A Review on Bamboo Strip Making Machine

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Abstract: At present the bamboo stripping is done manually and some sort of machines are available in market, these research papers is a study of literatures are available in market as well as the present manual processes done to get the required shape of the bamboo for utilization of bamboo in various products. Some machines are available in market but did not achieve minimum thickness of 2 mm so that's why this machine has been designed and it will be the extension for our previous project 'BAMBOO MAT WEAVING MACHINE', this machine will achieve min 2 mm thickness of strips using pneumatic and electrical energy. And it is fully automatic which will minimize the human interference.

Keywords: Bamboo, 2mm thickness, fully automatic, pneumatic, electric energy.

I. INTRODUCTION

Bamboo, commonly known as "cradle to coffin" timber is closely associated with life and livelihood of human being. Nearly one thousand five hundred uses of bamboo have been documented so far. The diversified uses of bamboo ranges from farm equipment's to storage device, from dolls to measuring tools, from furniture to decorative items. The credit of this varied utilization of bamboo goes to the bamboo artisans, who since centuries have been engaged in shaping the bamboo strips into such varied uses. Though the number of bamboos arti-sans in Orissa enumerated is about 30,000 in the year 2003 as quoted by Director of Handicraft and Cottage industry, in actual the number is fairly big and expected to cross one lakh if thoroughly surveyed. Apart from this, quite a large number of populations out their livelihood from bamboo cutting operation in the state.

The initial processes to be done on a bamboo to make it as a useful product is called as bamboo processing. The initial processes include splitting, external and internal knot removing, slicing, bamboo sticking making, stick length setting, stick polishing. Bamboo and bamboo splits are used as the fencing material and for making various types of tool handles, ladders and scaffolding. In its natural form, bamboo as a construction material is traditionally associated with the cultures of South Asia, East Asia and the South Pacific, to some extent in Central and South America. Bamboo sticks are used for various purposes like building construction. Splits as well as slivers are used to make a wide range of products such as baskets, the core of incense sticks, kites and toys, flutes and a large number of handicraft items. They are also use to make cages for poultry, drying, packaging and transport of grains. Bamboo splits are woven into mats and use to manufacture mat boards.

Bamboo and rattan are important non-timber forest products, particularly in Asia. These commodities have contributed significantly to the livelihood security of millions of indigenous peoples in the region who have adopted numerous practices to harvest and process the raw materials, employing simple hand tools. These traditional technologies and tools have been passed on from generation to generation, and have undergone some modifications and refinement. Because of the ecofriendly, labor intensive nature of these processes, their relevance has remained strong to the present day. Information on such local technologies, however, is restricted, localized and largely unpublished, and hence not easily accessible to other interested groups. This publication, although by no means exhaustive, is intended to fill this gap and help in the wider dissemination of the knowledge for the benefit of the rural poor, particularly women who are generally engaged in processing and finishing the products. Linking of practices and tools in different regions will open up opportunities to merge elements that save cost, time and drudgery, and help develop new technologies, or replace an inefficient technology or tool in one place by a more efficient alternative from elsewhere. This will not only result in improving the living standards of people but also in reducing wastage of bamboo and rattan raw materials.

The bamboos are widely distributed in India and abundantly occur in Andhra Pradesh, Arunachal Pradesh, Assam, Manipur, Meghalaya, N . E . Misoram, NagaIand, Sikkim, Tripura, Orissa, West Bengal and Madhya Pradesh States. A few species are also found scattered in other parts of the country both in the hills and the plains.

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The bamboos may occur as either an under story or in pure form in all other parts except the Kashmir Valley. Their natural distribution is governed by rainfall, temperature (8oC to 36OC), altitude and soil. A minimum of 100 cm annual rainfall and a high atmospheric humidity promote luxuriant growth. In well drained parts of tropical and sub-tropical habitats going up to 3700 m altitude in the Himalayas, these often form rich be of vegetation. The main genera in India are: Arundinaria, Bambusa, Cephalostachyum, Chimonobambusa, Dendrocalamus, Dinochloa, Gigantochloa, lndocalamus, Melocanna, Naohouseaua, Ochlandia, Oxytenanthera, Plaioblastus, Phyllostachys, Pseudostachyum, Schizostachyum, Semiarundinaria, Sinobambusa, Teinostachyum, and Thamnocalamus. The exotic genera Guadua, Pseudosasa and Thyrsostachys are also in cultivation.

