Design and Performance Evaluation of an Electric Go-Kart

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1. Abstract

In this paper we present an electric go-kart suitable for an instructional laboratory in electric drives. An overview of propulsion system design, power conversion structure and control is presented.. The motor is controlled at different operating conditions by means of a simple scalar control using a low cost controller board developed for light electric vehicles used in local areas. The prototype has been designed specifically to meet the requirement of low cost and it contains all of the active functions required to implement the control of the go-kart. With the help of a voltage controller was used for controlling speed. Design calculations were carried out and optimum results were obtained. The main frame and force analysis was done on SOLIDWORKS software.

Keywords:. *Design, Frame, SOLIDWORKS*

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2. INTRODUCTION:

The general definition of any kart, a vehicle without suspension and differential. It is a vehicle specially designed for a flat track race. A wide range of engine karts were on track since the mid of the twentieth century. The design of the frame indicates that it is an open kart with a straight chassis. The frame acts as a suspension in karts. It must also be rigid not to break under extreme load conditions. Hence, flexibility should be compromised with stiffness. The primary objective is to design a stable and safest vehicle for the driver. Every subsystem is designed based on the primary objective and then integrated into a final blueprint. In adiition it brings an awareness of of the various parameters that can be altered to try to improve the competitiveness of the kart that also exist in other form of motor racing.

3. FRAME DESIGN

3.1 Frame material

The material used for the frame is 1080 AISI MILD CARBON STEEL due to safety reasons as well as its cost. The chemical and physical properties of the material are shown in a tabular form as below:

SNO.	PROPERTIES	VALUES
1	Tensile strength	440 Mpa

2	Yield strength	370 Mpa
3	Bulk Modulus	140 Gpa
4	Shear Modulus	80 Gpa
5	Youngs Modulus	205 Gpa
6	Poisson Ratio	.290
7	Factor of safety	1.8

3.2 CHASSIS

The chassis of go-kart is a skeleton frame made up of pipes and other materials of various cross sections. The chassis of go-kart must consist of stability, torsional rigidity, as well as it should have relatively high degree of flexibility as there is no suspension. It can also adequate strength to sustain load of operator and other accessories.

3.3 DESIGN OF THE VEHICLE

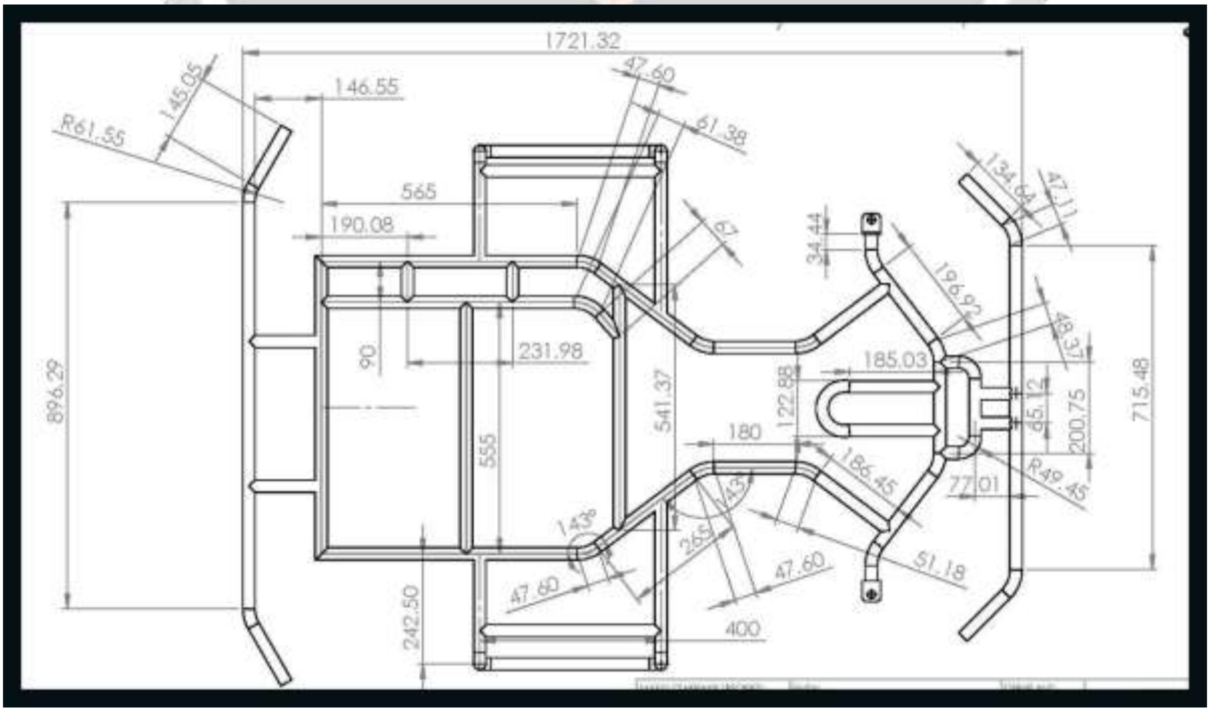


Fig-1 outline sketch of model WITH dimensions.

