

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

Fabrication of a Two Way Human Powered Bike

T.Sravan Kumar¹, V.Yashwanth Kumar², S.Medha³, Akshita Puli⁴

U.G. Student, Department of Mechanical Engineering, VJIT College, Aziznagar, Hyderabad, India¹

U.G. Student, Department of Mechanical Engineering, VJIT College, Aziznagar, Hyderabad, India²

U.G. Student, Department of Mechanical Engineering, VJIT College, Aziznagar, Hyderabad, India³

U.G. Student, Department of Mechanical Engineering, VJIT College, Aziznagar, Hyderabad, India⁴

ABSTRACT: Eventually natural fuels will run out and we will be in search of alternate power to run our vehicles, this lead to the concept of development of human powered bike. A human powered vehicle is powered without any external power source, such as a bicycle.

The proposed design of the Human Powered Bike uses the following 2 designs

1. Recumbent bicycle model works with pedal power and
2. Treadmill powered design.

Here the safety frame of normal bicycle is replaced with our own design. Several other design parameters were incorporated to ensure ease of use. These parameters include mid-height riding position, strength, fatigue life, etc. The preliminary design uses computer aided design (CATIA software) and finite element analysis (HYPERMESH software) to analyze stress, strain, and deflection and fatigue acting on the frame, manufacturing is done as per the specified results from design and analysis of the frame. The main aim here is to fabricate a cost effective, easy to use and easy maintenance cum repairable vehicle. This project is based on making a hybrid human powered vehicle. Two different designs have been merged and uniquely manufactured in this purpose.

KEYWORDS: Treadmill bike, recumbent bike, Strength, Fatigue life, Deflection.

I. INTRODUCTION

Recumbent bike: A recumbent bike is a bicycle with a seat position that is inclined backwards and the pedals are attached at front with front wheel at a lower height than the rear wheel. This configuration provides more stability to the driver. The design includes over-the-seat steering to control the cycle more efficiently and reliably. A shorter wheelbase is used to improve driver comfort and safety.



Model: Recumbent Bicycle

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

Treadmill bike: A treadmill attachment is flexible, which can be arranged when needed by just inclining the treadmill downwards and we can propel the bike by running on the treadmill, this design is provided with a flexible handle to adjust as per the requirement of the raider



Model: treadmill bike

Innovative combination: We have customized a bicycle which has smaller front wheel and bigger rear wheel along with 2 small supporting side wheels and has its center of gravity lower near to ground and roll center at the center line of the vehicle to prevent rolling of the vehicle during turning.

Treadmill is initially mounted on the chassis resting on the frame inclined at 120 degrees while using as a recumbent bike raider lean back on the treadmill and pedal the bike.

In other case by just sliding the treadmill it becomes horizontal the raider can walk on the treadmill which propels the bike. Adjustable handle plays a prominent role in giving the stability to the raider.

II. MODELLING

Modelling of our bike is based on the designing (drafting). All the components are modelled separately in the catia v5 software and then assembled in the assembly module.

Various components of HPV:

1. "U" shaped Fork-Front
2. "U" shaped Fork-Rear
3. Main Frame
4. Assembly

1- "U" shaped Front –Fork

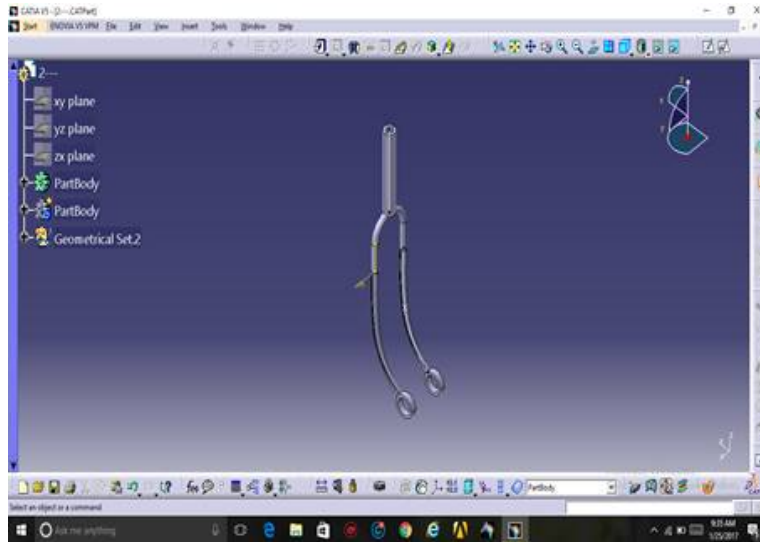
The front U clamp is modelled to attach the frame with the front wheels, it is in the shape of a fork modelled in part module using multi sectional solids on 1 side of the fork and by applying mirror operation on the other side. Radius of u clamp is 7.5mm and length of fork from top to bottom is 85mm.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

