

# Single Seated Hybrid Electric Vehicle

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**Abstract:- This paper titled “Single Seated Hybrid Electric Vehicle” focused on reduction of environmental pollution caused by the combustion of fossil fuels from the vehicles. Number of vehicles are increasing day by day, as a result pollution rate also increases. Controlling in the number of vehicle is not possible. The only method to control the pollution is introducing hybrid vehicles or electric vehicles instead of conventional fueled vehicles.**

**This paper describes about the constructional features of a single seated hybrid electric vehicle. Gasoline engine and electric motor for the propulsion of the vehicle. As a result we can reduce the toxic emissions to the environment and also it will reduce the consumption of fossil fuels.**

**Keywords:- Single seater ,Electric, Hybrid Transmission, Bldc Motor.**

## I. INTRODUCTION

This paper proposes a single seated hybrid electric vehicle which can reduce the toxic emissions from the vehicles and consumption of fossil fuels by using a combination of electric motor and an internal combustion engine, which helps to save our environment from pollution. A hybrid vehicle is named so because it can run on two distinct fuels. We are using petrol and electric power by a 306 cc petrol Engine and 2kW BLDC motor to power the vehicle. The motor is powered by a rechargeable battery. The vehicle can run in three Modes. Economy mode, Power mode, Hybrid Mode 100% Electric 100 % Petrol and Both Electric and Petrol respectively.

Hybrid vehicle typically achieves greater fuel economy and lower emissions than conventional internal combustion Engines. By the report of environment protection agency Hybrid vehicles emissions are getting closer even lower than the recommended level. Even though hybrid cars have been on the market since the late 1990s, have never really caught on with consumers. It's not because of consumers not enough knowledge about the hybrid vehicles benefits, but the higher price of hybrid vehicle and low service support. These are the

reasons why are decide to design a hybrid vehicle with low cost.

## II. VEHICLE CONFIGURATION

The vehicle is in open-wheeled and open-cockpit with four wheels that are not in a straight line.

Definition of “Open Wheel” – Open Wheel vehicles satisfy the following criteria.

- The top 180 degrees of the wheels/tyres are unobstructed when viewed from vertically above the wheel.
- The wheels/tyres is unobstructed when viewed from the side.

### A. Bodywork

There is no openings through the bodywork into the driver compartment from the front of the vehicle to the roll bar main hoop or firewall other than that required for the cockpit opening. Minimal openings around the front suspension components are allowed.

### B. Wheelbase

The car have a wheelbase of at least 1525 mm (60 inches). The wheelbase is measured from the center of ground contact of the front and rear tyres with the wheels pointed straight ahead.

### C. Track width

Track width of the vehicle have crucial role in the stability of the vehicle. If the track width reduces stability of the vehicle reduces.

### D. Ground clearance

The ground clearance with the driver aboard must be a minimum of 50.8 mm (2 inches) of static ground. Clearance measured from the lowest point (except tyres) of the vehicle, under the complete vehicle. Compensation for chain sprocket, brake disc in ground clearance would be entertained.

### E. Driver's cell

Among other requirements, the vehicle's structure must include two roll hoops that are braced, a front bulkhead with support system and Impact Attenuator, and side impact structures.

## III. CHASSIS

Chassis is a skeletal frame on which various mechanical parts like. Engine, tyres, axle, assemblies etc. are mounted the chassis is considered to be most significant component of an automobile. It is also called backbone of an automobile.

The major components like engine, power train, steering systems and seats are mounted on the frame. In student formula vehicle the commonly used material for chassis is AISI 4130 or AISI 1018 which is mostly used in bicycle frames. It can be easily machined by conventional methods. Due to the some favorable conditions and availability we choose Chromoly 4130 for our chassis. It has high tensile strength, yield strength, which helps it to withstand heavy loads. AISI 4130 or Chromoly is an alloy steel contains chromium and molybdenum as strengthening agents. It has low carbon content, and hence it can be welded easily. The first two digits i.e., 41 in 4130 tell the main alloying elements chromium and molybdenum. The last two digits 30 designate that the alloy contains 0.3% carbon.



Fig 1:- Chassis

## IV. SUSPENSION SYSTEM

Suspension is a very important component of any car as it should keep the tire in contact with the road while encountering forces acting on the tires. Suspension systems must support both road holding/handling and ride quality which are at odds with each other. The tuning of suspensions involves finding the right compromise. It is important for the suspension to keep the road wheel in contact with the road surface as much as possible, because all the road or ground forces acting on the vehicle do so through the contact patches of the tires. The suspension also protects the vehicle itself and any cargo or luggage from damage and wear. The design of front and rear suspension of a car may be different.

### A. Components

#### • A arm

A arm is a tubular structure fabricated by tig welding. And the material used is same as the material for the chassis.

In A arm there are total three connecting points. The two points are connected with chassis and other one is connected with the hub. It has only one direction movement (up and down). Chassis connecting points is arranged by bushings where hub connecting point is by the help of pos bearing. Which has same function of rod end bearing.

