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Design and Fabrication of Bamboo Mat Weaving Machine

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Abstract: Bamboo are ideal resources for development that integrates poverty reduction and environmental sustainability bamboo mat, a plywood-like wooden board made from layers of woven bamboo strips that have been pressed together, has enormous income generating potential for the rural poor, who make up the vast majority of weavers. The following technology describes how to produce bamboo mat. The bamboo mat technology is a commercially and socially effective means of processing bamboo into quality end products for the construction, packaging and transport sectors. Its development attributes imply considerable scope for income and welfare improvement for rural poor people. In addition, it enables governments and wood-based industries to cope with the problem of wood shortages and to reduce environmental degradation due to overharvesting of timber trees. If properly organised and guided by private enterprises, state agencies and/or NGOs, the technology as well as its backward and forward linkages can increase the income and welfare of many people in a sustainable manner.

Keywords: Bamboo, bamboo strips, bamboo mat, weavers, mat technology.

I. INTRODUCTION



Fig.1. Bamboo mat.

With recent development of Bamboo mats technology have found varied applications in numerous industrial products that include bamboo mat boards (BMB), shuttering board and roofing sheets and different varieties of bamboo laminates. An average bamboo Mat producing unit in India utilizes about 4000 – 5000 units in a day. This requires a dedicated 2500 mat weavers per unit. On an average a person can weave a maximum of 8 mats and earn Rs 120 per day. With Mechanization in the feeder units, the productivity rises to 3 – 4 mats a day. The project has been conceptualized after a thorough analysis of the social and economic aspects of the whole operation circling around bamboo. The potential of bamboo lies in its utilization for making panel materials, with the process techniques and value addition, products like superior quality 'BMB' can be produced commercially. The project covers three types of activities such as processing of green bamboo to make bamboos strips, weaving of bamboo mats and making bamboo mat. Bamboo is gaining importance as a replacement for wood in flooring and roofing panels and other housing components (such as windows, doors and partition panels), in furniture and in packing cases. Some of these products are made of bamboo mat board, some have a core of bamboo mats with thin veneer facings and others are made of laminated bamboo slabs/strips of different sizes and shapes (bamboo parquet and floorboards). Bamboo mats are plane wovan bamboo products that are designed and finished for numerous applications, especially interior design and furniture. This project will design and fabricate machine for bamboo mat weaving to increase productivity. The bamboo mat technology is a commercially and socially effective means of processing bamboo into quality end products for the construction, packaging and transport sectors. Its development attributes imply considerable scope for income and welfare improvement for rural poor people. In addition, it enables governments and wood-based industries to cope with the problem of wood shortages and to reduce environmental degradation due to overharvesting of timber trees. If properly organised and guided by private enterprises, state agencies and/or NGOs, the technology as well as its backward and forward linkages can increase the income and welfare of many people in a sustainable manner.

II. PRODUCTION OF RAW MATERIAL

A. Harvesting Bamboo

Matured bamboo culms are extracted following the locally prescribed silvicultural methods and crosscut into convenient lengths varying from 50 to 250 cms. The nodal portions are retained in species with short internodes, such as *Dendrocalamus strictus* (30 cms), whereas in species with long internodes such as *Ochlandra travancorica* and *Melocanna baccifera* (50 to 100 cms), the nodal portions are removed. The splits of long-internoded species, such as *Ochlandra travancorica* are of a more even thickness than those of short-internoded species such as *Dendrocalamus strictus*. Although both species are suitable for mat making, about 40% more resin is required for bonding mats made of *D. strictus* and other similar short-internoded species.

B. Splitting Bamboo

The crosscut bamboo lengths can be split by the following methods:

- 1) With a machete
- 2) With a hand splitting knives or
- 3) With a splitting machine

When using a splitting machine, the bamboo pole is fixed longitudinally in front of the set of splitting knives and a mechanical pushing device pushes the bamboo over the knives to produce splits of a uniform size. The number of splits produced depends upon the number of knives present in the splitting knives set. In general the width of the splits varies from 10 mm to 15 mm depending on the species and quality of bamboo. The splits are then allowed to dry in the air or in artificial ventilation to reduce their moisture content to around 30%.

C. Knot Removal

It is necessary to remove the nodes to maintain an even thickness of sliver and to facilitate further processing. The inner and outer knots are removed from the splits either manually with a sharp knife or mechanically with a knot removal and width-sizing machine. This machine also sizes the width of the splint and planes the surface.

D. Sliver making

The green epidermal layer of the splints is removed using a sharp knife and can be set aside and used for making other products. It is not suitable for making into slivers. Slivers 0.6 mm thick (+/-10%) and 12-16mm wide are made manually from splints using a sharp knife or a slivering machine. Keeping the variation in thickness of the slivers to within 10% is very important. Higher variation than this results in increased requirements for resin.

