

DESIGN, ANALYSIS AND MANUFACTURING OF FOLDABLE ELECTRIC BICYCLE

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ABSTRACT

As we all know the fuel prices especially the petrol is rising steadily day by day. Again the pollution due to vehicles in metro cities & urban areas is increasing continuously. To overcome these problems, an effort is being made to search some other alternative sources of energy or to move back on the non-conventional sources of energy for the vehicles. Again, it is also not affordable to purchase vehicles (mopeds, scooters or motorcycles) for all the class of society. Moreover the vehicles which use the non-conventional sources of energy are not economic feasible for all the class of the society of Human life. In the concept of smart cities, quickness is something which everyone craves for. People prefer the fastest means while travelling from one place to another. Generally, while maintaining a trade-off between speed, comfort and cost public transit comes out to be the best solution. But since these vehicles have specific routes and stations, people face difficulty in going to the station from source location and then from the other station to destination. Use of fuel powered vehicles is not recommended due to the depletion of fossil fuels, also these vehicles pose a major threat to the safety to the lives of many. Apart from the noise and air pollution, fuel powered vehicles are quite powerful and thus unsafe if don't used with care. Transportation has been one of the most important issues to be dealt with. Short distance traveling is tedious, time consuming and expensive task. It is very difficult to reach the nearest public transport facility and in many cases the destination will be very far from the main roads. To overcome this common problem an idea is conceptualized to design and fabricate a foldable cycle, which can be used to reach nearest public transport facilities, easy to fold around the bag and carry or can be utilized as a trolley. Unlike the conventional cycles, it will be light weight and less space consuming. The main objective is to design and fabricate a foldable cycle which is comfortable to ride and economical A foldable electric bike may be possible solution to these problems. The weight of the bike is kept such that it may easily be carried on shoulders without the feeling of uneasiness. This bike is ideal to use for short distance (around 40-50 kilometers) trips. The major target of this foldable electric bike for commercialization are the people who travel by metros and public transport means for their daily routine work. This bike can be sold in cities where people needs a solution to travel shorter distance at low price.

Keywords :- *Electric bike, Pollution, Effective drive, Foldable.*

1. INTRODUCTION

In the modern societies, the increasing needs of mobility means sometimes increasing the number of vehicles circulating. Ambient concerns, as for instance local pollutant emissions for the atmosphere, influence also, in nowadays, the technical decisions related with all kind of vehicles. In this context, new alternatives to the existing internal combustion engines are mandatory. So, vehicles with electric propulsion seem to be an interesting alternative. As we all know the fuel prices especially the petrol is rising steadily day by day. Again the pollution due to vehicles in metro cities & urban areas is increasing continuously. To overcome these problems, an effort is being made to search some other alternative sources of energy or to move back on the non-conventional sources of energy for the vehicles. Again, it is also not affordable to purchase vehicles (mopeds, scooters or motorcycles) for all the class of society. Moreover the vehicles which use the non-conventional sources of energy are not economic feasible for all the class of the society of Human life.

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A foldable electric bike may be possible solution to these problems. The weight of the bike is kept such that it may easily be carried on shoulders without the feeling of uneasiness. This bike is ideal to use for short distance (around 40-50 kilometers) trips. The major target of this foldable electric bike for commercialization are the people who travel by metros and public transport means for their daily routine work. This bike can be sold in cities where people needs a solution to travel shorter distance at low price.

2. CURRENT SCENARIO

Nowadays we use the gasoline flues in the automobile market as this gasoline used in market emits the high amount in market emits the high amount of CO₂, CO, NOX, Hydrocarbon which causes the global warming of the earth due which many live are in danger hence the alter native to the gasoline fuel is the electric drive and it is the one and only way to reduce the pollution on the earth hence on this basis the recent technologies on electric drive launch in the market and on this basis we have developed the electric drive foldable bicycle which gives the comfortable ride to ride and provide high efficiency and running upto 30-40km/hr in one charge and on other hand it is foldable

The First electric drive was invented by Hosea W. Libbey in 1870 as an source of travel to the people he developed the bicycle which was working on double electric motor and the efficiency of that bicycle was high as compared to other electric drives on this invention later on various types of modern technology are made which are more accurate than sir libbey.

