FINAL REPORT

TEAM: PHOTORAPTORS

LOVELY PROFFESSIONAL UNIVERSITY

HYBRID GO-KART CHAMPIONSHIP (2014-2015)

ABSTRACT-

The objective of this report is to highlight the final design report of team **PHOTORAPTORS** hybrid Go-Kart vehicle to compete in Hybrid Go-Kart Championship 2014-15.The Team's primary objective is to design a safe and functional vehicle based on a rigid and torsion-free frame, well mounted power train and to understand the finer aspects of vehicle design with the ulterior motive of fabricating prototype vehicle that could be manufactured for consumer sale, while strictly adhering to the competition rule. The secondary objective is to enhance driver's comfort and safety, and to increase the performance and maneuverability of the vehicle .To achieve our goal the team has been divided into core groups responsible for the design and optimization of major sub-systems which were later integrated into the final blueprint.

Summary

The goal of the project was to design a hybrid go-kart. A hybrid go-kart will allow for luxuries such as increased gas mileage, automatic recharging of batteries, less pollution, and quieter operation.

The basic system of the go-kart works as follows. The electric motor is powered by batteries. When these batteries lose their power, the gas engine is activated and is used to propel the go-kart, and also charge the batteries. The batteries are charged by using the electric motor as a generator whose shaft is rotated by the gas engine. Once the batteries contain enough power to sustain propulsion of the go-kart, the gasoline engine is deactivated and the electric motor is reactivated.

The main problem of the project was to design a working prototype that was able to easily switch between the electric motor and the gasoline engine. This feat was accomplished by using the two motors in parallel, a centrifugal clutch, and by implementing an automatic gasoline engine starting circuit. The following report has details about this switching system, final budget values, labor costs, an operator's manual, and more.

Problem Statement

Although most motor vehicles are powered by gasoline engines, this is not the only option. There are several types of alternative fuel-powered cars including ethanol, hydrogen fuel cells, and solar energy.

These are all attempts at decreasing the population's dependency on gasoline. Another type of alternatively-powered car is a hybrid. A hybrid vehicle is a vehicle that uses two or more power sources to propel the car. The goal of using two or more combined power sources is to minimize the amount of fuel used. With that, the goal of our project was to decrease the go-kart's dependency on gasoline. The project can be considered a success if a prototype is produced that can operate on either a gasoline engine or an electric motor. The go-kart should be able to flawlessly switch between the two motors during operation.

System Specifications

- The go-kart runs on a separate gas powered engine and electric powered motor
- The go-kart switches between the two motors
- The electric motor operates on 48V.
- An on-board controller converts the DC voltage from the batteries to an AC voltage that outputs to the electric motor
- The controller was programmed and customized to fit the design
- The gasoline engine is able to start manually or automatically based on low voltage levels
- While using the gas engine, the electric motor is converted into a generator, which recharges the batteries
- A voltmeter on the steering wheel gives the user constant updates on the voltage level of the batteries
- Power to both the gasoline and electric motors can be restricted at any time by closing switches on the dashboard of the go-kart

INTRODUCTION-

We approached our design by considering all possible alternatives for a system & modeling them in CAD software SOLID WORKS. And subjected to analysis. Based on analyses result, the model was modified and retested and a final design was frozen .The design process of the vehicle is iterative and is based on various engineering and reverse engineering processes depending upon the availability, cost and other such factors. So the design process focuses on following objectives:

Safety, Serviceability, Strength, ruggedness , Standardization, Cost, Driving feel and ergonomics ,Aesthetics

The design objectives set out to be achieved were three simple goals applied to every component of the car: durable, eco-friendly, and high performance, to optimizing the design by avoiding over designing, which would also help in reducing the cost .With this we had a view of our kart. This started our goal and we set up some parameters for our work , distributed ourselves in groups.

Sub-Teams for Design

- Frame design
- Body and Composites
- Steering system design
- Brake and Wheels
- Drive train design
- Electrical design

We proceeded by setting up the budget for the project. Throughout the design process we distributed the budget in such a way that if we assign more money to one system, we reduce that amount from some other system.

DESIGN OF VEHICLE

The design section of this report is broken into four major topics-

- The design objectives
- The design calculations and analysis
- Considerations
- Testing

Based on the overall design objectives of durability , performance, and light- weight design, the component is evaluated by the design team and must meet all of the criteria to become a part of the overall successful design alternatives were also considered during each process and testing commenced once the chosen design met the design objectives.

FRAME DESIGN

OBJECTIVE

The frame is designed to meet the technical requirements of competition the objective of the chassis is to encapsulate all components of the kart, including a driver, efficiently and safely. Principal aspects of the chassis focused on during the design and implementation included driver safety, drive train integration, and structural weight, and operator ergonomic. The number one priority in the chassis design was driver safety. By the competition rules and Finite Element Analysis (FEA), the design assured.

DESIGN

The main component of the frame are divided into the two major parts first the front block (cockpit) for steering and seat positions etc. and second rear block (engine compartment) for transmission and brake assembly.

MATERIAL USED

The material AISI-1020 is used in the frame design because of its good weld ability relatively soft and strengthens as well as good manufacturability. A good strength material is important in a roll cage because the roll cage needs to absorb as much energy as possible to prevent the roll cage material from fracturing at the time of high impact. AISI- 1020 has chosen for the chassis because it has structural properties that provide a low weight to strength ratio.

1 inch diameter tube with a thicker wall is used instead of 1.5 inch diameter tube with a thinner wall for manufacturability purposes. Although the thinner wall, 1.5 inch diameter tube would be slightly lighter than the thicker wall, 1 inch diameter tube, it would have been more material and more difficult to weld. Then it is also assured by analysis in SOLID WORK software.

The various Physical properties of the material are as follow-

S.N	PROPERTIES	VALUES
1	TENSILE STRENGTH	394.7(Mpa)
2	YIELD STRENGTH	294.8(Mpa)
3	ELASTIC MODULUS	190-210(Gpa)
4	POISSON'S RATIO	0.27-0.30
5	ELONGATION	36.5%
6	HARDNESS	111(HB)
7	IMPACT STRENGTH(izod)	123.4 (J)

The chemical composition of the material is as –

- Carbon C = 0.22%
- Manganese Mn = 0.55%
- Silicon Si = 0.22%
- Sulphur S = 0.009%
- Phosphorus P = 0.01%
- Chromium= 0.15%
- Iron= 98.84%

The above mentioned properties satisfy the technical requirement of material which is to be used in frame.

SAFETY

Roll cage feature were first implemented bykeeping on mind the safety requirement of the event .The first primary safety standard focused on during design was maintaining the proper clearanceof the driver's body rest to the other rigid parts like engine compartment, firewall structure, and panel bracing of the vehicle. Once the basic requirements fulfilled the other safety design were implemented. The chassis was designed to give occupant extra space to operate the vehicle easily. The place of the fire extinguisher is designed in the easily accessible point and also the eathen foam padding is provided over the pipes adjacent to driver.

SAFETY HARNESS-

A five point racing harness attached to the most rigid members of the roll cage was utilized to ensure the maximum amount of driver safety restraint. Attaching the seat belts to the most rigid and structural chassis components guarantees reliability of the seat belt under the extreme forces possible in a collision. Using a quick release lever style seat belt clasp gives the driver the ability to get out of the vehicle in a safe amount of time in. The safety restraints provided in the car will be sufficient for keeping a driver safe in the event of a collision, while still allowing the driver to escape in the required amount of time.

STRUCTURAL RIGIDITY-

Overall frame structural rigidity is important to enhance the capabilities of a 4-wheeler vehicle. To measure the overall frame rigidity, tensional rigidity analysis was conducted through FEA. The objective of the tensional rigidity analysis was to manipulate the chassis design within the FEA software to increase the amount of torque per degree of chassis deflection. By theoretically increasing this value, the actual vehicle could have the ability to be more torsion-ally rigid, making it able to withstand more intensive without failure

WEIGHT

Keeping the frame as light as possible was a top priority. When power is limited, vehicle weight is a large factor in vehicle performance. The frame is one of the largest and heaviest components of the car, and which is why special attention was placed on the vehicle's frame weight. The strategy utilized to minimize weight consisted of determining defined goals for the chassis and employing the correct material in the best places to accomplish those goals. Once baseline safety design requirements were met, FEA aided the material decision making process. FEA specifically helped to determine whether a member was under high or low stresses, in the scenarios discussed previously, making the chassis design process efficient and effective. Chassis members were made out of 0.078 inch (2mm) wall thinness and 1 inch

(25.4mm) outer diameter SAE- 1018, this material was chosen because of its weight reduction capability and beneficial material properties, as was stated previously. Through accurately determining stresses on the chassis in different scenarios, weight reduction was able to be maximized through material selection and placement also the simplicity of the frame design that is use of_less number of members tends to reduction in the weight. The final weight of the chassis was measured on software is 22kg

ASTHETIC

Aesthetically, the roll cage design is improved by the use of more rounded corners than the straight. The unique use of rounded corners allows for a more pleasing look to the vehicle's body as well as a reduced number of welded joints. The use of continuous bended pipes also reduced the no of joints the lack of sharp edges on the roll cage allows for the design of more streamlined body panels which not only look smoother, but may also have a positive effect on the overall aerodynamic drag forces

MANUFACTURABILITY-

All design work for the go kart championship has done In the SOLID WORKS software. Using this program to produce three dimensional model allowed easy revision of prebuilt designs, and gave design team members a visual picture of what the frame would look like. After the design of the frame was finalized, a list of required support members was created and the frame modal was modified. The design for manufacturability, ergonomics, and aesthetics for the roll cage are favorable for its reproduction, serviceability, and comfort. The material selectedSAE-1018 has good manufacturability qualities. To increase manufacturability, many bends were used as frame members. These bends not only give the vehicle a sleek, attractive look but also reduce the total amount of frame members and welds between these members resulting in a lighter, cheaper, and customized chassis. By implementing bends into the design of the frame, the number of cuts and welds were decreased. Decreasing the number of cuts and welds lowers the production cost and increases overall chassis strength. For example, by using more bends, A bending die can perform the job of bending behalf of the welding and joining hence reducing man-hours and production costs. All bends were designed to be made using a tube bender fitted with primary die of 10 cm, secondary die of 15cm, and tertiary of 30 cm, diameter die, which would eliminate costly tooling changes from the manufacturing process.

BODY AND COMPOSITES

OBJECTIVES

The purpose of the body is to prevent debris from entering the vehicle, with the intent of protecting the driver and the vehicle's components. The seat was designed to support the driver comfortably and safely while they are operating the vehicle.