E. Drying and Weaving

Slivers are dried to around 15% moisture content. The dried slivers are manually woven into mats of different sizes and patterns depending on the specific requirements set. The two most common weaving patterns are the herring bone pattern (45 degrees) and the rectangular pattern (90 degrees). The most common sizes of the mats are 250cm x 125cm, 180 cm x 125cm, and 180 cm x 150cm.

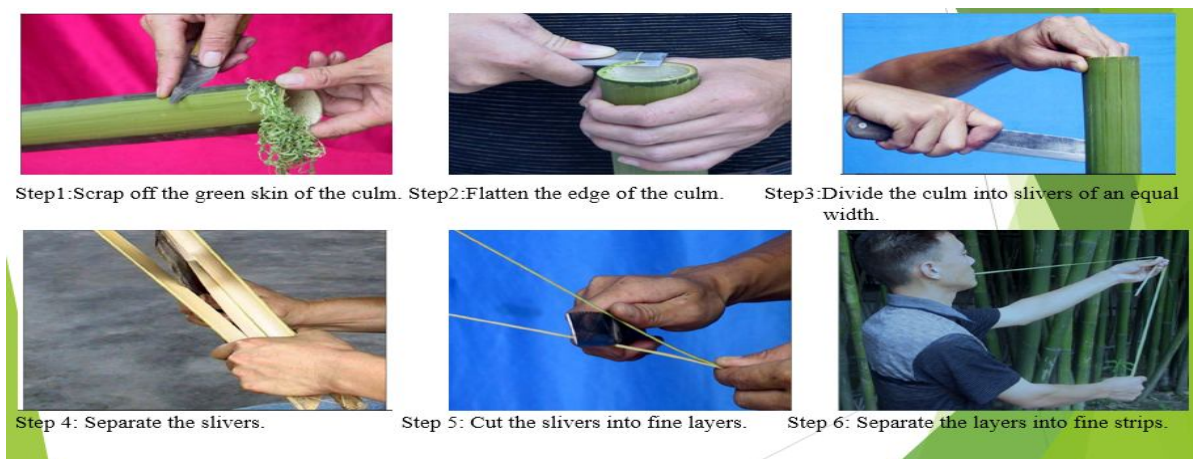


Fig.2 Processing of Bamboo Strips.

III. NEED OF PROJECT AND OBJECTIVE

Usually bamboo mat are woven by hand. But it take's lots of time to woven a single mat by hand, which means rate of production of weaving bamboo mat by hand is vary less. If we have bamboo mat weaving machine, by using this machine, we can increase rate of production of bamboo mat. Whenever there's human involved in any kind of work, then there's definitely error exist. By using bamboo mat weaving machine, we can avoid errors and produce good quality of bamboo mat.

A. Eco-friendly with nature

Bamboo is composite material so it is safe than the plastic mat. Improve productivity:- By traditional way a man can weaving a 6-8 mat in a day but after using a machine he can weaving a 10-15 mat in a day.

B. Low in cost.

Because productivity improve its manufacturing cost is decrease easily available in the market.

C. Easily Availability of raw material

Bamboo is main material of the mat which are easily available in India.

D. Self-Employment

In traditional process skilled labour are required to weaving the mat, but after manufacturing a machine no need of skilled labour required.

IV. ABOUT BAMBOO

"Bamboo fiber comes from nature, and completely returns to nature in the end" therefore bamboo fiber is praised as "the natural, green, and eco-friendly new-type textile material of 21st century".

Bamboo is fastest growing woody plant on this planet. It grows one third faster than the fastest growing tree. Sometimes the growth of Bamboo is approximately three feet over a night. Bamboos are plants of global interest because of their distinctive life form, their ecological importance and the wide range of uses and values they have for humans. Bamboo has tremendous economic potential. Bamboo use in India has a long and wide history. Millions of people in India depends on bamboo for housing, food, fuel, paper and even cloth. Bamboo and its related industries already provide income, food and housing to over 2.2 billion people worldwide. India has one of the richest bamboo resources in the world, second to China in Bamboo production. The annual bamboo production in the country is estimated at 3.23 million tons. According to Forest Survey of India (FSI), in India bamboo grows in 8.96 million hectares of forest area, which constitutes about 12.8% of total forest area of the country. Government of India runs National Bamboo Mission (NBM) to promote growth of bamboo sector. Generating employment opportunities for skilled and unskilled persons, especially unemployed youths.