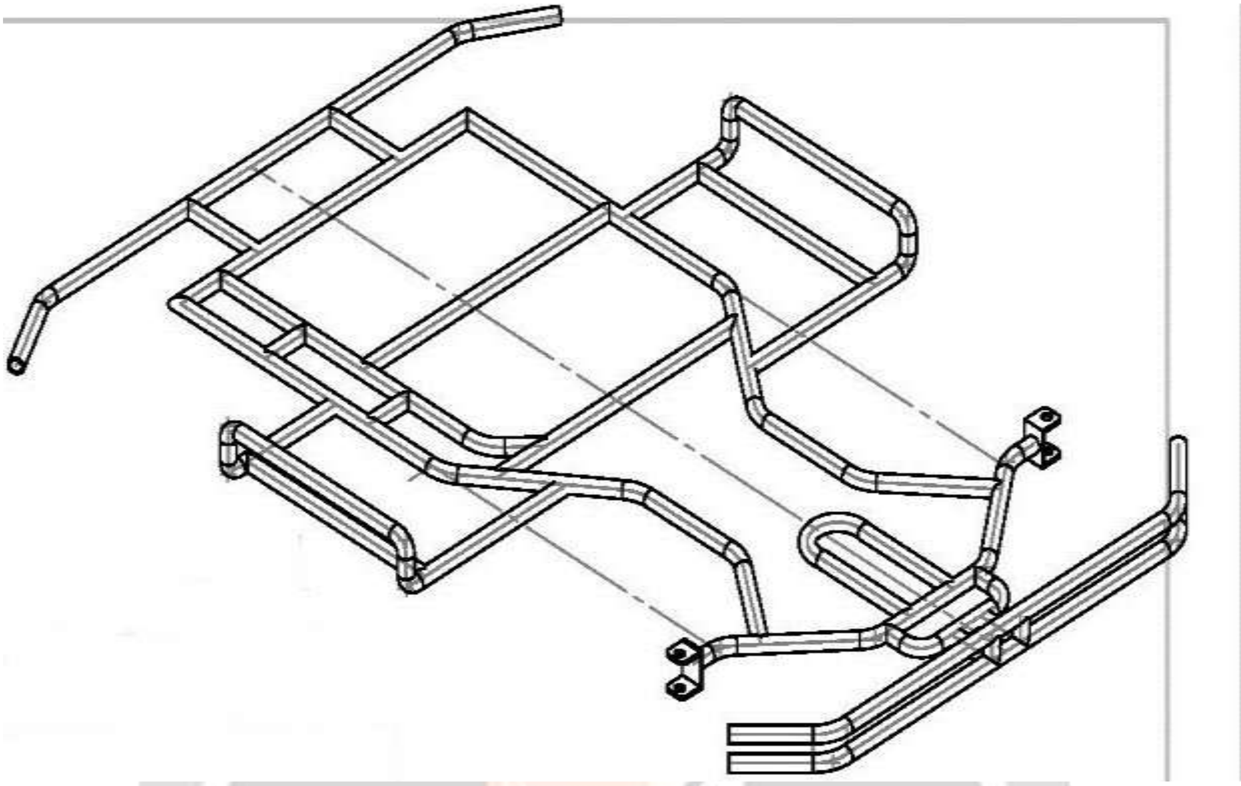


FIG-2 ISOMETIC VIEW OF THE SKETCH.

3.4 Front Impact Analysis

Through computed software analysis the impact test of the frontier part was done. It is as follows.

Mass of the vehicle(approx.) M = 160 kg

Velocity of the vehicle=60KM/H =16.6M/S

With the help of mass moment of inertia equation, impact force:

F= PXT , here P= momentum

T= duration of time =0.9s

P=M x V = 160x 16.6 =2656 kgm/s

F=PxT=2656 x0.9 =2390.4 N

3.4 Side Impact Analysis

Rear impact Force F = P x ΔT

where P = M x V; M = 160 Kg , V = 50 kmph = 13.8 m/s

so, P= 160x13.8=2208 kgm/s hence F=2208x.9

F= PxT= 1987.2N

4 Steering system

The steering system converts the rotation of the steering wheel into a swivelling movement of the road wheels in such a way that the steering-wheel rim turns a long way to move the road wheels a short way. Our steering is of ackerman type for easy manouvering of the vehichle and also as the wear between the links of the system is considerably less as compared to the davis steering system and in ackerman type turning links are present contributing to the long lide of the system.

