Design and Analysis of a Go Kart Chassis

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Abstract : Go Kart is a small four wheeled vehicle with no suspension and differential. This paper is aimed to design a light weight and rigid chassis for a Go Kart Vehicle. The Go Kart vehicle chassis is totally different from standard automotive chassis. The chassis is intended in such how that it needs less materials and ability to withstand loads applied on it. Modeling and analysis were performed in SOLIDWORKS 2016 and ANASYS 15.0. In this kart, AISI 1018 grade steel tube of 1 inch diameter and 1mm wall thickness were used which is having high tensile strength and good machinability. Front, Rear and Side impact tests were simulated in the design to ensure the safety of the drivers. Static analysis was carried out to find its maximum deformation and Stress. Calculations were done to find out the impact force and factor of safety of the chassis.

***IndexTerms* - Chassis, Go Kart, Modeling, Static Analysis, AISI 1018, Impact test, Factor of Safety.**

I. INTRODUCTION

The Go-Kart is a vehicle which is simple, lightweight and compact and easy to operate. The go-kart is specially designed for racing and has very low ground clearance when compared to other vehicles. The common parts of go-kart are engine, wheels, steering, tyres, axle and chassis. No suspension can be mounted to go-kart due to its low ground clearance.

Go-Kart is a great outlet for those interested in racing because of its simplicity, cost and safer way to race. The tracks go-kart is similar to F1 racing track. A go-kart is powered by 125cc engine in most of the countries. In some countries, go-karts can be licensed for use on public roads. Typically, there are some restrictions, e.g. in the European Union a go-kart on the road needs head light (high/lo beam), tail lights, a horn, indicators and a maximum of 20 HP.

II. CHASSIS

The chassis of go-kart was designed on the parameters to guide complete safety of rider as well as to maintain the feasibility of go-kart for all loads applicable. The loads that are applicable on the chassis are studied under various considerations like go-karts spring mass load, Cornering forces, impact forces, torsional rigidity and the overall dynamic loads applied during running conditions. The thereby was designed to rider safe and to combat the loads applied on it without compromising the structural strength

III. METHODOLOGY

The work that is done on the chassis are explained easily using a flow chart. The flow cart are shown below

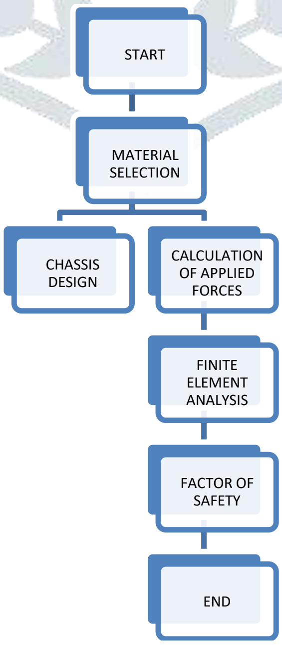


Fig. 3.1 Design Flow Chart\

IV. MATERIAL SELECTION

The frames which are actually tested for corrections using the pipes are to be made real for the construction of the chassis. In order to do that we need to select the material, this is the best one in building the vehicle. So a survey is been done to select the materials for the chassis. We need to select the material with high strength and less in weight. We had gone through a series of materials, which are suitable for chassis construction.

The material used for the frame is AISI 1018 MILD/LOW CARBON STEEL. The material is selected due to the following reasons,

1. Strength 2. Cost 2. Availability 3. Toughness 4. Machinability

The physical properties of the materials are as follows:

Table 4.1 Material Properties

S.No	Properties	Values
1.	Tensile strength	440 Mpa
2.	Yield strength	370 Mpa
3.	Bulk modulus	140 Gpa
4.	Shear modulus	80 Gpa
5.	Young's modulus	205 Gpa
6.	Poisson's ratio	0.29

The chemical properties of the material are as follows:

Table 4.2 Material Compositions

S.No	Material	Composition
1.	Carbon	0.14-0.20%
2.	Manganese	0.6-0.9%
3.	Sulphur	Less than 0.05%
4.	Iron	98.81-99.26%
5.	Phosphorous	Less than 0.04%

V. MODELING OF CHASSIS

Modeling of the kart is performed using SOLIDWORKS 2016. This is done by drawing part in the software and then assembling in the assembly section. Then it is exported to ANYSYS for further analysis.