A. About the Bamboo

Bamboo is a naturally occurring composite material which grows abundantly in most of the tropical countries. It is considered a composite material because it consists of cellulose fibers imbedded in a lignin matrix. Cellulose fibers are aligned along the length of the bamboo providing maximum tensile flexural strength and rigidity in that direction [Lakkad and Patel 1980]. Over 1200 bamboo species have been identified globally [Wang and Shen 1987]. Bamboo has a very long history with human kind. Bamboo chips were used to record history in ancient China. Bamboo is also one of the oldest building materials used by human kind [Abd. Latif 1990]. In Asian countries, bamboo has been used for household utilities such as containers, chopsticks, woven mats, fishing poles, cricket boxes, handicrafts, chairs, etc. There are about 35 species now used as raw materials for the pulp and paper industry.

B. Physical Properties of Bamboo

With the continued rapid development of the global economy and constant increase in population, the overall demand for wood and wood-based products will likely continue to increase in the future. According to a FAO (Food and Agriculture Organization) global outlook study on the trends of demand for wood products, there will be an increase in demand of the order of 20% by 2010. As a cheap and fast-grown resource with superior physical and mechanical properties compared to most wood species, bamboo offers great potential as an alternative to wood.

India is home to about 45% of the world's bamboo production. There are 125 species of bamboo in India spread across 18 genera. According to a survey by BMTPC (Building Materials and Technology Promotion Council) India produces about 13.5 Million Metric Tons of bamboo annually from 9.6 Million Hectares land area (used only for bamboo plantation).

Bamboo is a very complex material and many things affect it including.

1) direction,
2) moisture content (MC%),
3) diameter,
4) wall thickness,
5) distance to node
6) height,
7) species.

Strength properties for bamboo have already been tested by universities around the world and present outstanding results which are in many cases much superior to conventional building materials. However, building code standards require more than the strength properties of a material alone, other properties to consider are:

1) Durability
2) Fire Safety
3) Environmental Impact
4) User Safety
5) Energy Efficiency.

C. Bamboo based Industry: an overview

Bamboo based products are produced from thin strips of bamboo. There are a wide variety of such products and they have been closely associated with the development of civilizations in bamboo growing regions of the world for many millennia. The products may be primarily intended for agricultural use, such as baskets for vegetables or animals and winnowing trays for cereals, or they may be household products such as baskets, trays, jars, case, lampshades, fans and mats. The techniques require considerable skill and experience on the part of the weavers and the designs require innovation on the part of the designers. A bamboo-based product unit provides income generation and skills development to those that it employs. Weaving can be done on site or at home in spare time or full time. Increasing the use of local bamboo resources also encourages their sustainable management and benefits the bamboo cultivators. The production of bamboo-based products is a traditional technology that has been practiced for more than a thousand years and is widely distributed. Manufacturing bamboo-based products combines traditional weaving skills with modern technology. The majority of the bamboo-based industries are grouped as cottage and small-scale enterprise.

There are various bamboo-based products including sofa, dining tables, baskets, trays, jars, boxes, cases, vases, folding screen, models of animals and figures, building, furniture, lamps and lanterns, bags, toys, fans and mats. Some are graceful pieces of art for decoration or enjoyment and some of them are indispensable commodities. The style of the products often varies according to place of production. This natural resource plays a major role in the livelihood of rural people and in rural industry.

