RESEARCH ARTICLE OPEN ACCESS

Design And Manufacturing Of Motorsports Vehicle

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ABSTRACT
The objective of this project was to design and manufacture a racing vehicle for participation in various GO-KARTING competition. The vehicle was designed by using mathematical modeling and computer-aided design, CAD and simulation by using a ANSIS software.The kart is introduced to the various on road compititions like International Series of Karting orhanised by Mean Metal Motors and Trinity Series Trophy. Kart was having a unique feature of Quick streeing mechamism. Additionally we have made the innovations like after tilting the vehicle accidently above 60 degree tilting angle the engine automatically shuts off and engine starts only by putting thr seat belt.It made the vehicle light weight, stable, efficient with having high strength and durability as well. Main goal of our kart making was compact design, maximum performance as well as safety.
Keywords: GO-KARTING, Mathematical Modeling, CAD, ANSIS.

I. INTRODUCTION

To achieve our goal team has been divide into various groups and each group is assigned a specific component of the vehicle (Chassis, Steering, Brakes ,Power Transmission and , Wheel Assembly).

The team is focused to, design the vehicle by keeping in mind the Karting competition requirements, driver's comfort and safety, to increase the performance and drive ability of the go kart.

We approached our design by considering all possible alternatives for a system & modeling & analysis them in CAD & CAM software. For designing, analysis and optimization of the vehicle components software like CATIA **V5 R16** (design, analysis and simulation) is used. Based on analysis results, the model was modified and retested and a final design was frozen.

Requirements of a vehicle:
1. Low cost but durable
2. Endurance
3. Parts easily available for maintenance
4. Optimum Speed and Acceleration
5. Safety
6. High efficiency
7. Ergonomically sound design

With this we had a view of our Go Kart. This started our mission and we set up some parameters for our work, distributed ourselves in groups.

Sub-teams for design
- ❖ Chassis
- ❖ Steering
- ❖ Braking
- ❖ Transmission
- ❖ Innovation
- ❖ Electrical System

Our main aim was to work under the guidelines of the rule book, and use the maximum limits.

Main sections:
The design of Karting competition is divided into following sections:
1. Roll cage and analysis
2. Steering
3. Braking And Wheels
4. Transmission

Chassis design and analysis

Chassis is designed by keeping in mind objectives and requirements of Karting competition, driver's comfort and safety, compact size, weight reduction, minimum stress concentration and a competing design. Special efforts have been taken for safety of the occupants, ease of manufacturing, cost, quality, weight, and overall attractiveness. Other design factors included durability and maintainability of the frame.

