Internship At Uravu

Final Report

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136130012
Product Design
Batch 2013-2015
IDC, IIT Bombay

Contents

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Date 25/6/14

Ref:

This is to certify that Mr.Anulal V.S ,MDes Product Design, Industrial Design Centre IIT Bombay has done his Summer Internship for a period of one month (from 12th of May till 13th of June) and has assisted in the following projects/fields:

1. **Solar Workstation**
2. **Redesign of Bamboo Pen**
3. **Accessories**
4. **Furniture design**

Mr. Anulal V.S has been found to be keen in conceptual and technological explorations and their respective mock-ups and has succeeded in formulating new ideas and concepts. His conduct has been good throughout the internship period and we wish him all the success for his future endeavors.

URAVU THRIKKAIPETTA WAYANAD

For URAVU
President

Acknowledgement

I would like to extend my thanks to Prof. B. K. Chakravarthy, the HOD , Industrial Design Center, Prof. R Sandesh for giving me the permission to proceed with my internship in Uravu.

This internship would not have had its true meaning without the guidance I received from Prof. A G Rao.

I am grateful to Uravu, Mr. Baburaj (President), T. Shivaraj (founder, President), Mr. Manoj (Manager) and the staff there , especially Mr.Thomas, Mr.Rakesh, Mr.Balan, Mr.Lenin, for supporting, encouraging and appreciating my work and helping me adjust into the dissimilar environment of Uravu.

Lastly, I would like to thank my parents and my classmates, especially Gautham Rajaraja Varma, Manu Revi and Isaac Junior for providing me with mental support and discussing my work from time to time.

I am grateful to all those people who wished me well and helped me making my days at Uravu most memorable one.

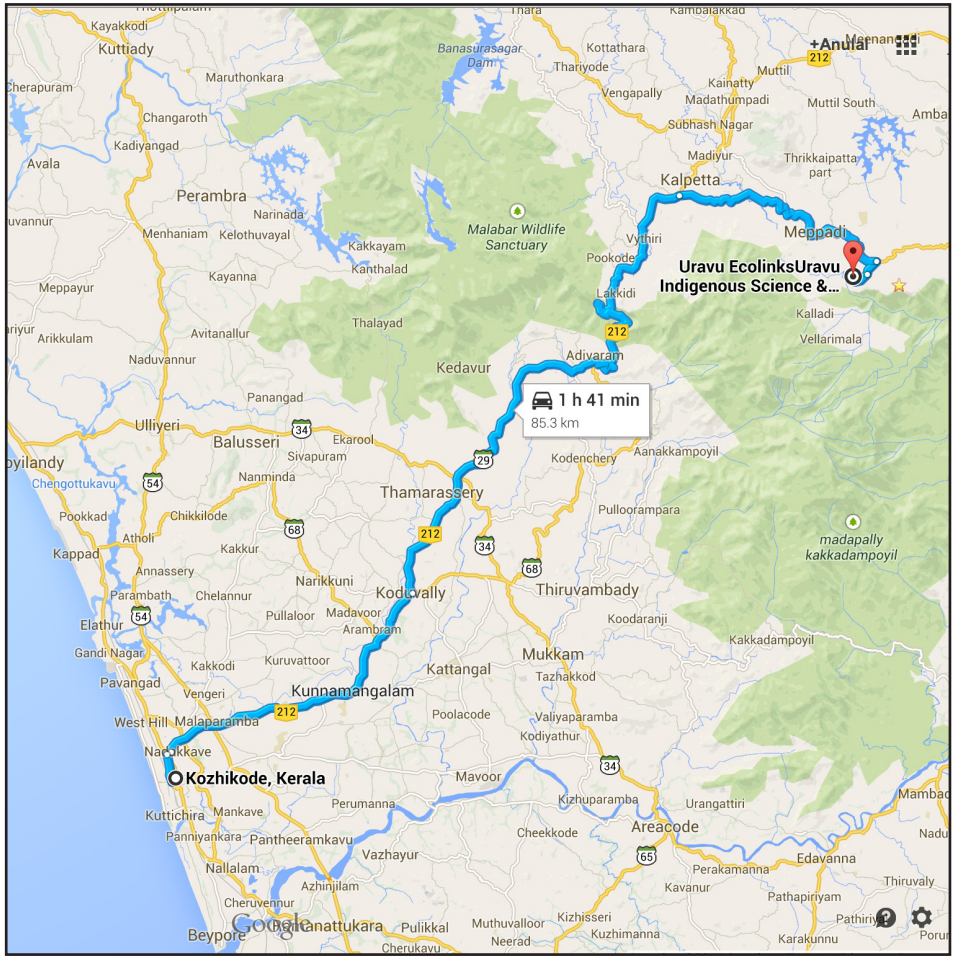


Fig 1: Showing the location of Uravu with respect to Calicut
Source: Google Maps

About Wayanad, Kerala

Wayanad is one of the fourteen districts in Kerala, situated about three hours from Calicut which is the nearest city. Wayanad has its headquarters in Kalpetta. It is also the least populated district in Kerala.

Wayanad is set high on the Western Ghats with altitudes ranging from 700 to 2100m.

About Uravu

'Uravu', set in the heart of woods on the Western ghats in Kerala among the misty mountain range and lush green backdrop, is an organization of international recognition acclaimed for promising a new path for many who missed out on their opportunities to live.

A non- government organization, currently focused on bamboo-centered products and services, believes in sustainability in every aspect it throws light on. Uravu implements integrated, end-to-end programs in the bamboo sector, which include providing skill training in bamboo processing, establishing micro enterprises, marketing of bamboo handicraft, cultivation of bamboo and promotion of eco-tourism.

Uravu is located in Thrikkaipetta village in Wayanad district. ***(Fig 1)*** shows how to reach Uravu from calicut which is the nearest railway station and airport.

Uravu Bamboo Nursery

Bamboo, essentially, is a grass. It is one of the fastest growing plants and its vertical growth depends on the geographical locations. In the Mediterranean regions bamboo grows only to a limited height of about 1-1.5 feet, whereas, in the equatorial regions, they would grow to its full potential, up to height of about 20-25 feet.

There exist more than 1250 varieties of bamboo across the world, out of which 136 are identified in India and 28 among them in Kerala.

Growth Pattern

During the early stages, the growth is less and is more confined beneath the ground at root level. From the middle of second year, shoots start coming out and roots propagate beneath the ground. In the subsequent years, more and more shoots sprout up. By fourth and fifth year onwards harvesting of the matured bamboo begins and the same can be continued from then on. Patterns start showing on the bamboo once its matured enough to be harvested. To make it easier for the on-site workers, colour coding is done, with respect to each year, to the shoots that come up.

Identifying different types of Bamboo

Natural methods for identifying different types of bamboo are:

By observing the development of the Sheath
The forms and patterns on the leaves

Types of Growth of Bamboo

• Monopodial - Bamboo grows individually, where different shoots sprout at a certain distance from each other.

