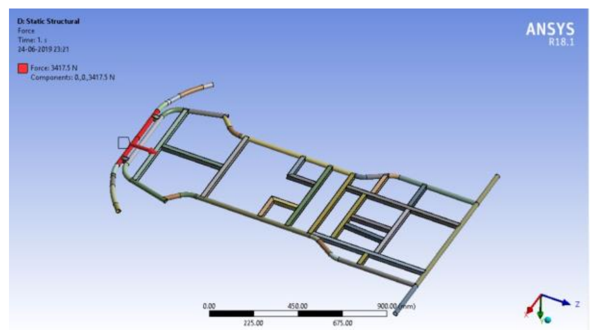

Fig. 11. Front impact force

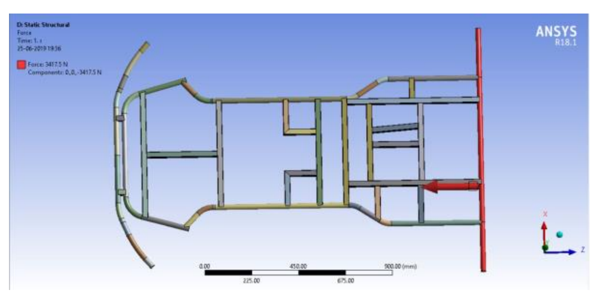

Fig. 12. Rear impact force

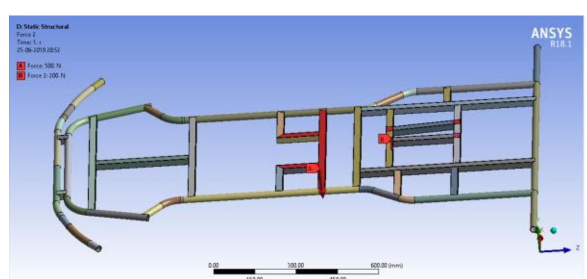

Fig. 13. Static loading

9. Result

Table 2
Analysis

Analysis	Deformation (mm)	Stress (MPa)
Front Impact	1.0262	380.11
Rear Impact	0.96278	252.84
Static Loading	1.4416	417.57

A. Front Impact Analysis

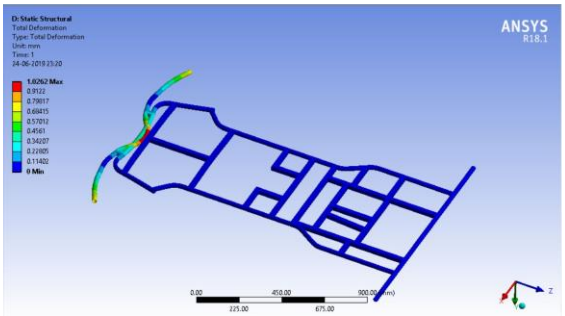

Fig. 14. Front impact deformation

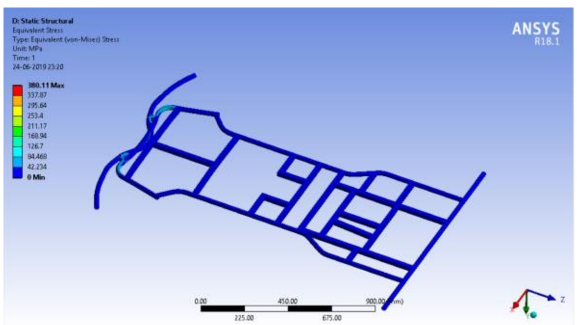

Fig. 15. Front impact stress

B. Rear Impact Analysis

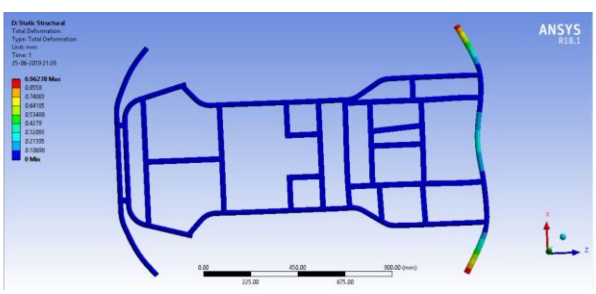

Fig. 16. Rear impact deformation

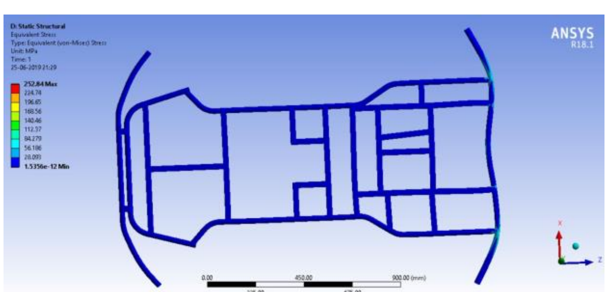

Fig. 17. Rear impact stress

C. Static load Analysis

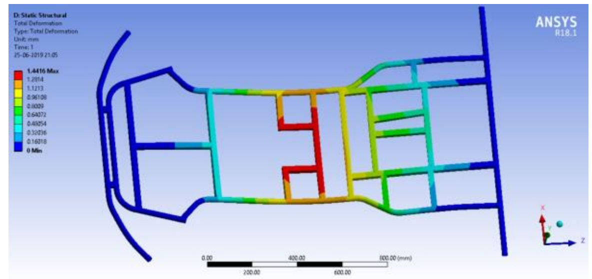

Fig. 18. Static loading deformation

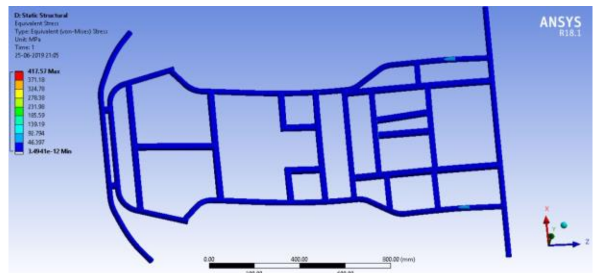

Fig. 19. Static loading stress

10. Conclusion

The analysis performed on the chassis yields results like the maximum deformation and maximum stress developed under both impact and static forces. These values are used to determine the safety of the vehicle under the acting loads. Too large values of deformation and stress concentration calls for changes in design of the chassis to re distribute the stress developed and provide more support to minimize deformation at critical areas. However too much support to minimize deformation can result in stresses being transmitted directly to the driver or other critical components. Therefore, an optimum value of deformation should be achieved for an overall safe design. Inclusion of various materials with light weight but high strength can be used to further optimize the design.

References

[1] Rahul Thavai, Quazi Shahezad, Mirza Shahrukh, Mukri Arman, Khan Imran, "Static Analysis of Go-Kart Chassis by Analytical and Solid Works Simulation," International Journal of Modern Engineering Research, vol. 5, no. 4, pp. 64-68, April 2015.

[2] "AISI 4130 Alloy Steel (UNS G41300)" Azom, 12 Nov. 2012, www.azom.com/article.aspx?ArticleID=6742

[3] "Aluminium Alloys - aluminum 6063/6063A Properties" Azom, 21 Apr. 2005, www.azom.com/article.aspx?ArticleID=2812

[4] "How to Calculate Force of Impact" Sciencing, 29 Apr. 2018, www.sciencing.com/calculate-force-impact-7617983.html