DESIGN

The design of the body and composites has done in the cad software and the FRP is selected for the body works of very less weight

BODY PANELS-

The body panels are made out of .080 inch thick FRP (fiber reinforced plastic) .FRP is a composite material made of a matrix reinforced with fibers the polymer is usually epoxy, vinlester or polyster thermosetting plastic are used in FRP.It is very light material that has desirable properties for a body panel. The panels are designed such that they tends to reduce the aerodynamic moments like pitching from front, yawing from side and also helps to create the downward force to which tends to make the good traction of vehicle with the road & also provide the properties necessary to protect the driver and vehicle components from rocks and other debris. When the panels were integrated into the car, the panels were recessed into the chassis to provide visibility to the chassis members, making the car aesthetically pleasing.

SEAT-

The seat in this kart is also designed to be very light it is very simple made of plastic material and is attached to the chassis by four points only and can be adjusted in angle of back rest according to the requirement of the drivers comfort the back side angle of the seat is at 17 degrees which is the good position of the drivers body rest according to the ergonomics point of view and is kept almost parallel to the fire wall .the seat implemented in our go kart provides a good combination of weight reduction and ergonomics

STEERING SYSTEM DESIGN

OBJECTIVE

The steering system is designed to withstand the stress of safely maneuvering the vehicle through any type of possible condition at the time of driving. The purpose of the steering system is to provide directional control of the vehicle with minimum input. The main goal for steering is to have steering radius of 4m or less and to have 100% Ackerman steering.

DESIGN

Simplicity and safety were the main design specifications for the vehicle's steering system. While designing the steering system the constraints that we possessed were center alignment of steering system, track width, human effort at the steering wheel and the desired response of the steering system. A Pivot Pin steering arrangement was chosen due to its light weight, simple design and low cost. Very less play due to limited number of joints. We are also introduced the multi sensitive steering system. This system has a tendency to increase or decrease the sensitivity of our steering by means of multi port pivot plate, by changing the position of tie rod from port one by one. This system provides the driver simplicity and directional control over vehicle according to condition.

The formulae's used for steering calculation are:

R **= d/2+Lcosec (A/2+B/2)**

Where, R is the turning radius, L is the length of the car, A is the angle of the inside angle of the wheel B is the angle of the outside wheel d is the width of the car.

Our tires is not skidding because the inside front wheel is angled just a little more than the outside front wheel. Inner and outer turning angle is calculated by the formulae-

Outer angle:- tanA = L/(R-d/2)

Inside angle:- tanB = L/(R+d/2)

Caster angle is the most important factor governing how the kart will handle. It will make the kart more stable in rough condition and the kart's straight line stability will also be improved. King pin inclination is used to making a steering tend to return to the straight ahead or centre position. If kingpin is incline at 12 degree, it gives self centering effect and leads to less steering effort

CALCULATIONS-

Various calculations are tabulated as follow according to the vehicle specifications –

INNER TURNING ANGLE	
OUTER TURNING ANGLE	
TURNING RADIUS	
CASTER ANGLE	0(DEGREE)
CAMBER ANGLE	0(DEGREE)
KING PIN INCLINATION	
TIE ROD LENGTH	
STERRING WHEEL RADIUS	

FRONT AXLE-

Front axles are also analyzed against the axial load of tie roads that were placed on the port of tie rod joint to the front axle while steering is on work.The material used for the axles is ASI-4140. Theoretically calculated load of 490 N forces were placed on the axle in which the stress generated is under the safe mode and the factor of safety obtained is 1.8 hence the overall analysis shows that the axle would be safe while working on the specified load conditions.

STEERING DESIGN CONSIDERATIONS-

CONSIDERATION	PRIORITY	CONDITION
SIMPLE DESIGN	ESSENTIAL	MINIMIZE WEIGHT TO MAXIMIZE POWER TO WEIGHT RATIO OF KART
LOW STEERING RATIO	ESSENTIAL	QUICK STEERING RESPONSE
ACKERMAN GEOMETRY	HIGH	TO AVOID SKIDDING WITHOUT USING DIFFRENTIAL
MINIMIZE BUMP STEER	DESIRED	CONSERVE MOMENTUM WHILE STEERING

BRAKE SYSTEM-

OBJECTIVE

The purpose of the brakes is to stop the car safely and effectively. In order to achieve maximum performance from the braking system, the brakes have been designed to lock up rear wheels, while minimizing the cost and weight.

DESIGN

The brake system design includes the single disc at the rear axle to stop the vehicle. It is mounted in the one third part position of the axle with opposing the position of drive train sprocket hence also enables the good balancing requirement.

Master cylinder is used at the front near the brake pedal providing the occupant to easily accessible space. A proper master cylinder bore size was found by doing brake calculations based on the mass, center of gravity, master cylinder volume size, and various dimensions of the vehicle. Though braking power increased with a decrease in bore size, the volume of brake fluid that was able to be displaced decreased with decreasing bore size.

BRAKE DESIGN CONSIDERATION

CONSIDERATION	PRIORITY	REASON
SIMPLICITY	HIGH	OVERALL GOAL OF VEHICLE
PERFORMANCE	HIGH	CAPABLE OF STOPPING THE VEHICLE
LIGHT WEIGTH	HIGH	PREVENT AIR BUBBLE WITHIN THE BREAK LINE
RELIABILITY	ESSENTIAL	LIGHT WEIGTH PARTS TO MINIMIZE TOTAL WEIGHT
ERGONOMICS	ESSENTIAL	OPTIMAL PEDAL ASSEMBLY FITMENT TO SUIT EVERY DRIVER

DRIVE-TRAIN DESIGN

OBJECTIVE

The drive-train is a very important part of the racing cars, taking into consideration that all of the car's poweris transferred through the drive-train system to the ground. The challenge is to harness the engine's 13 brakehorsepower and distribute it to the ground in the most efficient way. The drive-train needs to be able to operate in the lowest and highest gear ratios while performing in all of the different aspects of the competition.

DESIGN

The goal of the drive train is to transfer power from the engine of the vehicle to the wheels. The power transferred must be able to move the vehicle. Acceleration is also an important characteristic controlled by the drive train.Thereare several different methods of power transmission that have been used in cars. We are using a chain drive

ENGINE-

We are using 125cc & 13bhp engine for the power transmission. Engine is mounted in the position above the rear axle on the rigid frame with the anti vibration mountings the positioning of engine is decided on the basis of the availability of the space in the engine compartment of the frame.

WHEELS-

The wheel is one of the main components of the wheel and axle which is one of the six simple machines. Wheels, in conjunction with axles, allow heavy objects to be moved easily facilitating movement or transportation while supporting a load. The selection of tires according to the requirement of performance, event, as well as budget plays an important role. We are using the wheels of diffrent size for front and rear. The size of the tires is (11”x7.1”)rear and (10”x4.5”)front the objective of selecting this tire is to get required ground clearance

ELECTRICAL DESIGN

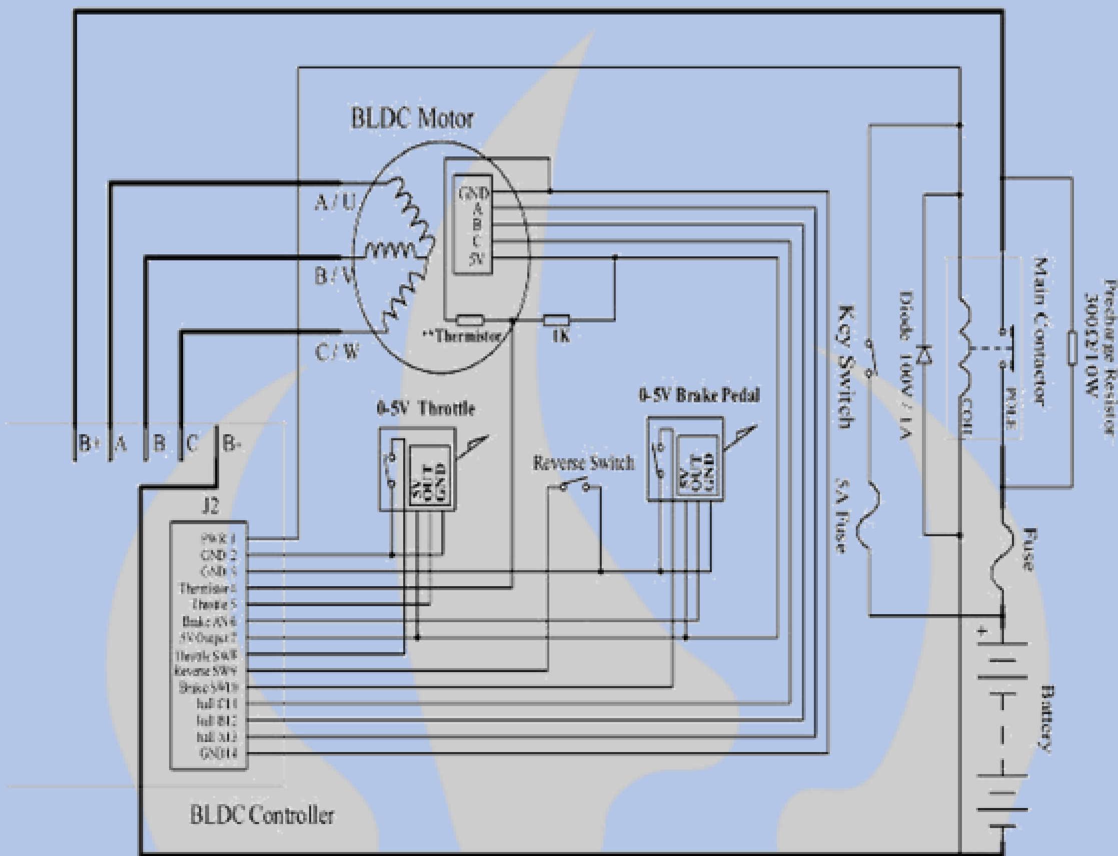
System Design

The go-kart will employ two motors that are connected by a common axle. The two motors are a gasoline engine and an electric motor. The engine is a 13 HP bajaj discover 125 st engine with an electric starter. Electric start capability was desired for two reasons. First, with the electric starter, the driver will not have to get out of the car to manually pull the engine to start it. Secondly, a circuit was designed that will automatically start the engine when the voltage of the batteries falls below a certain threshold (for recharging the batteries). For this, an electric starter is necessary.