Design Methodology : Inside - Out methodology considering ergonomics

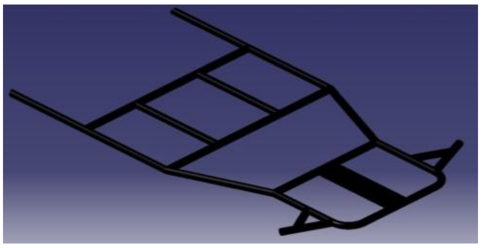


Fig. 1 Main chassis

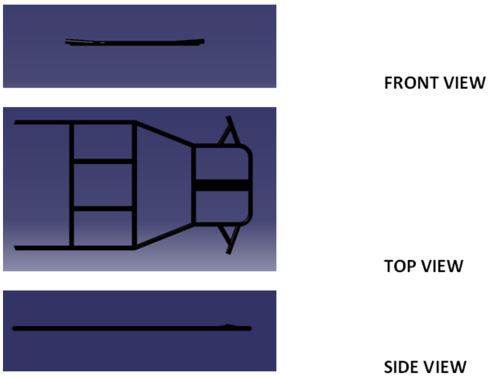


Fig.2 View of chassis

Material selected

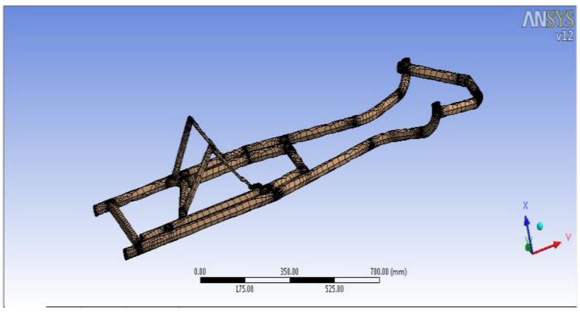
Material – grade : aisi 1018

Composition (%) c = 0.20 %; mn = 0 .90 %; p = 0.035 %; s = 0 .05

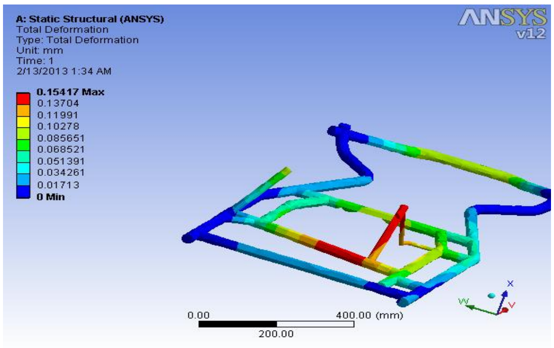
Yield stress	370 N/mm²
Ultimate stress	440 N/mm²
Density	7800 kgm-3
Poisson's ratio	0.29
Tube specifications	OD= 1.25" (31.75 mm) Thickness = 0.0787" (2 mm)

Final element analysis

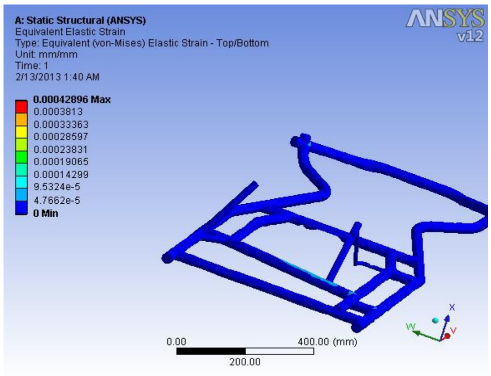
The FEA can be seen below with various constraints given below:

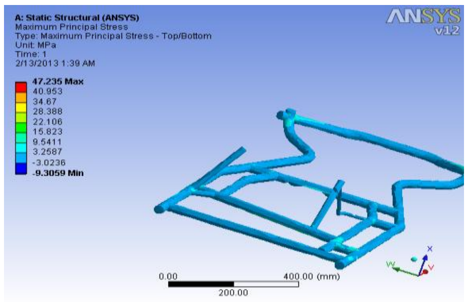


The Model of the Go-Kart design above meshed model. As can be seen, the design distributes the load equally and thus, the strength of the design is high and is effective for high speed driving.



As can be seen from the image above, the total deformation is maximum at red portion (in diagonal bar and Seat clamp) apart from that total deformation is minimum even at 150 Kg (including dead weight of the engine and an expandable load of the driver and fuel) of load on the design.





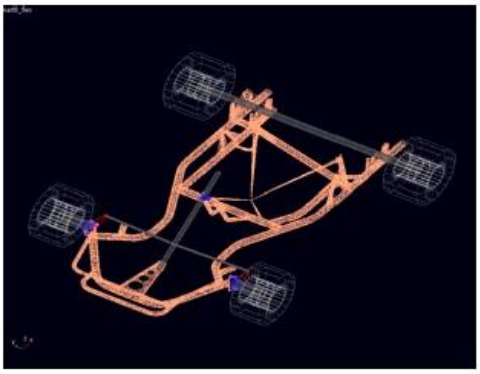
As can be seen from Equivalent Elastic Strain Test and Maximum Principal Stress test, the design has minimum stress points where the load is showing defects in design.

Multi-body analysis

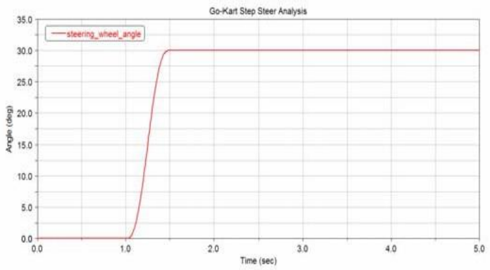
Multi body numerical analysis is a powerful tool to evaluate the global vehicle performance, a comparative virtual method of testing for performing various dynamic tests on various software analysis.

After the FEM model was correctly understood upon, it was possible to set up a software environment of torsional tests on the chassis and the following results were obtained for various constrains.

Modulus of Elasticity (MPa)	Displacement (mm)
190	2.4356
210	2.203
220	2.1027
250	1.8501



The above image shows the final Multi-Body Model .The rear axle has been modelled as hollow, to consider exclusively only the frame deformation rate in the virtual dynamic maneuvers. The virtual prototype has been subjected to a step steer analysis to understand the vehicle dynamic behavior and the importance of the frame torsional stiffness to reach maximum level of performance.During this maneuver the steering angle is valid from 0^o to 30^o in a time of 0.5 seconds with initial speed about 80 km/hr.