#### • POS bearing

It is a type of bearing or a joint used in the end of the rods. Here we used this bearings at the three connecting ends of the A arms which are connected with chassis and the hub. It helps the movement of the hub in all direction as a ball joint bearing

#### • Coil spring shock absorber

Coil spring shock absorber is a commonly used shock absorber in motor bikes. The suspension is selected according to the design calculations. So the number of coils. Coil diameter and eye to eye length will be different accordingly. The important factor while fabricating the mounting brackets for suspension the vehicle should be in no loaded condition. This type of suspension have a small adjustment on it to change the hardness by rotating the end adjuster.

## V. STEERING SYSTEM

Steering system is used for controlling the direction of vehicle. It is a collection of components linked together to work as a single system. Steering system is of different type, Power steering, rack and pinion etc. Rack and pinion is the simplest type of steering system, which is very simple mechanism. The vehicles available in the market are right hand drive and the steering joint is of right side, but our vehicle's steering is in the center position. We solved this problem by using Tata Nano steering rack and using universal joints.

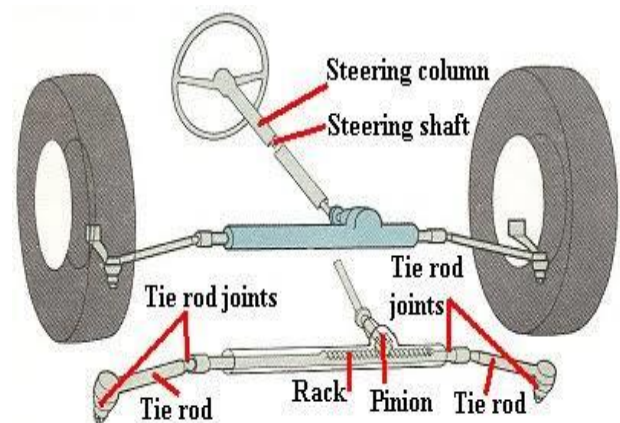


Fig 2:- Steering system

### A. Components

#### • Rack and pinion

It is the main component in steering system. It used to convert the rotary motion in to linear motion. The rack and pinion is available in market of different vehicles. We prefer the Tata Nano steering rack assembly with two tie rods. By considering the machining time and other miscellaneous works, bought out part reduced the total fabrication time.

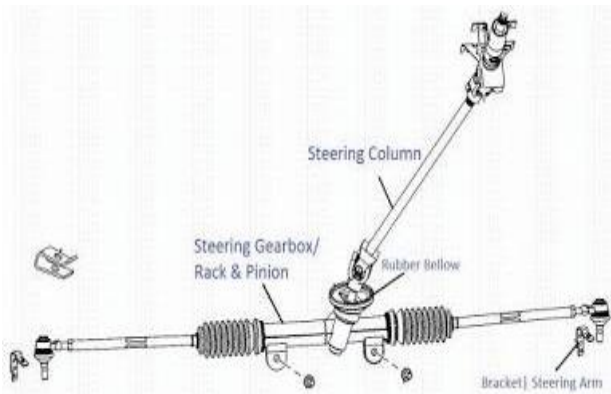


Fig 3:- Steering rack

• *Clevis*

It is a type of joint used to connect components which are perpendicular to each other. We used here instead of steering tie rod end joint. A clevis fastener system consisting of a clevis, clevis pin, and tang. The clevis is a U-shaped piece that has holes at the end of the prongs to accept the clevis pin. The clevis pin is similar to a bolt, but is only partially threaded or unthreaded with a cross-hole for a split pin.



Fig 4:- Clevis

• *Steering wheel*

It is an input component of the steering system. The whole steering system will work according to driver in put through steering wheel. The steering wheel is made of aluminium tube. The tube is bend in circular shape and a laser cut aluminium plate is welded at the center of the bended tube. And a quick release mechanism is also attached.



Fig 5:- Steering wheel

• *Quick release*

It is a mechanism used for quick releasing of steering wheel from the steering hub. It is a method used in F1 cars. It enables the attaching and dismantling of steering wheel from the steering hub. It is bought out from the market.



Fig 6:- Quick release

• *Universal joint*

The joint which can transmit the motion in any direction is called universal joint. We use two universal joint in our steering to make the steering vertical from the Nano steering system.



Fig 7:- Universal joints

**VI. BRAKING SYSTEM**

The braking system is an important part in a vehicle. It is used for stopping and speed reduction using frictional force between tyres and brake pads. Here we are using hydraulic breaking with disc brake.

A. *Components*

• *Brake pedal*

Brake pedal is used for applying mechanical force by driver leg. A single action from the leg distributed equal forces to the four wheels with the help of master cylinder and the action of piston.