Table 1: Electric Motor Decision Matrix

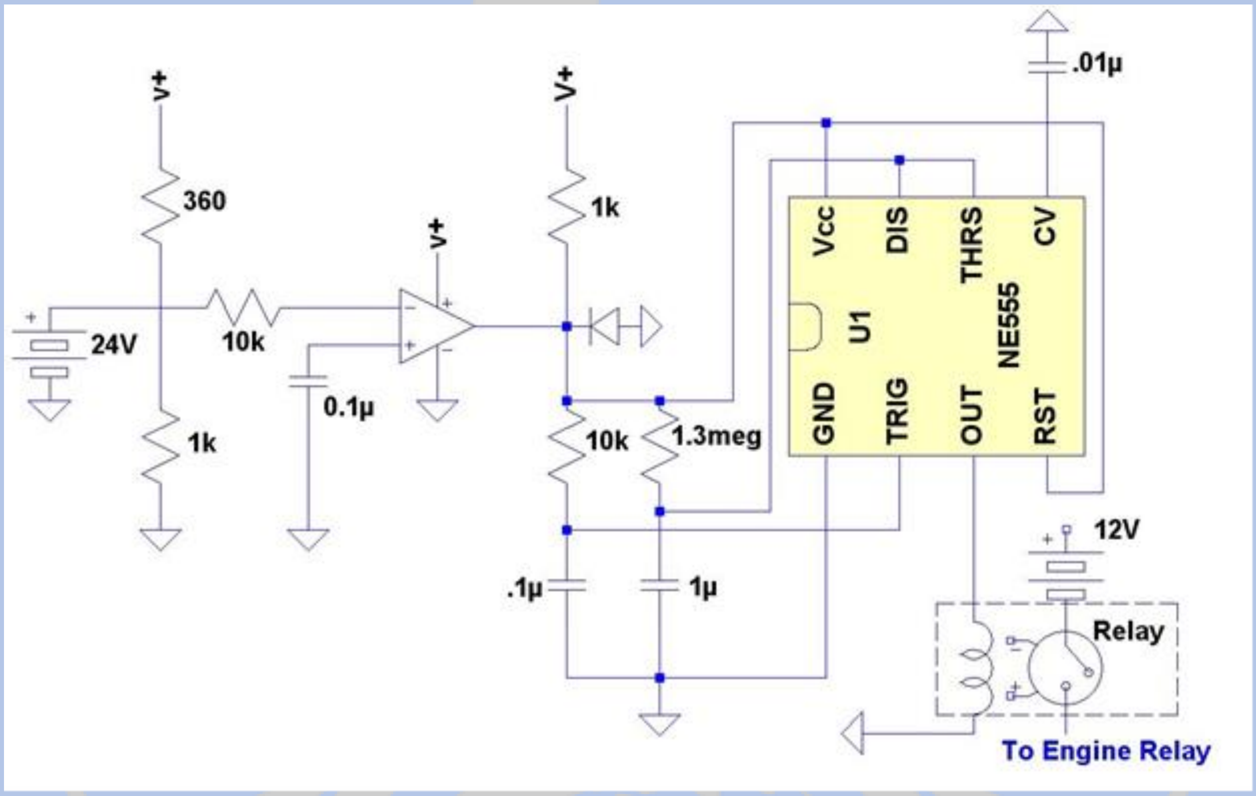
	Cost (.20)	Efficiency (.30)	Safety (.30)	Maintenance (.20)	Total
Brushed Motor	4	2	3	1	2.5
Brushless Motor	1	4	4	4	3.4

To operate the electric motor, a controller was needed. The controller selected was a brushless motor controller that operates on 48 VDC, but send a three phase signal to the motor. This controller is what is needed to convert the DC battery power to three phase power, and also to convert the regeneration power from three phase power back to DC power to recharge the batteries.. Although not yet utilized due to time constraints, the controller is also capable of providing brake regeneration, which would help to keep the batteries charged longer



Controller Connections

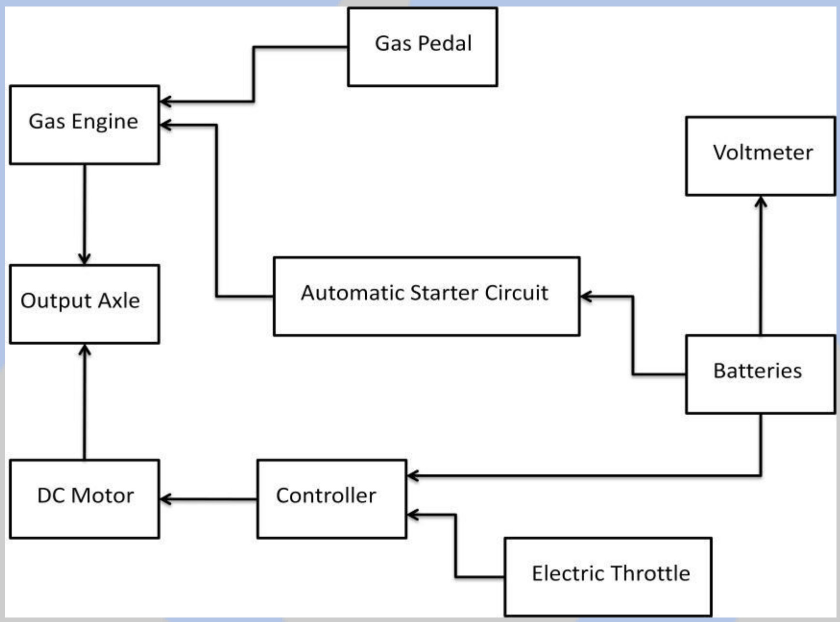
As previously stated, when the battery voltage level falls below a certain threshold (currently 20 V), there is a circuit that will automatically start the gasoline engine. The circuit employs an op amp that sets the reference voltage level, a 555 timer to make the output pulse long enough to start the gasoline engine, and a solid state relay that is used to supply enough current to the gasoline engine starter relay. This circuit diagram can be seen in Figure 2. When the gasoline engine automatically starts, the operator will hear the engine turn on, but can continue to operate on the electric motor if desired, because the clutch for the gasoline engine is still not engaged. If the operator decides to do this, he/she can turn off the gasoline engine with the “kill” switch to save gas. However, the controller will cease operation when the voltage falls below 18 V, so it is highly suggested the operator should charge the batteries when they reach the 20 V level. While recharging the batteries, there is a voltmeter on the steering wheel that the operator can watch to determine when the batteries are at a suitable level to resume electric motor operation. To do this, the operator simply begins using the electric motor throttle, and can then “kill” the gasoline engine. The voltmeter allows the user to know what the voltage level of the batteries is at all times. The user may decide to switch to the gasoline engine at any time by simply manually pushing the engine start button.



Automatic starter schematic

We are using here 4 12 v 33 amp dry cell batteries. The appealing part of these batteries is that they are sealed, which means they can be mounted in any orientation on the go-kart and will not leak. This is convenient due to limited space under the body of the go-kart. Unfortunately the batteries used for testing will not fit under the body. However, the group has researched and found several battery options that could be used in the future that would fit within the body . The two 12 V batteries are connected in series to equal 48 V for operation of the electric motor. This voltage level was desirable for several reasons. First, 48 V is the lowest level at which the controller can operate at for sustained time. At 18 V, the controller will shut off. Lastly, operating at 48 V allows the electric motor to rotate at approximately 3000 RPM. This is also the approximate maximum speed of the gasoline engine. Therefore, when the electric motor is acting as a generator at about 3000 RPM, it will output approximately 48 V that will charge the batteries.

A basic block diagram containing the previously mentioned items and how they are connected can be seen



System Block Diagram

Implementation Considerations

The goal of this project was to provide a prototype of the hybrid go-kart so that it could be used for multiple purposes such as:

1. For racing (fast)
2. For travelling between buildings at a worksite (medium)
3. For warehouse use (slow)

This was made possible with the implementation of a potentiometer throttle that runs in parallel with the existing gasoline throttle. With each of these, the throttle can be varied, as to choose the desired speed. A governor or other type of limiter can be implemented to provide the go-kart with a specific maximum speed.

There are several items to be checked before each operation of the go-kart occurs:

- Check all engine fluid levels
- Check that both chains are tight and have the proper amount of slack
- Check the frame integrity. Make sure there are no major bends or gaps present as this could weaken the go-kart causing injury to the user
- Check for any debris around motors
- Check that the brake stops car immediately after starting operation

The majority of the go-kart will require very little maintenance throughout its life. The following are some general maintenance guidelines that will ensure the best performance of the go-kart:

- Refer to the gasoline engine service manual for all engine concerns, troubleshooting and service schedules
- Check the integrity of the tires. Be sure to replace the tire if any punctures or major scrapes are present
- Periodically check that all bolts are present and tightened
- Periodically have the electric motor serviced by a professional to be sure it is working safely and efficiently
- Periodic general maintenance of the car is recommended by a local auto mechanic

Design Challenges

- **Electric Controller:** When initially looking into the project and researching ideas, the controller appeared to be a "do-all" piece of hardware. However, the controller was a necessary component in our design because it was needed to operate the electric motor. The biggest challenge faced with the controller was figuring out a way to automatically start the gasoline engine based on a low voltage level.

- **Automatic Starting Circuit:** In the early stages of brainstorming, it was thought that the controller would be able to automatically start the gasoline engine if the voltage level of the batteries drained too low. Once discovered this was not the case, a new method needed to be implemented. After researching timing circuits and some help from the group advisor, a solution to this problem was found. A timing comparator circuit, made up of integrated circuits and a relay, could be used to send a pulse to the starter solenoid. This circuit would sense a low voltage level, trigger the internal relay, and send an output pulse for a given amount of time. For this project, a pulse period of 1.5 seconds was chosen to sufficiently start the gasoline engine.

Constraints

Environmental:

The environmental constraints of the project were directly proportional with efficiency. The more efficient the go-kart was able to be designed, the more environmentally friendly it would be. In today's world, two major environmental issues are pollution and decreasing amounts of fossil fuels. With the hybrid go-kart, there is no pollution emitted from the motors while it is being powered by the electric motor. The only emissions occur when the batteries need charged (while the go-kart is being powered by the gasoline engine). The hybrid go-kart also efficiently uses fossil fuels. Although the combustion engine does use gasoline to charge the batteries, the go-kart can be driven during this time, therefore using the fossil fuel more efficiently.

Sustainability:

It was important that the hybrid go-kart be well built. The switching of the two motors must be near flawless as to not cause frequent problems. However, since the product uses many electrical devices and many moving mechanical parts, a chance of failure is never out of the question. This could include everything from a flat tire, to a short circuit. In the design of the go-kart, the group attempted to eliminate any chance for these failures to happen. To help eliminate these chances for failure, a user manual is provided to the operator.

For prolonged use of the go-kart, certain care is required. For example, such things as regularly changing the oil and cleaning the brakes are highly recommended. The tires will need to be replaced on a regular basis, but is dependent upon the amount of usage. The tire manufacture should be consulted for exact information and a replacement schedule. Even though the batteries are rechargeable, eventually they will be too weak to sustain any charge and should be replaced. The longevity of the batteries also depends upon the amount of usage. With proper care and without abuse, the product should hold up very well. The hybrid go-kart will be a step in the direction of solving the current problem of oil dependency and air pollution, in turn benefiting future generations.