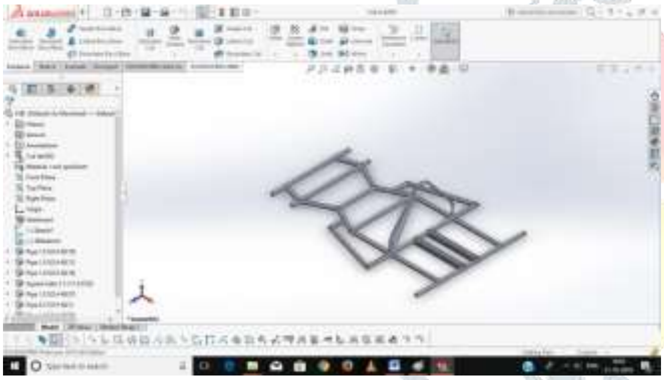


Fig. 5.1 Design Screen Shot

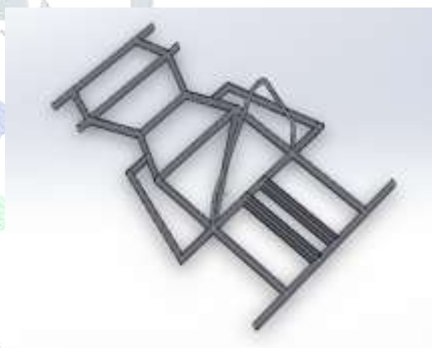


Fig.5.2 Chassis Design

Fig. 5.3 Front View

Fig. 5.4 Side View

VI. CALCULATIONS

The chassis are to be made from the selected material. To check the stability of the chassis using the finalized material, we need to calculate the force up to which the frames prevent from deformation

Front impact analysis:

The front impact test in the chassis is carried out as,

Mass of the vehicle (m) =180kg

Velocity (v) = 64kmph = 17.77m/s

Side impact analysis:

The side impact test of the chassis is carried out as,

Mass of the kart (m) = 180kg

Velocity (v) = 48kmph = 13.33m/s

From mass moment of inertia equation,

Front Impact force,

F = P x ΔT

Where, P = momentum

ΔT = collision time = 1.1s

P = m x v

= 180 x 17.77

= 3200 Kg m/s

F = P X ΔT

= 3200 x 1.1

= 3520 N

From mass moment of inertia equation,

Side Impact Force,

F = P x ΔT

Where, P = momentum

ΔT = collision time = 1.1s

P = m x v

=180 x 13.33

=2399.4 m/s

F = P X ΔT

= 2399.4 x 1.1

= 2639.34 N

Rear impact analysis:

The rear impact analysis of the chassis is carried out as,

Mass of the kart (m) = 160kg

Velocity (v) = 50kmph = 13.88m/s

From mass moment of inertia equation,

Rear Impact Force,

F = P X ΔT

Where, P =momentum

ΔT= collision time = 1.1s

P = m x v

= 180 x 13.88

= 2500Kg m/s

F = P X ΔT

= 2500 x 1.1

= 2750 N

VII. ANSYS TEST

The next stage after design is analysis of chassis under various impact forces. Aside from exceeding the minimum material requirement set by the discussion by team members. Standard values of the material are compared with the analyzed result to verify the structural integrity of the frame. By performing the analysis the stress induced in the frame can be determined.

Thus the ANSYS test is employed to find the chassis analysis. The method used here is known as Finite Element Analysis (FEA). The Finite Element Analysis (FEA) or Finite Element Method (FEM) is a numerical method for solving problems of engineering and mathematical physics. The typical problem area is structural analysis. From that we can found the Von misses stress and Total deformation. Frame analysis is done under ANSYS 15.0 software.

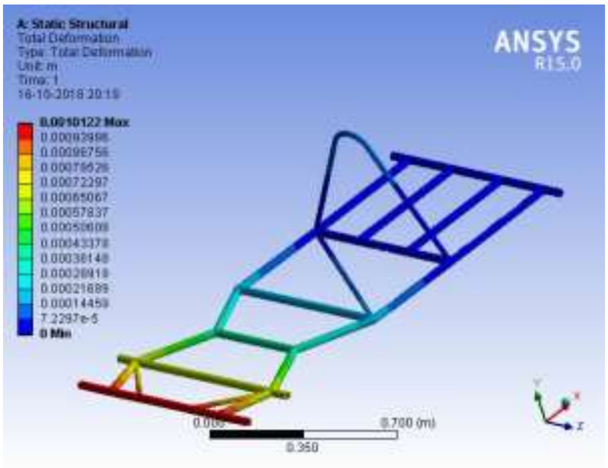
The three cases needed to be found using ANSYS software is

1. Front impact test 2. Side impact test 3. Rear impact test

Impact test on the frame is conducted according to ENCAP (European New Car Assessment Programme). According to ENCAP, linear Velocity remains at 64 Kmph for frontal impact, 48Kmph for side impact and 50 Kmph for rear impact.