• Sympodial - Bamboo grows as a bunch and shoots sprout close to each other

Bamboo Varieties Used for Construction

Guadua augustifolia *(Fig 2)*

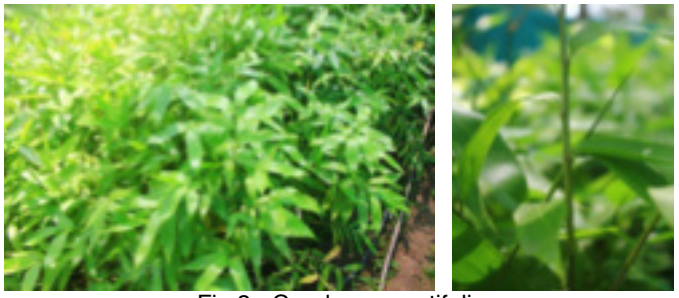


Fig 2 - Guadua augustifolia

A bamboo variety from Columbia
Monopodial
Non- Bendable
Diameter same for first 15m and then tapers to top
One thorn at a node
Used singularly or can be bolted together, as per need
Lifespan of about 70 years
15% more BTU than other fuel woods (alternative fuel)

Bambusa bambos *(Fig 3)*

Fig 3 - Bambusa bambos

Native of Kerala Ghat
Sympodial- difficult to harvest
Structural strength- almost double as of Guadua
Thorny
Pruning technique while growing- for easy harvesting
Pruning - if not done, results in wastage of immature bamboo as the whole bunch is harvested

Dendrocalamus strictus *(Fig 4)*

Fig 4 - Dendrocalamus strictus

A tropical genus; similar to Bambusa genus
Best for cantilever structures
Attains a height of 30ft
Also used in furniture
Variants exist within Kerala, in different districts

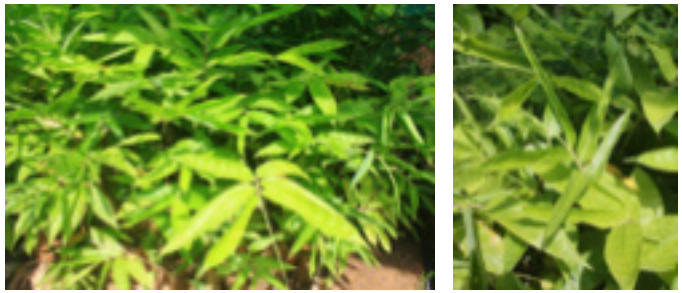


Fig 5 - Denrocalamus brandisii

Comparatively thin cross section of 3-4cm

Denrocalamus brandisii *(Fig 5)*

Native of Southeast Asia- wet evergreen tropical forests
Also known as velvet leaf bamboo
Lifespan of 60 years
Thornless
Sympodial, but less branches- hence easy to harvest
Used for pillars and roofing
Also used in handicrafts

Fig 6 -Dendrocalamus giganteus

Dendrocalamus giganteus *(Fig 6)*

World's thickest bamboo but not the strongest
Will reach heights up to 46m
Pillars can be made out by splitting this bamboo and filling concrete within
Lifespan of 100 years

Fig 7 - Bambusa balcooa

Bambusa balcooa *(Fig 7)*

Indian origin
Strongest, thorn less
Called a semi solid bamboo as the cavity within is comparatively small
Inner wall thickness of 4-6 cm

Bambusa nutans *(Fig 8)*

Grows at altitudes between 500-1500m
Thrives on moist hill slopes and flat uplands
Commonly found in the North East, Orissa and Bengal
Thorn less
Strong bamboo used for scaffolding
Sympodial growth, but still can be cut out individually with skill
Used for creating ladder, pillars etc

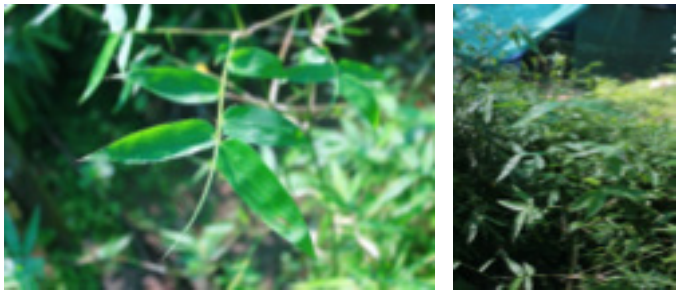


Fig 8 - Bambusa nutans

Schizostachyum dullooa *(Fig 9)*

Grows up to an altitude of 1200 m
Found in the North-eastern region of India
Thorn less
Sympodial
Thin cross section
Grows straight without bends
30 ft in height
Comparatively less strong

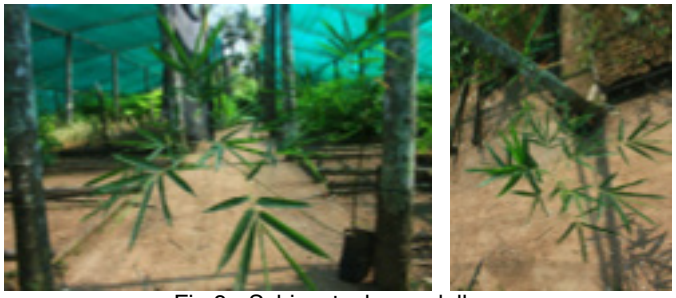


Fig 9 - Schizostachyum dullooa

Rostretta *Fig (10)*

25 ft in height
3-4 cm wide cross section
Used in furniture making too
Easy to harvest
Interior hole is comparatively small


Fig 10 - Rostretta



Fig 11 - Dendrocalamus sikkimensis

Dendrocalamus sikkimensis *(Fig 11)*

Similar to Brandisii but shorter and thinner
40 ft in height
Branches are normally orange in colour
Used in pillars as strength is more
Immature ones used in weaving too

Burmese bamboo

Just below Dendrocalamus giganteus in height, width and strength
Used in pillars

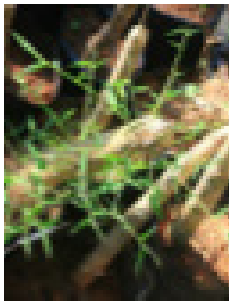



Fig 12 - Siamensis

Siamensis *(Fig 12)*

No hole inside
Bendable
Used more in furniture
20 ft in height
Bends sideways while growing



Fig 13 - Melocanna baccifera

Melocanna baccifera (*Fig 13)*

25 ft in height
Grows in tropical region
Monopodial - one metre between successive shoots
Thorn less
3-4 cm wide

Dendrocalamus longispathus *(Fig 14)*

Glaucous green when young, grayish-green on maturity
Grows straight
Distribution: Thailand, Malaysia, Bangladesh and India
Thorn less: good for construction
Requires shade to grow
Grows up to 50ft in height and 1.5 to 2 inch wide

Fig 14 - Dendrocalamus longispathus

Thyrsostachys oliveri *(Fig 15)*

Distribution: Thailand, China, India
Needs less space to grow
Thick sympodial
Tough to harvest
2-3 cm width

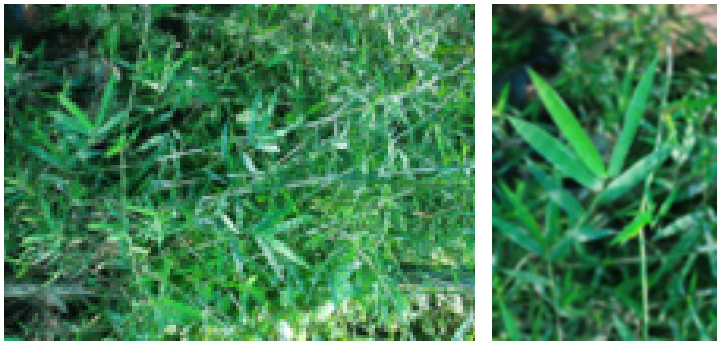


Fig 15 - Thyrsostachys oliveri

Unidentified Species

Soft and lush green
Thickness of 3-4 cm
Has lots of branches
Big hole inside
Hollow, but used in roofing