II. CONCLUSION

In this work, a detailed methodology of the virtual design and testing has been presented including the reasoning of using the materials used for the fabrication of the chassis and axle.
Also, the reasoning of fabrication of new chassis design of go-kart which is different than the chassis de design of the standard Go-Kart has been given and proven. Even if the entire process of design and testing proposed has shown interesting results but methodology must be still validated through dynamic experimental tests. This will allow the creation of mathematical model completely defined and validated, giving the basis of future developments regarding the optimization process of go-kart performance

Steering mechanism

Primary function of steerin gsys temisto achieve angular motions of the wheels tonego tiatea turn.This is done through hlinkage andsteeringgear whichconvert the rotarymotionof the steering wheel into angular motion of the frontroadwheelsbymeansof rackandpinionmechanismandother functionsareto provide directionalstabilityof vehicle,tominimize tyrewear andtoprovide perfectsteeringconditions. Thesteeringsystemhasthree major components:

- The steering wheel and attached shaft in the steering column which transmit the driver'smovementtosteeringgear.
- The steeringgearthatincreasesthe mechanicaladvantage whilechanging the rotarymotionof steeringwheeltolinearmotion.
- The steeringlinkage (tie-rods) thatcarriesthe linear motiontosteering knuckle arms.

Implementation:

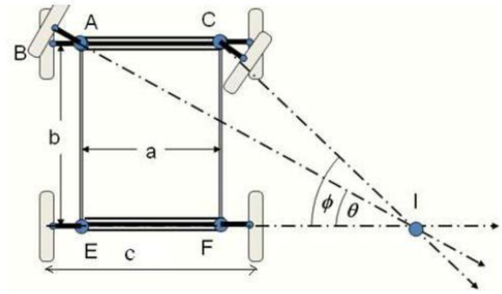
Thesixlinksteeringmechanismwillfunctioni nthe followingmanner. When thedriver willmove the steeringhandle whichisconnectedtothe triangular platethe one of the linkswhichisconnectedtothetriangular plate willbe pulledandanother linkattachedtoitwillbe pushedleadingtoturningof the wheelatdesiredangle.

Feasibility:

Thesteeringmechanismspracticallyfeasibleasithasbe enanalyzed onadams andthe resultonAdamswassatisfactoryandsuccessful.

Correct SteeringAngle Condition

The steeringisachievedwhenallfour wheelsare rollingperfectlyunderallconditionsof running.Whiletakingturnsthe perfectrollingis satisfiedwhentheaxesoffrontwheelswhenprodu cedmeettherear wheelaxisatonepointcalledInstantaneouscentre of vehicle.Ithasbeen foundthatinner wheeltakesgreater angleof turningthanouter wheel.



Here ,
b=Wheel base
a=distancebetweenpivotcenter.
ϴ= Angle ofinner wheel
Φ= Angle of outer wheel
Fromfigure,
CotΦ=(FI+a) /b=FI/b+a/b=cotϴ+b/a,
Cot Φ- Cot ϴ= b/a;
Turningradiusfor front innerwheel=b/sinϴ–(c-a)/2.
Turningradiusfor frontouterwheel= b/sin Φ+(c-a)

Six link Triangularplate steering mechanism
Thissteeringmechanismcanbe theoreticallySplitintotwocombined4bar linkages.Inthismechanismtriangularplate isconsideredasafixedlinkwithis joinedbyone of itsendtotie rods whichare fixedtowheels.Withsixlink steeringmechanismwe

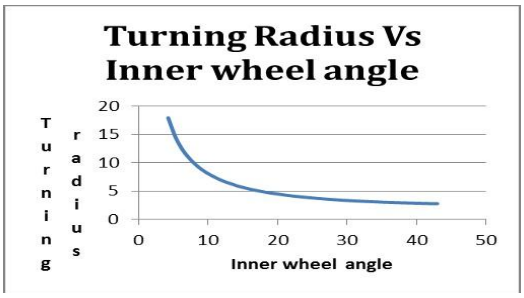
- Achievedbetterhandlingofthevehicle.
- Bettercontrolover Ackermanerror
- Increasedmanoeuvrabilityof the vehicle.
- Reducedthesteeringratio.
- Hadeasyreparabilityandbetter serviceabilityof thesteeringmechanism

Basicdesign procedure
1. Designthe triangular linkfirst.
2. Designthe lengthof thelinksconnectedtohubsthroughiteration.
3. Calculate the turningradiusandthenfindtherespective angleof rotationof inner wheelthroughdifferentiteration.

