

Article Info

Received: 25 Jun 2017 | Revised Submission: 20 Jul 2017 | Accepted: 28 Jul 2017 | Available Online: 15 Sept 2017

Design and Fabrication of Bamboo Bicycle

*Anuj Kumar Jain**, *Feras Hakkak***, *Mudit Gupta**** and *Siddharth Jain*****

ABSTRACT

Bicycles provide a convenient means for curbing the growing challenge of traffic congestion and pollution in cities. Steel bicycles are available in India in millions. However, as production of steel is a polluting process, replacing it with greener version has occupied the minds of researchers all over the world. In this respect, bamboo seems to be a viable substitute to steel in making of bicycle frames. Bamboo frame bicycles are lighter than steel frame bicycle, have aesthetic looks, are more environment-friendly, and can potentially be cheaper than steel frame bicycles. This paper reports our attempt to design and fabricate a bamboo bicycle. Special jointing technique was developed to attach the bamboo poles. Tests showed that the bicycle actually could withstand various rides in smooth and bumpy roads.

Keywords: *Bamboo; Bicycle; Joints; Frame.*

1.0 Introduction

Bicycles provide a convenient means for curbing the growing challenge of traffic congestion in cities. They also provide rural communities with better access to markets and services. They do not consume fossil fuels and do not add to the pollution in cities. Moreover, pedalling is commonly considered to be a good exercise. Bicycles can play an important role towards a healthier and better life. Steel bicycles are available in India in millions. They are sturdy, and the simple types are not so expensive. But, they are quite heavy and not very cheap for low-income people.

Moreover, mining of iron and processing it into bicycle frames has shown to have a negative impact on the environment. Bamboo-frame bicycles seem to solve these issues of steel-frame bicycles. Bamboo is an important plant.

It is part and parcel of the life of hundreds of millions of people in South and East Asia, Central and West Africa, and South America. It is strong, cheap, and eco-friendly, and has traditionally been used for building construction, artwork, medicine, food, etc. Bamboo has been in use for bicycle

construction since 19th century [[1]]. But it has never achieved wide acceptance till date. However, in the last two decades many bicycle manufacturers in the world have started showing interest in bamboo bicycles [0-0].

The present paper reports about project designing and fabricated a bamboo bicycle. The reason for use of bamboo was to make a more eco-friendly as well as economical version of the available steel-frame bicycles.

This comes along with the fact that bamboo is a very good shock-absorber, has very high strength [0], and is easily available in India at low cost. Unlike other trees, bamboo grows rapidly and can be harvested within 3 to 4 years after plantation [0].

It also has a low carbon footprint [0]. Therefore, bamboo is considered a very viable alternative to wood or metals from financial as well as ecological perspectives. The design requirements we chose for our bicycles were as follows:

- Touring type bicycle for use by Indian adults
- Sufficiently strong to withstand bumpy roads
- To use bamboos grown in India
- Low weight
- Low cost

*Corresponding Author: Mechanical Engineering Department, The NorthCap University, Gurugram – 122017, India (E-mail: anujkjain@ncuindia.edu)

**Mechanical Engineering Department, The NorthCap University, Gurugram – 122017, India

***Mechanical Engineering Department, The NorthCap University, Gurugram – 122017, India

****Mechanical Engineering Department, The NorthCap University, Gurugram – 122017, India

2.0 Methodology

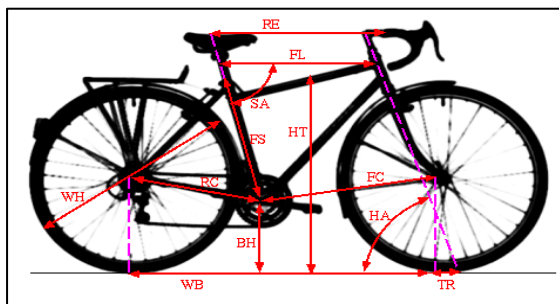
2.1 Material selection

There are very few species of bamboo poles commercially available in Delhi markets. A bamboo type with small diameter was selected and two types of this bamboo as thicker (28mm outside diameter) and thinner (18mm outside diameter). The bamboos were chemically treated against insect and fungi.

2.2 Dimensions

Frame dimensions are shown in figure 1 from a good existing steel bicycle, a touring bicycle from Roberts Bicycles, New York.