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D. Bamboo Utilization

Bamboo is utilized for various purposes depending upon its properties. It plays an important role in the daily life of people for house construction, agricultural tools and implements, as food material and weaponry etc. Besides being a convenient source of cellulose for paper manufacture and rayon, it supports a number of traditional cottage industries. Bamboo based industry is one of the oldest of traditional cottage industries in India. The origin of this rural craft is traced from the beginning of the civilization when men started cultivation of food crops. People started making baskets, mats and many other products of households use with

bamboo that was abundantly available in nearby forests. Later, tribal and rural people in the vicinity of bamboo forest took up this as a means of livelihood.

Now bamboo-based industries are spread in all rural areas of the country and it feeds millions of traditional workers. Bamboo is emerging as a major source of raw material for several processed products primarily due to its fast growth, wide spread occurrence and its multiple uses. Bamboo has versatile uses as building material, paper pulp resource, scaffolding, food, agriculture implements, fishing rods, weaving material, substitute for rattan, plywood and particleboard manufacture. Pickled or stewed bamboo shoots are regarded as delicacies in many parts of the country2. The major user of bamboo in India is paper industry, which consumes sizeable proportion of the total annual productions. Bamboos are good soil binders owing to their peculiar clump formation and fibrous root system and hence also play an important role in soil and water conservation.

E. Bamboo and the Environment

Call it green gold or nature's band-aid, bamboo is a great protector of the earth's health and wealth. It is a critical element in maintaining the balance of oxygen and carbon dioxide in the atmosphere. Carbon gets trapped within bamboo forests, thus reducing carbon dioxide gases. It also lowers the intensity of light and protects us from harmful ultra-violet rays. Bamboo exists naturally on every continent except Antarctica. It has found a niche for itself in sea-level tropics and on 13,000 ft mountain slopes. It is a cheap, abundant resource that is recyclable and can outgrow any other plant. A 60-foot tree cut for the market takes 60 years to replace, whereas a 60-foot bamboo takes just 59 days to replace. Bamboo can tolerate diverse soil moisture regimes, can heal degraded land, stop soil erosion and help in drought-proofing. Bamboo foliage acts as a shelter for the top soil against tropical downpours and cloudbursts, while the leaf litter helps in moisture conservation by forming a soft cushion on the soil. Bamboo has an extensive underground root-and-rhizome system that effectively binds the top one foot of soil, critical for soil health. A single bamboo plant can bind up to six cubic meters of soil. Bamboo forests nurture wildlife. Apart from the endangered panda, the most famous symbol of bamboo forests, many birds, monkey sand boars depend on bamboo shoots. Their very survival depends on this grass.

Bamboo is a good substitute for fossil fuels in the form of charcoal briquettes. Experiments indicate that the charcoal obtained from bamboo is of good quality and can be used in industrial processes after activation. Gasification with bamboo is a process in which a solid fuel is burnt at very high temperatures, between 700°C and 900°C, in the presence of a gasification agent such as air. by this process, the energy present in the biomass is converted into a gaseous combustible, or chemical energy. Gas products are easier to handle. They can be used in combustion engines or gas turbines. The combustion is clean and less polluting.

The produced gas has a calorific value of 25-30 per cent of that of natural gas and is a valuable source of bio energy for a variety of purposes. Bamboo has a number of desirable fuel characteristics such as low as content and alkali index. The heating value is higher than most agricultural residues, grasses and straw. Besides, bamboo has high biomass productivity and is self-regenerating. It can thus provide power on a sustainable and environment-friendly basis.

II. PROBLEM IDENTIFICATION

Traditionally the bamboo is processed in different steps and for each step a different method and skilled labor required which will increase the cost of product. So, there is need of manufacturing a machine which can perform number of operations. So here the main aim is to develop a bamboo stripping machine to reduce the number of steps and also to reduce some amount of cost required to do Stripping operation. Here are traditional steps of bamboo strip making.