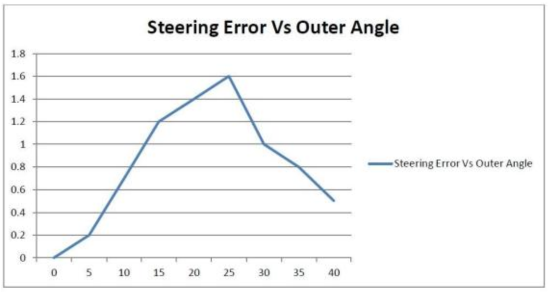
Assumptions
1.Wheeltrackis 40in.
2.Wheelbase is42 in

Calculations
Turningradiuscalculation(for sixlinkmechanism)
The turningradiushasdifferentvaluesforeachtyre. Themaximumbeingfor the frontouter wheel.
Therefore:-
1. For outer frontwheel:
R= (b/ sinØ)+ ((a-c)/2),

where, Øisthe maximumangleturnedbyouter wheel, a= Dist.Between Centre of frontwheels=30in, b=wheelbase=41.73in,
c= wheeltrack=44in, r=3.729m
The Resultsobtainedfor the mostOptimizedmechanismthusobtainedare tabulatedasshowninthetable

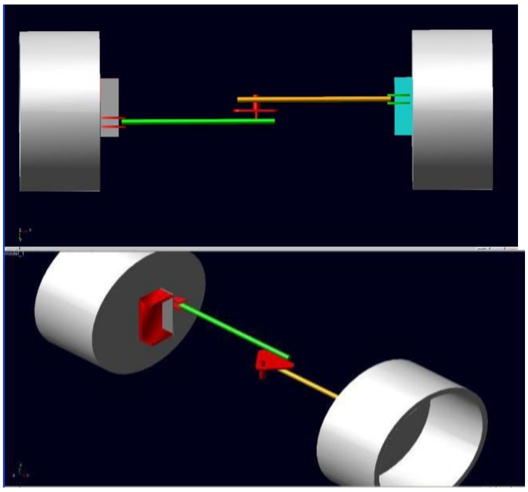


GraphshowingtheTurningRadiusVsInner tireangle



GraphshowingtheAckerman error VsInner tireangle

Methodofimplementation
Allthepartsof thesteeringmechanismwillbe manufacturedinour workshop andassembled. Nootherpartswillbe requiredfrommarketinmanufacturing thisdesign.Allthe weldingprocesseswillbe done throughMIGwelding



Brake design

Thebasicprincipleonwhichthebrakesworki stheconversionofKinetic energy ofthevehicle intoheatsoastobringthe vehicletorestposition.Atthe timeofapplicationofbrakestheinertiaforceandtheretr adingforceform an overturningcouplewhichresultsinincreaseoffrontrea ctionanddecreaseof rear reaction. Thussome of the weightistransferredfromrear tofrontwheels.

Drumdiameter	195 mm
Shoe width	43 mm
Frictionfactor	0.35
Contact angle of shoe	11.50
Distance b/w pivotpointand pointof applicationof force (c)	165 mm
Distance b/w pivotpointand centre (a)	82 mm
Wheelcylinder pistondiameter	15mm

The designofbrakesystemwascreatedtocomplywi thallSAEregulations.

Braking System

- Hydraulic disc brake is used in Go kart
- Rear shaft single disc brake
- Master cylinder of TATA NANO (Non Booster Version) is used
- Rotor of Bajaj pulsar 150 cc is used
- Pedal ratio of 3:1 is used
- **Front weight**: 117 lbs (53 Kg)
- **Rear weight**: 273 lbs (123 Kg)
- **Cg** : 10 ”
- **Dynamic Front Weight**: 170 lbs (77 Kg)
- **Dynamic Rear Weight**: 220 lbs (99 Kg)
- **Wheelbase** : 46 “
- **Leg input force** : 40 lbs
- **Pedal ratio** : 3
- **Rotor dia**: 9.44”
- **Caliper piston dia**: 0.98”
- **Brake pad cf**: 0.4
- **Brake pad radial ht**: 0.98”
- **Brake torque available** : 246.7 lbft (112 Kg.ft)

Design criteria forwheelbrakes

• Braketype
• Endurance (resistance towear andsevereuse)
• Space available forinstallation
• Acceptablepressurelevels
• Rigidity(volume of brake fluidrequiredfor actuation)
• Pedaltravelandpedalforce
• Comfortrequirement