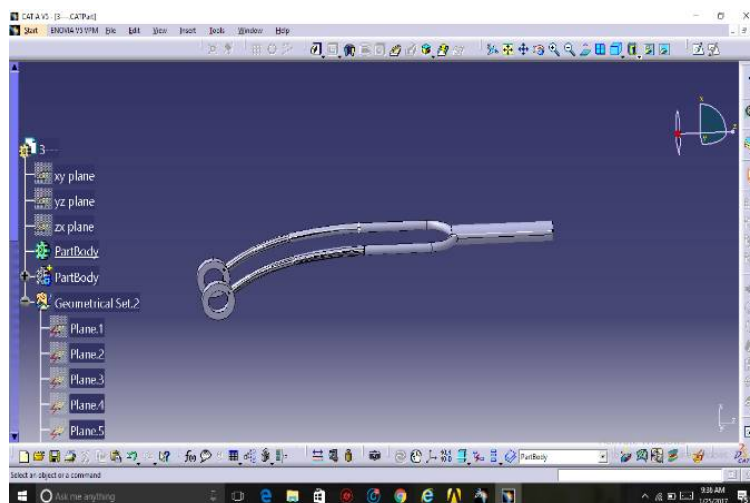


Front U fork

2- “U” shaped Rear-Fork

Rear U fork is similar in shape of the front U fork the only difference between both of them is in the length .the length of this fork is 100mm

The modelling procedure is same as the front U fork



Rear U Fork

3- Main Frame

The basic frame is modelled in the part module by drawing profile and assigning circular path I.e.Rib operation and 2 weld pieces are attached as per the requirements.

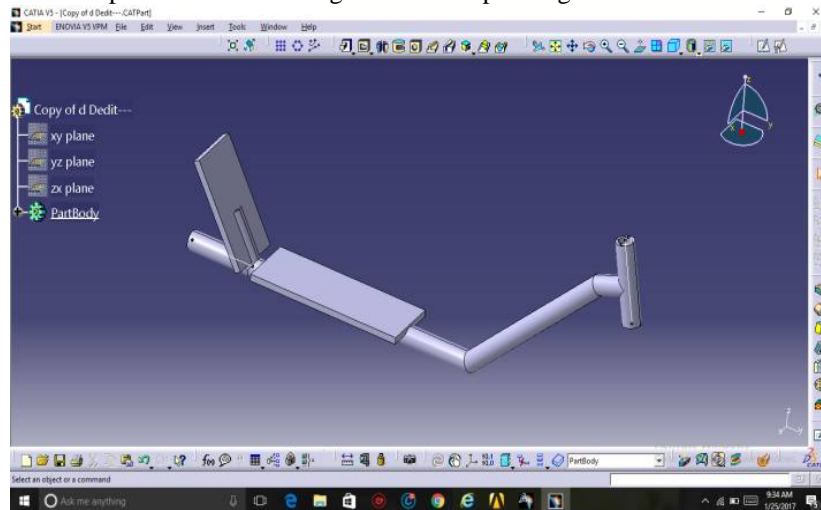
International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

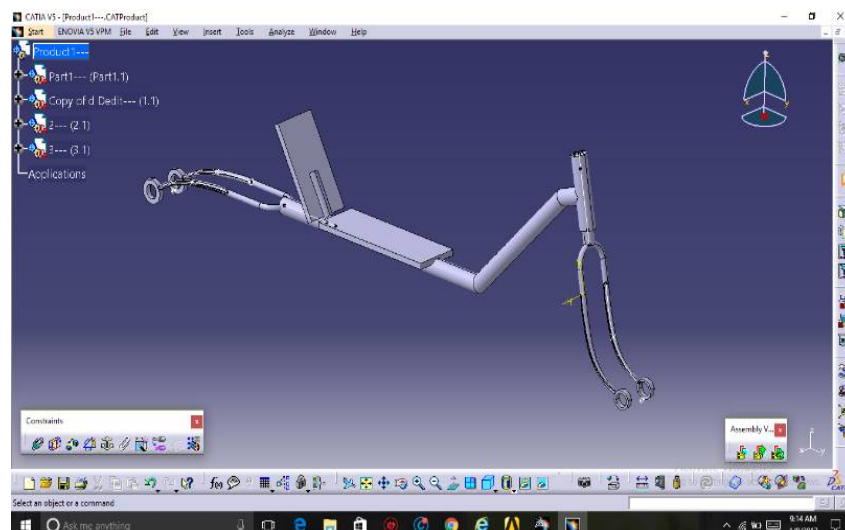
Few components of this frame part are modelled in generative shape design & wire frame and surface modelling