Health and Safety:

There were several safety constraints in designing the go-kart. However, several safety concerns could not be designed for. If the go-kart were to go into production, there should be warnings on the body of the car, such as:

1. Do not use the car amongst other traffic
2. Do not use the car unless over the age of 16
3. Do not use the car while impaired
4. Do not drive the car at unsafe speeds

Reliability and safety were very important factors while determining the design. For example, there is a switch to cut power to the motors when not in use, a “kill” switch to instantly cut power during use in case of emergency, a fuse on the batteries to prevent over powering the motor, and also a voltage display so the batteries are not over drained or over charged. In addition, the user should wear a helmet any time he/she is operating the go-kart.

Economic:

The economic constraints of this project mainly came from the cost of the parts that were purchased. which includes the seam less pipes for frame, tires, and a 12.9 Hp bajaj discover 125 st engine. Some of the larger expenses included the controller, and miscellaneous parts such as contactors and wires. The cost of making a prototype will be larger than the production cost. This higher cost would mainly be due to the initial cost of tools required to build the prototype. Once the prototype is complete, manufacturing costs will be lower. Also, purchasing parts in bulk will minimize the cost. An assembly line to produce the go-karts could be arranged if necessary, which would also cut final production cost.

Also with regards to economic constraints, the cost for gasoline is very important. The go-kart is going to implement both a gasoline engine and an electric motor. Adding the electric motor will substantially increase the gas mileage of the go-kart (gasoline engine will be used far less with the electric motor installed).

Future Plans

Now that the prototype is complete and working, thoughts of future work on the project have begun to surface. One idea for the go-kart would be for it to be used as an capstone project. It is also very possible that this prototype could be entered in a hybrid go-kart racing competition or a design competition. This could potentially lead to a manufacturer buying rights to the prototype to mass produce. Another idea for the prototype is to research and develop ideas on an efficient way to mount batteries without making modifications to the body. Also, more advanced features of the controller could be researched and programmed such as regenerative braking. Such features are easy to implement on the controller. However, building the physical parts on the go-kart takes much longer than programming the controller. This application is very practical, and would make the recharging system more versatile.

Conclusion

Through the long hours of brainstorming, researching, and implementing, our group has considered the project a success. We have successfully designed a working prototype that implements an electric motor as well as a gas engine. Not only does the prototype have both types of propulsion, but the two are integrated seamlessly. Automatic starting of the gasoline engine allows the driver to focus more on driving than monitoring battery voltages. Our design will have a beneficial impact on the environment, as it emits much less pollutants while in use. We hope that others will view this project as an opportunity and a stepping stone to further develop this prototype to make it even better

REFRENCES

1.THEORY OF MACHINES(R.S KHURMI)

2.DESIGN OF MACHINE ELEMENT(V.B BHANDARI)

3.CHASIS DESIGN (HERB ADAMS)

INNOVATIONS

- **CENTRIFUGAL CLUTCH**
- **HHO KIT (DI-HYDROXY)**
- **AUTOMATIC ENGINE STARTER**
- **USING MOTOR AS GENERATOR**
- **MULTI-SENSTIVITY STEERING**

• CENTRIFUGAL CLUTCH

A centrifugal clutch is a clutch that uses centrifugal force to connect two concentric shafts, with the driving shaft nested inside the driven shaft. It engages more at higher speeds.The input of the clutch is connected to the engine crankshaft while the output may drive a shaft, chain, or belt. As engine revolutions per minute increase, weighted arms in the clutch swing outward and force the clutch to engage. The most common types have friction pads or shoes radially mounted that engage the inside of the rim of a housing. On the center shaft there are an assorted number of extension springs, which connect to a clutch shoe. When the central shaft spins fast enough, the springs extend causing the clutch shoes to engage the friction face. It can be compared to a drum brake in reverse. This type can be found on most home built karts, lawn and garden equipment, fuel-powered model cars and low power chainsaws. Another type used in racing karts has friction and clutch disks stacked together like a motorcycle clutch. The weighted arms force these disks together and engage the clutch.

When the engine reaches a certain speed, the clutch activates, working somewhat like a continuously variable transmission. As the load increases, the speed drops, disengaging the clutch, letting the speed rise again and reengaging the clutch. If tuned properly, the clutch will tend to keep the speed at or near the torque peak of the engine. This results in a fair bit of waste heat, but over a broad range of speeds it is much more useful than a direct drive in many applications.

Advantages

- No kind of control mechanism is necessary
- It is cheaper than other clutches.
- Prevents the internal combustion engine from stalling when the output shaft is slowed or stopped abruptly therefore decreases the engine braking force.

Disadvantages

Since it involves friction and slipping between driving and driven parts there is loss of power.As it involves slipping, therefore it is not desirable in cases where there is heavy load or in high torque requirements.

- **HHO KIT** (DI-HYDROXY)

What is HHO?

HHO is the short name for hydroxy gas, browns gas, green gas, Di-Hydroxy or oxyhydrogen. While there are many names, they all mean the same thing. A mixture of 2 parts hydrogen (H2) and one part oxygen (O2) gases.

How Do You Make HHO Gas?

Our HHO Kits operate on a 100 year old, proven technology called electrolysis. By sending electricity through stainless steel plates that are submerged in water in a certain pattern, we are able to seperate water in to the H2 and O2 Gases making HHO Gas.

Can Water Really Help Me Save Gas?

The answer is simple. Yes. Our HHO Kits have made the technology easy and affordable to use. Just check out this video for similar technology!

How Does HHO Help Me Save Gas?

HHO Kits help you save gas by burning along side your gasoline or diesel. The HHO Gas is sucked in through the air intake of your engine. The HHO Gas causes the gasoline to burn more efficiently, cleans out your engine, and the end product of the HHO Gas is water. Because of the increase in efficiency, your MPG increases.

Is HHO Safe to Use?

HHO and HHO Kits are very safe to use because the HHO Gas is extracted only as needed and burned steadily from water. Why compress Hydrogen into a large hydrogen tank when you can store it safely in the form of water?! Our setup produced hydrogen only as the car needs it.

TEAM NAME:	PHOTORAPTORS	COLLEGE NAME: LOVELY PROFFESSIONAL UNIVERSITY	
CAR NUMBER	NOT DEFINED	TIME PERIOD FOR TESTING:12 DAYS	
Vehicle owner: Lovely Professional University Vehicle design: Ram Kishor Singh, Akash Suresh		DVP CREATOR: DVP VALIDATION APPROVER: FACULTY ADVISOR	RAM KISHOR SINGH AMANDEEP SINGH SIR AMANDEEP SINGH SIR

S.NO	PROCEDURE	DESCRIPTION	ACCEPTANCE CRITERIA	RESPONSIBILITY	TEST RESOURCE	START DATE	FINISH DATE	REMARKS
1	ISO 5011	PRESSURE DROP ACROSS AIR CLEANER	ACCORDING TO PERFORMANCE	RAM KISHOR SINGH	TEST RIG	1/12/2014	2/12/2014	TEST RESULTS
2	SAE 1012	AIR FILTER CLEAN AND CHANGE PERIOD	ACCORDING TO PERFORMANCE	ABHINAV ANAND	HIGHWAY	3/12/2014	4/12/2014	
3	SUPRA 3.2.1.5	BRAKE TEST	ACCORDING TO TEST	BRAKE DEPARTMENT	SPEED MEASURING EQUIPMENT AND TARMAC ROAD	5/12/2014	6/12/2014	
4		WELD TEST	ON THE BASIS OF INSPECTION	FACULTY ADVISOR	WORKSHOP	7/12/2014	8/12/2014	
5	IS10003 /DIN70020	ENGINE POWER AND TORQUE IN NEW AND FULLY CLOGGED CONDITION OF AIR FILTER	BASIS OF EFFICIENCY AND PERFORMANCE	TEST ENGINEER	ENGINE TEST BED	9/12/2014	10/12/2014	
6	M&M	SERVICE ABILITY AND MAINTAIN ABILITY		SERVICE ENGINEER	SERVICE	11/12/2014	12/12/2014	

Technical Inspection (TI) Sheet

ENGINE SPECIFICATIONS

MAKE	BAJAJ
MODEL	DISCOVER 125ST
ENGINE	4 VALVE TWIN SPARK AIR COOLED
ENGINE DISPLACEMENT	1246cc
MAX. NET POWER	13PS. @9000RPM
MAX. NET TORQUE	11kgm @7000 RPM
IGNITION SYSTEM	DIGITAL CDI
CARBURETOR	CV type
STARTING	SELF+KICK START
TRANSMISSION	5SPEED CONSTANT MESH
MAX. SPEED	
SYSTEM	DC IGNITION
BATTERY	12V 5AH

COMPOSITION OF MATERIAL USED (CHASIS)

AISI 1020 SEAMLESS PIPE

ELEMENT	WEIGHT%
CARBON	.22
SILICON	.22
MANGANESE9	.55
PHOSPHOROUS	.01
SULPHUR	.009
CHROMIUM	.15
IRON	98.84

PROPERTIES OF MATERIAL USED

MECHANICAL PROPERTIES

PROPERTIES		CONDITIONS	
NAME	PROPERTIES	TEMP.(CELCIUS)	TREATMENT
DENSITY (1000 kg/m3)	7.7-.03	25	-
POISSON'S RATIO	0. 27-0.30	25	-
ELASTIC MODULUS (GPa)	190-210	25	-
TENSILE STRENGTH (MPa)	394.7	-	-

YIELD STRENGTH (MPa)	294.8	-	-
ELONGATION(%)	36.5	25	ANNEALED AT 870
REDUCTION IN AREA (%)	66.0	-	-
HARDNESS (HB)	111	25	ANNEALED AT 870
IMPACT STRENGTH(J)(IZOD)	123.4	25	ANNEALED AT 870

THERMAL PROPERTIES

PROPERTIES		CONDITIONS	
NAME	PROPERTIES	TEMPERATURE	TREATMENT
THERMALEXPANTION (10^-6/Celcius)	14.8	20-700	ANNEALED

TYRES SPECIFICATIONS

REAR TIRE (DIAxRAD)	(11”X7.1”)
FRONT TIRE (DIAxRAD)	(10”X4.5”)

BRAKES SPECIFICATION

DISC DIA	200MM
DISC THICKNESS	3MM
CALLIPER TYPE	FLOATING TYPE
PEDAL RATION	5:1
ARE OF MASTER CYLINDER	1CM^2
DISC TYPE	PETAL
MAKE	BAJAJ