• *Brake line*

Brake line is fluid line. Which is carrying the brake fluid from the master cylinder to the calipers both the rear and front wheels. Mostly the break line is made up of copper alloy tube. But for the flexibility while rotating the wheels we use flexible brake line in front wheels.

- *Calipers*

Brake caliper is used to convert the fluid pressure developed in the master cylinder to mechanical force. The pads which is used to hold the disc are actuated by fluid pressure. The main function of the caliper is develop force for holding the disc by the pads. The caliper itself has no function, the caliper connected to the wheel hub and the brake disk is connected to the tyre. When the brake pedal apply force of action the brake pads restrict the rotation of the bake discs and the speed is controlled. The caliper and disc will be of high quality material. The disc will have porous holes to eliminate the heat generated while braking.

- *Master cylinder*

It is a device used to convert the mechanical force (by driver foot) to hydraulic pressure. It is done by the piston motion inside the cylinder. Here we are used Bajaj auto master cylinder. It has two output ports for front and rear wheels.

## VII. POWER TRAIN

Power train is the heart of any vehicle. The term power train describes the main components that generate power and deliver it to the wheels. Hybrid consists of two power sources or two prime movers, Engine and Motor. So hybrid power train comprises of Engine, Motor, Transmission, Battery differentials and the final drive. According to the design hybrid drive train can classified into parallel hybrid and series hybrid. Series hybrid means engine not propel the vehicle it only charge the battery or act as a generator for battery, Where in parallel drive train electric motor or conventional engine can run the wheels. We use series parallel hybrid which has the benefit of both series and parallel configuration.



Fig 8:- Power train

### A. Engine

We are used BRIGSS & STRATTON 1450 XR Professional Series™ engine having 306 cc and 10 hp power output and high starting torque. It's is imported from USA. The engine is powered by gasoline with self-start and also quick start. It has an engine oil sensor for its safety to avoid starting without oil.



Fig 9:- B&S Engine

### B. Brushless Dc Motor (BLDC)



Fig 10:- Brushless dc motor

Brushless motor has a permanent magnet rotor surrounded by a wound stator. The winding in the stator get commutated electronically, instead of brushes. So it don't have the friction and voltage drop that brushes create by dragging against the spinning commutator.

- Simpler to maintain
- More durable
- Smaller
- 85%-90% more efficient
- Able to respond faster and higher operating speeds
- Simpler to control in regard to speed control and reversing
- Lighter
- Less prone to the failures

### C. Motor Controller



Fig 11:- Motor controller

Bldc motor is most popular among electric vehicles. Bldc motors don't utilise brushes, motor movement is controlled by means of carefully designed drive signals, which helps to improved reliability, longer life, and higher performance. All the controls are happening inside the component called motor controller. It can't run without this controller.

#### D. Throttle



Fig 12:- Throttle

The speed of the vehicle should be controlled while running in motor or Engine. But we can't use two throttles simultaneously. Hence we design a cable mounting lock on the throttle for the bldc motor. The throttle has two wires that will be connected to the bldc controller, the motion in the motor is as the force applied on the throttle pedal. Since there is different control switch for motor and engine no matter of connecting two control to same pedal.

#### E. Gear Box

- Maker - Mahindra alpha
- Speed - 4 speed
- Attached dry differential

Transmission is mandatory to every engine running vehicles. Which provide controlled application of power. The gears and gear train provide speed and torque conversions from rotating power source to another device. Similarly a differential unit is also mandatory to avoid skidding while taking a turn. Both these problems are solved by one single unit of Mahindra alpha gear box unit which contains a wet type attached differential.



Fig 13:- Gear box

#### F. Chain Drive

Chain drive is used to transmit the power from Engine and Motor to wheels. Most often the power is conveyed by a roller chain, known as drive chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. We can easily adjust the length of chain easily than belt drive, also we can reduce frictional loss and slip by using chain drive. Although chains can be stronger than belt their greater mass increases drive train inertia. The shaft diameter of motor and gear box shaft and engine shaft are of different size. Hence we make it suitable by boring it from lathe.



Fig 14:- Chain and sprocket

#### G. Battery

We used four 12 V, 40 AH Battery, connected in series to give the output of 48 v for the motor operation. We arranged two batteries on the one side pods and two are on other side pods and connected them in series. Battery can be charged from outside manually or can charge from vehicle itself while running in petrol. Lithium ion battery is most suitable for electric vehicles because it has high discharging current and fast charging capacity. Also the efficiency is above 80% and the weight is three times lesser than flooded battery. But the cost of lithium ion batteries is very high and it's highly explosive and also its need special license to use in vehicles. Even though flooded battery is not much efficient for electric vehicles due to the above reasons lead us to use flooded battery for our vehicle.

## VIII. CONCLUSION

A vehicle according to the design is fabricated and the results shows that hybrid power train will be a better solution for the present pollution problem. The only problem arises here is the cost of battery will be very high when comparing to normal vehicle battery, so there will be a greater difference in price. This is the reason that decreases the popularity of hybrid vehicles.

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