5. Tyres: assuming that there is enough friction between tyre and road to accommodate the drivers braking force request, the tyre will develop slip in order to react and retarding force develop by its rotor assembly. The force reacted to the ground will be equal to: F(tyre)=T_b/R_t. The go kart wheels used are of the dimensions 10X4.7X5 inches for the front wheel and 11X7.1X5 inches for the rear wheel.

6 Braking system: in order to achieve optimum brake balance or to achieve 100% base brake efficiency the ratio of the front and rear braking force will be equal to the ratio of the front and rear brake forces:

$$\mathbf{F_{tyre}/v_F = f_{tyre}/v_R}$$

6.1 Braking System calculation

a) Gross weight of vehicle: (W) = 160 * 9.81 =1569.6 N

b) Brake Line Pressure:

Pedal ratio: 4:1

Normal force on pedal : 2000N

Area of master cylinder: 334.06mm²

Brake line Pressure = 23.94 N/mm²

c) Clamping Force:

CF = B Pressure * (Area of caliper

Piston * 2)

CF = 23.94 * ( ) * 27² * 2

CF = 27413.94 N

d) Rotating Force:

RF = CF * no of caliper piston *

Coeff. Friction of brake pads

= 27413.94 * 2 * 0.4

= 21931.152 N

e) Braking Torque:

= RF * effective disc radius

= 21931.152 * 0.0875

= 1918.97 Nm

f) Braking Force:

BF = braking torque/ tyre radius

= (1918.97 / 0.41) * 0.8

= 3744.3317 N

6.2 TYRE REACTIONS

TOTAL WEIGHT= 160KG =1570N

a) Reaction at rear wheel= 55%of total weight = 0.55x1570=863kg

b)Reaction at front wheel= 45% of total weight= 0.45x1570=706kg

c) skid force required F_t= μ(863+706), let μ= 1.5 , thus

F_t=2354.25N

7.Battery Selection*:*

a) Charging time of battery

= Battery Amph / charging current

= Ah / A

Charging current should be 10% of the

Ah rating of battery

Therefore, Ah = 35Ah

Charging current for 35 Ah battery

*= 35 * 10/100*

=3.5 A

Charging time of battery

= 35/3.5 =10 hrs. (Ideal case)

b) Practical case:

40% of losses occurs,

*35 * 40/100 = 14*

35 + 14 = 49 Ah

Charging time of battery=49/3.5= 14hrs

c) Discharge time =

*Battery Ah * Battery volt*

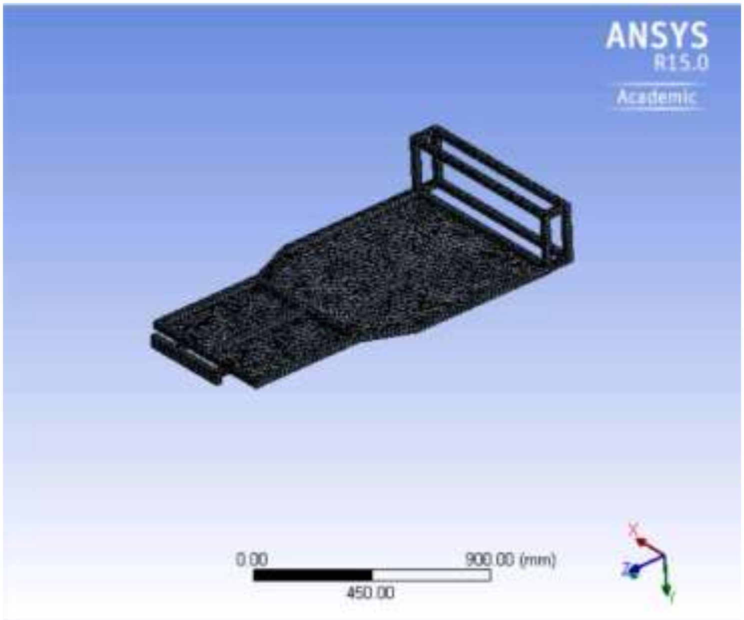
Applied Volt

*= 35 * 12*

1000= 0.42 hrs. = 25.2 min

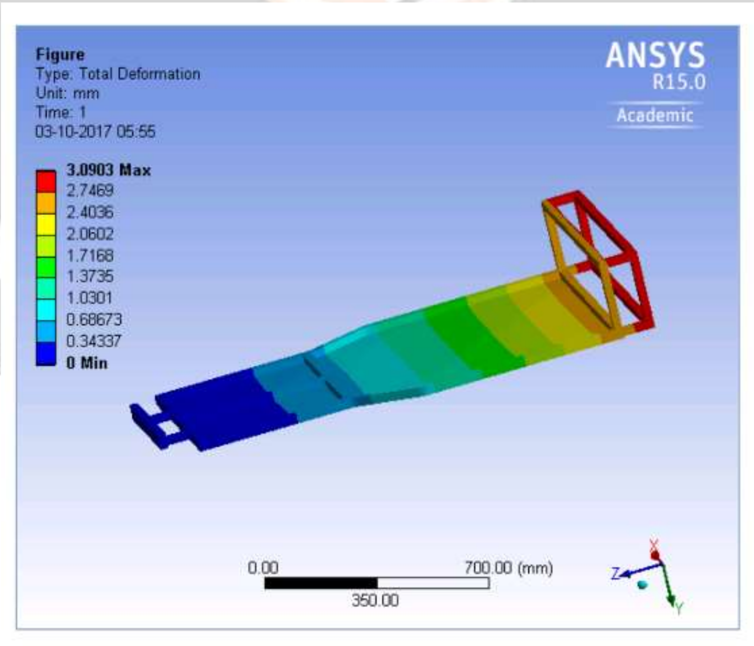
8. ANALYSIS/RESULTS:

Mesh of chassis



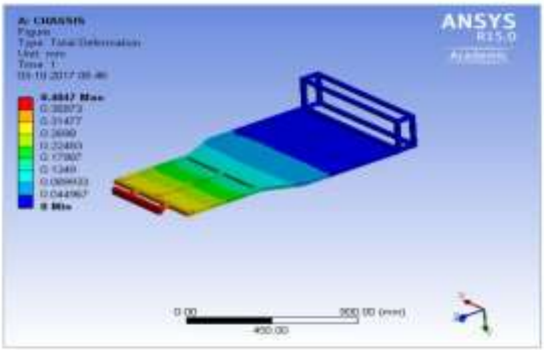
8.1 Total deformation (Rear impact)

For deformation first load of 700N(Compressive) is applied on rear end and front end is fixed. Fig below shows the result:



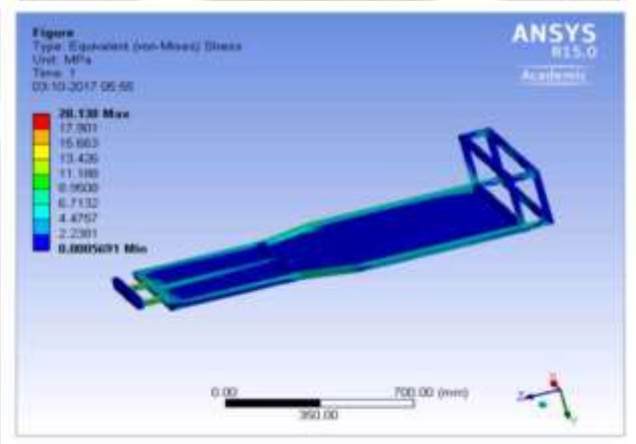
8.2 Total deformation (Front impact)

For deformation first load of 700N (Compressive) is applied on front end and rear end is fixed. Fig below shows the result:



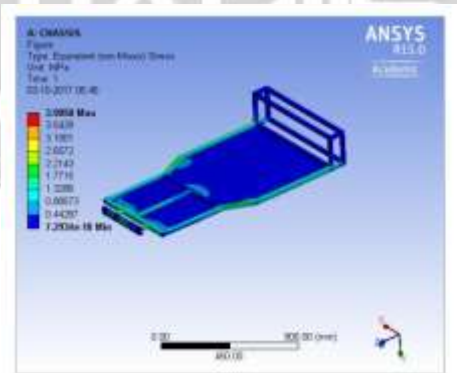
8.3 Equivalent stress (Rear impact)

For Equivalent stress first load of 700N (Compressive) is applied on rear end and front end is fixed. Fig below shows the result



8.4 Equivalent stress (Front impact)

For Equivalent stress first load of 700N (Compressive) is applied on front end and rear end is fixed. Fig below shows the result



9.ACTUAL MODEL:

The above figure indicates the complete go-kart model after fabrication.

10. ACKNOWLEDGEMENT

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11. CONCLUSION

The designing of chassis for go-kart can develop many skills. In this review paper, some researchers and their research methodology with remarks is included so it can be concluded the analysis of design determines the stresses developed in the chassis which plays an important role in factor safety. From the analysis Design Engineer can predict the chassis is safe or not and also by seeing the deformation and stresses modification in the kart chassis is possible.

12.REFERENCES

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