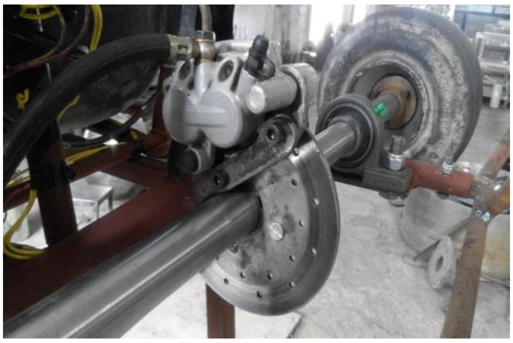
Input ParametersFor BrakeDesign

• Inputforce:F
• Outsidediameter:D_O
• Inside diameter:D_I (for disc)
• Fac /shoe Width:b
• Number ofbrakes(brake surfaces):‘n’
• Brakepressure (Max.):$P_{(Max.)}$
• Brakepressure*Speed(Max.):$P*V_{(Max.)}$
• Brakingtorque andstartspeed : N_0

Xtypeof circuit is usedto avoidaccident in caseofa line failure.

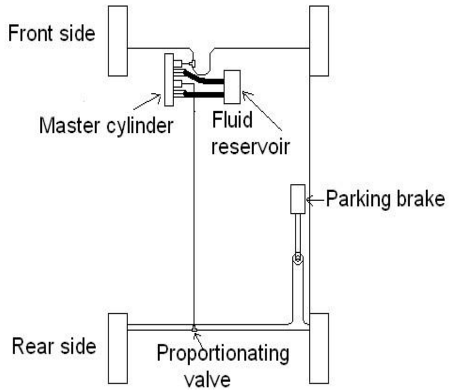
Use of tendom type of master cylinder forindependentbraking. Why use tandemtypemastercylinder?
Tandemmaster cylinder is an independentbrake circuit, in caseof anyleakage inthe front line asshowninabovefigure effective brakingprovided bythe rearbrakesorvice versa.

BrakesCalculation

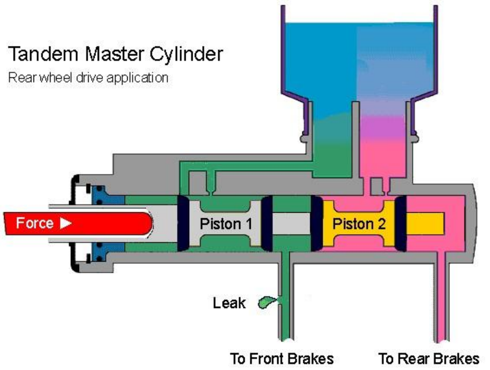


Typesof Brake Forourvehicle

Our vehicle is equipped with a hydraulic braking system that acts on all wheels and is operated by a single foot . The brake system is capable of locking ALL FOUR wheels in a static condition and dynamically on pavement or an unpaved surface. Independent brake system has incorporated in the vehicle. We use disc brakes in the front wheels and drum brake in the rear wheels. At the time of braking almost 60% weight reaction is transferred to the front side and 40% to the rear side. As disc brakes are more efficient than drum brakes, so we use disc brake in front



Braking Distance Calculation



VELOCITY (KMPH)	25	30	35	40	45	50	55	60
BRAKING DISTANCE (M)	3.3	4.7	6.4	8.4	10.6	13.1	15.9	17.5

Since,
V2= U2-2as
AtStillcondition,V=0
And,a = u*g=0.75*9.81=7.35m/s2
S =BrakingDistance= U2/ 2a
AndAlso,
V=U+a*t
V= 0
BrakingTime = U/a

ISO chain no.	Pitch (p) mm	Roller dia.(d1) mm (max)	Width (b1) mm (max)	Transverse pitch (pt) mm	Breaking load min. (N)
12A	19.05	11.91	12.57	22.78	31100
12B	19.05	12.07	11.68	19.46	28900

III. TRANSMISSION SYSTEM

Engine Specifications
Rated power:11bhp (11.165 ps) @ 8000 rpm.
Maximum torque:11 N-m @ 6500 rpm.
The engine and gear box was selected of **HONDA STUNNER 125 cc**.
The gear box specification is 1 downward and 4 upward gear.
So we have little choice while working on transmission. Configuration of vehicle would be side engine rear wheel drive. We have decided to keep the maximum vehicle speed at 72 Km/hr as vehicle does not require larger torque. To increase the speed we have only chance to increase the tire diameter and decrease the sprocket reduction ratio as much as possible.

Dimension	Notation	Value(mm)
Chain pitch	P	19.05
PCD	D	91.625 &139
Roller diameter	d1	12.07
Width	b1	11.68
Transverse pitch	Pt	19.46
Top diameter	Da	Da(max)=103.367&148 Da(min)=96.573&143
Root diameter	Df	79.277&130
Roller seating radius	Ri	ri(max)=6.253 ri(min)=6.095
Roller seating angle	A	α(max)=114&117 α(min)=134&137

Priorities while working on transmission

1. By using appropriate parts so as to reduce cost and transmission losses.
2. We used standard parts so as to increase the reliability of the parts.

