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Go Kart Vehicle

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Abstract-Our aim is to design a go-kart through this competition so as to achieve synchronize automotive machine compatible to perform at each level of usage. Our basic fundamental priority is the safety of the passenger and then to increase both fuel economy and performance of the kart on the track. The feasibility of kart and its factors like safety of rider, strength&endurance of go kart, manoeuvrability etc. were kept in mind while designing of the kart.

I. INTRODUCTION

A go-kart, also written as go-cart (often referred to as simply a kart), is a type of open-wheel car. Go-karts come in all shapes and forms, from motorless models to high-powered racing machines. Some, such as Superkarts, are able to beat racing cars or motorcycles on long circuits. Go-carts are child transportation.

Gravity racers, usually referred to as Soap Box Derby carts, are the simplest type of go-karts. They are propelled by gravity, with some races taking place down a single hill.

Many recreational karts can be powered by four-stroke engines or electric motors, while racing karts use a two-stroke or, rarely, higher powered four-stroke engines. Most of them are single seater but some recreational models can accommodate a passenger.

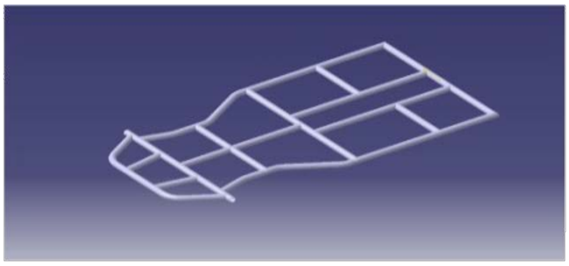
1.1 Technical Data (Vehicle Specification)

PARAMETER	***VALUE***	
Wheel base	46"	
Vehicle Track	37"	
Tube Dimension	1.25"	
Roll Cage Material	AISI 4130	
Max. Speed	60 kmph	
Battery	12 v	
Roll Cage Mass	13.203Kg	
Total Mass	200 Kg	
	(INCLUDING DRIVER)	
Ground Clearance	2.5" (approx)	
Brake disc	7" (diameter)	
Wheels	Front	Rear
	9"*5"-6"	9.5"*7"-8"

II. DESIGN METHODOLOGY

The design process of the single person go-kart is iterative and is basically based on several engineering and reverse engineering processes. Listed below are few of the major points that were considered for designing the following go-kart:

- Endurance
- Safety and Ergonomics
- Market availability
- Cost of components
- Standardization and serviceability
- Manoeuvrability
- Safe engineering practices



2.1 Chassis

Cad Design

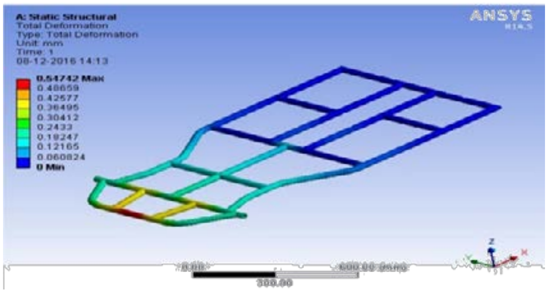
- Round tubing pipes of outer diameter = 1.25"
- Thickness of pipe = 0.0787"
- Material used AISI 4130
- Designing : CATIA software

2.2 Cad Model

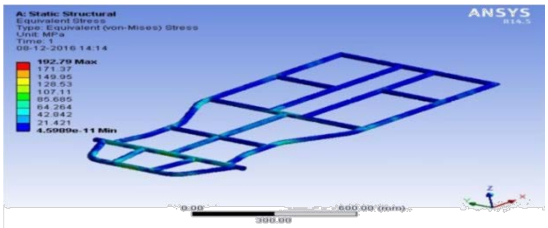
Chassis Design (CATIA)

