# Design and Development of "Bamboo Air Sander"

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*Abstract:* **- The Invention relates to a sand blasting method using abrasives like sand on a bamboo to remove outer layer. Bamboo is a natural composite material; it has reinforced longitudinal strong fibres which are densely arranged at the outer surface area and freely pin the inner surface area, and at radius volume fraction changes.**

## I. INTRODUCTION

Bamboo is most extensively used material within Asia, South America, & Africa. Bamboo is an interesting plant for Europeans and it was like stranger for them before 16th century when introduced for the first time. But for more than thousand years in continents like Asia, South America & Africa bamboo was used in their daily life from buildings to furniture and bridges to foods. In many realms like China, India, Bamboo is widespread in Japan & Korea for painters, poets as an icon of good personality, making evolution, modest and straight [1]

India is one among foremost bamboo producing countries (More than11.4 million hectares) which accounts for coarsely in Asia half of the total area covered. There are different reports on the number of classes and species of bamboos in India. It is a good replacement for wood, it is been ever used as one among the strongest and ancient construction materials. Use full for science and engineering purpose the bamboo has been used into a prolonged variety of items ranging from household related to industrial related applications and creating revenue and jobs. Bamboo adds significantly to the environmental, cost effective and societal improvement.

The Bamboo Air Sanding Machine for obtaining smooth grainy finish proposed with extensive literature survey. The machine is developed and proposed with concept of simple to operate, cost effective and easy for maintenance. This will provide edge for self-employment, increase in productivity of making good quality finish to the Bamboo.

The developed Air sanding machine involves a pressurized Spraying gun and a tank, increased process efficiency to accommodate varied sizes of bamboo from 12.5mm to 5mm. Advanced Air sanding machine or tool manufacturing involves less number of parts and least number of manufacturing processes which has reduced cost of machine to greater extent which make it very affordable with increased batch production.

Bamboo is considered as energy efficient, eco-friendly and a renewable natural reserve with an environmentally sustainable building material. Nowadays bamboo has become viable alternative timber due to rapid depletion of forest. Bamboo touches its complete height in 4-6 months with growth of 150 to 180mm/day. As compared to timber growth of 20 to 40 years, bamboo can be harvested within 3-5 years. Bamboo has an exceptional strength-weight ratio when related to materials such as timber, steel and concrete [4].

About 13% of area of forest is covered by bamboo in India. Government is setting up innovation centers in different states where bamboo is largely grown too make value added bamboo products [6] considering demand in bamboo sector.

Bamboos belongs to wood family, evergreen to deciduous plants belonging to the grass family Poaceae, subfamily Bambusoideae, tribe Bambuseae. From olden times bamboo has been part of human due to its adaptability in which it is good material for abundant applications. Bamboo is established in 3.2% of the total forest area in the world (36 million hectares worldwide). Bamboo inhabits over one percent of the tropical & subtropical forest area - over 22 million ha. Of the total area covered bamboo inhabits over 80 % in Asia, 10% in Africa and 10% in America. About 30% of bamboos are classified into forest plantations against 3.8% of woody plantations.

*Mechanical Properties:*

Bamboos are mainly used in various applications like durable building materials. It has three directional mechanical properties: i.e., longitudinal, radial and tangential. The stem wall microstructure seen in Figure 1.1. The outer part of the bamboo stem wall is dense, has dark color and it has a quarter of a millimeter thick. The outer layer contains much silica, which works as a protective layer and also a good material to the plant, but the drawback is that damages the sharp edges of the tools in no time. Means the tool edges get damaged in the initial cutting operation. If you see the cross section the dark spots decreases from left to right which are cellulose fibers together with vessels. Cellulose is good and works as reinforcement and gives better strength as steel bars in reinforced concrete or like glass fiber in fiber-reinforced plastic. These fibers are denser or more concentrated near the outside[1]

In bamboo wett ability is the property that it's ability of a liquid that it forma coherent film on a surface, owing to the dominance of molecular attraction between the liquid and the surface over the cohesive force of the liquid itself.[Padday1992]. Thus It has significant influence on

adhesion and other related properties. In terms of adhesion theory, bond formation involves wetting, adsorption, and inter-diffusion of the resin with the respect to the adhered substrate[Kaeble1967].