3. Methodology

The design of a foldable electric Bicycle is carried out in systematic way. The following is a detailed analysis of each step

Step 1: Input Study

This is the first step and involves gathering and analyzing the information. It collects all relevant data and assemble it for evaluation and summarizing. The main sources of information are current market and trends. Complete, accurate data allows designers in identifying, finalizing the specifications required of the end product.

Step 2: Deciding of geometry and material

The frame is designed such that it forms a suitcase like compact structure with sufficient strength when folded. For this we design a pivot joint which connects the rear wheels with the frame.

Step 3: Selection of motor

An electric motor which satisfies the needs of power, speed and compactness is selected from overall available motors based on space constraints, required acceleration and torque.

Step 4: Selection of battery

A battery composition of Li-ion is selected as it has best performance and minimal drain overtime. For an assumed range, the battery capacity is calculated and a controller is selected to protect, provide right amount of power to motor.

Step 5: Making of CAD model of the Bicycle

Using the above collected and calculated data, a CAD model is prepared of the proposed Bicycle.

Step 6: Structural analysis of the CAD model

The final CAD model of the Bicycle is structurally analyzed using ANSYS for failure of parts.

Step 7: Thermal analysis of battery pack

On the battery pack consisting of cells in series and parallel, thermal analysis is done. The corresponding values are noted and the design process is iterated until a safe design is concluded.

Step 8: Manufacturing phase

The finalized design is used for manufacturing of Bicycle

4.Mechanical Design

There are a wide variety of materials used in bicycle frames. Bike frames were originally made from wood, but modern frames are made primarily from aluminum, steel, titanium and carbon fiber. Some of the less common materials used in creating frames include bamboo, thermoplastics and magnesium.

The materials used for mountain bicycle frames have a wide range of mechanical properties. These properties can be seen in Table 1. There is not one material in the table that has advantageous properties in each category, which explains why manufacturers continue to fabricate frames from several different materials.

- **Different Material Properties**

	Modulus of Elasticity (GPa)	Yield Strength (MPa)	Tensile Strength (MPa)	Fatigue Strength at 50,000 Cycles (MPa)	Density (kg/m ³)	Weldability and Machinability	Cost (rupess per kg)
Aluminum – 6061-T6	72	193-290	241-320	75	2,700	Excellent	280
Steel - 4130	205	800-1,000	650	250	7,800	Excellent	170
Titanium – Grade 9	91-95	483-620	621-750	250	4,480	Fair	4000
Carbon Fiber	275-415	Varies	Varies	Varies	1,800	Fair	Varies