- CAE analysis
- Front impact deformation analysis

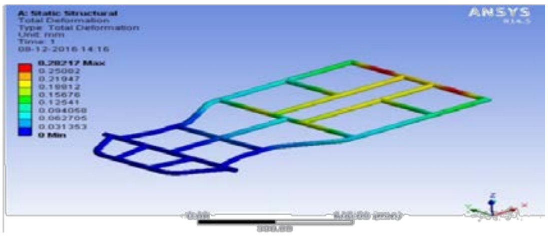
Maximum Deformation=0.5474 mm



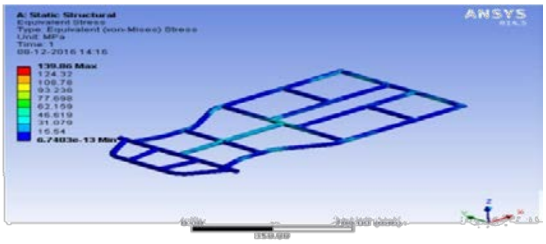
Front Impact Stress Analysis Maximum Stress=192.79 MPa



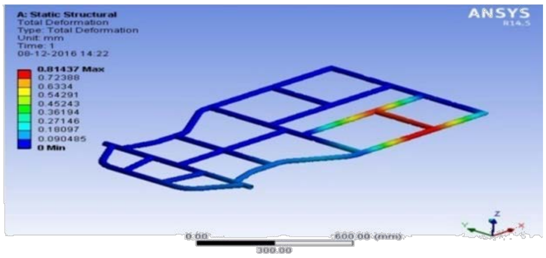
Rear Impact Deformation Analysis Maximum Deformation=0.2821 mm



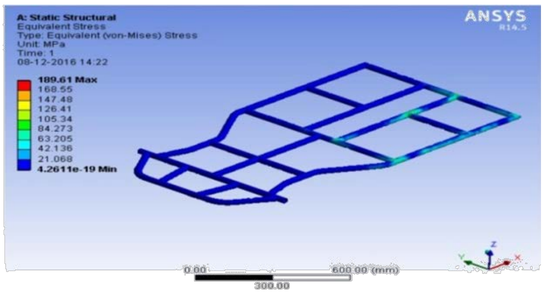
Rear Impact Stress Analysis Maximum stress=139.86 MPa



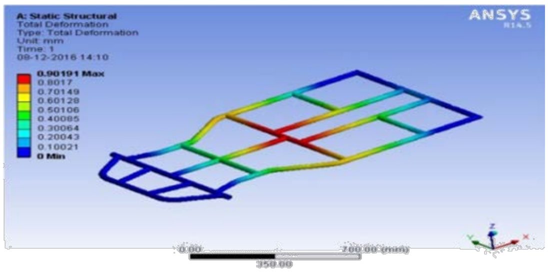
Side Impact Deformation Analysis Maximum deformation=0.8143 mm

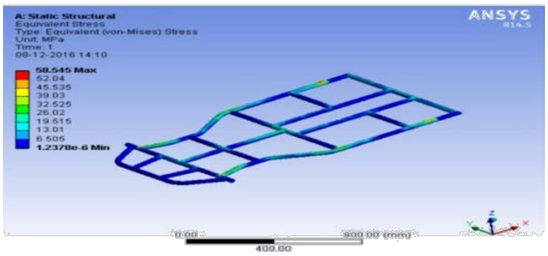


Side Impact Stress Analysis Maximum stress =189.61 MPa



Self Weight Analysis: Maximum deformation=0.9019 mm





SELF WIEGHT STRESS: Maximum stress=58.545

LOAD TYPE	TOTAL WEIGHT (Kg)	FORCE (N)	DEFORMATION (mm)	STRESS (MPa)	FACTOR OF SAFTY
Front impact	200	14000 (7g)	0.5474	192.79	2.2563
Rear impact	200	10000 (5g)	0.2821	139.86	3.1103
Side impact	200	6000 (3g)	0.8143	189.61	2.2941
Self weight	200	2000 (200*10)	0.9019	58.545	7.4301