Bamboo is equaled to steel in relations of strength and stiffness efficiency, while the production drive required for bamboo (per $m^3$) is only 0.1% of steel. Bamboo culms reach 8-15m length, 50-120mm diameter with wall thickness 5-10mm, and 100MPa tensile strength and compressive strength of about one third of tensile. Report says there are 1000 kinds of bamboo and for certain kinds a tensile strength of 370MPa. [5]

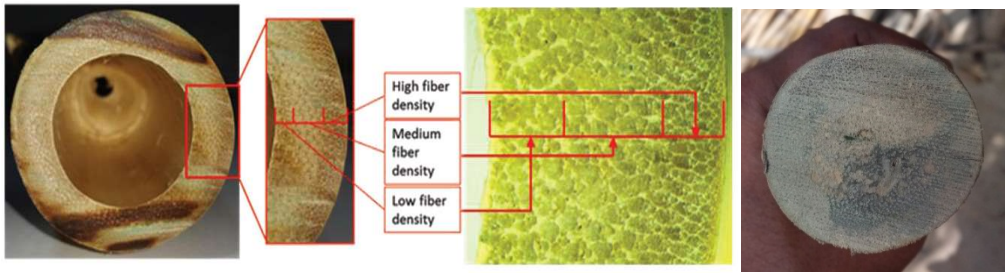


Figure: 1.1 Vascular Bundles of bamboo structure [1]

Composites of bamboo can be efficiently used as construction materials and furniture material because of its mechanical properties. Specific tensile strength bamboo composite is 4-5 times greater than mild steel and similar to that of a composite of glass-epoxy composite.

Bamboo are used in Structures for building homes, Airports, Hotels, used in scaffoldings, Fencing, Medicines, Cold storage rooms, used in making furniture etc.,

As per market Survey there is no method evolved for polishing bamboo except manual method i.e., conventional method.

*Manual sanding using sand paper:*

Manual sanding is been done to arrive to get rough finish or smooth finish.

The quality will be arrived till the grains of bamboo will be seen. The sanding papers uses to get the finish are No: 80, No 100, No: 120, No: 220 and No: 320.

Nos 80 and 100 are used to get rough finish. The nos 120, 220 and 320 are used to get Smooth finish on the surface of the bamboo. The sanding will be done as shown in the figure. The sanding will be done longitudinally i.e. length wise to get proper finish, so that the grain structure will be achieved as existing inside the bamboo.

By continuous rubbing by hand one after one the Surface finish will be achieved as shown in figure 1.2.

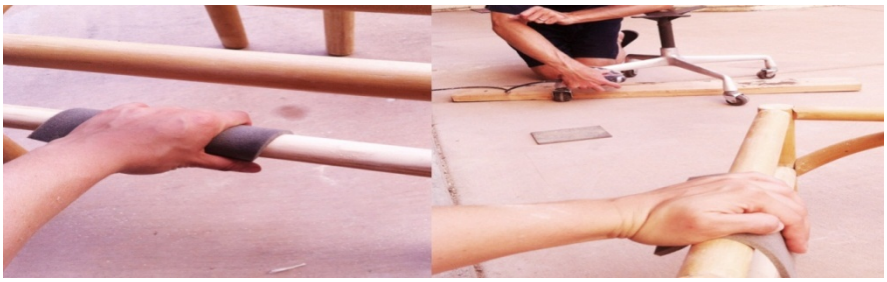

Figure 1.2Manual sanding

Figure 1.3 Sanding by machine tool

Figure 1.4 Manual sanding samples using different sandpapers

*Sand blasting of wood:*

The system explains the cleaning of wood for a better finish. The Rough sand is used to get rough finish and fine sand with pressurized air will be blown through proper nozzle to remove stains, dirt to arrive a better finish. But the Sand mixture is polluting the atmosphere.