By considering all the factors we have calculated the speed of vehicle. As engine will be operating in the range between 6000 - 8000.
The table shows the speed of vehicle.
The torque at wheel is also calculated at various speeds. The table shows the torque at various speeds.

Torque at wheel

Gear position	8500 rpm	8000 rpm	7500 rpm	7000 rpm	6500 rpm	6000 rpm	5500 rpm	5000 rpm
1	153.97	163.59	174.5	186.96	201.34	218.125	237.95	261.75
2	97.41	149.12	172.07	186.41	203.35	137.997	150.54	165.598
3	71.953	109.89	126.8	137.37	149.86	101.933	111.2	122.32
4	56.51	86.40	99.69	108.00	117.81	80.056	87.33	96.0678

FOR:12/21
Speed at wheel

Engine rpm	8000	7000	6500	6000	5500	5000
Gear position						
1	23.140	20.487	19.024	17.560	16.097	14.633
2	37.048	32.417	30.101	27.786	25.470	23.155
3	48.899	43.971	39.727	36.671	33.615	30.559
4	60.522	52.957	49.174	45.392	41.609	37.826
5	69.385	60.712	56.375	52.039	47.702	43.365

FOR:14/21

Engine rpm	8000	7000	6500	6000	5500	5000
Gear position						
1	27.316	23.902	22.194	20.487	18.780	17.072
2	43.223	37.820	35.118	32.417	29.715	27.014
3	57.044	49.913	46.348	42.783	39.217	35.652
4	70.609	61.783	57.370	52.957	48.544	44.131
5	80.949	70.831	65.771	60.712	55.652	50.593

FOR:14/27

Engine rpm	8000	7000	6500	6000	5500	5000
Gear position						
1	27.316	23.902	22.194	20.487	18.780	17.072
2	43.223	37.820	35.118	32.417	29.715	27.014
3	57.044	49.913	46.348	42.783	39.217	35.652
4	70.609	61.783	57.370	52.957	48.544	44.131
5	80.949	70.831	65.771	60.712	55.652	50.593

FOR:14/27

Engine rpm	8000	7000	6500	6000	5500	5000
Gear position						
1	21.247	18.591	17.263	15.935	14.607	13.279
2	33.619	29.416	27.315	25.214	23.113	21.012
3	44.369	38.823	36.050	33.276	30.503	27.730
4	54.920	48.055	44.623	41.190	37.758	34.325
5	62.963	55.092	51.157	47.222	43.287	39.352

FOR:14/36

Engine rpm	8000	7000	6500	6000	5500	5000
Gear position						
1	15.934	13.943	12.947	11.951	10.955	9.959
2	25.213	22.062	20.486	18.910	17.334	15.758
3	33.276	29.116	27.036	24.957	22.877	20.797
4	41.189	36.040	33.466	30.892	28.317	25.743
5	47.221	41.318	38.367	65.415	32.464	29.513

FOR:13/51

Engine rpm	8000	7000	6500	6000	5500	5000
Gear position						
1	10.444	9.139	8.486	7.833	7.180	6.527
2	16.526	14.460	13.427	12.394	11.361	10.329
3	21.810	19.084	17.721	16.358	14.995	13.631
4	26.997	23.623	21.935	20.248	18.561	16.873
5	30.951	27.082	25.148	23.213	21.279	19.344

FOR 14/25

Engine rpm	8000	7000	6500	6000	5500	5000
Gear position						
1	22.946	20.077	18.649	17.209	15.775	14.341
2	36.473	31.769	29.500	37.230	24.961	22.692
3	47.917	41.927	38.932	35.938	32.943	29.948
4	59.312	51.898	48.191	44.484	40.777	37.070
5	67.998	59.498	55.248	50.998	46.748	42.498

Transmission characteristics

Gear position	Overall gear ratio	Vehicle speed at maximum torque (km/hr)	Maximum vehicle speed attainable (km/hr)	Torque available at wheel (N-m)	Acceleration (m/s^2)
1	16.92	26.457	26.76	153.97	3.72
2	10.70	41.816	42.31	97.41	2.34
3	7.907	56.611	57.28	71.953	1.66
4	6.21	64.29	72.08	56.51	1.36

Diameter of shaft – 35 mm.
Material of shaft – En8
IS Indian- C45
UTS- 660 N/mm^2

- No. of links required approximately – 69
- Engine mounting – Vertical
- No. of teeth on sprocket 1 – 14
- No. of teeth on sprocket 2 – 41
- Total sprocket reduction – 2.92

✓ Pedestal bearings are used to support the shaft as per requirement of shaft.
✓ Hub and Keys are used to lock the sprocket with shaft.
✓ Neoprene rubber packing's are used to damp the vibrations.