Calculation of loads:

F=(total mass of vehicle)*(g)*(coefficient(n)) where; n=5,7,3(depending upon the impact loading) we have applied following loads

FRONTIMPACT=7g=7*200*9.81=13734 N=(14000N(approx))

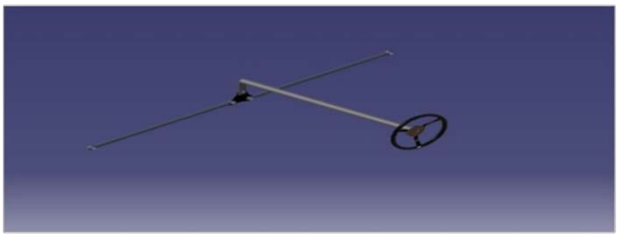
RAREIMPACT=5g=5*200*9.81=9810 N=(10000 N(approx))

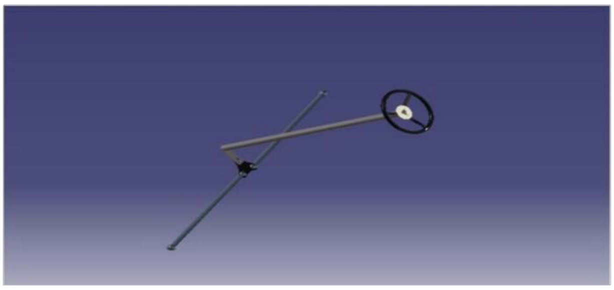
SIDE IMPACT =3g=3*200*9.81=5886 N=(6000 N(approx))

SELF WEIGHT=200*9.81=1962 N=(2000 N(approx))

STEERING

- Inversion of four bar linkage steering mechanism
- Modified Ackerman geometry
- The suggested mechanism gives fairly accurate results.





The mechanism gives better end response leading to shorter turning radius.

- Transmission and system used
- Specification and calculation

Engine	CG 135 cc
Type	4-stroke, DTS-i, Air Cooled,
	4-valve single cylinder
Displacement	134.66 cc
Bore X Stroke	54.0 mm x 58.8 mm
Rated Power & Rotating Speed	13.3 bhp @9000 rpm
Max. Torque & Rotating Speed	11.4 Nm @7500rpm
Ignition	Electric/kick self
Lubricating	Pressure / Splash
Clutch	Wet Multi-plate Clutch
Number of gears	5

Taking into account the specification parameter in the rule book, we have chosen this engine.

On the basis of maximum torque, rpm, power On the basis of its efficiency

On the basis of Bore x Stroke value amongst 135 cc engines.

- *TIRES/WHEELS*

Taking into account the desired ground clearance and disc availability, we choose from a range of tires available.

- *Specification of Tires*

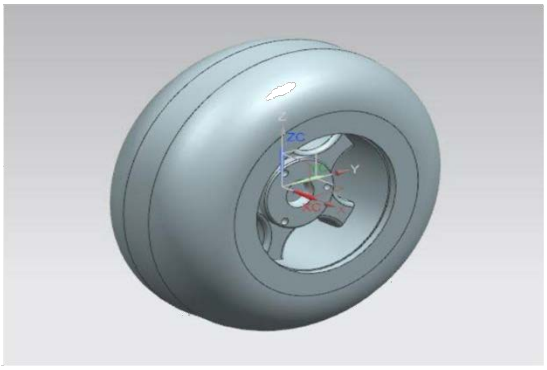
Front - 9"*5"-6"

Rear - 9.5"*7"-8"

- *Type of tires*

BKT tires – tubeless

- *Rim*



Type - bearing type

2.3 BRAKE SYSTEM

Design Methodology

- Disk brake on rear wheels.
- Single master cylinder.
- Diameter of disc : 7 inches

Technical Data

Time taken by our vehicle to stop from a speed of 40 Km/hr is 1 second.