1. **Separate the slivers.**

Fig1. Separate the slivers

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2. **Cut the slivers into fine layers.**

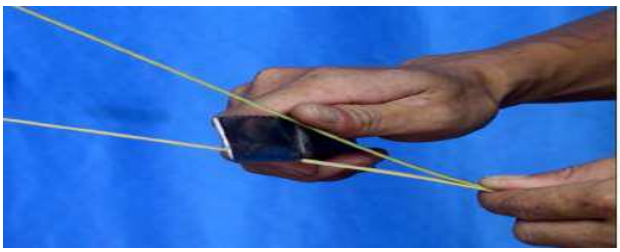

Fig2. Cut the slivers into fine layers

The above method is a traditional method of making bamboo thin strips which is time consuming and there is a chances of causes accidents as the operator use tool (cutter knife) by manually that is the main reason to develop this design of bamboo strip making machine as well as it will be the extension for our previous developed bamboo mat weaving machine.

III. DESIGN OF PROJECT

At the time of designing this device, priority was given to make it as simple as possible. This would be a benefit in terms of conforming to the available manufacturing techniques on website and lowering costs so that this prototype is further produced in large quantities. This means two things: the number of parts is to be kept to a minimum and the complexity of each part should be as low as possible.

At the design stage the consideration of some critical parameters is considered. These parameters are design feasibility, Automation in Design, Operator's safety, cost of materials, Availability of material, Minimum manufacturing cost of Material etc. As during freeze the design all these parameters are analyzed.

With all the points, The Freeze design is shows in Below figure.

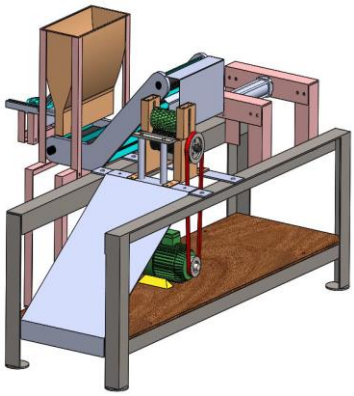

Fig3. Bamboo Stripping Machine.

Above shows Principle parts of the machine are Frame, Pneumatic Actuator, Cutting Blade, Knurled Roller, Ball Bearing, Spring, Motor, Hopper, Belt Conveyor, Pulleys, Transmission belts, Etc. The functionality of the project is the strips are kept in hopper and then the conveyor keeps one strip and move towards the strip slot, then the pneumatic actuator move the strip forward towards the blade mounting with the help of knurled wheels. Then the bamboo strip is Divided into two parts. As well the cycle is repeated. and the whole cycle is controlled by PIC 16F877A Microcontroller. The best Advantage of these project is fully automated due to the use of PIC 16F877A Microcontroller. And due to these fully automation the human interference is eliminated.

IV. CALCULATIONS FOR DESIGN.

1. Belt and pulley calculations

N1 =150 (Required speed of roller pulley)

N2 = 750 (Motor pulley speed in RPM)

D1 =? (Roller Pulley Diameter)

D2 = 40 mm (motor pulley diameter)

• Diameter and RPM of each pulley is calculated by

N1*D1 = N2*D2

150*200 =750*40

D2 = N1*D1

N2

= 150*200/750

D2 = 40

• Belt Velocity

V = π D1 * N1

60

= 3.14*0.2*150

60

V = 1.57m/sec

• Belt Length

L = (D1*π2) + ((D2*π2) + 2D + (D2 -D1)2

4D

= 0.314+0.0628+0.648+0.526

4*0.324

L = 0.81 m

• Belt Tension

F= P/V

Where P= Transmitting Power of motor i.e. 180

F= 180/1.57

F= 114.64 N

• Torque

T= P

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2π*N2 /60

T= 180

2*3.14*750/60

T= 2.29Nm

2. Cylinder Bore Diameter.

As Calculated in the solid works the weight is max up to 4 kg to be translated by the pneumatic cylinder.

So we Assume the diameter of 10 mm

D= 10mm

Surface of Drive friction

A= π4*D2

A= 10*3.14

4

A= 28.5 mm2

Operating pressure of the compressor

P= 5 bar

= 0.5 n/mm2

Calculation of force

F= P*A

F= 0.5*78.5

F= 39.25N

As a thumb rule says that we can deduct 5% for friction.