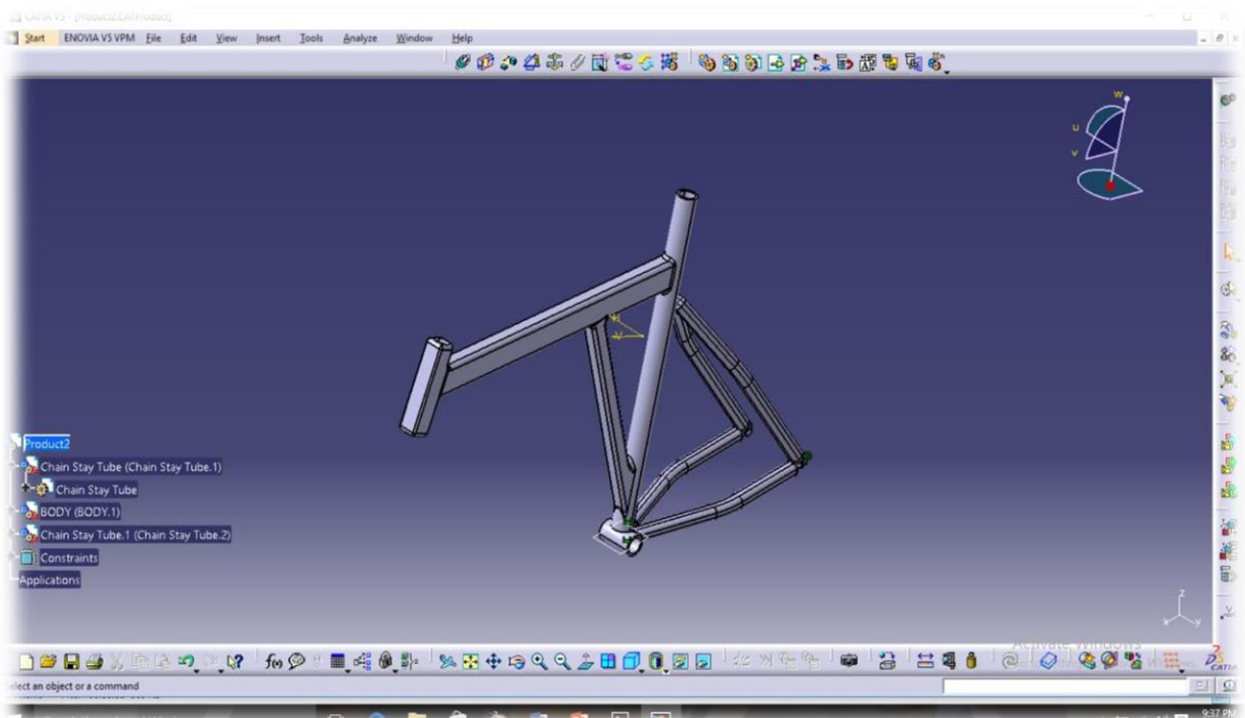
Requirement of chassis material:

1. High bending strength.
2. High torsional stiffness.
3. Great availability at lower cost.
4. Light weight.

Material Selected for the chassis on the basis of:

- i. Strength and Machinability
- ii. Cost per kg for the economic aspect
- iii. Wide availability of material and easily weld able Material Selected: Steel