Figure 1.5 Sand blasting for wood in atmosphere

## II. SCOPE OF WORK

Bamboo is an excellent substitute for timbers. Major role is played by bamboo in the field of house constructions, house hold items, and so on. Now a days timbers are not available abundantly from forests for many reasons and also Honourable Supreme Court of India, has banned usage of felling trees, bamboo's are so important now a days that they are replacing timbers is gaining more and more grounds in India, that to in backward countryside where development of roads and communication are not there. In the world India is the 2nd highest producer of bamboo and paper industries consumes 45% of total production of bamboo of the Country. India has vast international market potentials in the years to come and the demand of paper industry and also of handicraft, bamboo mat ply, bamboo tiles, etc and lots of other items (of about 1500 documented use of bamboo) is increasing. Bamboo markets are now ruled by china and some South East Asian countries. In 4-5 years bamboo matured whereas a tree of economic importance requires minimum 60 years to mature. For about 30-40 years bamboo can be harvested annually after certain years continuously.

Bamboo has opened up an employment by giving jobs and business to unemployed people; hence job opportunities are increased due to bamboo industries. It is very important plant economically, as it checks soil erosion and reclaims degraded lands. Shoots of the bamboo are also a nutrient food items in different forms and in our day to day life these plants have more importance.

Bamboosare different in properties along longitudinal, radial and transverse in directions. Hence bamboo globally considered as an encouraging structural material. India being second largest bamboo producer in world, has a vast tradition of its usage in buildings, furniture, art. Infrastructure sector is second largest polluter and promoting bamboo usage will contribute towards reducing the emission of carbon in any country. One of the plans from the government of India is "Housing for all by 2022", according to which in next six years our country will need more than two crores of houses need to be constructed for the poor. India's total $CO_2$ emission is from building sector is about 22% approximately [24]. The properties of bamboo with their inherent ecological advantage over other high energy materials, usage of the bamboo is one of the solutions for the global warming.

Bamboo is special arrangement, in garden it not just a plant in construction it is an important material, in different

fields and in different areas. They have been used in various methods to make abundant items, buildings, furniture, tools and other things for practical uses.

## III. DESIGN AND MANUFACTURING

This phase talks about designing of the product and manufacturing the same. The 2D Drawings are generated using AutoCAD software. This will help in creation and modifications easily during manufacturing and assembly. Once the sketches / drawings are generated, design of concept will be tested for calculations and released for manufacturing.

The following are the main parts of sand blasting / Borax blasting technique.

- Nozzle
- Flexible pipes and hose
- Compressed air
- Fine Sand and Borax

*Sand Blasting Mechanism:*

Sand blast cleaning is a surface treatment process widely used in different industries with many diverse applications. Abrasive blasting means, the process by which an abrasive media (sand) is accelerated through a blasting nozzle by means of compressed air. These sand blasting is used to achieve a good surface finish on metal surfaces.

Hence same is tried on Bamboo to achieve a good surface finish to exhibit the natural finish of the bamboo with grains.

For rough sanding and stripping, 40 to 60 grit sandpaper used, for smoother surfaces and removing lesser imperfections, 80 to 120 grit sand paper is used. For high surface quality fine sandpaper with 220 to 600 grit sand paper is used.

Abrasive sharp edges i.e., numerous sharp edges that cut away at wood or metal are glued on to backing such as kraft paper with a bonding agent to form sandpaper. Grit size, or number of sharp particles per square inch of sandpaper tells the sandpaper number. If the grit size is larger and contains more edges it is harder and there are small grit size then the sandpaper paper is smoother. The density of the grit is important, too.

In *Bamboo Air sander* method the Sand particles of finer sizes are used to make the smooth surface on the bamboo. Initially by adjusting the air pressure the sand (fine) will be blown on the surface of the bamboo and oscillated vertically i.e., lengthwise to achieve the grain structure finally.

