TAKE KAGU
Bamboo plywood furniture

Master Examination
Department of Interior Architecture and Furniture
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for your passion in tutoring for my master examination

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Thank you very much. Tack så mycket. ありがとうございました。
"Long long time ago, there was an old Bamboo Cutter man called Taketori-no-Okina. He cut bamboos from forests and used it for many different daily tools."

This is the first sentence from "Princess Kaguya", Taketori-Monogatari or Kaguya-hime in Japanese. This is the tale of the Bamboo Cutter that was written in 9th or 10th century Japanese folktale. It is considered the oldest existing Japanese narrative. The story is about the life of a mysterious girl called Kaguya-hime, who was discovered as a baby inside a glowing bamboo plant by Taketori-no-Okina. According to the first sentence of this tale there is a very close relationship between human life and bamboo in Japan.

TAKE, bamboo is one of the typical trees in Asia. I grew up in the countryside in Japan and my house was located just in front of a bamboo forest. I also have some experiences of using bamboos the same as in the tale, "Princess Kaguya". When I walk in the bamboo forest, I have a very special feeling that is intricately related to my childhood background. Nowadays there are several problems about bamboo forest, but on the other hand bamboo itself is focused as an ecological and sustainable material.

There is an interesting project involving bamboo forests that is going on near my hometown in Japan. This project is producing bamboo plywood and furniture made from this material. For my Masters examination, I have designed furniture made of this bamboo plywood related to my background and my feelings towards the bamboo forest.
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1.0 Introduction

1.1 My background

I was born and grew up in the countryside in Japan, in an area which is called Yamaguchi Prefecture (figure 1.1a). It has the forth-biggest area of bamboo forest in Japan and my house was also located in front of the bamboo forest. I went into the forest with my family to pick the bamboo shoots in order to eat them in the spring and sometimes to cut the bamboo to make toys. The bamboo plants do not grow as thick trunks but they grow up straight and densely. The light that comes between the bamboos creates the contrast between dark and light patches and creates a very particular scenery. When I look up, the bamboo plants bend and wave by wind and gravity. The leaves of bamboos rub together and create rustling noises. I feel calm when surrounded by bamboo forest and this scenery touches and reminds me of my childhood a lot.

figure 1.1a; Japanese map. The pink area is Yamaguchi prefecture.

\[1\] 竹取物語

1.2 Bamboo and Bamboo forest

Bamboo is one of the typical trees to be cultivated in warm and humid climates like Japan. According to the map (figure 1.2a), most of the bamboo forests are distributed between latitudes 35 degrees north and south in areas with more than 1,000mm of precipitation per year. It is said that 80% of the bamboo in the world is be found in Asian countries such as China, Thailand, Vietnam, India and Japan. There are a lot of different types of bamboo in the world and even different species within Japan. Most of the bamboos that grow in Japan have hard yet flexible bodies. That is one of the reasons why Thomas Alva Edison used bamboo from Kyoto, Japan for his incandescent lamp invention.

Bamboo has a lot of mysterious characteristics, for example it grows very fast (figure 1.2b). The fastest recorded growth was 121cm in a day for Madake, one of the Japanese bamboos (figure 1.2c).

Bamboo has been used for our daily necessities for a very long time (figure 1.2d). Its forests and human villages had a very good relationship for a long time, but nowadays there are new problems. One of these is deforestation which happens everywhere in the world. There are many forests and bamboo forest that disappear for land development in Japan. Conversely, many bamboo forests are neglected and propagation is not taken care of. For example my hometown is becoming a typically depopulated area and almost nobody uses its resources anymore. Bamboo forests were very close to human life and it created a healthy balance between the forests and people.

In fact, Japan has the second biggest Forest Conservation Rate for land area covered by forest in the world. It was 68.2% in 2007, next to Finland 73.9%. Sweden is the third biggest Forest Conservation Rate with 66.9%. However, the self-sufficiency ratio for tree material is only 20%. It is because a lot of cheap woods are imported and many woodmen have retired from their jobs in Japan.

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5 http://www.kyoto.zaq.ne.jp/dkakd107/C-e.html
6 http://www.ritsumei.ac.jp/ba/~hyodot/semihomepage/koduchi.take=yama1.html
8 商店建築 2008年10月号 p. 202, l.3-5
9 商店建築 2008年10月号 p. 202, l. 69- 71
Nowadays though bamboo is focused as an ecological and sustainable material because it grows fast compared to other trees. It has become a popular material even in countries, such as in Europe, that do not have bamboo and we can find many products made of bamboo (figure 1.2e).
2.0 Material

2.1 Bamboo plywood

When using bamboo as a material for furniture there are a number of problems. Bamboo is focused as an ecological and sustainable material but it is very sensitive to humidity. If the air is too dry, it is very likely to crack, especially if the bamboo is still fresh. It is common to use the natural shape of bamboo to make furniture in Asia (figure 2.1a and 2.1b) and it is popular for people who like Asian interiors.