Bambusa Tulda *(Fig 16)*

Similar to balcoa
Medium diameter hole inside

Fig 16 - Bambusa Tulda


Fig 17 - Pseudoxytenanthera ritchii

Branches at base
Sympodial

Pseudoxytenanthera ritchii *(Fig 19)*

No hole and bendable
2-3 cm wide and 20 ft height
Suitable for furniture


Fig 18 - Palida

Palida *(Fig 18)*

Grows straight
2 inch wide and big hole


Fig 19 - Dendrocalamus membranaceous

Dendrocalamus membranaceous *(Fig 19)*

Used for construction
Grows up to 60ft tall
Bigger hole
Used for making ladders


Fig 20 - Dendrocalamus Asper

Dendrocalamus Asper *(Fig 20)*

Native to Southeast Asia
Used for heavy construction
Shoots are consumable

Bamboo Used for Ornamentations

1. Buddha bamboo (Bambusa Vulgaris Wamin)

2. Bambusa multiplex

Can be used for making pens

3. Bush Bamboo

4. Golden Bamboo

5. Creeper Bamboo

6. Bambusa multiplex vangata (it has white striations on its leaves)

7. Chinese Bamboo (Phyllostachis Bambusoides)

8. Bambusa vulgaris- Green

9. Bambusa vulgaris- Yellow

10. Black Bamboo

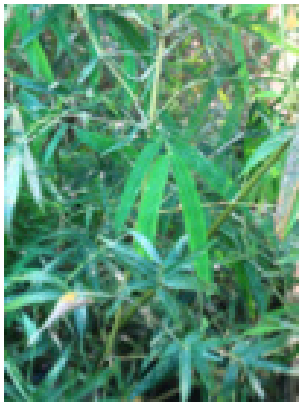


Fig 21 - Buddha bamboo

Fig 22 - Bambusa multiplex

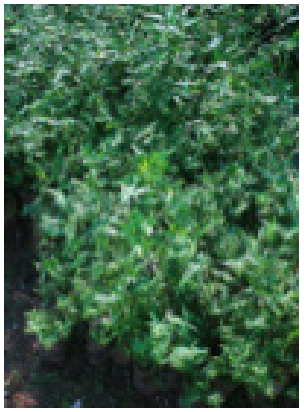


Fig 23 - Bush Bamboo

Fig 24 - Golden Bamboo

Fig 25 - Ochalndra Travancorica

Bamboos Used for weaving

1. Ochalndra Travancorica

2. Ochalndra Scriptorla

Used for making pens and jewellery

3. Schisostachium Bedomi

Need shade to grow

Fig 26 - Ochalndra Scriptorla

Cultivation techniques at Uravu

1. Growing seeds

2. Hormonal Process ***(Fig 27)***

A small hole is made on a bamboo stem. A mix containing 7gm Naphthalic acid, 100ml alcohol and 900ml water is made. This mix is added to 9L water and poured inside the bamboo through the hole till brim. Then it is wrapped up with plastic and buried in ground. Shade is provided. New bamboo shoots grow from the nodes.

Fig 27 - Explaining the Hormonal Process

3. Replanting from a bunch after taking one plant (with root and shoot) out.

Units Associated With Uravu

As part of getting familiarised and understanding the different stakeholders associated with Uravu a visit was done to the different units that work under / obtain guidance from Uravu. The micro enterprise units were established under the Rashtriya Sam Vikas Yojana (RSVY) programme, providing employment in bamboo craft to rural people [http://www.hindu.com/2005/11/09/stories/2005110912410300.htm].

The visit encompassed Bhavm Mural Arts, Niravu, Soubhagya and Unarvu. These units laid out pictures of achievement, struggle, stagnation and hopes that people live with as they continue to be part of the craft industry in Kerala. These following are the short glimpses into the lives of many who help constitute the fragile craft sector in and around Uravu.

Niravu - A self-help group run by women, Niravu has been creating variety of craft products ***(Fig 28***) such a The Rainmaker, phone stands, pen stands etc. for more than nine years. The products created are as per the requirement / orders which are delegated from Uravu. Employees at Niravu receive their income based on the number of products that they deliver to Uravu. The unit is still not self-sustained even after being in operation for a decade. Even though there are opportunities for them to attract craft orders on their own, such a potential has not been realized and they still depend heavily on Uravu.

Fig 28 - Craft products at Niravu

Fig 29 - Bamboo murals at Bhavm(top)

Fig 30 - Book of spices design at Soubhagya (bottom)

Bhavm Mural Arts [http://bhavmarts.blogspot.in/] – This unit showcased a successful story of creating a steady market for craft products. The unit focuses on mural art works. Dendrocalamus Gigantus variety of bamboo is used to create mural paintings. Bhavm are no longer under Uravu, and require assistance only regarding raw material and guidance. ***(Fig 29)*** The mural paintings from Bhavm were done on walls, canvas, and on all things that had utilitarian value. They progressed in a way where they utilized the technical knowledge about bamboo along with their creativity to create a niche sustainable market that nourishes crat and creativity.

Soubhagya – Another self-help group run by women, situated in Parathode. The unit has adequate machinery in terms of sander, grinder etc. The workers are paid a fixed salary per month. Their output is also based on the orders delegated from Uravu. Training for the workers are imparted from Uravu and their working hours are from 9am to 5 pm every day. The transporting of products / raw materials in between Uravu and Soubhagya are through public transport buses or via hired goods vehicle.

Self-sustainability has not been achieved by the unit even after being operational for about 5-7 years. Soubhagya is still heavily dependent on Uravu. They still have not attained the level to ensure quality check and to manufacture totally finished final products. Semi-finished goods are transported back to Uravu for the final steps and quality check. The members have the skill to work with bamboo, but are not able to explore additional products owing to the lack of time. Most of the members are housewives and mothers.

Unarvu – Another self-help group run by women situated in Moorikkappu, Vengappally. Unarvu showcases a story in which the bamboo craft training imparted to them were put to use in accessory design, creating earrings, necklaces and other jewellery ***(Fig 31)*** for women. They faced difficulties to own a working space and hence registered their self-help group as a society and built a space using a loan. They devised a strategy of employing only married and settled down women who belong to the nearby villages, thus ensuring that there were no fallouts once the members were trained.

After breaking even to a certain extent, they even started to source raw material on their own without the assistance from Uravu. They use minimal machinery for the production. Students and Interns specializing in accessory design provide their valuable input in jewellery design. Unarvu is also active in conducting exhibitions across India.

Fig 31 - Bamboo jewellery designs at Unarvu

Bamboo as a material

Bamboo in the pure and natural form is less resistant to the biological degrading organisms. The large amount of starch content present in bamboo attracts the degrading organisms like fungi, termites, and becomes the food for these organisms which are generally called Borers. The average natural durability of bamboo is less than 2 years. However if stored with care, the untreated bamboo may last up-to 4-7 years that too very rare. Bamboo is also known to be rich in silica, but the entire silica content is present in the outer layer. Even though it has minor amount of waxes, resins and tannins, but none of these have enough toxicity to improve its natural durability.

Compared to timber, bamboo has a low natural durability, hence few chemical treatment methods are used to improve the durability of the bamboo columns. The treated bamboo are completely safe from the borers and the durability increases many folds.

Bamboo Treatments used in Uravu

1. Gas pressure impregnation

(Fig 32) The bamboo columns are placed in a pressure chamber and the air inside the chamber is sucked out. With the help of a vacuum pump, the chamber is then pressurised with vacuum. The chamber then slowly filled with the treatment chemical (Borax and boric acid powder) and pressure is applied to a predefined value of 16kg/cm2 . Due to this pressure the chemical gets pushed into even the small pores in the bamboo and the entire bamboo column gets soaked in chemical. For a 100 litre of water , 3 kg of boric acid powder and 2.5 kg of borax is used as the chemical . The entire pressurised chamber is kept untouched for a day and the columns are removed from the chamber the next day. The treated bamboo's are then dried, and used for further manufacturing processes.

Fig 32 - Gas pressure impregnation(top

2. Hot dipping

(Fig 33) The fresh cut branch-less column with punctured nodal walls are weighed down and boiled in a container with chemical solution (Boric and Borax powder). The minimum process time is 4 hours. The treatment is done for splitter and small diameter bamboo in small quantity.

Fig 33 - Hot dipping

Fig 34 - Source: www.ecowatch.com

Fig 35 - Planting bamboo shoots in the nearby school

June 5 - World Environment Day

June 5th is World Environment Day. As a patron of green movements, the environment day was well celebrated at Uravu. A gathering was called for, to remind and remember the ecological imbalance faced by earth at present and how we, as humans, are responsible to change or rather slow down its course as it has reached an extent where it seems the catastrophes are irreversible.

It was also said that, at Uravu, Environment day is not just for a day. It is a social responsibility every human has to carry with him through out his life for the sake of the planet and for the sake of the future generation.

The Environment day was celebrated in the nearby schools also. There were rallies by the students pledging themselves to be a part of this social cause. Bamboo shoots were planted at Uravu as well as in the school ***(Fig 35).***

There was also a performance by a student trainee, Mr. Vibhu, who made beautiful musical instruments with bamboo.

Uravu ECO LInks

Uravu has come up with novel solutions to housing problem at wayanad, especially how to tackle uneven terrain in a sustainable way.