BATTERIES SPECIFICATION

BATTERY TYPE	DRY CELL BATTERIES
BATTERY VOLT AND AMPERE	12V.33AMP

MOTOR SPECIFICATION

MOTOR TYPE	BLDC
MOTOR RATING	4 V
MOTOR RPM	3000

CONTROLLER SPECIFICATION

CONTROL TYPE	14 BIT

CHASIS SPECIFICATION

WHEEL BASE	52in
TRACK WIDTH	39in
GROUND CLEARANCE	3.5in

BRAKE SPECIFICATION

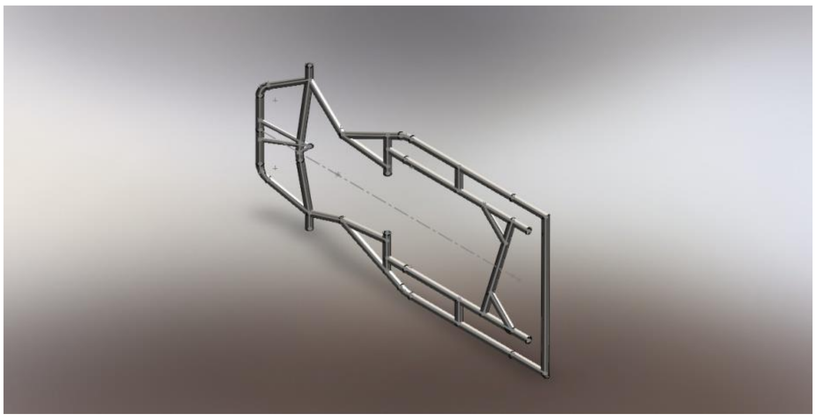
BRAKE PEDAL RATIO	5:1
BRAKE PEDAL FORCE	100N
BRAKE STOPING FORCE	958N
BRAKE TORQUE	38.32N
BRAKE STOPPING TIME	2.75 SEC

FINAL FRONT IMPACT

Simulation of newfinal2

Date: Monday, August 18, 2014
Designer: Solidworks
Study name: Study 1
Analysis type: Static

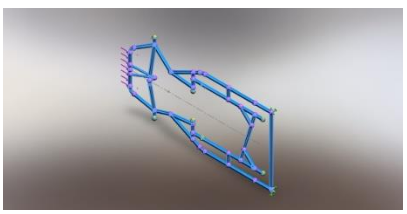
Table of Contents



Description

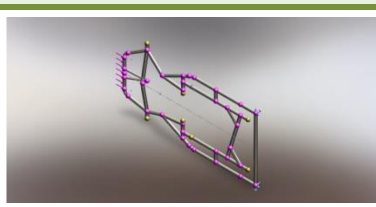
No Data

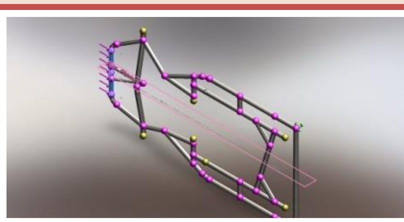
Material Properties

Model Reference	Properties	Components
	**Name:** AISI 1020 Steel, Cold Rolled **Model type:** Linear Elastic Isotropic **Default failure criterion:** Max von Mises Stress **Yield strength:** 3.5e+008 N/m^2 **Tensile strength:** 4.2e+008 N/m^2 **Elastic modulus:** 2.05e+011 N/m^2 **Poisson's ratio:** 0.29 **Mass density:** 7870 kg/m^3 **Shear modulus:** 8e+010 N/m^2 **Thermal expansion coefficient:** 1.17e-005 /Kelvin	SolidBody 1(Structural Member1[5])(newfinal2), SolidBody 2(Structural Member1[4])(newfinal2), SolidBody 3(Structural Member1[3])(newfinal2), SolidBody 4(Structural Member1[2])(newfinal2), SolidBody 5(Structural Member1[1])(newfinal2), SolidBody 6(Structural Member2[5])(newfinal2), SolidBody 7(Structural Member2[4])(newfinal2), SolidBody 8(Structural Member2[3])(newfinal2), SolidBody 9(Structural Member2[2])(newfinal2), SolidBody 10(Structural Member2[1])(newfinal2), SolidBody 11(Structural Member3[9])(newfinal2), SolidBody 12(Structural Member3[8])(newfinal2), SolidBody 13(Structural Member3[7])(newfinal2), SolidBody 14(Structural Member3[6])(newfinal2), SolidBody 15(Structural Member3[5])(newfinal2), SolidBody 16(Structural Member3[4])(newfinal2), SolidBody 17(Structural Member3[3])(newfinal2), SolidBody 18(Structural Member3[2])(newfinal2), SolidBody 19(Structural Member3[1])(newfinal2), SolidBody 20(Structural Member4)(newfinal2), SolidBody 21(Structural Member5)(newfinal2), SolidBody 22(Structural Member6[2])(newfinal2), SolidBody 23(Structural Member6[1])(newfinal2), SolidBody 24(Structural Member7)(newfinal2), SolidBody 25(Structural Member8)(newfinal2),

		SolidBody 26(Structural Member10)(newfinal2), SolidBody 27(Structural Member12[1])(newfinal2), SolidBody 28(Structural Member12[4])(newfinal2), SolidBody 29(Structural Member12[5])(newfinal2), SolidBody 30(Structural Member12[3])(newfinal2), SolidBody 31(Structural Member12[2])(newfinal2), SolidBody 32(Trim/Extend1[2])(newfinal2), SolidBody 33(Trim/Extend2[1])(newfinal2), SolidBody 34(Trim/Extend2[2])(newfinal2)
Curve Data:N/A		

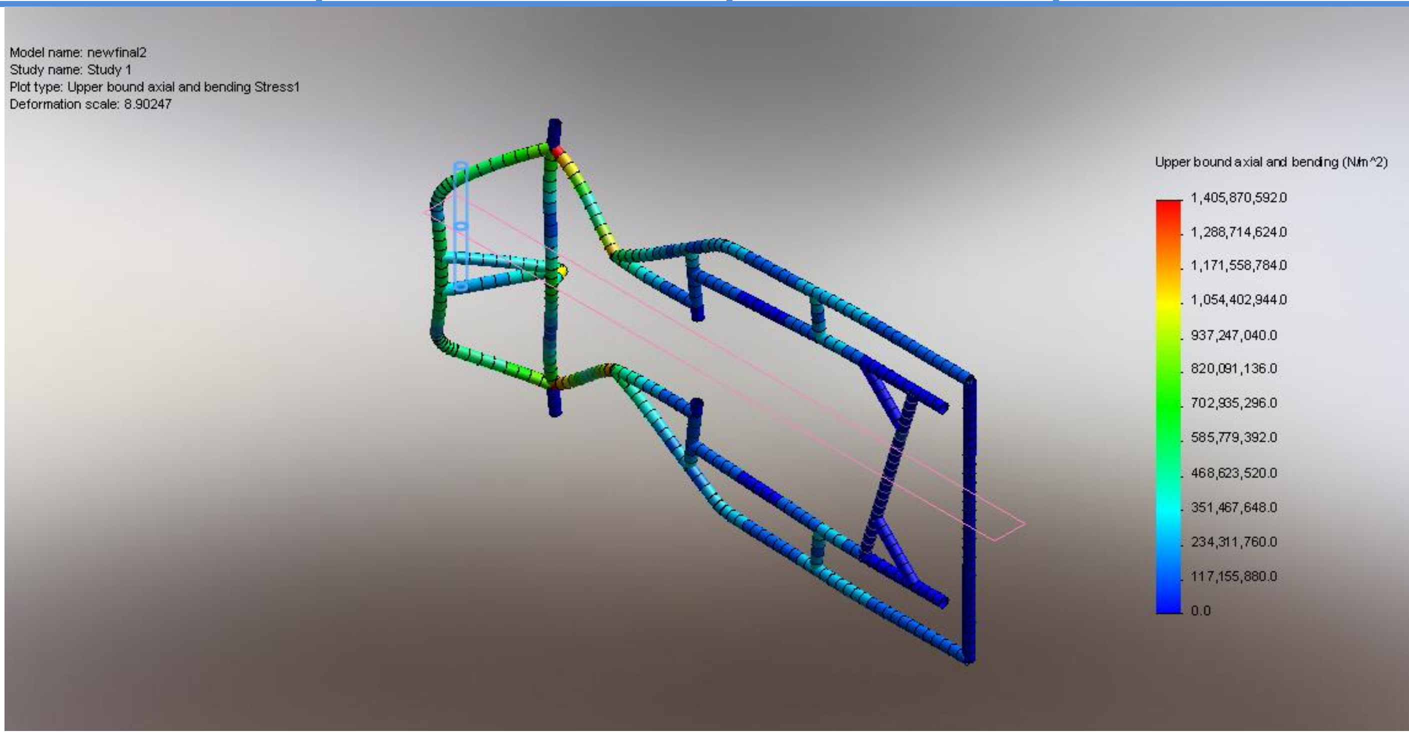
Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** 2 Joint(s) **Type:** Fixed Geometry

Load name	Load Image	Load Details
Force-1		**Entities:** 1 plane(s), 2 Beam (s) **Reference:** Top Plane **Type:** Apply force **Values:** 29430, ---, --- N **Moments:** ---, ---, --- N·m