A. Properties of Bamboo Strips

- 1) It has good durability, softness, luster, stability, moderate tenacity.
- 2) Strength
- 3) Compressive Strength
- 4) Elastic Modulus
- 5) Bending Strength
- 6) Shearing Strength
- 7) Fracture Behavior

V. MECHANISM & WORKING

The principal parts of a machine are the frame, the strip-beam or weavers beam, the mat-roll (apron bar), the heddles, and their mounting, the reed and pneumatic actuators. The strip-beam is a wooden or metal cylinder on the back of the machine on which the strip is delivered. The threads of the strip extend in parallel order from the strip-beam to the front of the machine where they are attached to the mat-roll. Each thread or group of threads of the strip passes through an opening (eye) in a heddle. The strip threads are separated by the heddles into two or more groups, each controlled and automatically drawn up and down by the motion of the heddles. The movement of the heddles is controlled by pneumatic actuators, solenoid valve and pressure control valve which move up the heddles by means of a frame called a harness;

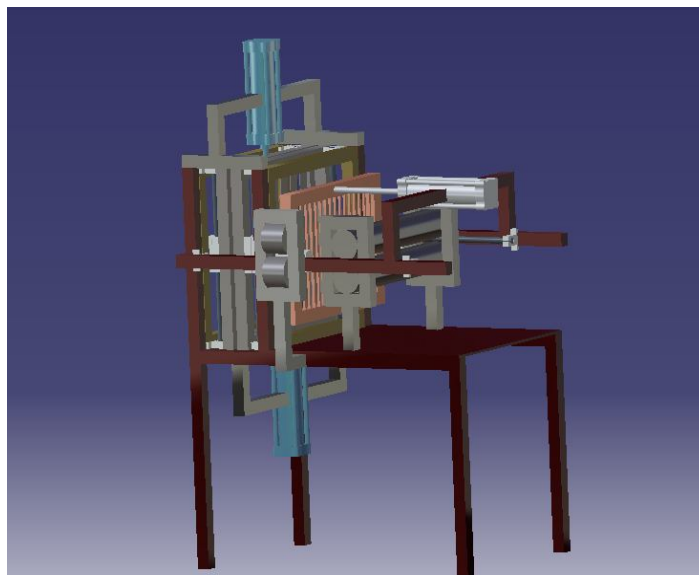


Fig.3 CAD model (Front view)

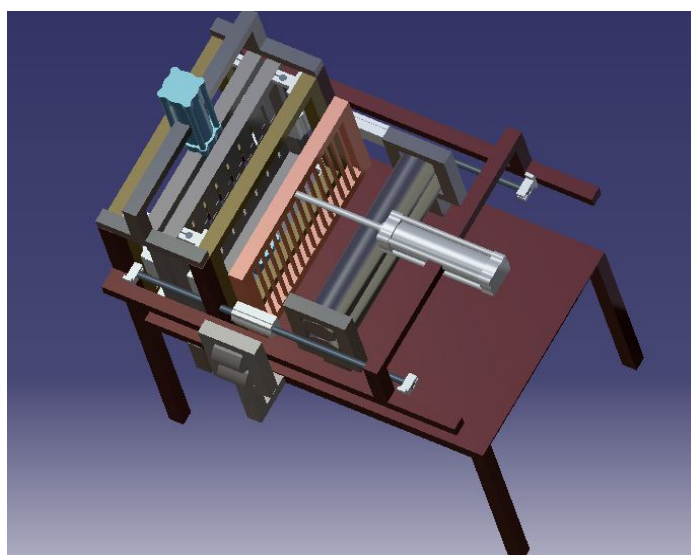


Fig.4 CAD model (Top view)

In general, weaving involves using a loom to interlace two sets of threads at right angles to each other: the strip which runs longitudinally and the weft (older *woof*) that crosses it. One strip thread is called an end and one weft thread is called a pick. The strip threads are held taut and in parallel to each other.

VI. SPECIFICATION

- A. Pneumatic Actuators 32×300 and 32×150.
- B. Solenoid Valve AC 220V Pressure 0 to 0.85 Mpa.
- C. Flow control valve.
- D. Bearings.
- E. Roller.
- F. Shaft {S.S}.
- G. M.S. Angle.

VII. ADVANTAGES

- A. Bamboo mat is a very versatile panel material, is highly popular and environmentally friendly.
- B. The mat poseses physical and mechanical properties on a par with waterproof plywood and have an excellent.
- C. Internal bond strengths, a high plane rigidity and hence high racking strength.
- D. They have better scratch and stain resistance properties than plywood.
- E. They are as fire resistant as fire-retardant treated plywood.

VIII. APPLICATIONS

- A. Since the beginning of civilization, bamboo has played an important role in the daily lives of Indian people. Bamboo craftwork is one of the oldest cottage industries primarily due to the versatility, strength and lightness of bamboo and to the ease with which it can be worked with simple hand tools.
- B. Bamboo has been put to use in various applications ranging from construction to household utensils. There are more than 1000 documented uses including an important industrial use in paper and pulp manufacturing. For this reason it is easy to involve local people in the making of bamboo mats and in the manufacturing of bamboo boards.
- C. It can be used for many of the uses to which plywood is now put such as paneling, ceilings, prefabricated shelters, packing cases and storage bins, roofs, doors and door panels

IX. CONCLUSION

The bamboo mat technology is a commercially and socially effective means of processing bamboo into quality end products, Its development attributes imply considerable scope for income and welfare improvement for rural poor people. Bamboo mat weaving machine will help to increase the productivity of the bamboo mat. The technology can increase the income and welfare of many people in a sustainable manner. Bamboo mat is much more flexible than wood-based-plywood and can be used in structural applications.

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