The main structure rest over a base made of palm pillars containing concrete. ***(Fig 36)*** Main structure that houses the bedroom is has wall made out of mud plaster (mud+sand+lime+1-2% cement) on the inside as this does not come into contact with water and the outside wall is lined with bamboo strips (Dendrocalamus Giganteus). Each structure has an attached bathroom which is lined using ferrocement due to the constant exposure to water. Interesting part of eco links structure is its butterfly roof, the 2 flaps of which are held together by ropes to prevent it from transferring excess weight to the pillars. The roofs are lined by 2 layers of bamboo (Dendrocalamus brandisii) mats, chicken mesh and 2 layers of ferrocement. Bambusa bamboo forms the pillar structure, while Dendrocalamus brandisii is used for beams.

Water management is one issue when it comes to housing and the way its managed is what makes eco links stand out of the rest. Water from reservoir is fed into a fresh water tank, which goes directly into shower, wash basin and kitchen. This water is then fed into a grey water treatment tank and then to grey water tank. This treated water is fed into the flush system which is again send for water treatment and finally into the landscape. This process ensures safety of ground water at the same time ensuring proper water supply to respective areas.

Fig 36 - Bamboo houses at uravu ecolinks

Fig 37 - Palm and concrete structure for base construction

Book Of Spices

About the book:

The Book of Spices is a unique product made in the Arrive Claptrap Bamboo Cluster, which has won much appreciation on account of the perfect match of innovative concept and utility value as a gift product. The Book is basically a box in the form of a book that can hold samples of spices (and for that matter many other items such as dry fruits, chocolate etc.) and be sold as a gift/ memento. Arrive has been using the Book filled with organic spices as a memento of Wayanad.

The present form of the Book comprises of front and back covers made of bamboo veneer board (8.25 X 5.25 inch) size. The inner portion of the back cover holds a rectangular frame made of giant bamboo reapers of 6 mm thickness which functions as the box. There are partitions(4 to 9) in the box made of thin strips of bamboo, which acts as a container for spices.

Fig 38 - Book of spices designed in Uravu

How is it made

Earlier Uravu was making the book covers by joining and gluing together 4 strips of giant bamboo longitudinally, using fevicol. The glued planks are then pressed but keeping stones on top.

Issue faced with current design

Under hot and cold climates in India as well as abroad, the strips displayed a tendency to gradually bend or warp ***(Fig 39)***. This appears mainly do to presence of moisture in the bamboo due to non uniform drying process.

Methods tried so far

- A cross-stitch with thinner bamboo strips were placed on the inner side of the front cover, taking out a groove on the board and inserting a strip of bamboo. This could not prevent warping to the required extend.

- A certain type of Bamboo Veneer boards (4 mm thick altogether with 0.5mm bamboo veneer sheets pasted on both sides of a 3 mm wooden ply board) were used ***(Fig 40)***. Scarcity and weightage period to procure the raw material made it a difficult choice of replacement, even though it helped in mitigating the problem to a certain extend.

- Hand-made slivers of D. giganteus (around 0.5 mm- I mm thickness) were pasted on both sides of a mechanically hot-pressed industrial board (of 3 mm thickness) ***(Fig 41)***. The process involved taking slivers of uniform thickness which were glued uniformly on both sides of the board followed by application of uniform pressure on the board to fasten the slivers without air blotches. Even though this could prevent warping, Uravu faced the following issues in this regard:

- Hand slivering combined with rotary sanders had to be used as machines were not able to provide the required uniform thickness (0.5 - 1 mm). This required proper training and skilled labour.

- Glues had to be applied in a uniform manner which required proper training and skilled labour.
Lack of hot press system.

Fig 39 - Warping issue at extreme tempratures

Fig 40 - Book of spices made from bamboo veneer boards

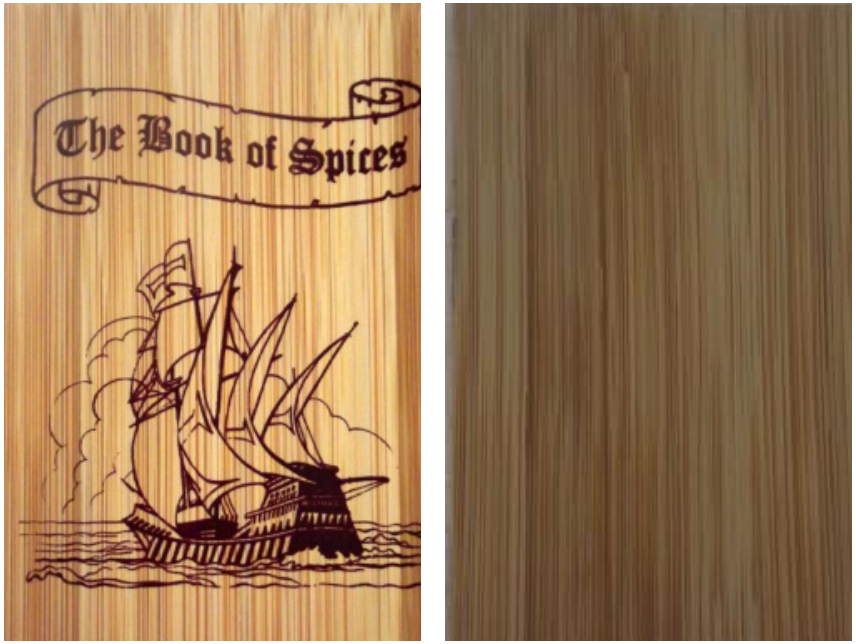


Fig 41 - Book cover constructed from bamboo slivers

Solutions suggested to prevent warping

Redesigning book of spice

After a brainstorming session, suggestions were put to redesign the book of spices. It was observed that warping was localized to only the front side, as the back side had its strength coming from the box like wood structure attached to it. Question was, why not bring in a similar structure to the opening flap where warping is observed. To an extend this could solve the problem, but at the same time gave rise to some issues like :

- Training artisans to the new designs
- The whole philosophy of opening a book to its starting page becomes non existent.
- Need for extra raw materials.
- Cuts had to be more precise due to existence of male and female pieces locking together.
- These issues led us into leaving behind the idea of redesigning book of spices and we started looking for new solutions to counter warping.

Into the world of adhesive

Absence of a hot press and cold press being the only choice, made us look into various options when it came to the choice of adhesive while laying out bamboo strips. We approached various organizations having prior experience in bamboo ply, one among which was Bamboo Corporation, Nallalam and got insights into adhesives like Starke D3, Blue coat D3 and Henkel food grade which could be directly used. They also suggested using Urea

Formaldehyde combined with Ammonium Chloride catalyst.

As most of the above adhesives could not be locally procured, we contacted the local manufacturer of urea formaldehyde - Poly Formalin Pvt Ltd and paid a visit at their factory to arrange for test samples as well as to understand ways of adhesive application. Following actions were suggested to prevent warping :

- Using 65% Urea Formaldehyde resin with catalyst formic acid(both of which could be locally procured)
- Mixing clay powder or starch with the adhesive to enhance bonding.
- Bamboo strips should be placed in a cross fashion to counter warping.
- Application of adhesive should not be too much or too less, preferably one layer of uniform thickness.
- Application of uniform pressure over the planks.

A Solar Workstation

The cottage industry, currently, is a place where a few people join under one roof to work on same or similar projects. This has been the practice for a while now and it has found success in its own realms. Many have been benefited with such small scale industries. But, even in such industries, a small group, especially house wives, are sometimes left out.

Uravu has taken notice of such situations and came up with a different structure for the cottage industry. They have planned to bring down the scale of industry to the table top level so that it may benefit all. Now the idea is that those who cannot leave their homes to work at the cottage industry can make a living by working from their home. The workstation provides the space and equipment to do such kind of work. The equipment are powered with the help of a solar panel kept on top of the house. Thus, the whole industry would witness a shift from ‘under the roof’ to a ‘table top’, giving more flexibility and convenience for the folks in work.

The table would hold equipment necessary for working with bamboo, such as, hand drill, hammer, screw driver, screws, nuts and bolts, saws, spanners, bending tool, knives etc.