Main Frame

4-Assembly

Assembly is done in the assembly module. The above fig.shows the assembly of frame, front and back supports using various commands and tools such as move and constraints etc.



Assembly

III. HYPERMESH

After modelling all the components assembly is performed any exported to hyper mesh software to give the material properties and load constraints.

International Journal of Innovative Research in Science, Engineering and Technology

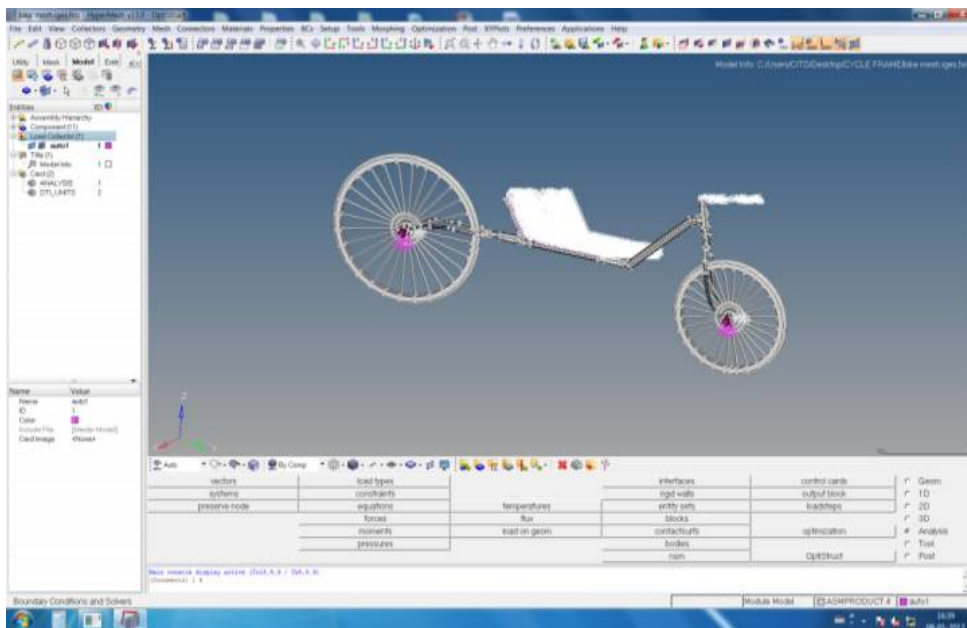
(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

Hypermesh is made by Altair.Inc the most popular software .It enables the trainees to create finite element models for analysis and prepare high quality meshes in an efficient manner. It also offer different working tools for geometry editing for preparing CAD models for meshing purpose.

Where here in our project were have already modelled our HPV where further we are importing this file from CATIA and performed meshing process.



Meshed in Hypermesh

Material properties & conversion factor:

Material- Mild Steel

Density-8050kg/Cu.m

Young's modulus-21000N/sq.m

Poisson's ratio-0.3

Tensile strength of M.S -280Mpa

Applied load:

200N=1000N=100KG on the seat

40N=200N=20KG on the handle

Conversion factor in the design:

1 inch=10mm

1 inch=2.54CM=25.4MM

Scale: 1:2

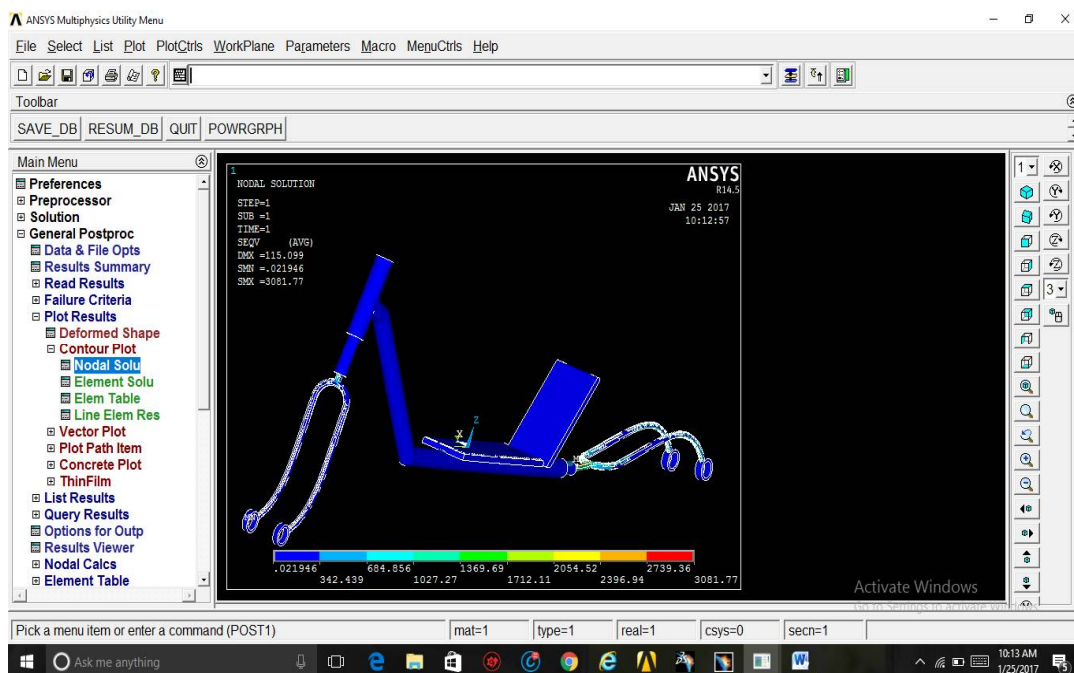
IV. ANALYSIS

After meshing and applying load the model is exported to ansys software to perform analysis.

Ansys is the standard FEA teaching tool within the engineering department at many colleges. Ansys is also used in civil and Electrical engineering, as well as physics and chemistry department.

Steps in Ansys

- 1- Import the geometry in Ansys
- 2- Fit the geometry
- 3- Solve the geometry model
- 4- Apply the stress and strain find the deformation



Deformation results in ansys

V. RESULTS AND DISCUSSION

Analysis is performed on the assembled frame in ansys and results are found out.

From this analysis we found out that rear u fork is subjected to more stress when compared to the front rear u fork.

Analysis is performed subjected to the condition that front and rear ends are fixed.

S.no.	RESULT	VALUES
1	Total deformation	11.5mm
2	Maximum principle stress	3081.77N/sq.m
3	Minimum principle stress	0.029N/sq.m

From this analysis we found out the max.stress induced in the frame is less than the yield strength of mild steel 280Mpa.Our design is safe and we proceeded for manufacturing.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

VI. MATERIALS AND METHODS

Materials used for the manufacturing of this human powered bike is Mild steel as , Mild steel is not readily tempered or hardened but possesses enough strength. Mild steel is made by adding carbon and other elements in the iron. These elements improve the hardness, ductility and tensile strength of the metal. As per we are required for the bike frame All steels have the same inherent stiffness and weight, regardless of Adding a tiny bit of chromium and molybdenum makes it strong enough to, thus making it lighter. This alloy is usually referred to as chromyl. Most quality steel frames use a variation of chromyl.

The strength of any type of steel allows builders to engineer a certain amount of flex by using thinner tubes which feel springiness, something builders using aluminium can't do because when aluminium flexes it fatigues the metal, which ultimately can lead to failure. Steel frames are also relatively easy and cheap to repair, and the technology has been around for a long time.

Cheaper steels are used in department store bicycles. Higher carbon content steel is easier to weld (and cheaper to manufacture into bike frames) although it yields much heavier frames.

VII. MANUFACTURING OF HUMAN POWERED BIKE

Manufacturing of our HPV is carried out at our college VIDYA JYOTHI INSTITUTE OF TECHNOLOGY by splitting the work into 4 different categories they are:

1. Gathering the required components
2. Doing required changes/modifications
3. Assembly/welding
4. Painting.

In step 1 we have gathered/purchased the following components:

- An old bicycle
- A treadmill
- Side wheels
- A scooter

In step 2 we have done the following modifications:

- Dismantled the old bicycle and took the required rear U fork along with rear wheel
- Dismantled the treadmill and reduced rear roller diameter ,attached crank and stoppers to the treadmill
- Made use of side wheels
- Cut the scooter to use it as a flexible handle.