Therefore, a cylinder with a piston diameter of 10mm & operating pressure of % bar can exert a force of approx. 37.25 N If we divide a force by gravity (9*81m/S2) we find in practice that our cylinder can hold a weight of about 3.71kg.

6.71 is nearest reach to the 4 kg.

so, the above calculation justifies that our assumptions for the 10 mm bore diameter is sufficient for our project.

V. LIETERATURE REVIEW

- **Design Development and Testing of an Integrated Bamboo Culm Splitting and Planning Machine.**

In this paper author, Rey Camillo Banawis, Richmond Elbert De Vera, Edwin J. Calilung, Ernest Shawn Quinones and Richard Yao discussed about design of the bamboo splitting section was based on existing design of commercially available bamboo splitting machine while the planning section utilized 2 sets of motor-powered portable wood planers integrated into the design which simultaneously planes the top and bottom sides of the bamboo strip. The separation of split bamboo strips and sequential transfer to the planning section was designed by the authors and consisted of axial-mounted vanes within a cylindrical pipe that separate the split bamboo strips and move each strip sequentially to an exit slide onto a chain feeder to the planning section. The automation of the process utilized an Arduino Mega microcontroller board which controlled a stepper motor drive and relays to control the feeding chain motor to the planning section. The testing of the individual processes of bamboo Culm splitting and strip planning were tested satisfactorily, however, the process of separating the split bamboo strips and sequential feeding to the planning section in feed chain conveyor require further improvements as misalignment problems were observed.

- **Bamboo stripping machine using pneumatic pressure**

In this paper author, Sufiyan Ahmed Khan, P G Mehar, A V Vanalkar and S S Khandare discussed about Bamboo stripping process number of steps are involve to make Strips are: (1) Bamboo Cross Cutting, (2) Bamboo Spliting, (3) Bamboo Slicing. So the basic aim of this approach is to make a unique machine which can perform all the above processes. This can be done by pneumatic cylinder arrangement which reciprocates the bamboo holder, so that when air compress expand in the pneumatic cylinder it allows bamboo holder to reciprocates on the Horizontal blade which strips the bamboo into small pieces around 15 cm long and 1 cm to 2 cm wide and around 1 to 2 mm thick. Here bamboo holder is rectangular shape box which contains bamboo, spring pressure arrangement at the top of bamboo holder is provided. As the bamboo strikes on horizontal blade, the bottom portion of the bamboo comes in contact with the horizontal blade and the strip is obtained, the spring expands from the top with the amount equal to the thickness of strip obtained which pushes the remaining bamboo downward to obtain further stripping.

- **Manual and mechanised processing aspects for bamboo artisanal technologies.**

In this paper author, Ranjeeta Dash and Anil Mundotiya discussed about aspects of mechanization in the field of bamboo processing. Mechanization can also go a long way in estimating product outputs from round bamboo of different diameter (ø) and wall thickness beside length. A schematic CFC layout has also been proposed in the present write up to make a beginning of mechanization in bamboo sector

- **Design and Fabrication Of Improved Bamboo Processing Machine.**

In this paper author, Er. Ulhas N. Sonkusre, Er. P.G Mehar, Dr. A.V Vanalkar and Dr. S. S Khandare discussed about numerous technologies being developed for the

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processing of the bamboo for the production of several bamboo products .Some of these technologies have remained unmodified over long periods of time, while others have seen alterations to suit changing requirements. The traditional processes which are carried out on six different machines from cutting of bamboo, splitting, knot removing, slicing, stick length setting, and polishing. For all this lot of time consumed, cost increases as different machines used, labor cost increases etc. Now we are trying to minimize all these processes in a single machine, less labor cost, less time, and increasing desired output at low cost.