Purpose of using chain drive:

1. For same power transmission the size of belt driven system is large.
2. It has less losses and chances of slipping.

IV. CONCLUSION

OUR TEAMS objective and motive at INTERNATIONAL SERIES OF KARTING 2016 is to design and build a Go Kart that can compete all competition and events in "ISK2016'' without failure and to excel in the game. All designs and calculations were done to realize this aim.

Durability, Reliability and Safety were considered as the key points of the design.

VEHICLE SPECIFICATION:-

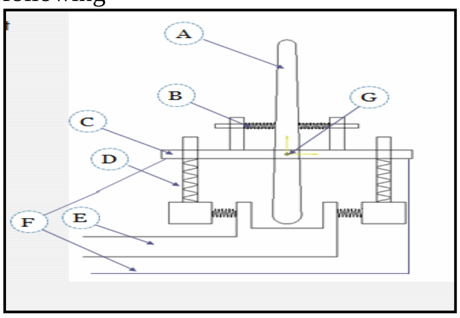
DIMENSIONS		
	Overall Length	66.53" (169 cm)
	Overall Width	54" (137 cm)
	Wheel Base	41" (105 cm)

	Front Track Width	38" (97 cm)
	Rear Track Width	46" (116 cm)
	Ground Clearance	1.5" (3.84 cm)
PERFOEMANCE		
	Max. Speed	72 km/hr
	Min. Turning radius	2.5 m
ENGINE		
	Company and Model	HONDA STUNNER 125 cc
	Displacement	124.55 cc
	Max. Output Power	11 Bhp @ 8000 rpm
	Max. Torque	11 N-m @ 6500 rpm
FUEL SYSTEM		
	Fuel System	Carburetor
	Fuel Tank Capacity	3.5 liter
TRANSMISSION		
	Type	Gear Box – Honda Stunner 125 cc , Manual Transmission
STEERING		
	Type	Tie Rod and Pit Arm Linkage Mechanism
BRAKES		
	Rear	Single Hydraulic Disc Brake
TYRES		
	Front	10-4.5-5 Tubeless
	Rear	11-7.1-5 Tubeless

INNOVATION

1. Quick gear shift mechanism:

The go kart designed by our teams is equipped with unique mechanism of quick gear shifting
Quick gear shifting mechanism is shown in following



Quick gear shifting mechanism

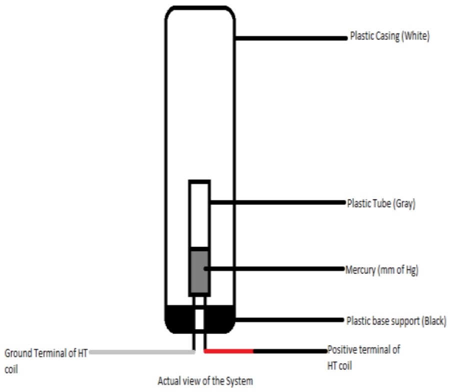
Main components of quick gear shift mechanism are
A: Gear shifting lever
B: Hard spring
C: Rectangular pipe with slot
D: Soft spring
E: Gear shifter
F: Clutch cable
G: Pivot point
Working:

When drive pulls the lever during changing gear, during first few rotation the clutch cable is pulled and clutch is disengaged, this happens because of the compression of soft spring, now during further rotation of the lever the plate stops, as a result clutch is disengaged now further rotation of lever displaces the gear lever and gear is changed and when the driver releases the lever the lever comes in mean position

V. APPLICATION

Quick gear shift mechanism allows the driver to shift the gear in very much less time than the conventional gear shifting This can help the driver to shift gear easily during races and make full utilization of the engine.

Electronic Kill Switch



Principle: Ignition switching phenomenon of the engine based on gravity action.

The Basic Components of the electronic kill switch System:

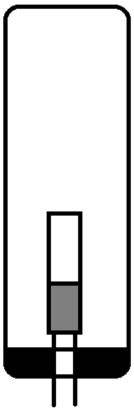
1. Electronic Float (Plastic tube + mercury).
2. Plastic Casing.
3. Plastic Tube.
4. Mercury.
5. Positive terminal connection wire.
6. Negative earth connection wire.