Design Brief

• The solar workstation has to be made with bamboo

• It should be easily packable and transportable

• The whole table should fit in a box of size 4’x2’x1’

• Should not be more than 20kg

• It has to be assembled.

• There should be enough space for two people to work

• There should be exclusive place for each of the instruments used

• There should be a space for the inverter and battery. [Inverter for Controlling the electric power]

•The whole workstation should be economical and low budget

The Approach

The design brief was carefully studied by the team and some changes were made after a quick brainstorming within the team.

The changes are:

Size of the box should be 4.5'x2.5'x1'.
It can be folded.

A resource base was made after the brainstorming session. A collection of images and text to identify the on-going trends in furniture/ workstations.

Different ideas were sketched out on a preliminary basis. The ideas which needed some background study and experimentation were carried out.

Fig 42 - Showing the design methodology followed for this particular project.
Source: Author

Fig 43 - The work stations made by Uravu before i started intern-ship.
Source : Author

Fig 44 - The work stations made by Uravu before i started intern-ship.
Source : Author

The Present Workstation

The workstation which the craftsmen have built at the institution is found to have many problems ***(Fig 43, Fig 44)***.

- It is not a knock-down furniture
- Not easy to transport
- Very Heavy
- Ergonomic issues
- Over designed
- Heavy labour requirement
- High cost

Two Tables were made by the institution prior to our arrival. But both the Tables had the above said issues when compared to the function which its going to serve.

The requirement, anyhow, was to negate all these issues.

The New Workstation

The new approach of designing the workstation was with the intention of semi-mechanizing the work load, putting up within the parameters and environment of the institution. It cannot be fully-mechanized since a lot of people depend on the institution for their livelihood. By converting it into semi-mechanized, the production rate would go up as well as a check on the quality. Also it wont threaten the livelihood of the workers.

The workstations can be mass produced and the new design would liberate the product from the craft sector. This would also help cutting down on production costs. The design is in such a way that the workstation could easily be packed at the industry and assembled on-site. Since there is a constraint in packaging size, the new design for a workstation is challenging.

Design Philosophy

Constraints shape-up designs. They act like a framework within which new designs take shape with an aim of breaking those barriers. Therefore, the one who understands the properties and limitations and sees the opportunity in each constraint can develop a better design.

Bamboo, as a material itself, has a lot limitations in terms of shape, size, rigidity and form. Working with such a material is definitely challenging. To accept that challenge and bring out a better design is something which every designer should do.

Parallel Product Study

An online search was done to explore various kinds of tables made in bamboo as well as other wood. This included tables which could be folded and where bending is also used.

The study helped in getting an idea of the new trends and the bench mark in terms of design in the market.

Other Inferences

Getting hold of various folding mechanisms

Different forms and colour schemes were studied.

Material exploration was also done.

A study on structural stability

Fastening mechanisms

Source: www.furniturefashion.com

Source: www.questushospitality.com

Source: www.bamboofurnitureguide.wordpress.com

Source: www.s13.zetaboards.com

Source: www.hahoy.com

Source: www.dezeen.com

Fig 45 - Showing various existing products in the market
Source: Various Sources

Fig 46 - The scaled mock-up made with bamboo sticks and flex quick
Source : Author

Concept of the New Workstation

Keeping the design philosophy in mind, an exploration was done to find out how bamboo is being used in its multiple forms. As expected, the answers were there right within the boundaries of the institution.

Bamboo reapers from Aanamula (Dendrocalamus giganteus) are being made at the institution. Using the reapers, along with the bamboo (Eramkol - Oxytenanthera) in the pure form paved the way to an improved design.

The approach was to cut down the labour effort and make the design very simple for the machineries and labourers available in the institution. Thereby reducing the material wastage, cost of production, manufacturing time and cost of transportation.

With all the said aspects in mind, several iterations were made. ***(Fig 46)*** Mock-ups were made to check the mechanisms, stability and feasibility of manufacturing.

The inspiration for the table came from the institute itself. The joints they used in making the Bamboo houses for their Bamboo village inspired me to create the modular Table.

Concept 1 - Fold-able Table

This concept was created keeping in mind the space utilised by the previously made tables by the institution. So in this concept the middle portion of the table was given solely for the common facilities like the inverter, batteries and the space for tools. And this part is designed to be a box like structure and the sides of the box opens to make the table top in both the sides, and the length of the table is taken as 4.5feet so that it can easily fit the person whose going to use it.

We had two options in material to be used as the table top. One was Readily available plywood made from bamboo and other was the bamboo reaper produced in institution. But as per the client requirement, the reaper table top was chosen.