Front Impact Test

Front impact test is which people usually think about a crash test. In this test, the material made to be fixed at one end while other is allowed to have an impact force. The front impact can be tested by using ANSYS software, where we can test the front impact force up to which it can withstand and to find the stress produced on the front side of the chassis. Now keeping the rear part fixed, the calculated force is applied to the Front part of the frame. The deformation of the frame is 0.5mm which is very small and safer to use. The Von Misses stress of the front impact test is found to be 110Mpa



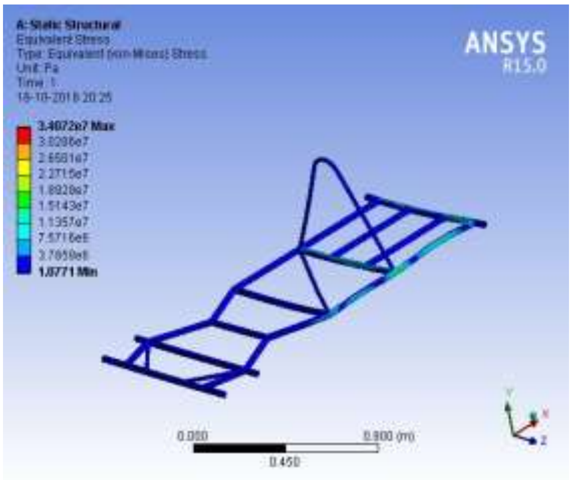


Fig.7.1 Total Deformation Fig 7.2 Von Misses Stress

Side Impact Test

Side impact is usually occurring when another vehicle hits on the side of the vehicle. So the impact on this side is found virtually using the analysis software itself. The side impact is tested by using ANSYS software, where we can test the side impact force up to which it can withstand and to find the stress produced on the side of the chassis. Now keeping one side of the frame fixed, the calculated force is applied on the other side of the frame and the results are as follows.

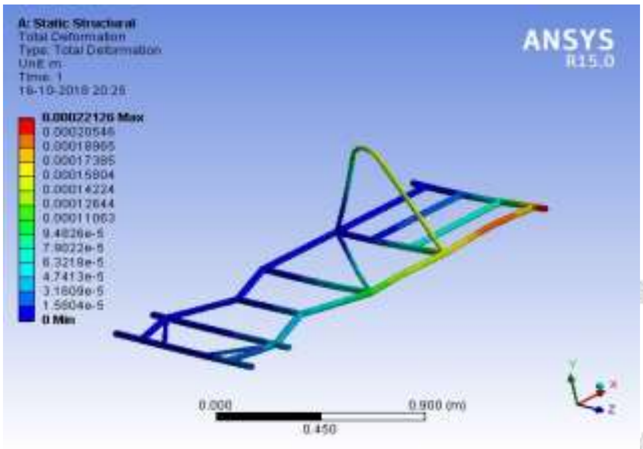


Fig.7.3 Total Deformation

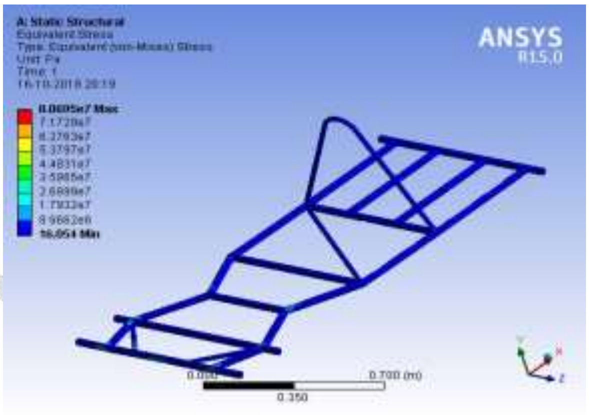


Fig.7.4 Von Misses Stress

The deformation of the frame is 0.1mm which is very small and safer to use. The von misses stress of the side impact test is found to be 105Mpa.