Dimensions of the System:

1. Plastic Tube Casing: 55 mm.
2. Plastic Base Support: 15 mm.

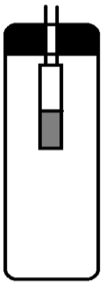
Working of the electronic kill switch:

Position 1:



Initially, the plastic tube is in the vertical position. It is in vertical position due to the gravity effect. When the mercury is in between the two connections of the wires. The positive terminal will be ground. Therefore the circuit will become short. Thus, the circuit remains in on condition.

Position 2:



When the Go Kart turns upside down. The mercury will move in the opposite direction of the gravity. Therefore, the supply to HT coil will shut off. The mercury will conduct. As a result of which the ignition will not be in operation. Thus, the circuit will be in off condition.

Effects Of Environment:

The design being implemented in the innovation will not harm the environment in any manner.

Feasibility:

1. The copper wires being used in the design are easily available in a certified electrical store.
2. The mercury metal is readily available in a chemical selling store/ scientific shop.
3. The plastic tube is available in any hardware store. Any size of plastic tube can be used considering the height of float.

Note: The size of the plastic tube should be equal or more than the size of the electronic float.

Costing VS Utility:

Cost Analysis:

Components	Cost (Rupees)
Mercury (10 gram)	100
Copper wires	10
Plastic Tube	20
Adeltite (Fastner)	15

The Total cost of the electronic kill switch system is 145 rupees approximately.

Utility:

It is a safety innovation. This innovation will be mainly utilized to save the precious life of the driver by switching off the engine automatically. The innovation can be utilized in every machine which is accompanied by an engine and which is prone to the phenomenon of toppling.

The categories of machine are as follows:

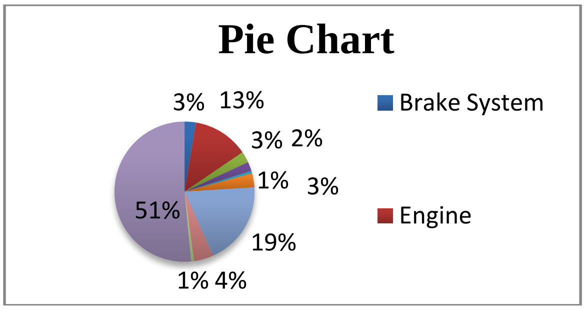
1. On-road: Bus, Truck, Automobile, Moped, Motorcycle.
2. Off-road: All terrain vehicles (Quad bike), Sports Utility vehicles (SUV).
3. Commercial Flight.
4. Sea transport: Cruise ships, Cargo carriers.
5. Helicopters.

Note: The innovation will not be utilized in any of the fighter planes. The topple phenomenon is a part of their flight.

This system is a very innovative alternative considering the safety aspect of the human body.

S. No.	Systems	Materials	Processes	Fasteners	Tooling	Total
1	Brake System	Rs 2,050/-	Rs 205/-	Rs 102/-	Rs 102/-	Rs 2,460/-
2	Engine	Rs 10,000/-	Rs 1000/-	Rs 500/-	Rs 500/-	Rs 12,000/-
3	Frame	Rs 2,000/-	Rs 200/-	Rs 100/-	Rs 100/-	Rs 2,400/-
4	Body Works	Rs 1,000/-	Rs 1,000/-	---	---	Rs 2,000/-
5	Instruments & Wiring	Rs 250/-	---	---	---	Rs 800/-
6	Steering System	Rs 2,500/-	Rs 250/-	Rs 125/-	Rs 125/-	Rs 3,000/-
7	Wheels, Rims & Transmission	Rs 15,000/-	Rs 1500/-	Rs 750/-	Rs 750/-	Rs 18,000/-
8	Miscellaneous, Fit & Finish	Rs 3,500/-	Rs 350/-	Rs 175/-	Rs 175/-	Rs 4,200/-
9	Innovation	Rs 150/-	---	---	---	Rs 150/-
10	Safety gears	Rs 48,000/-	---	---	---	Rs 48,000/-
	Total					93,010/-

Bill Of Material:-



Sr.No	Sub-Assembly	Part list	Vendor	Cost (INR)
1.	Chassis	AISI 1018	Steel Mart, Mumbai	2400/-
2.	Transmission	Rear Shafts , Wheels, Rims , Couplings, etc	Mahindra Trendy wheels, Hyundai etc	18,000/-
3.	Engine	125 cc Petrol Engine	Honda Stunner	12,000/-
4.	Braking	Master Cylinder, Brake caliper, discs etc	Marvellous motors	2,460/-
5.	Steering	Tie Rod , Pit Arm , Knuckle , Stub Axle etc	Marvellous Motors, etc	3,000/-

Kart

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