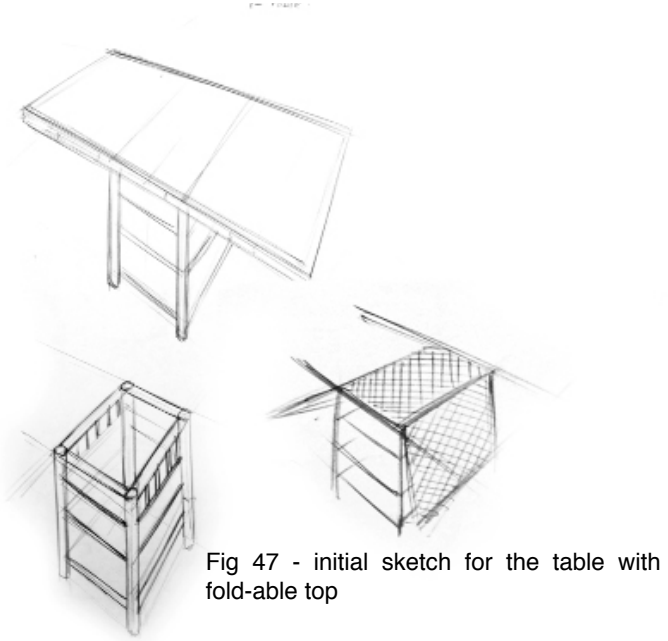


Fig 47 - initial sketch for the table with fold-able top

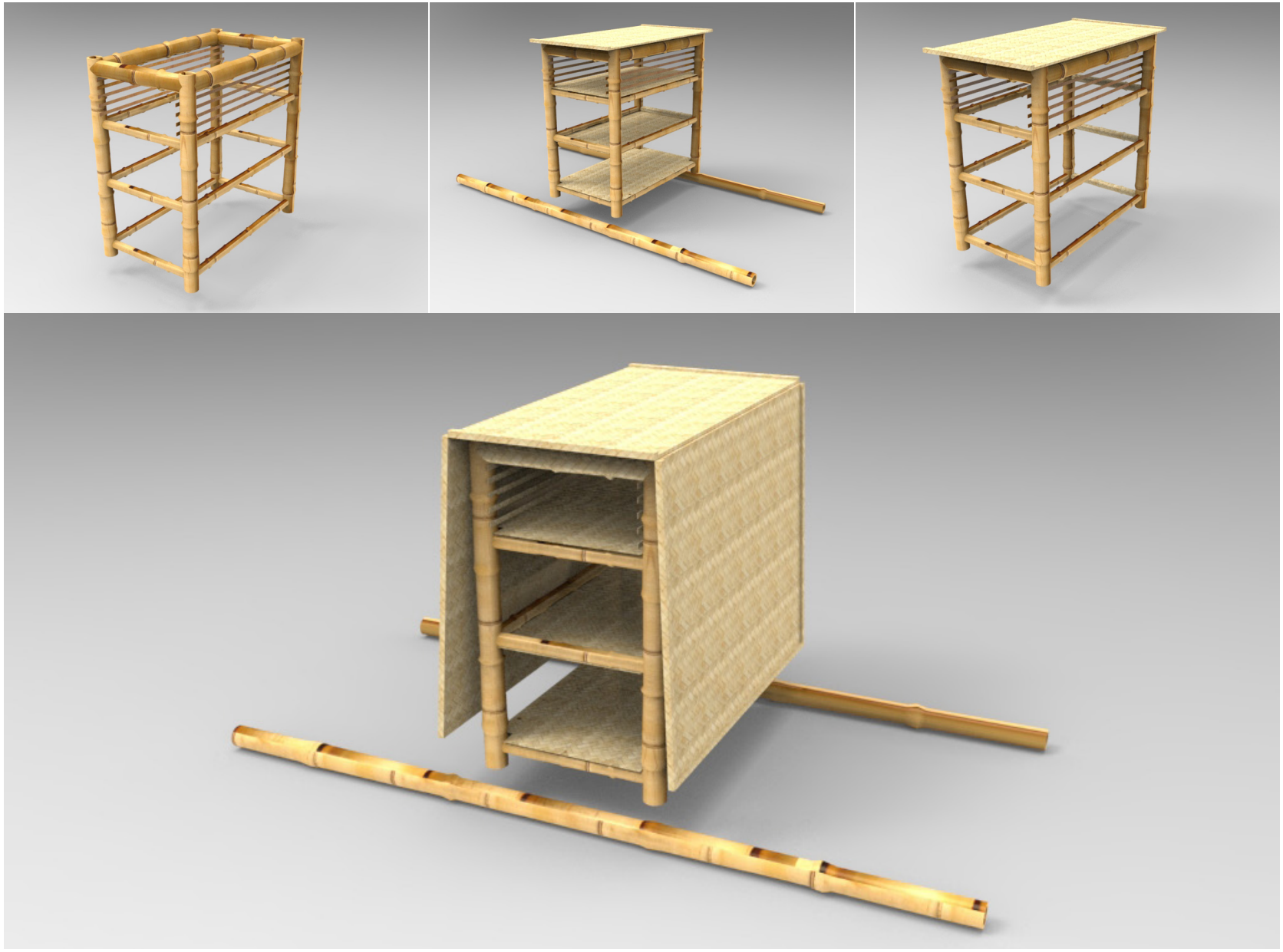


Fig 48 - Showing various rendered images of concept 1
Source : Author

Concept 2 - Modular table (Bamboo in Pure form)

Though Folding table concept helped in saving space. It seemed to be not that compact enough to be transported in a box. The table was not that stable, It had the chances to topple if someone puts pressure on any of the sides. This put forward the actual challenge to further reduce the space occupied by the table while transporting it and also to increase the stability. This was when the Joints used for the bamboo houses came into sight.

By utilising the same joints ***(Fig 49b)***, the complete table had been broken into number of similar parts. This actually helped to utilise the bamboo in the pure cylindrical form, reducing the number of cuts to be made by the labourer.

Since every parts are similar in form, it was possible to arrive at a standard measurement for the parts making the mass production easier.

The reapers made from the Bamboo is used for the table top. The reapers are attached close to each other using industrial grade fevicol and nailed to a rectangular frame below it.

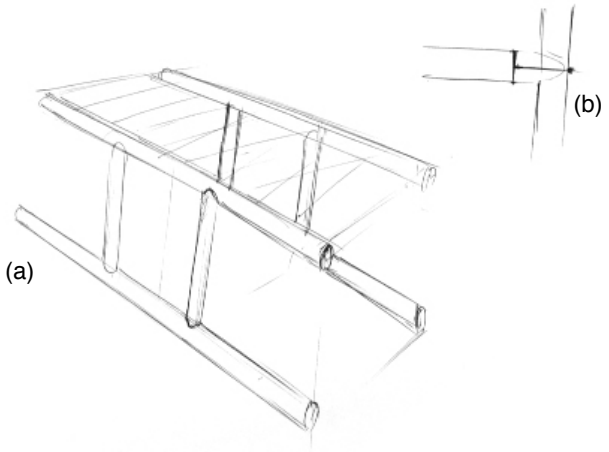


Fig 49 - Showing initial sketch of (a) Modular frame (H Sections)
(b) Joint used

Fig 50 - Showing various rendered images of concept 2
Source : Author

Concept 3 - Modular Table (Advanced shelves)

The second concept was made only using the pure form of the bamboo for the shelves and legs. Here instead, the processed bamboo reapers are used for the shelves in the middle supported by the cylindrical legs.

The shelves are designed such that they over lap each-other in such a way that they create three different layers for the inverter and batteries to be placed.

The 2 inch reapers are heated using fire flames and applied pressure to bend it forming loops ***(Fig 51)***. These separate loops are joined together using nut and bold system. This shelf system functions as the module which holds both the leg module. The use of reapers for the shelves helped in reducing the over all weight of the table to a much more lesser value. Which in turn reduces the transportation cost.

This concept can be considered as the best example for table utilising both the untouched (natural) and advanced form of the bamboo.

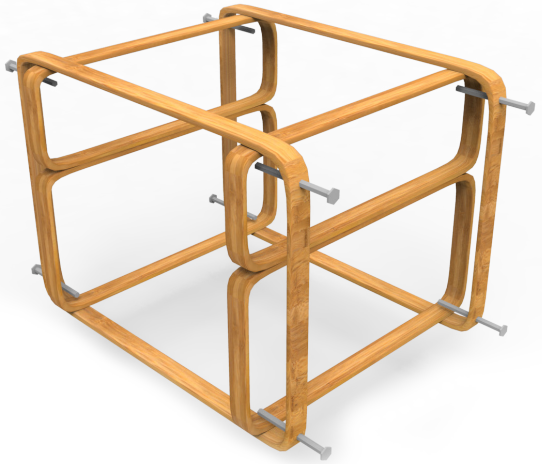


Fig 51 - Showing rendered images of concept 3 Shelf made from bamboo reapers
Source : Author

Fig 52 - Showing various rendered images of concept 3
Source : Author

Finalised Concept 3 (pure bamboo form)

Among the three concepts put forward, the authority decided to go further with the third concept which is the modular design using the bamboo in its pure form. This decision was made considering the time that would be required to prototype the design.

The measurements were finalised for the design after few role plays and discussions with my fellow mate Gautham. We decided to increase the length of the table form 4.0 feet to 4.5 feet considering the space required for a person to sit on both the sides of the middle shelf.

The measurement of the bamboo is also calculated and with the final design i approached Mr. Rakesh who was the staff in Uravu who builds furnitures. He also agreed to go further with the design and the materials were collected from the store house. The work for prototype was started soon after it.

Gautham Rajaraja Varma also helped a lot in the prototype making process like cutting, measuring , drilling etc.