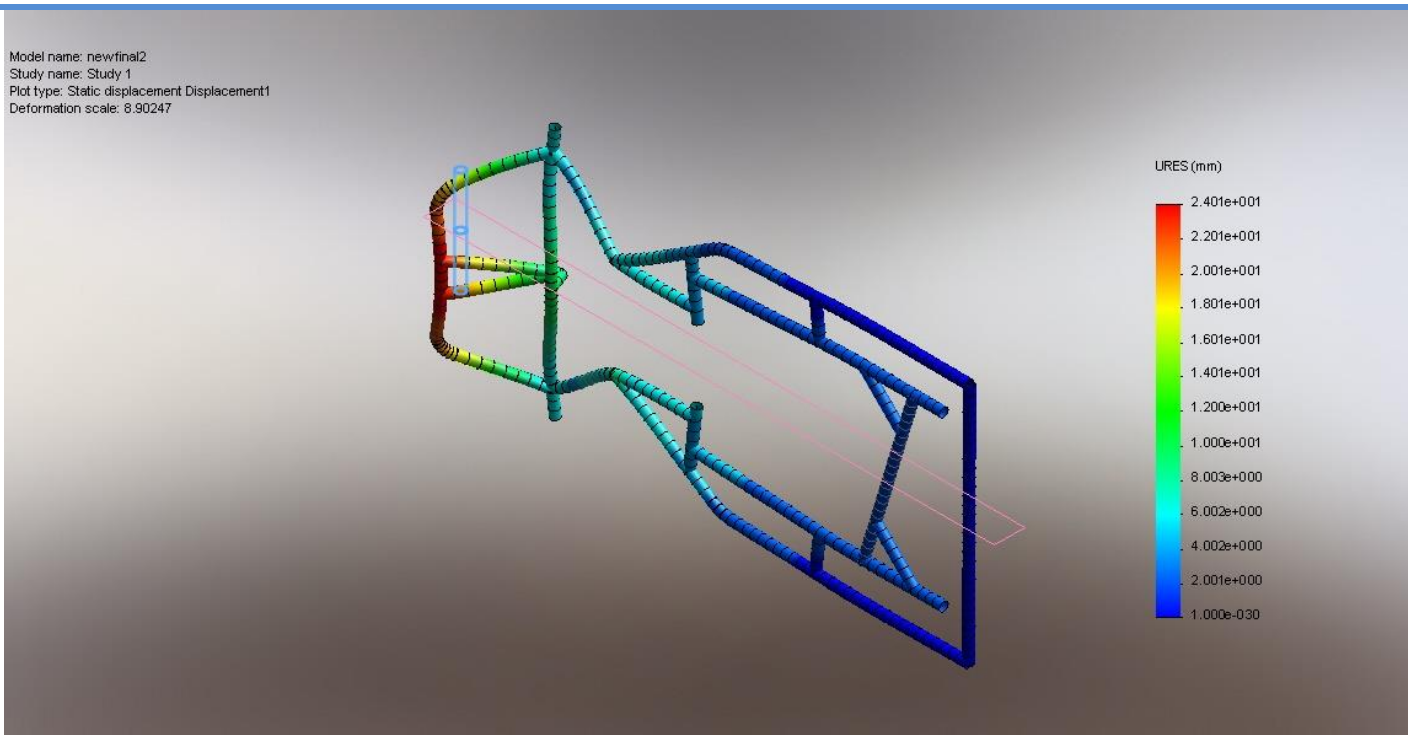
Study Results

Name	Type	Min	Max
Stress1	TXY: Shear in Y Dir. on YZ Plane	0 N/m^2 Element: 133	1.40587e+009 N/m^2 Element: 11



newfinal2-Study 1-Stress-Stress1

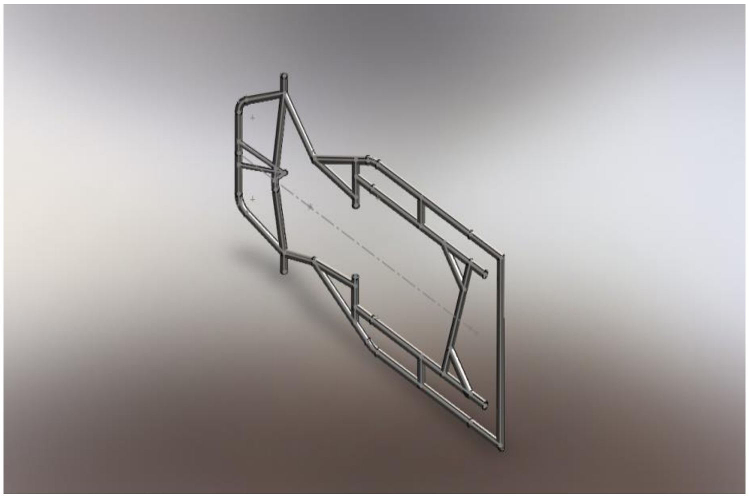
Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0 mm Node: 133	24.009 mm Node: 38



newfinal2-Study 1-Displacement-Displacement1

Conclusion

FINAL BACK IMPACT TEST



Description

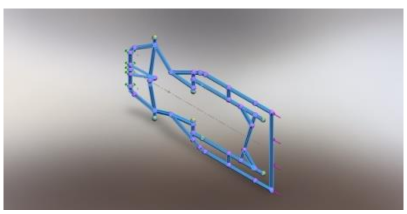
No Data

Simulation of newfinal2

Date: Monday, August 18, 2014
Designer: Solidworks
Study name: Study 4
Analysis type: Static

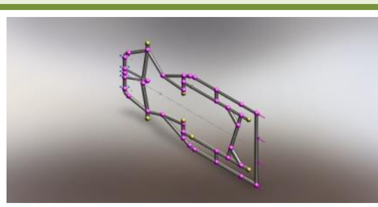
Table of Contents

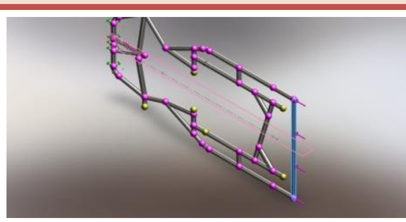
Material Properties

Model Reference	Properties	Components
	**Name:** AISI 1020 Steel, Cold Rolled **Model type:** Linear Elastic Isotropic **Default failure criterion:** Max von Mises Stress **Yield strength:** 3.5e+008 N/m^2 **Tensile strength:** 4.2e+008 N/m^2 **Elastic modulus:** 2.05e+011 N/m^2 **Poisson's ratio:** 0.29 **Mass density:** 7870 kg/m^3 **Shear modulus:** 8e+010 N/m^2 **Thermal expansion coefficient:** 1.17e-005 /Kelvin	SolidBody 1(Structural Member1[5])(newfinal2), SolidBody 2(Structural Member1[4])(newfinal2), SolidBody 3(Structural Member1[3])(newfinal2), SolidBody 4(Structural Member1[2])(newfinal2), SolidBody 5(Structural Member1[1])(newfinal2), SolidBody 6(Structural Member2[5])(newfinal2), SolidBody 7(Structural Member2[4])(newfinal2), SolidBody 8(Structural Member2[3])(newfinal2), SolidBody 9(Structural Member2[2])(newfinal2), SolidBody 10(Structural Member2[1])(newfinal2), SolidBody 11(Structural Member3[9])(newfinal2), SolidBody 12(Structural Member3[8])(newfinal2), SolidBody 13(Structural Member3[7])(newfinal2), SolidBody 14(Structural Member3[6])(newfinal2), SolidBody 15(Structural Member3[5])(newfinal2), SolidBody 16(Structural Member3[4])(newfinal2), SolidBody 17(Structural Member3[3])(newfinal2), SolidBody 18(Structural Member3[2])(newfinal2), SolidBody 19(Structural Member3[1])(newfinal2), SolidBody 20(Structural Member4)(newfinal2), SolidBody 21(Structural Member5)(newfinal2), SolidBody 22(Structural Member6[2])(newfinal2), SolidBody 23(Structural Member6[1])(newfinal2), SolidBody 24(Structural Member7)(newfinal2), SolidBody 25(Structural Member8)(newfinal2),

		SolidBody 26(Structural Member10)(newfinal2), SolidBody 27(Structural Member12[1])(newfinal2), SolidBody 28(Structural Member12[4])(newfinal2), SolidBody 29(Structural Member12[5])(newfinal2), SolidBody 30(Structural Member12[3])(newfinal2), SolidBody 31(Structural Member12[2])(newfinal2), SolidBody 32(Trim/Extend1[2])(newfinal2), SolidBody 33(Trim/Extend2[1])(newfinal2), SolidBody 34(Trim/Extend2[2])(newfinal2)
Curve Data:N/A		

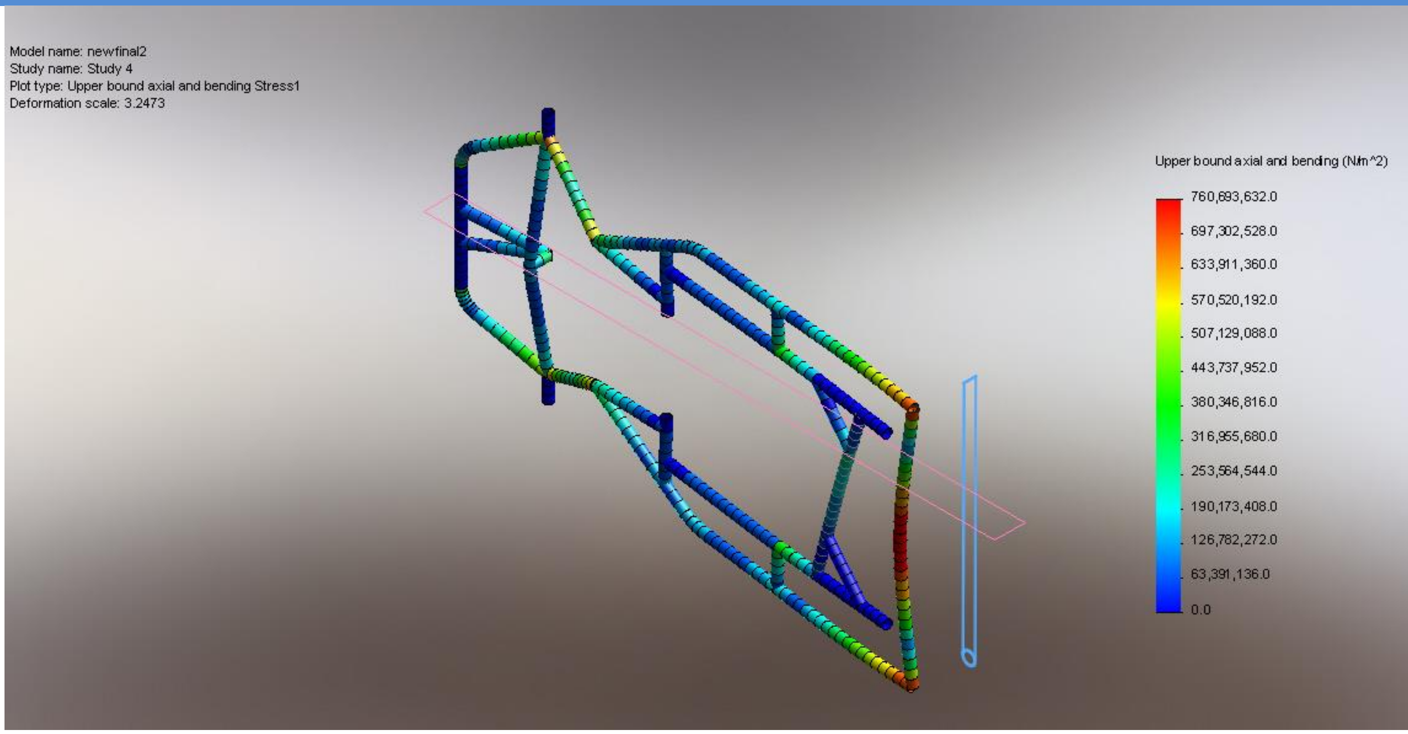
Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** 5 Joint(s) **Type:** Fixed Geometry