Stopping distance is 5.6 m with coefficient of friction 0.7 Braking force =999N

Energy dissipated = 11,108.889Nm

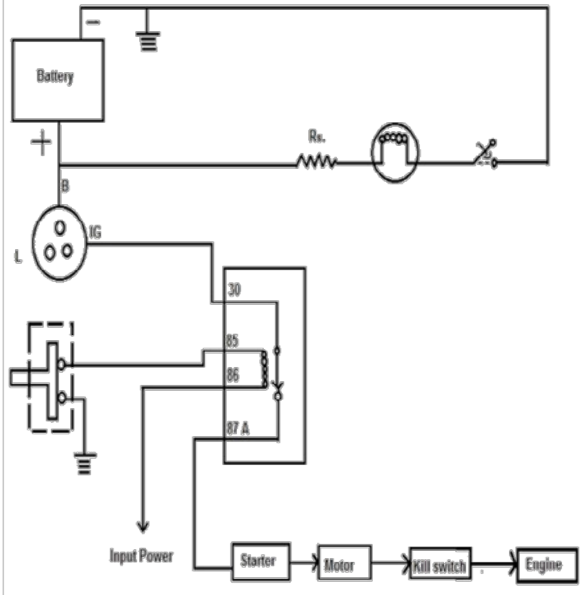
Procedure and Calculations

Stopping distance = V*V/ 2*μ*g

Braking force = mass of vehicle* deceleration Deceleration = V/ time taken

Energy dissipated = [M*{V2(initial)- V2(final)}]/2

2.4 ELECTRICAL SYSTEM



Failure Mode and Effect Analysis

Following can be the modes of failure of the above presented electrical system :

- Under overloading condition
- Due to loose connections
- Due to overheating of engine which may damage the circuit

Validation Report

Following circuit is valid under following conditions

- If motor works on its rated rpm and won't disfunction
- If kill switch is not pressed
- If the coil of the starter won't burn due to excess voltage

Weight of Vehicle

Parameters	**Weight (in kg)**
Roll Cage	20(aprx)
Tyre and wheel hub assembly	20
Engine	25
Steering system	5
Brake assembly	5
Driver	75
Exhaust	5
Miscellaneous (seat, battery, fuel tank, etc.)	20
Chain, sprocket,front and rear drive shaft	25
Total (approximate)	200

2.5 EXHAUST

- CARBON FILTER BEING USED WITH FUEL VAPOUR PREVE
- NTION CAP (FVPC)

2.6 ADVANTAGES

- Up to 15-17 % fuel saving on your mileage per litre.
- Up to 40 % reduction in carbon monoxide emission.

Up to 30 % increase in life of your catalytic convertor exhaust system.

I. PROPOSED COST REPORT

SYSTEM	TOTAL COST(Rs.)
Engine	35000
Steering &Electrical	5000
Brakes &Tyres	12000
Pipes &Materials	15000
Fuel Tank	1000
Exhaust	4000
Finishing & Painting	2000
Safety & Innovation	2000
Miscellaneous	10000
VEHICLE COST	86000
Registration	12500
Transportation(spon)	50000
Driver Suit &Accessories	25000
TOTAL COST	173500(approx)

II. DVP (DESIGN VALIDATION PLAN)

4.1 Vehicle Specification

Under article 4, kart dimensions at page no.30

CATEGORIES	**PARAMETER TAKEN**	**PARAMETERGIVEN(a/c to rule book)**
Maximum length	72 inches	90 inches
Wheel Base	46 inches	43 inches (minimum)
Wheel Track	37 inches	Must be 65 % of thewheel base
Height of Steering from the ground	According to thedriver	According to thedriver
Ground Clearance	2.5inches(approx)	(1.25 – 4) inches
Maximum Weight	125 kg (approx)	230 kg (withoutdriver)