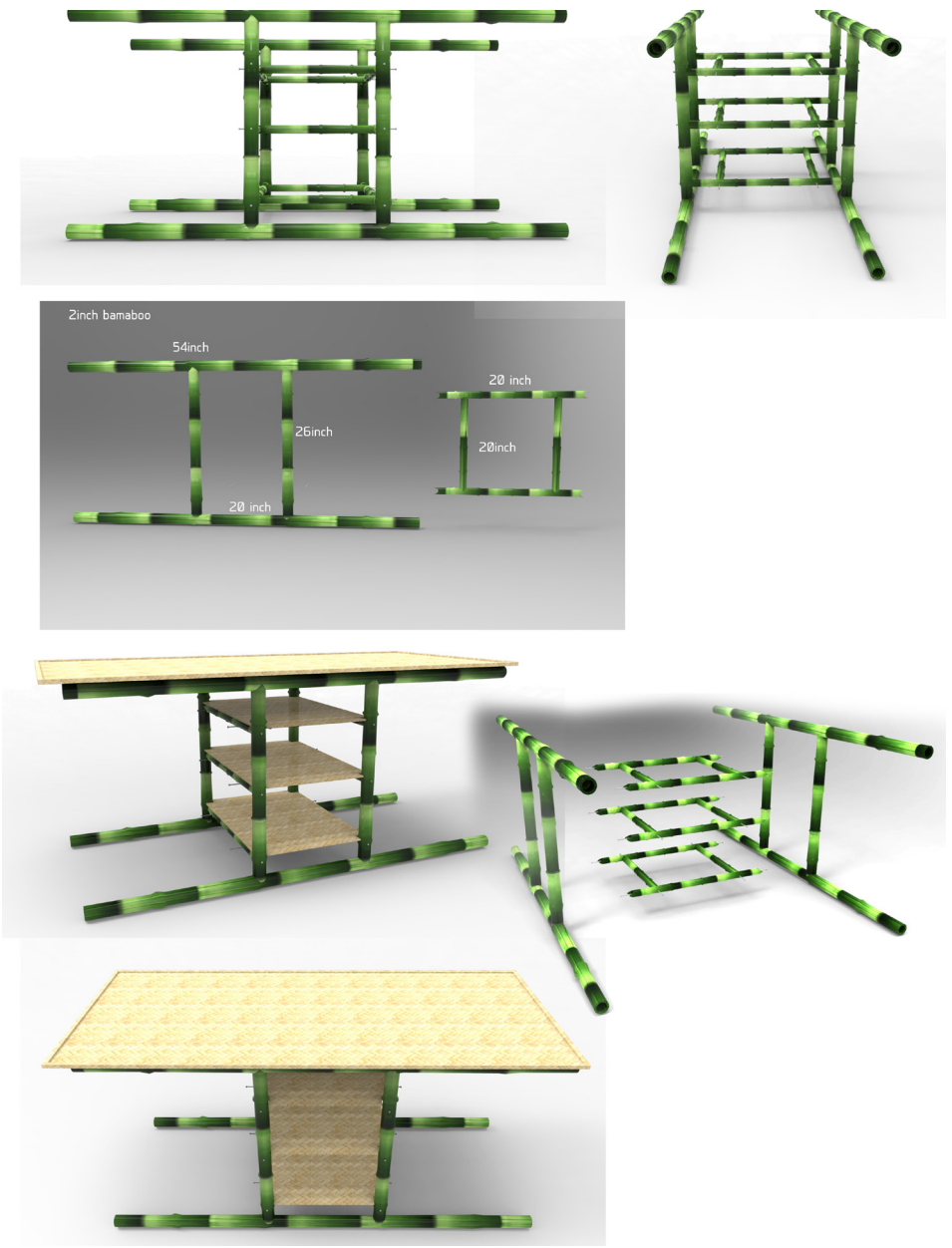


Fig 53 - Showing various rendered images and measurements
Source : Author

Prototyping

The bamboo that we used for the table is Eramkol (Oxytenanthera), which is generally smaller in diameter and have great thickness. The have very small hollow space inside, hence provide immense strength for the furnitures. One of the main feature of eramkol is that , they are pretty straight enough to be used for straight furniture legs.

Fig 54 - The frame after fitting Source : Author

The eramkol of 2 inch diameter were chosen to make the prototype. They are cut in proper measurements, Using a whole cutter of 2inch diameter the sides of the joins were cut out to make it fit properly with the leg to which it is to be jointed.

The main H-Sections were made first. The joints are sealed with industrial grade adhesive (fevicol). The small gaps around the joints were sanded and filled with a paste made by mixing fevicol and bamboo powder. After this, the small H-sections for the shelves were made. The procedure for making these were exactly same as the main H-sections. Since the frames are of similar in shape, it made it easy for the labourer to cut pieces for the whole table at once and then start fixing them. This also avoided confusions in fixing and measurements.

The next step was to fix the whole frame and make sure all the angles and joints are fitting properly. Once the frame was complete. The table top and shelf top were made using the bamboo reapers. Making sure everything is perfect, the excess metal screws in the joints were sanded to required length.

Final Workstation Prototype

The Internship in Uravu ended on 15th May 2014. But as the staff couldn't come to work for last one week, due to some personal reasons. This affected the work progress of the Workstation too. Hence i couldn't complete the prototype before leaving Uravu.

But regular contact have been kept with Uravu through mails and calls. The staff there in Uravu completed the design in another one week. The photos of the final product has been mailed to me .

Though they had completed the product, few changes had been made to my design. When enquired, I came to know that the client had demanded for more shelves in the workstation to keep the tools. As a result, They had to increase the number of shelves on both sides of the workstation.

This final workstation had been de-assembled and sent to the client. The client approved the workstation design and ordered 10 more workstations. The design of the proposed workstation, and the final prototype is given in the next page

Fig 55 - The porpossed workstation
Source : Author

Fig 56 - The Final workstation which client accepted (Modular)
Source : Author

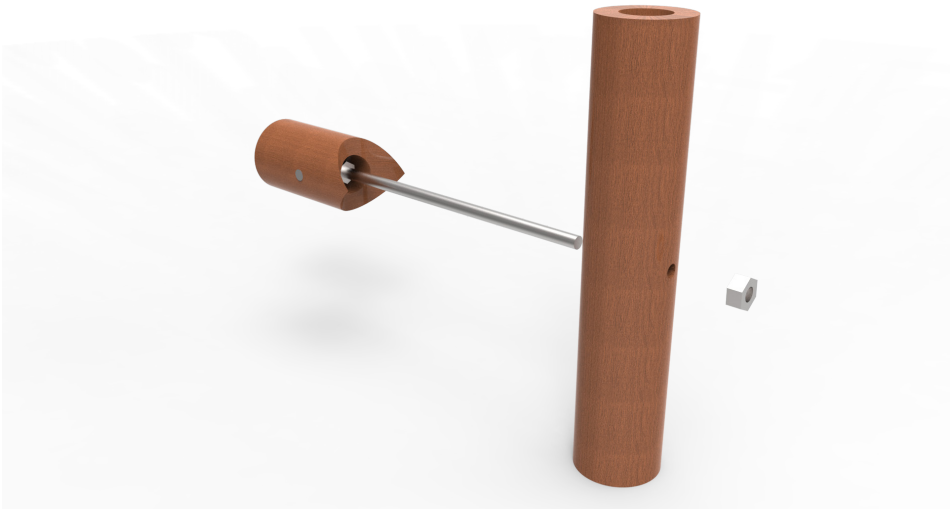
Joint Used in the Table

For the joints we didn't have the readily available material. So instead we had to weld a custom joint. The Joint was made using a 6 inch nut, bolt and a washer ring suitable for it.

The washer rings were welded on to the head of the nut as shown in the image. Another full threaded rod is taken and cut to suit the diameter of the bamboo. The bamboo is drilled and the pieces if Rod is inserted into the drill hole in such a way that it goes through the hole of the washer ring

Fig 57 - The custom made joint and its connecting mechanism
Source : Author

PTO



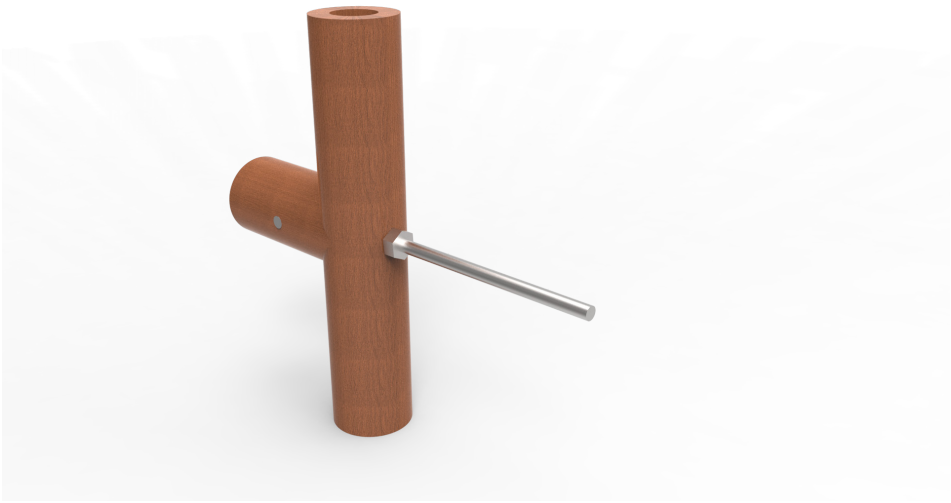


Fig 58 - The bamboo parts connected with the metal joint mechanism
Source : Author

The thus fitted bamboo along with the nut is then inserted through the bamboo which is to be jointed. When these are tightened with the bolt, it remains strong enough ***(Fig 58) (Fig 59)***. The extra protruding part is then sanded to fit the nut size. The user can remove this bolt system to disassemble the table when required.

For the fixed part also this joint system is used. But the only difference is that in the fixed parts, we stick both the bamboos with the adhesive.