Load name	Load Image	Load Details
Force-1		**Entities:** 1 plane(s), 1 Beam (s) **Reference:** Top Plane **Type:** Apply force **Values:** -29430, ---, --- N **Moments:** ---, ---, --- N·m

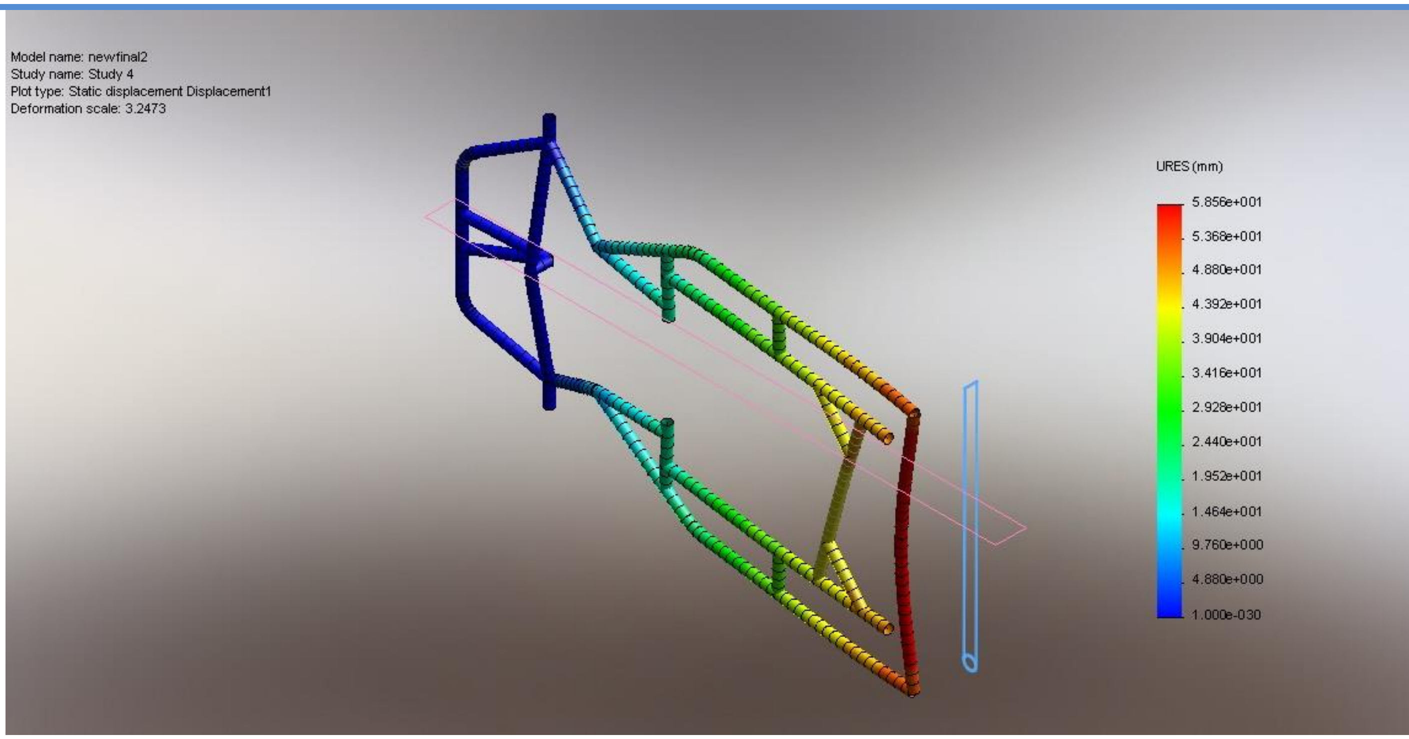
Study Results

Name	Type	Min	Max
Stress1	TXY: Shear in Y Dir. on YZ Plane	0 N/m^2 Element: 37	7.60694e+008 N/m^2 Element: 147



newfinal2-Study 4-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0 mm Node: 35	58.5629 mm Node: 149



newfinal2-Study 4-Displacement-Displacement1

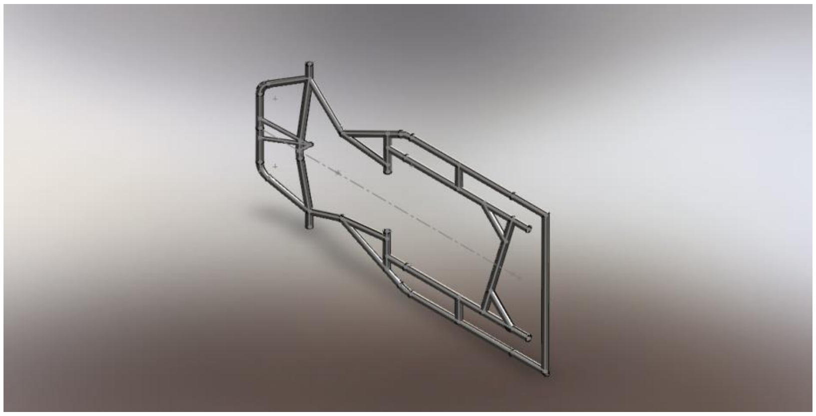
Conclusion

FINAL SIDE IMPACT

Simulation of newfinal2

Date: Monday, August 18, 2014
Designer: Solidworks
Study name: Study 3
Analysis type: Static

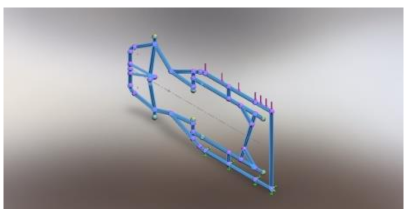
Table of Contents



Description

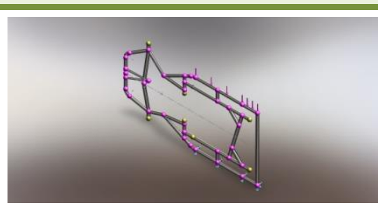
No Data

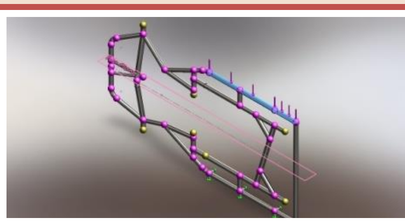
Material Properties

Model Reference	Properties	Components
	**Name:** AISI 1020 Steel, Cold Rolled **Model type:** Linear Elastic Isotropic **Default failure criterion:** Max von Mises Stress **Yield strength:** 3.5e+008 N/m^2 **Tensile strength:** 4.2e+008 N/m^2 **Elastic modulus:** 2.05e+011 N/m^2 **Poisson's ratio:** 0.29 **Mass density:** 7870 kg/m^3 **Shear modulus:** 8e+010 N/m^2 **Thermal expansion coefficient:** 1.17e-005 /Kelvin	SolidBody 1(Structural Member1[5])(newfinal2), SolidBody 2(Structural Member1[4])(newfinal2), SolidBody 3(Structural Member1[3])(newfinal2), SolidBody 4(Structural Member1[2])(newfinal2), SolidBody 5(Structural Member1[1])(newfinal2), SolidBody 6(Structural Member2[5])(newfinal2), SolidBody 7(Structural Member2[4])(newfinal2), SolidBody 8(Structural Member2[3])(newfinal2), SolidBody 9(Structural Member2[2])(newfinal2), SolidBody 10(Structural Member2[1])(newfinal2), SolidBody 11(Structural Member3[9])(newfinal2), SolidBody 12(Structural Member3[8])(newfinal2), SolidBody 13(Structural Member3[7])(newfinal2), SolidBody 14(Structural Member3[6])(newfinal2), SolidBody 15(Structural Member3[5])(newfinal2), SolidBody 16(Structural Member3[4])(newfinal2), SolidBody 17(Structural Member3[3])(newfinal2), SolidBody 18(Structural Member3[2])(newfinal2), SolidBody 19(Structural Member3[1])(newfinal2), SolidBody 20(Structural Member4)(newfinal2), SolidBody 21(Structural Member5)(newfinal2), SolidBody 22(Structural Member6[2])(newfinal2), SolidBody 23(Structural Member6[1])(newfinal2), SolidBody 24(Structural Member7)(newfinal2), SolidBody 25(Structural Member8)(newfinal2),

		SolidBody 26(Structural Member10)(newfinal2), SolidBody 27(Structural Member12[1])(newfinal2), SolidBody 28(Structural Member12[4])(newfinal2), SolidBody 29(Structural Member12[5])(newfinal2), SolidBody 30(Structural Member12[3])(newfinal2), SolidBody 31(Structural Member12[2])(newfinal2), SolidBody 32(Trim/Extend1[2])(newfinal2), SolidBody 33(Trim/Extend2[1])(newfinal2), SolidBody 34(Trim/Extend2[2])(newfinal2)
Curve Data:N/A		

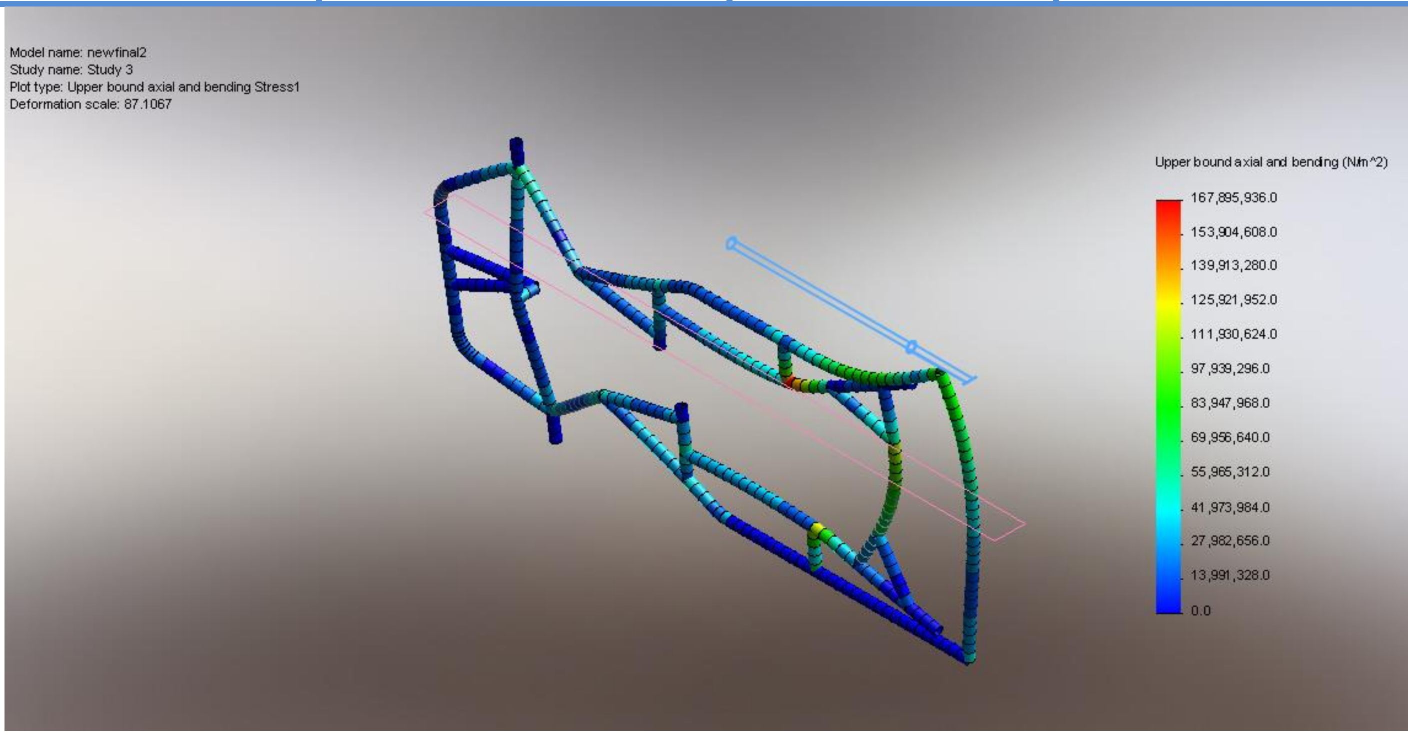
Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** 4 Joint(s) **Type:** Fixed Geometry