Fig 1: Dimensions of the a Touring Bicycle by Roberts Bicycles [0]



2.3 Developing the joining method

The bicycle frame consists of straight bamboo pieces connected to each other via suitable joints. There are many methods to join bamboo pieces with the help of bolts, nuts, ropes, glues, etc. [0]. Some of these techniques tested the joints for strength. Joints having glue (fevicol) and bolt and nuts failed and finally we made a clamp-type joint in which steel pipes were welded to each other and bamboo pieces were clamped in them as shown in figure 2.

Fig 2: The Bush and Clamp Joining System



2.4 Fabrication

As mentioned a C-type bush piping system was used i.e. 29mm OD for thick bamboos and 19mm OD for thin bamboos. In areas where standard bicycle parts needed to be fitted, used metal inserts. Then, clamps were fitted on bushes to tighten them and make a stronger grip on bamboos. After that, a drilling machine was used to make a hole of 3mm in each bush for inserting a bolt to hold the bamboo pieces and not let them come off the bush. As the next step, M-seal glue was applied at the joints to make a good texture as well as to protect them from humidity and dust. In the end, all the joints were coated with teflon tape and then painted with skin-color acrylic spray paint. Similarly, the bamboo piece polished with lacquer protect them from moisture.

	FS	FS	HT	RE	BH	FL	SA	HA	TR	WH	CR	FC	RC	WB	Wt
	cm	in	cm	cm	mm	mm	deg	deg	mm	mm	mm	mm	mm	mm	kg
ROB	47	19	72	57	262	502	75.2	70.7	62	686	163	583	423	993	12.5

Fig 3(a): The Frame Before Coating



Fig 3(b): After Coating the Joints



The frame was made and then bought the other parts such as tires, front handle, pedals, etc. from the market.

For assembling the parts to the frame, we had already chosen bushes with appropriate sizes.

After two weeks to fit all the parts and adjusting them for smooth running of the bicycle.

Fig 4: Our Bamboo Bicycle Ready for Riding



3.0 Results and Discussion

The final product is shown in figure 4. It was tested by riding it in the vicinity of the University for 2-3 kilometers and rode it on uneven roads and made it jump on speed breakers. It survived the test and we found it comfortable.

The cost of the project was Rs. 6000. In case of mass manufacturing this bicycle, it can be sold in the Indian market at around Rs. 2500.

The originality of product is in using Indian bamboo and having developed a clamp joining system using nut & bolts for joining of bamboo pieces.

The bicycle is light (9.5 kg), has good looks, and is cheap. The durability of this cycle depends on the way we coat the bamboo (for protection against environmental conditions), as well as the quality and strength of the joint.

Considering the coating method we have used, we can expect 2-2.5 years of life for our bicycle. The future work should focus on increasing this lifetime to 5 to 7 years.

4.0 Conclusion

A light-weight, cheap bamboo bicycle using Indian bamboos tested and it is possible to improve it further and introduce it in the Indian market.

This can be a step towards a cleaner and greener environment and better future.

References

- [1] 1898 Bamboo Cycle Co Light Roadster, <http://www.oldbike.eu/museum/bikes-1800s/1898-2/1898-bamboo-cycle-co-light-roadster>
- [2] FH. de Oliveira, AC Garay, SC Amico. Use Of Bamboo Culms in Bicycle Frame Construction, 7th international Symposium on natural polymers and composites - ISNAPOL 2010, Brazil.
- [3] Bamboo Bicycle Club London, <http://bamboobicycleclub.org>
- [4] Bamboo bikes by Calfee Design, <http://calfeedesign.com/products/bamboo/>
- [5] Ghana Bamboo Bikes, <http://ghanabamboobikes.org>
- [6] This Son of a Carpenter Made India's First Bamboo Bicycle for a Greener Ride, The Better India news, <http://www.thebetterindia.com/79260/vijay-sharma-bamboo-bicycles-bambike> (accessed on 19th June 2017)
- [7] Introducing the Unique Bamboo Bike! The Godrej Bambusa, Godrej & Boyce Mfg Co Ltd, <https://www.fueladream.com/home/campaign/795>
- [8] Bamboo Bicycles Beijing, <http://www.bamboobicyclesbj.com>
- [9] A Widyowijatnoko. Traditional and Innovative Joints in Bamboo Construction, PhD Thesis, RWTH Aachen University, 2012.

- [10] RL Banik. *Harvesting Techniques, Bamboo: The Plant and its Uses*, 2015.
- [11] JG Vogtlander, P Lugt. The environmental impact of industrial bamboo products: Life-cycle assessment and carbon sequestration,
- [12] <http://www.myra-simon.com/bike/pt-specs.html>
- The International Network for Bamboo and Rattan, 2nd edition, 2015.