- Both primary and secondary members have outer dia = 1.25 inches
- Both primary and secondary members thickness= 0.0787 inch ie., (2mm)
- Under article 4, according to general technical rules, chassis page no.21
- Round tubing pipes outer dia = 1"- 2"
- Thickness of pipe =

Minimun 0.078’’(for tubing of 1 inch diameter)

Minimum 0.060’’(for tubing of DIA equal to 1.125’’ or more)

4.2 STEERING

- Under article 4, general technical rules, steering page no.24
- Control front 2 wheels
- Have steering stops
- Inversion of 4 bar linkage mechanism at 1 piviot is used

4.3 TRANSMISSION AND SYSTEM USED

Under article 4, general technical rules, engine at page no.26

4 stroke, air cooled, 135cc engine is used

TIRES

Under article 4, general technical rule, tires page no. 39

We have chosen tires according to our design

BRAKES

- Under article 4, general technical rules, brake page no.25
- Single system disc wheel brakes at rear wheels
- No hand brakes are used

4.4 ELECTRICAL SYSTEM

Under article 4, general technical rules, electrical system page no.39

- FMEA is given
- Validation report is given

III. DFMEA

- FMEA is a deliberate and thoughtful method for focusing on “expected quality” that ;
- Identifies possible faults (failure modes) in a system.
- Evaluates the effects of the fault on the operational status of the system
- Determines the risk priority of the failure (based on severity, probability of occurrence, and probability of detecting and avoiding the failure
- Recommends corrective actions for high risk items
- Implements corrective actions until risk is reduced
- Documentsthe design process and allows for efficient review and communication with respect to system safety.

5.1 FAILURE MODES (WHAT CAN GO WRONG)

Analyze operating conditions, environment conditions,all potential failure modes.

Structural systems	Fracture (max load &fatigue), excessive deflection, excessive wear
Kinematic systems	Bearing seizure, reduced accuracy of relative movement, interference
Thermodynamic systems	Overheating, reduction ofefficiency
Fluid flow equipment	Leakage, blockage,distorted flow
Electrical equipment	Short circuit, open circuit, loss of power
Material properties	Incorrect material,incorrect geometry
Environmental effects	Temperature, contamination, corrosion, excessive friction

5.2 CAUSE OF FAILURES:

Design deficiencies

- Failed to consider effects of notches &stress concentrations
- Inadequate knowledge of service loads and environment
- Incorrect use of finite element analysis for complex parts
- Relying on analysis results without adequate experimental validation
- Material selection deficiencies
- Inadequate material data / use of inappropriate data
- Cost emphasized over quality
- Manufacturing defects that remain in the final part
- Inadequate maintenance, inspection, and repair
- Overload
- Effect of Operating environment
- Unexpected conditions, beyond those allowed for in the design
- Deterioration of material properties due to prolonged exposure to the environment

5.3 EFFECT ON ENVIRONMENT / SOCIETY

The competition as well as our report will definitely be helpful for other enthusiastic minds and will help the society to grow more stronger in the technical field.

IV. PFMEA (PROCESS FAILURE MODE AND EFFECT ANALYSIS)

Process Failure Mode and Effect AnalysisEffect Criteria 1 Criteria 2 Criteria

Degradation ofSecondary Function	Degradation ofsecondary function (vehicle operable, butcomfort/convenience functions atreduced level ofperformance).	A portion of theproduction runmay have to bereworked off line and accepted.
Loss ofSecondary Function	Loss of secondary function (vehicle operable, butcomfort/convenience functionsinoperable).	100% ofproduction runmay have to bereworked off line and accepted.
Degradation ofPrimaryFunction	Degradation ofprimary function(vehicle operable,but at reduced level ofperformance).	A portion of theproduction runmay have to bescrapped.Deviation fromprimary process includingdecreased line speed or added manpower.
Failure to Meet Safety and/orRegulatory	Potential failure mode affects safe vehicle operation and/orinvolves noncompliance with government regulation withwarning.	May endanger Operator (machine orassembly) withwarning.