Rear Impact Test

The rear impact force is created by the collision in the traffic accident wherein a vehicle crashes at its rear side. It causes damages at the end causing deformation at the back side of the vehicle. The rear impact is tested by using ANSYS software, where we can test the rear impact force up to which it can withstand and to find the stress produced on the rear side of the chassis. Now keeping the front side of the frame fixed the calculated force is applied on the rear side of the frame and the results are as follows.

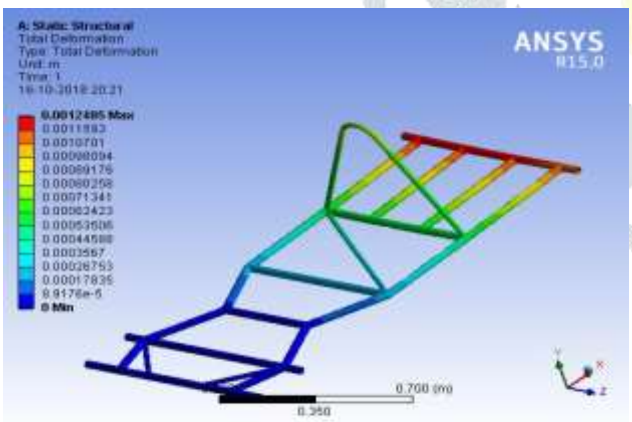


Fig.7.5 Total Deformation

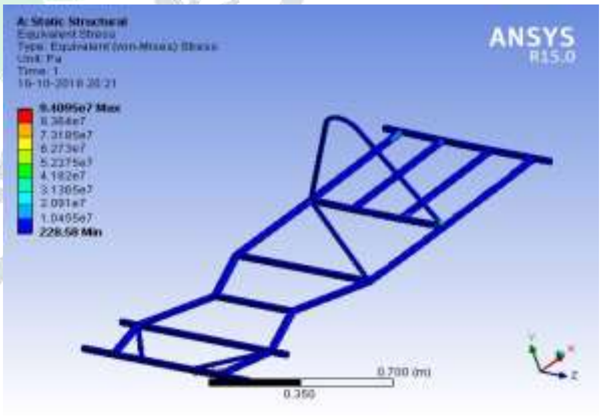


Fig.7.6 Von Misses Stress

The total deformation is 0.4mm which is very less and safer to use. The Von Misses stress of the rear impact test is found to be 131Mpa

VIII. FACTOR OF SAFETY (FOS)

Factor of Safety (FOS) is also known as Safety Factor (SF), is a term describing the load carrying capacity of a system beyond the expected or actual loads. Essentially, the factor of safety is how much stringer the system is, than it needs to be for an intended load.

The definition of the Factor of Safety is the ratio of the yield stress to the Von misses stress.

For Front impact test,

FOS = Yield strength / Von misses stress

370/110

For Side impact test,

FOS = Yield strength / Von misses stress

=370/105

= 3.3 = 3.

For Rear impact test,

FOS = Yield strength / Von misses stress

= 370 / 131

= 2.86

IX. RESULTS AND DISCUSSION

Hence the chassis is successfully completed using SOLIDWORKS 2016 and ANSYS 15.0. The goal is achieved by simplifying the overall design to make it a safe frame and light weight.

Table 9.1 Comparison of all calculated results

Factor	Front	Side	Rear
Impact Force (N)	3520	2639.34	2750
Total Deformation (mm)	0.5	0.1	0.4
Von Misses Stress (MPa)	110	105	131
F.O.S	3.3	3.5	2.86

X. CONCLUSION

From the results it was concluded that the material AISI 1018 is best suited for chassis. It was designed on SOLID WORKS and static analysis using finite element method, it was performed on ANSYS 15.0. Front, Rear and Side impact test was done on the chassis and impact force was found to be 3520N, 2750N and 2639.34 N. Structural deformation and the value of von Misses stress were found and the factor of safety was calculated and it is greater than 1. So the frame design was safe and it can be used for Go Kart. With the help of this analysis it is easy to find the strength and weak area of the chassis and it can be further processed for improvements.

XI. REFERENCES

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