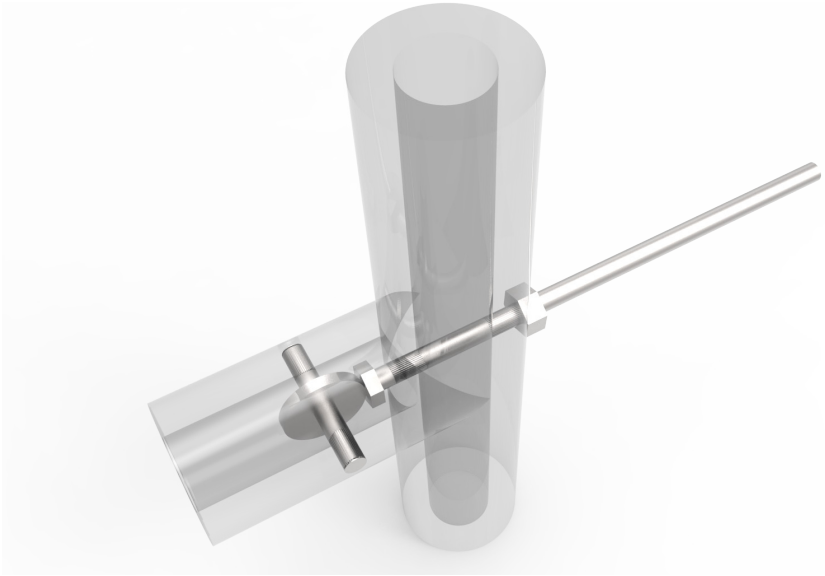


Fig 59 - Showing how the joints are placed inside the bamboo
Source : Author

Bedroom Lamp

The institution already have a wide variety of lighting solutions made there. But in most of the cases the lighting products are seen to be made very complex that it will utilise very good amount of time by the labourers to complete the product. Many small parts are cut and crafted together to form a simple lighting product.

Though Uravu had many lighting units, a lighting system utilising the cylindrical bamboo form was not see anywhere. Every lamps utilises weaving or strips or jute fabrics to give the ambient lighting

My approach

Since we get a wide range of diameter in bamboo naturally, my direction was to utilise this liberty and find a simple product which could be modular in nature.

The modularity is maintained because, there are chances of the product to break if fell hard on to ground. In such cases it would be better to change the only broken piece than replacing the whole lamp.

Keeping in mind the above said things, different sketches were made.

Fig 60 - Showing different quick sketches made for lamp
Source : Author

Fig 61 - Prototype making and fully functional prototype
Source : Author

Lamp Design and Prototype

Based on the drawings, a quick 3D model was made in CAD and rendered it with materials. This helped to check the modularity part of the lamp. CAD also helped to solve small issues which popped up while building the actual prototype.

A complete working prototype was made using bamboo and wood. The bulb and holder was installed on to the wooden piece with screws. Drills have been made in the horizontal and vertical direction as a pathway for the wires from the bulb holder to come outside to the plug connector.

The bulb holding unit is glued to the wooden base and the connecting piece of the main-body of the lamp is glued to the main body. The body fits to the base with the help of snug fit.

The external skin is sanded to fineness to obtain a smooth texture.

Conclusion

The foundation course during the first year has been of great help when it came to understanding the need and purpose of design. It has created a flare for exploring new realms in design.

From that spark, came our enthusiasm to understand the issues faced by people in various domains and trying to put some thought into it.

The intern-ship was a platform for us to understand a new material in which we never had prior hands- on experience. It was important for us to understand the material and its properties, physical and chemical, to use it well. We understood how a material could be used in its own various forms and how it affects the entire design. We also learnt the practical difficulties and constraints while working with bamboo.

Uravu, is of-course, a good place to learn about bamboo as well as a good environment to discover yourself. It is definitely a great place to get closer to nature.

The Response From Uravu

The response from Uravu had been sent by mail to us regarding the workstation we designed. The screenshot of the mail is given below.

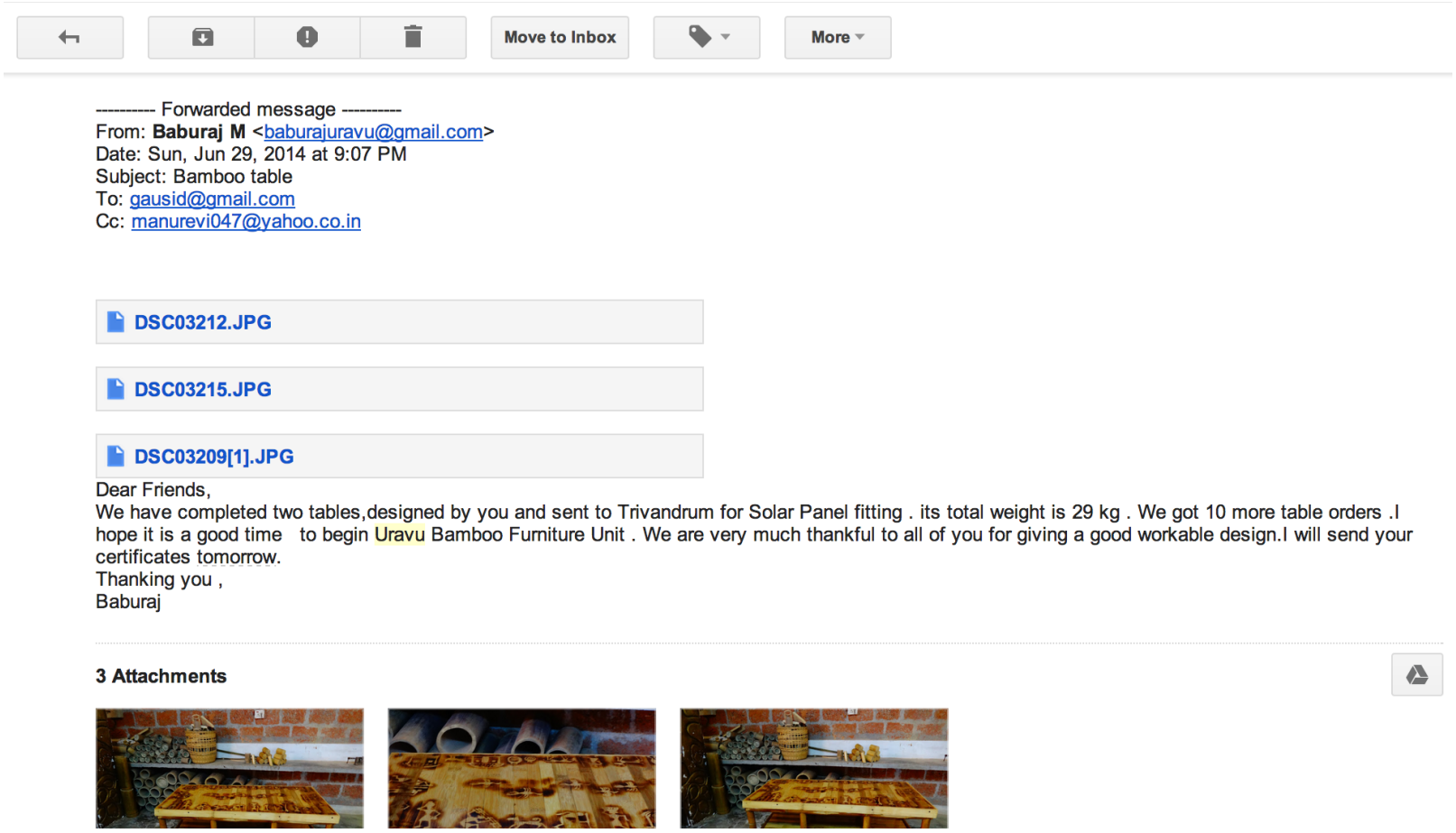


Fig 62 - The picture showing the mail received from the side of Uravu as response to the workstation design

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Folding Dining Table <http://www.questushospitality.com> as seen on 05.07.2014

Bamboo Table <http://www.s13.zetaboards.com> as seen on 05.07.2014

Sustainable modern bamboo table <http://www.hahoy.com> as seen on 05.07.2014

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