5.AUTO CAD DESIGN



MESHING OF BICYCLE ON ANSYS

Fig :- . 3-D View of the Frame

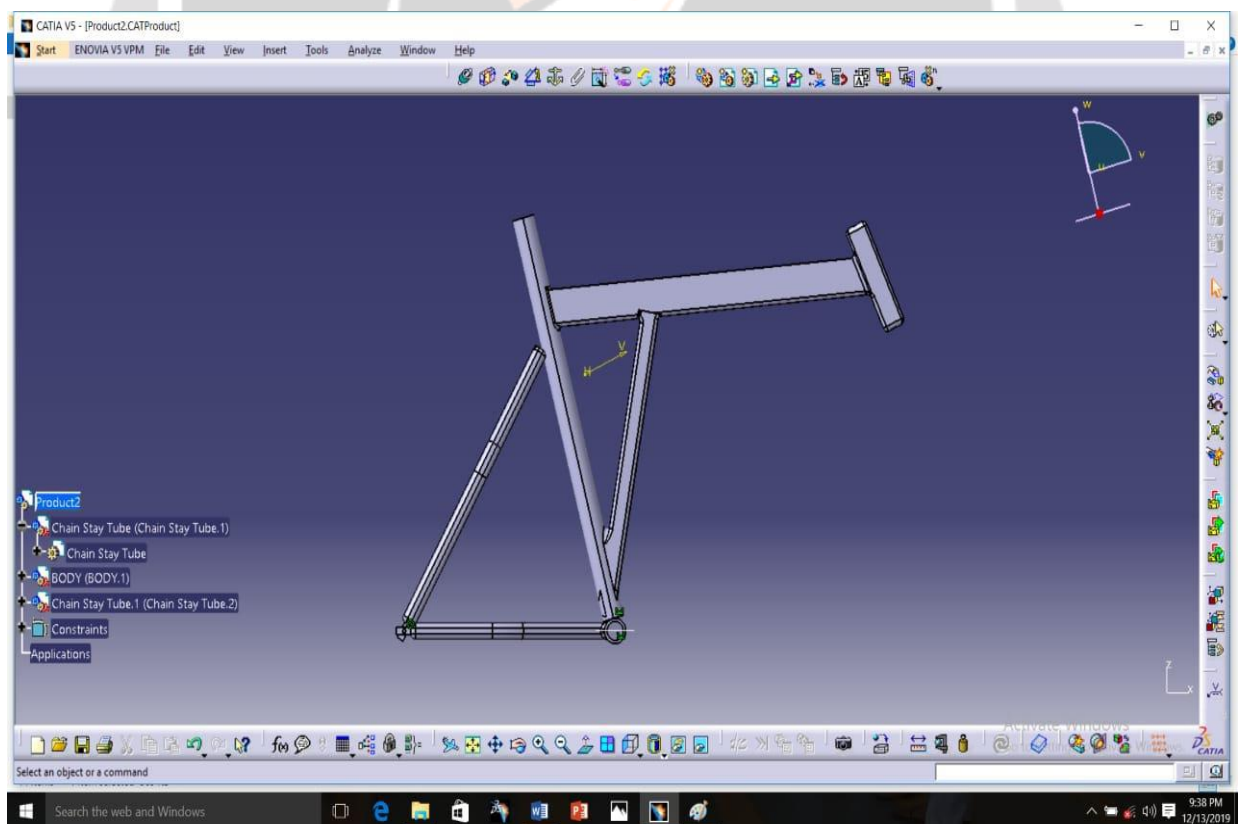
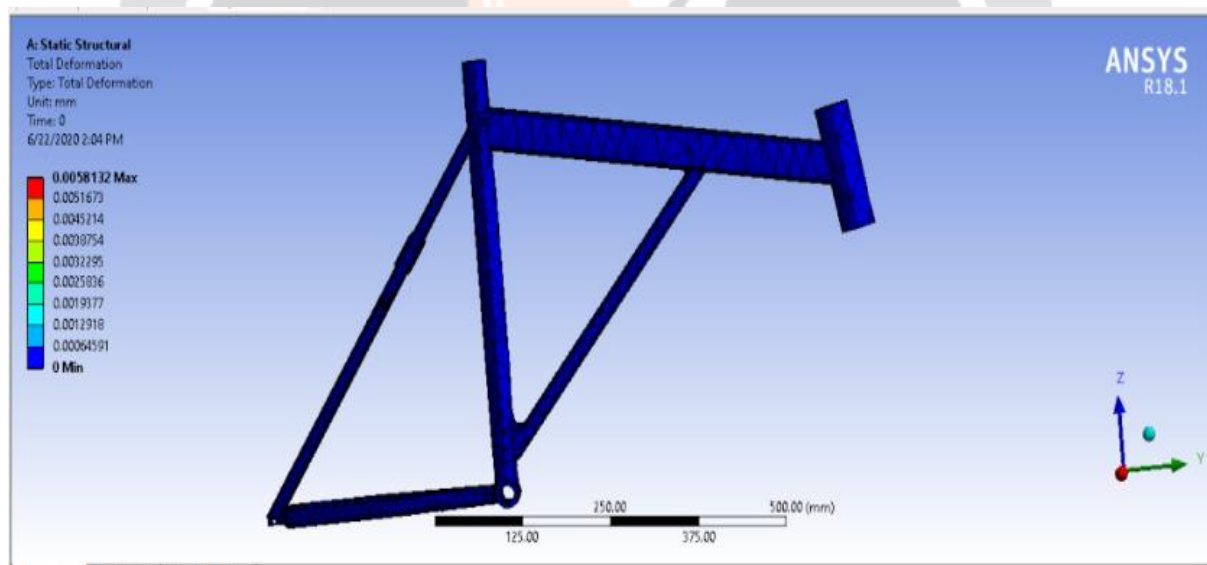
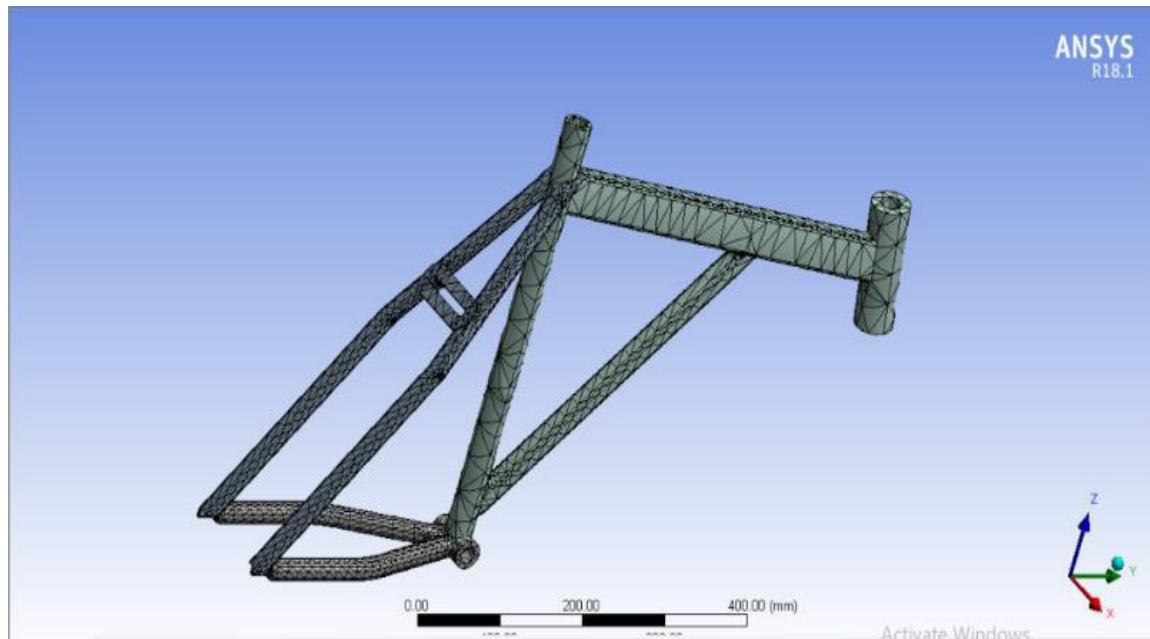


Fig 2 :- Side-view of the frame

Fig 3 :- Meshing Image of the Frame in Ansys**Fig 4 :- Total Deformation of the frame on Ansys**

6.CONCLUSION

It is concluded from the design and study of research papers, the motor power required for this foldable Bicycle is much lower on conventional streets. The brushless DC motor is selected for this Bicycle is suitable and easily available at cheaper cost. Also torque at standstill is sufficient to propel the Bicycle with 150 kg weight. Selected battery type is cobalt based lithium ion battery pack. The li-on cell has maximum specific energy and amprh capacity than any other type of batteries. The single cell of various capacities is easily available in market with affordable cost.

Material chosen for chassis is general steel tubes with rectangular cross section (40*25*2 mm wt). The section has sufficient bending strength to satisfy the chassis design and bending stiffness to satisfy swing arm design. As the Bicycle is light in weight and controls are easy wide range of age group can drive the Bicycle (from 10 to 60 yrs), also load carrying capacity of Bicycle is good. Foldability of Bicycle allow to reduce occupied space so it can handle easily after breakdown and no much parking problems are associate with the Bicycle.

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