There are four main types of sandpaper grits: aluminum oxide, garnet, silicon carbide and ceramic. Aluminum oxide lasts longer than the other kinds of grits since it contains a self-renewing property; because it's the most delicate, it crumbles easily, forming new soft edges. Garnet wears out the fastest but produces the smoothest surface. Silicon carbide is ideal for sanding harder materials such as metals and plastic. Finally, ceramic, the most expensive and roughest grit, is used for shaping wood.

Figure 1.6: Sand

Figure 1.7: Borax powder

Results are achieved by using *sand* with Pressurized air at 4-6bar. But still Sand can't be recycled to some extent. Then ***Borax*** powder is used to get the smooth surface on the bamboo due to the borax powder is extensively used for treatment of bamboo and the Borax powder will be reused for the same application and can be used for Bamboo treatment purposed which is economical also. Even though the borax powder is costlier than the sand, Borax can be re used multiple times compared to sand and Borax is non-hazardous to health.

*Assembly Drawings:*

The Assembly of the equipment is as below.

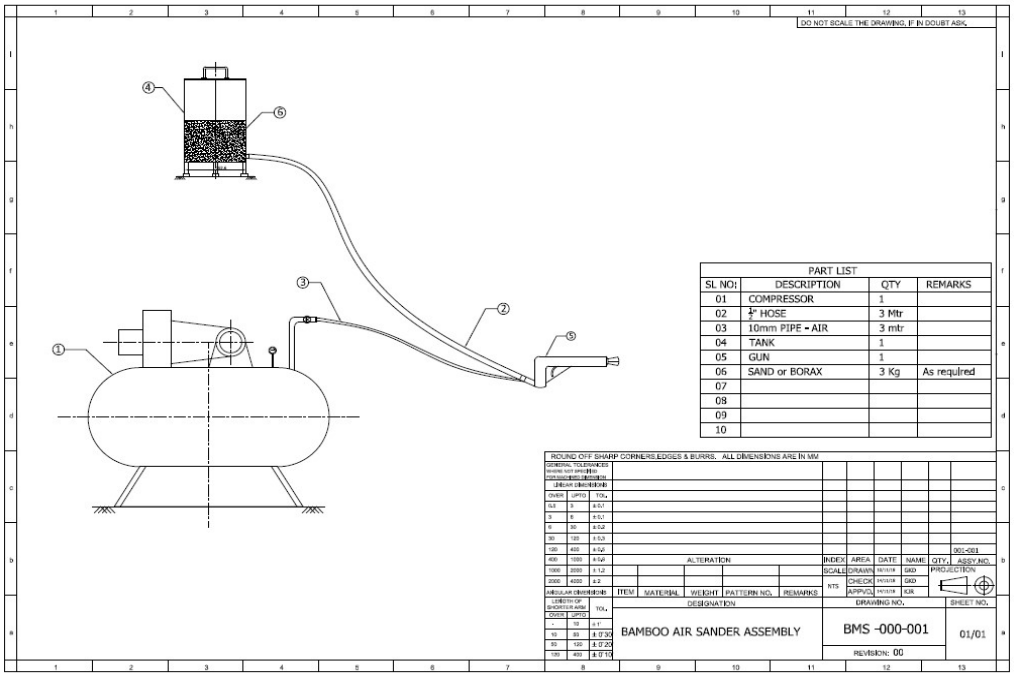


Figure 1.8: Main Assembly of the Bamboo Air Sander.