According to the Asahi newspaper published on the 20th February 2008, a company produces and exports to Finland new furniture made of bamboo plywood. This company is named TAKE create Hagi CO., LTD. They attempt to help the redevelopment campaign in under populated towns so that they refocus their economy on bamboo. TAKE create Hagi CO., LTD. has succeeded in producing bamboo plywood and making furniture from it. That means there are many possibilities to design different shapes of bamboo furniture. They have started to collaborate with Artek, which is a famous Finish furniture company and export new style furniture (figure 2.1c and 2.1d). CEO of TAKE create Hagi CO., LTD. said that they have many offers to collaborate with other furniture companies, designers, architects, etc.
Bamboo plywood (figure 2.1e) has a very characteristic surface compared to other plywoods. It has straight lines on the surface and there are also knots remaining within it (figure 2.1f). From looking on the side (figure 2.1g), it is difficult to know there are layers of plywood (figure 2.1h) but when looking at the end grain it has layers of bamboo sticks (figure 2.1i). When it is bent there is a smooth and sleek surface.
2.2 How to produce bamboo plywood

There are many processes and steps involved in producing bamboo plywood. Firstly, a nice bamboo called Mousoudake (figure 2.2a) needs to be cut for it. Other types of bamboos typically have thinner flesh than Mousoudake. Basically, bamboos grown in tropical climes have a soft stem and it is easier to bend and make knitted products like baskets (figure 2.2b). Mousoudake grows in cooler climes like Japan and it has a stronger stem. It is difficult to bend but as a material for plywood it is one of the best bamboos. Bamboo has a hollow inside (figure 2.2c). The standard bamboo for this plywood has approximately 12cm diameter for the trunk (figure 2.2d) and approximately 1cm thickness for the stem (figure 2.2e).
Production process - TAKE create Hagi CO., LTD. (figure 2.2f)

1. The bamboo is cut as long sections in a radial fashion from the middle of the trunk that is hollow.

2. Knots are removed and the piece made as straight as possible. (figure 2.2g)

3. The bamboo is placed in a boiler to remove the bitterness, sugar and oil of the bamboo. (figure 2.2h)

4. The bamboo is dried using a drying machine and sunlight. (figure 2.2i)

5. A pressure machine is used to protect against mothballs in the future and give colour.

6. The pieces are glued and made into a pile using pressure.

7. The plywood is sliced up.

8. The side of the board is glued and further pressure applied.

9. The board is sanded and made into the thickness required. (Standard thickness is 2mm)
3.0 Design process

3.1 Concept and Inspiration

The furniture designs made of bamboo plywood that follow are inspired from my background, which is my bamboo forest feeling and vision. When I lived near the bamboo forest, I had many feelings and experiences. I represent these feelings and experiences within the furniture design.

Walk in the bamboo forest
Bamboo forest is dark and I feel cooler and some humidity. Light comes between bamboo plants and it creates contrast between dark parts and light parts.
Bamboo leaves rub together and create a murmur.
Bamboo grows straight with almost the same trunk thickness and it has knots. The trunks of bamboos have knots and create rhythmic scenery. It has density, depth, and layers which create particular scenery.
I feel that I am surrounded and supported by bamboos. The bamboo trunks give as they gradually curve to the top, waving with the wind.
Inherent in each of these inspirations is the desire to create furniture design within which people can feel the bamboo forest.

To create those feelings, I have designed two different kind of furniture. Basically, one is from the bottom up; a floor, and the other is from the top down; a ceiling. These two different kinds of furniture create the bamboo forest atmosphere.

I can see the sky from the opening of bamboos.
3.2 sketches
3.3 Design method

For the design idea, I have used simple features from the bamboo forest.
- same thickness and straight
- provide a gradual curve
- dense and layer

I represent these shapes for the design of tables and luminaires and consider the characteristic of plywood.
3.3.1 Side table design

Legs
The basic shape for the legs is a combination of straight lines and arcs (figure 3.3.1a and 3.3.1b). This arc represents the image that bamboo plants give a gradual curve from the ground to the top and also emphasizes the characteristic of the bamboo plywood. To have the same curve for each part means the same mould can be used, which can reduce costs for the production process. One part is joined to two others and becomes a leg for the side table (figure 3.3.1c and 3.3.1d). This one leg is joined to two others and creates the side table base (figure 3.3.1e and figure 3.3.1f). This curve is produced by pressure in a vacuum machine at school but for full scale production a combination of both pressure and heat will be required.
Joints

The joints between three legs are the most important and difficult part for this side table. These joints become connections between the legs and a tabletop. The ends of the legs have a flat surface so it is possible to glue them together (figure 3.3.1g). There are wooden plugs between legs to provide more stability. The legs are made up from a slightly curved triangular element with a foot and two ends. These ‘ends’ are joined to the next foot element in a lapping fashion, ie one over and one under the next element. (figure 3.3.1h). The legs are tilted a little bit towards the side and outwards because of the joints (figure 3.3.1i), version A.