In step 3 we have welded the components to get the final assembly, the assembly process is discussed below:

I. Chassis assembly

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017



Figure : Chassis Assembly

Specification

Length-18inches

Height-27inches

Shape-triangular cross-section.

Rod length-17inches

Chassis is designed considering the treadmill length and width

2. Considering the chassis as reference small front wheel of 20inches along with front U fork and rear U fork are welded
3. Flexible handle is welded over normal handle assembly
4. Crank assembly and side wheel assembly is followed.
5. The HPV is coated with black color spray painting in order to prevent corrosion of the bike .

Rear gear mechanism:

1. To the back wheel hub an additional free wheel is attached so that while pedalling the chain is connected to 1 free wheel and while using as a treadmill bike the chain mechanism is connected to the 2nd free wheel.
2. Initially while we walk on the treadmill the crank attached to the treadmill rotates in the reverse direction so in order to change the direction of the crank rotation the mechanism shown in the figure is used.
3. Here the chain is connected between the main crank of treadmill and the freewheel present at the end .so that the motion is transmitted to the freewheel at the end.
4. In between these crank and freewheel one more freewheel is welded such that it rests on the upper part of the chain so that its direction of rotation reverses thus we are obtaining the required directional motion.
5. Now we need to transmit this clockwise motion to the rear end sprocket so we are attaching shaft to this freewheel along with a sleeve.so when this freewheel rotates this motion is carried to the inner freewheel near to the rear end sprocket .with the help of a chain we can connect these freewheel and sprocket.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017



Figure: gear mechanism

Final Recumbent bike: Initial position of the HPV while using as a recumbent bike, here the raider can sit on the aluminum sheet and lean on the treadmill. The handle is adjustable so that one can pull the handle towards him and can pedal the bike.



Figure: Final Treadmill bike

Final Treadmill Bike: By just sliding the treadmill it becomes horizontal and rests on the chassis by adjusting the handle upwards one can walk on the treadmill resulting the motion of HPV.



Figure: Final Treadmill bike

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

VII. CONCLUSION

It can be concluded that the design and manufacturing of human-powered bike are performed successfully. This can be shown by the final prototype product of the HPV. The safety issue of the design is solved by the FEA analysis. The product has it all package, functioning really well and have the safety measure appropriate to the vehicle. The modest design for fabrication has been demonstrated.

In this paper we also described a new way of travelling as well as exercise with the help of a new model of bike which is combination of treadmill and bicycle. It can be used in place of regular bike at cheaper cost and without use of fuel. The treadmill bike will prove to be a future vehicle as no fuel is used for travelling through this and it is pollution free. The treadmill which is used for walking helps to keep us fit as exercise is also one of the important task for a person to be fit and healthy for day to day life. Treadmill is cheaper than the normal bike which also makes it efficient and economic.

REFERENCES

- [1] Chakrabarti, DK, 1993, Indian Anthropometric Dimensions, National Institute of Design, McGraw-Hill, Inc.
- [2] Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Reports. 1985; 100(2):126-131.
- [3] Wolthuis, R. A., Froelicher, V. F., Fischer, J., Noguera, I., Davis, G., Stewart, A. J., &Triebwasser, J. H. (1977). New practical treadmill protocol for clinical use. The American journal of cardiology, 39(5), 697-700.
- [4] Kooijman, J. D. G., and A. L. Schwab. "Experimental validation of the lateral dynamics of a bicycle on a treadmill." ASME 2009 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference. American Society of Mechanical Engineers, 2009.
- [5] Kisan, Ravikiran, et al. "Treadmill and bicycle ergometer exercise: cardiovascular response comparison." Global Journal of Medical Research12.5 (2012).
- [6] Dr Ravi kiranKisan MD, DrSwapnaliRavikiranKisanMD,DrAnitha OR MD &DrChandrakala SP MD, "Treadmill and Bicycle Ergometer Exercise Cardiovascular Response comparison", Global Journal of Medical research, Volume 12 Issue 5 Version 1.0 June 2012 Online ISSN: 2249-4618 & Print ISSN : 0975-5888.
- [7] "Cyclists Touring Club: internal gear ratios". Archived from the original on 2 July 2011. Retrieved 2011-06-29.