- **Development of Experimental Set Up of Improved Bamboo Processing Machine.**

In this paper author K. G. Ahuja, Dr. A. V. Vanalkar and P. G. Mehar discussed about development of experimental set up of improved bamboo processing machine with a capability of doing two operations in a single unit. The details of different components, construction and working are explained in this paper. The force required to split the bamboo in 8 pieces is also included in this paper. This paper also includes the traditional process of processing the bamboo.

- **Experimentation on various dies for slicing on improved hydraulic Bamboo processing machine.**

In this paper author concluded that the present work shows the experimentation on various dies on improved bamboo processing machine for slicing of split bamboos. The details of different components, construction and working are explained in this paper. The force required to slice the bamboo in 4 pieces is also included in this paper. This paper also includes the traditional process of slicing the split bamboo.

- **calculation of forces and analysis of stresses in bamboo stripping machine.**

In Present Bamboo Stripping Process Number of steps are involve to make Strips are 1. Bamboo Cross Cutting 2. Bamboo splitting 3. Bamboo Slicing. So, the basic aim of this approach is to make a unique machine which can perform all the above processes. This can be done by Pneumatic Cylinder arrangement which the bamboo holder, so that when air compressor expand in the Pneumatic cylinder it allows bamboo holder to reciprocates on the Horizontal blade which strips the bamboo into small pieces around 15cm long and 1cm to 2cm wide and around 1to2mm thick. Here Bamboo Holder is rectangular shape box which contains bamboo, Spring Pressure arrangement at the top of bamboo holder is provided, As the bamboo strikes on horizontal blade, the bottom portion of the bamboo comes in contact with the horizontal blade and the strip is obtained, the spring expands from the top with the amount equal to the thickness of strip obtained which pushes the remaining bamboo downward to obtain further stripping. This paper also represents the calculation of Forces required for stripping of Bamboo of various diameter and the stresses produce on the different region of horizontal Blade is also find out with the help of ANSYS software.

- **Bamboo Strip Cutting Machine.**

In this paper author designed and calculated the main objective is to reduce the manual operation of cutting the bamboo which is time consuming and the mechanism once automated, the high production rate of the strips would allow more time and resources to produce a wide range of applications. Bamboo - Material of the Century would then be in the right direction towards better resource utilization and can sustain an industry on its own, which would intensify employment & revenue. The machine is powered by a pneumatic cylinder arrangement which enables the bamboo reciprocation on the guideway provided and the blade at the bottom cuts the strips.

- **Bamboo Evaluation of Uniformity of Bamboo Bundle Veneer and Bamboo Bundle Laminated Veneer Lumber (BLVL)**

In this paper author describes that The lack of an effective and practical quality control method for industrialized bamboo bundle veneers is the key restriction in the application of bamboo bundle composite materials in the field of construction. In this work, the density uniformity and mechanical properties of bamboo bundle veneers were systematically evaluated by the combination of light transmittance and mechanical stiffness. It was found that the number of booming's, dipping's, and high-temperature heat treatments had different effects on the bamboo bundle veneers. On this basis, the uniformity of the density and mechanical properties of the bamboo scrimber (BS) that underwent hybrid paving, and the bamboo bundle laminated veneer lumber (BLVL), were analyzed. The results showed that the performance stability of bamboo bundle composites could be greatly improved by bamboo bundle veneer laminated paving. A large-scale quality evaluation system for bamboo bundle veneers was established in this work, and it provides conditions for the manufacture of bamboo bundle composites with stable and controllable performance.

VI. CONCLUSION

This paper presented in a depth review of the efforts made by various researchers for the bamboo products and according to the review the bamboo mat is one of the most frequent bamboo products is used in India, for getting this very easy we developed the machine regarding the same.

Before going to the prototype, we just analyze that the bamboo strips making using this machine is getting easier

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regarding to the current scenario for strips making.

Then we are designed and going to develop a machine is capable of doing strips of bamboo and able to achieve minimum thickness of 2 mm using electrical and pneumatic energy. The machine is capable of going to achieve a quantity of 24 strips per hour and a single operator will operate 2 machines as a single input multiple output (SIMO) which will enhance productivity.

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