Main assemblies are

1) Air Compressor

2) Tank

3) Hose for Air and Media

4) Nozzle

5) Sand and Borax

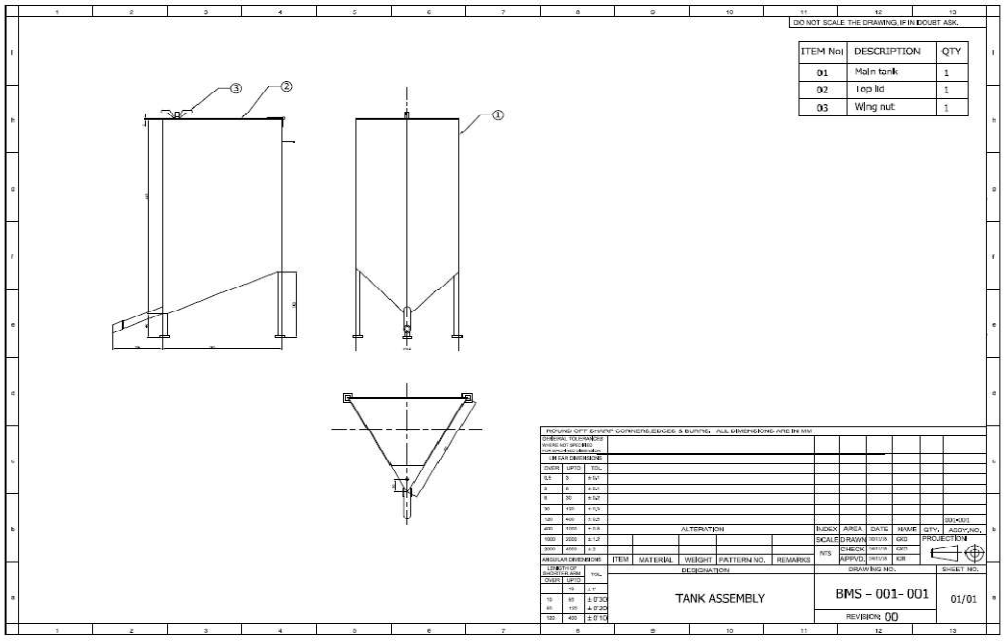


Figure 1.9: Tank assembly drawing

Figure 1.10: Sand blasting

**TOTAL SETUP OF THE APPARATUS**:

Figure 1.11: Apparatus Setup

## IV. CONCLUSION

Bamboo is a feasible replacement for wood and as good as to steel. It is extensively used in building construction for houses, resorts, Furniture etc., Systematic method of using bamboo to be applied in market and industrial skills on bamboo has led to an extended range of products from domestic to industrial uses and creates revenue and job opportunities. It adds greatly to the ecological, economic and social development.

The major achievements from the design and development of the product are:

- Product is handy.
- Used to serve the purpose in less time.
- The product is used by consumer without much difficulty by taking little care.
- The customer can provide the service to the Bamboo industries as a business point of view.
- The cost is less and more economical.
- User friendly.

Considering bamboo application in various sectors majorly in furnitures it has been noticed that recent need is in structural and furniture applications. Based on this requirements many positive connections will be used in both structural & furniture applications. Among them is Bamboo Air sander is extensively use to increase the productivity using less labour, less time to reach the market demands.

Bamboo Air sander is developed for the following reasons

- Generating Skin removal and obtaining finish compared to manual method
- Bamboo sizes considered 30mm Diameter to 50mm x any length.
- Productivity increase with increased efficiency of 70%
- Ease of use due to its minimum number of mechanisms and parts.
- Even though the cost of Borax powder is costlier than sand this will be reused for Bamboo treatment as regularly they are using.
- It is very economical to any small scale industries.

With reference above mentioned points we can concluded that the Bamboo air sander will serve the purpose of small scale industries to overcome the difficulties in mass production to some extent to avoid the labor burden. Product

developed will serve the purpose of compactness, easy to use, economical with increased productivity.

## V. FUTURE SCOPE OF PROJECT WORK

This project "Bamboo Air Sander" is effective and efficient in many ways still it has scope for improvements and product can be made more efficient. Scope of improvements are identified in following areas

- The Media for sanding like Borax to be collected in a container for reuse
- Total Air sanding can be done in a Enclosure like Sheet metal enclosure with proper mechanism to move and rotate the lengthy bamboo.
- Sliding bamboo inside the enclosed can be manual or automated as per the budget.
- Instead of using single Nozzle we can use multi Nozzles for Air sanding purpose and for more number of bamboo's.
- Vacuum arrangement can be provided to remove / suck bamboo powder during operation.

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