To connect the legs at the same level, it is necessary to cut the end of the legs. According to figures, there are two different versions for the joints. One, version B involves only cutting one side and then connecting together, the other, version C involves cutting two sides and creates a straight line for the joints (figure 3.3.1j). Even though only cutting one side, version B still maintains the total length of the parts (figure 3.3.1k) the same. Version C has a larger surface for a connection between the legs and the tabletop (figure 3.3.1l). In both version B and C, the legs are tilted outwards, but it is smaller angle than version A.

For this examination, I choose version B because it stands straighter than version A and still has an original figure compare to version C.

The joints between the legs and the tabletop have rubber to prevent slipping of the tabletop.

Considering shipping costs, it is desirable to have as little volume as possible. For the future, the legs can be self build style at the joints, using for example metal plates and screws.
Tabletop
The tabletop is made of a circle of clear glass. This circle is almost the same size as a circumscribed circle of the legs. The reason for using a clear glass is to emphasize the structure of the legs. When the light comes from above, there is the possibility of creating shadows of the legs. The glass is 10 mm thickness to be sufficiently sturdy and create less impress for emphasizing construction of the legs (figure 3.3.1m).

Testing different kind of glasses.

Figure 3.3.1m
3.3.2 Luminaire design

For the luminaire design, I use the characteristics of bamboo forest; grow up straight and long, dense growth and depth, create contrast between dark parts and light parts. To represent these characteristics, I use straight and thin wood sticks and create two layers (figure 3.3.2a). The sticks of each layer have different thickness to produce emphasis on depth.

There are different sizes of luminaires and have small differences in the design for each.

To create bamboo forest feeling, the luminaire design is mainly for ceiling light but it is possible to create other type of luminaire design, for example, a standing light and a table light.

Light source

There are a lot of discussions about incandescent lamp nowadays but for this project, it is best to use incandescent lamp. Because incandescent lamp has a more natural visible spectrum than fluorescent lamp (figure 3.3.2b). In addition, this luminaire needs to have a good colour rendering light source and create warm feelings.

To avoid glare from the light source, I have used a light source which has a reflector to the back (figure 3.3.2c), and also make narrow gaps between the sticks to mask the glare.
4.0 Working process

4.1 Production method

The bamboo plywood is bought from TAKE Create Hagi Ltd., Co. in Japan. There are two different thickness of plywood, one is 2 mm and the other is 1 mm.

For the legs of the sidetable, I use 5 layers of 2 mm plywood and glue it and put them in a vacuum machine and create a form. Normally, it is necessary to use both pressure and heat, but with the facility at Konstfack, I am only able to use pressure to create a form. For the tabletop, I buy glass in Stockholm and make a circular form at Konstfack.

For the luminaires, I use 2 layers of 2 mm plywood and make 4 mm thickness plywood. For a framework of the luminaires, I use 12 mm thickness pain plywood and make rings. Those rings are covered by 1 mm bamboo plywood. For a lamp folder, I use metal to hold luminaires and light sources.
5.0 Result

5.1 Sidetable
5.2 Luminaire

plan A

plan B

300
330
204
500

300
220
95

300
215

500
460

500
300

300
50

5.0 RESULT | TAKE KAGU 46
6.0 Discussion and Conclusion

The aim of this project has been to create bamboo forest feeling with furniture made of new material, bamboo plywood. The combination of my background and this material can create this furniture. When people use this furniture, they can more clearly imagine a bamboo forest.

Bamboo is a typical tree growing in Asia and has been used for daily necessaries for a long time. It is focused as ecological and sustainable material nowadays. However it had limitations on how it could be used. Bamboo plywood will be a great influence in furniture design in the future.

Bamboo plywood is an unfamiliar material to work with in Sweden until now. It is hard to find the material in Sweden so it is necessary to buy and to ship it from Japan. It is the first time bamboo plywood has been used as a material at Konstfack wood workshop, therefore it is a bit trial and error. It was really hard material to work with. Normally, it is necessary to use heat and pressure to bend bamboo plywood, but this time I tried to bend it without heat due to limitations in the school facilities. It works but there are problems with warping of this material. Climate difference between Sweden and Japan are also problem for this project. Some of the materials had warped and broken when they are arrived in Sweden because of the dry air.

It is possible to create other furniture, for example a chair and a shelf with the same theme next time. It is also possible to create self build parts furniture to ease shipping of the items.

Nature is not consistent and has many attractive forms. We can take a lot of ideas and forms from nature which provide pleasant feelings. For this project, I choose bamboo forest due to my Japanese background. Also my furniture design is functional but it can be create emotional feelings as well.

In conclusion, furniture design can create feelings and emotions of nature and can achieve a connection with a new material technique.
7.0 References and plate credits

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Online resources

Plate credits
All images by Sachiko Segawa unless listed below:

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