Load name	Load Image	Load Details
Force-1		**Entities:** 1 plane(s), 2 Beam (s) **Reference:** Top Plane **Type:** Apply force **Values:** ---, ---, -2934 N **Moments:** ---, ---, --- N·m

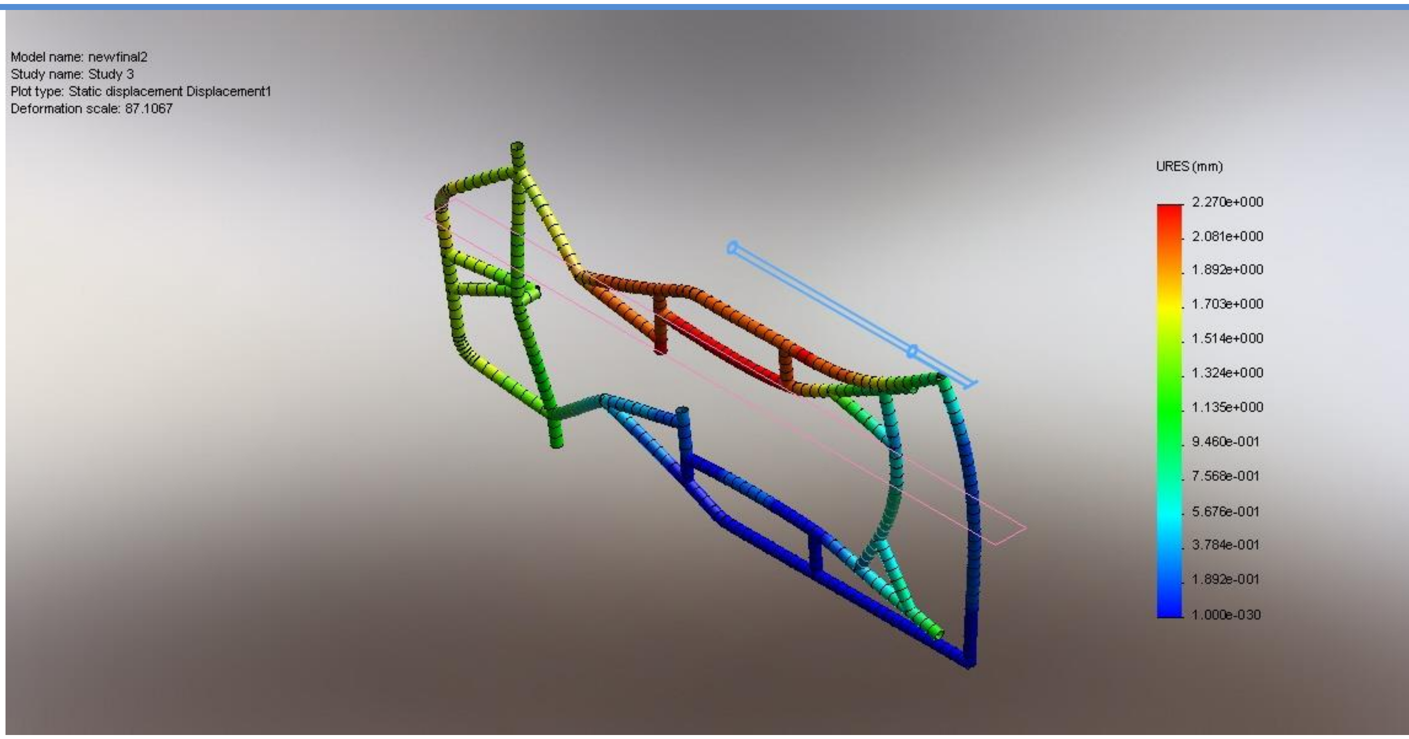
Study Results

Name	Type	Min	Max
Stress1	TXY: Shear in Y Dir. on YZ Plane	0 N/m^2 Element: 163	1.67896e+008 N/m^2 Element: 226



newfinal2-Study 3-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0 mm Node: 134	2.27038 mm Node: 219



newfinal2-Study 3-Displacement-Displacement1

Conclusion

FINAL DFMEA

PROJECT-HYBRID GO-KART **DATE -15/12/2014**

OCC/OCCURRENCE-HOW FREQUENT IS THE CAUSE LIKELY TO OCCUR
DET/DETECTION-HOW PROBABLE IS DETECTION OF CAUSE
RPN=RISK PRIORITY NUMBER IN ORDER TO RANK CONCERN:CALCULATED AS SEVxOCCxDET

Process step	Potential failure mode	Potential failure effects	SEV	Potential causes	OCC
What is the step?	In what ways can the step go wrong?	What is the impact on the customer if the failure mode is not prevented or corrected?	10	What causes the step to go wrong? (i.e., How could the failure mode occur?)	10
Braking	Leakage in cylinder	Brake failure/Risk of accident/Vehicle damage	8	Damage in cylinder	5
	Hydraulic hoses oil leakage	Brake failure/Risk of accident/Vehicle damage	8	Excess pressure in the Hoses	6
Welding	welding breakage	Sudden misalignement	8	excess Load	4
	Weld Breakage	Brakage	10	Impact	5
Tyre	Deflate	Inability to drive	7	piercing by objects	8
Fuel	Fuel Leakage	Engine stops	8	Damaged fuel pipe/joints	6
Engine	air filter failure	Poor milage / harmful for cylinder, piston	7	Dirt inside the pipe	6
	over heating	Harmful for Engine	6	Continuous working	8
	mounting points failure	exessive vibration / noise	8	loose monting nut	6
	Chain	vehicle stops	6	loose or tight	5
	wire break	inability to accelerate	8	Excess use of acc. Wire	4
Steering	end of tie rod breaks	no steer	8	high impact forces	6
	Steering linkage breaks	no steer	6	high impact forces	4

FINAL DFMEA

PROJECT-HYBRID GO-KART DATE -15/12/2014

OCC/OCCURRENCE-HOW FREQUENT IS THE CAUSE LIKELY TO OCCUR
DET/DETECTION-HOW PROBABLE IS DETECTION OF CAUSE
RPN=RISK PRIORITY NUMBER IN ORDER TO RANK CONCERN:CALCULATED AS SEVxOCCxDET

Current process controls	DET	RPN	Actions recommended	Responsibility (target date)	Actions taken	New SEV	New OCC	New DET
What are the existing controls that either prevent the failure mode from occurring or detect it should it occur?	10	1000	What are the actions for reducing the occurrence of the cause or for improving its detection? You should provide actions on all high RPNs and on severity ratings of 9 or 10.	Who is responsible for the recommended action? What date should it be completed by?	What were the actions implemented? Include completion month/year (then recalculate resulting RPN).	10	10	10
Diff. master cylinders for each brake	6	240	Repair / Replace		Cylinder replace	8	5	5
Standard hoses of BAJAJ DISCOVER	6	288	Repair / Replace		Hoses replace	8	6	5
					replace			
TIG welding	4	200	Reweld		Re-weld	10	5	3
Hosier tire	3	169	Replace/ repair	RAM KISHOR SINGH	Replace	7	7	2
Standard size	4	192	Repair / Replace	AMRITKUMAR	Repair	8	6	2
Standard air filter (BAJAJ DISCOVER)	6	252	Clean / Replace	HARSHWARDHAN	Clean	7	6	4
Air cooling	2	96	Use cooling system		Air cooling	6	5	2
high strength nut bolts	6	288	washers		washers used	7	6	4
mount properly	5	150	Repair / Replace		replace/ repair	6	4	4
Standard BAJAJ DISCOVER wire	6	192	Repair / Replace		replace	8	4	4
	6	288	Repair / Replace	NITISH	replace	8	4	5
1 to 1 linkage	3	72	Repair / Replace		replace	6	4	2

FINAL DFMEA

PROJECT-HYBRID GO-KART **DATE -15/12/2014**

OCC/OCCURRENCE-HOW FREQUENT IS THE CAUSE LIKELY TO OCCUR
DET/DETECTION-HOW PROBABLE IS DETECTION OF CAUSE
RPN=RISK PRIORITY NUMBER IN ORDER TO RANK CONCERN:CALCULATED AS SEVxOCCxDET

ACKERMAN	3	108	Repair / Replace	AKASH SURESH	replace	9	4	3
	4	160	Repair / Replace		replace	8	5	3

New RPN
1000
200
240
128
150
98
96
168
60
168
96
128

FINAL DFMEA

PROJECT-HYBRID GO-KART DATE -15/12/2014

OCC/OCCURRENCE-HOW FREQUENT IS THE CAUSE LIKELY TO OCCUR
DET/DETECTION-HOW PROBABLE IS DETECTION OF CAUSE
RPN=RISK PRIORITY NUMBER IN ORDER TO RANK CONCERN:CALCULATED AS SEVxOCCxDET

160
48
108
120

COST REPORT

THINGS	PRICE(Rs)
Engine	15,000
Seamless pipe	4,000
Batteries(4)	9,200
Tyre assembly	2,500
Brushless motor	10,000
Controller	2,500
Steering assembly	1,000
Brake assembly	1,500
Transmission assembly	3,000
Total	48,700