The Application of Bamboo Materials in Furniture Design

1Muri Wang, 2Jijuan Zhang and 3Zhongfeng Zhang,
1,2,3School of Materials Science and Engineering, Central South University of Forestry and Technology, Changsha, China

Abstract: In the rapid development of the global economy today, the forest resources are plummeting, which is required to seek a new resource to replace wood. China's bamboo resources are rich, in some aspects, the some performance of bamboo is better than wood, which become a good substitutable material. The paper describes the bamboo culture firstly, then represents the application in furniture design from different classifications and characteristics of bamboo material; according to the characteristics of bamboo material, which shows the situation and effect in the modern life when they combine with different materials, such as stainless steel, wood; finally from the direction of the development of bamboo furniture design, exploring the development trend of bamboo furniture design.

Keywords: Bamboo Materials; Furniture Design; Classification; Application

I. INTRODUCTION

China's bamboo resources are very rich, bamboo species, size, yield are ranked first in the world. Forest area of about 4 million hectares, of which the economy with high value of utilization of bamboo forest area of 2 million 500 thousand hectares, accounting for more than 90% of the total output of the world of bamboo; bamboo forest area in China accounts for about 5% of the land area, accounting for about 2.8% of the forest area, every year to cut bamboo about 600 million trees; many bamboo species in China there are more than 40 genera, 400 species belong to about 50 kinds of excess, in 1200 kinds of bamboo species worldwide. Moreover, bamboo grows fast and has a short growth cycle. It usually takes only 3 to 5 years. In recent years, with the pollution and destruction of forest resources, deforestation, global wood resources declined sharply, so the need to seek a new resource to replace the wood furniture production, development and utilization of bamboo resources to further attention.

II. BAMBOO CULTURE

Bamboo is fresh, elegant and natural. Since ancient times, is the object of praise of many men of literature and writing. Since the Tang and Song Dynasties, "pine, bamboo, plum" called "bamboo in the first place, pine, bamboo and plum blossom"; in the Ming Dynasty, "plum, orchid, bamboo, chrysanthemum, is known as the" four gentlemen ", was praised by the literati. The great poet Su Shi in the "green" Yun Xuan monk to dive in the record: "would rather eat no meat, cannot live without bamboo, no meat is thin, without bamboo is vulgar, thin person can be fat, unbearably vulgar person......" This can be seen, the feelings of love of ancient bamboo; Qing Dynasty poet Zheng Xie's "bamboo": "insist Aoyama do not relax, rooted in the broken rock. Thousand mill strike, Seoul, the four corners of the world wind." Bring out the bamboo exemplary conduct and nobility of character is more popular.

III. CLASSIFICATION AND APPLICATION OF BAMBOO

A. Original Bamboo Furniture

Bamboo furniture refers to furniture production for bamboo utilization according to the ancient style, a kind of furniture making the base material directly to the original bamboo as raw bamboo. There are three different forms, including bamboo section, bamboo slice, bamboo strips.

1. Bamboo section

One of the most basic processing methods of bamboo is to cut the whole bamboo, take it, and then remove the oil, polish, bleach and so on. Then, the bamboo section is bent after firing, and then the surface layer is processed. Finally, the frame joint is carried out by inserting, winding and dowel joint. Because the bamboo texture appearance, well-proportioned bamboo, bamboo furniture design enables the production of some natural elegance, beautiful and generous. It can be designed as bamboo bed, bamboo collapse, bamboo chairs, bamboo stool, bamboo tables (Figure 1, Figure 2), but the furniture structure is simple, but durable.

2. Bamboo slice

Bamboo slices are made of bamboo with a larger radius and are made into a certain specification of bamboo sheet after being cut transversely. The thickness of the bamboo sheet is greater than 1mm. In the furniture design, bamboo sheets are often used in single chip, multi chip, tandem and woven forms, such as bamboo chairs, bamboo sheets, mat and so on. Bamboo slice has natural texture of bamboo, so it has a strong decorative.
3. Bamboo strips

The bamboo can be cut into bamboo pieces for weaving, can be made into a flat or three-dimensional furniture products, such as the traditional bamboo trunk, bamboo trunk, bamboo curtain, etc., using different weaving method can form a different pattern of rhythm. In addition, the use of bamboo seats as table, Taiwan furniture surface, the use of the door facade has been very common. Made with bamboo bamboo furniture modeling lightweight, natural texture, pattern ever-changing. (Figure 5, Figure 6)

B. Bamboo Artificial Board Furniture

Artificial bamboo board is with bamboo as raw material, through a series of mechanical and chemical processing as structural units with various geometries, at a certain temperature and pressure, the binding force of adhesive or bamboo itself, the plate material pressed. Because of the physical and mechanical properties of bamboo artificial board, there are many wood wood-based panels not good performance, such as high strength, good elasticity and good impact resistance, and so on, it is a good non wood wood-based panel material. According to its structure, processing technology and method of blank, it can be divided into different kinds. According to the current artificial bamboo board in longitudinal direction blank consists of laminated bamboo, recombinant bamboo, A bamboo LVL, bamboo veneer laminated lumber four categories.

1. Bamboo Laminated Furniture

Bamboo gluelam is a kind of new furniture material, it is with bamboo as raw material after cutting and slicing rectangular bamboo, rough planing processed into a certain size, and then after three treatment (anti-corrosion, mildew and moth) or by carbonation, drying, coating, film selection, tissue culture, hot pressing, sanding a series of processing of the bamboo lumber. Bamboo laminated timber has the characteristics of physical and mechanical properties of bamboo. It has the characteristics of large size, small deformation, stable size, high strength, good rigidity and wear resistance. Because the product has good sealing property after certain water heating in the process of bamboo aggregate production, it can effectively prevent moth eaten and mildew. Compared with wood furniture, because of its strong physical and mechanical properties, bamboo has the power and aesthetics of the new type of laminated furniture. Table 1 is a comparison between bamboo and several commonly used wood parameters.

<table>
<thead>
<tr>
<th>Material</th>
<th>Coefficient of Dry Shrinkage(%)</th>
<th>Tensile Strength(Mpa)</th>
<th>Bending Strength(Mpa)</th>
<th>Compressive strength(Mpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bamboo</td>
<td>0.255</td>
<td>184.27</td>
<td>108.52</td>
<td>65.39</td>
</tr>
<tr>
<td>Gluelam</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oak</td>
<td>0.392</td>
<td>153.55</td>
<td>110.03</td>
<td>62.23</td>
</tr>
<tr>
<td>Korean pine</td>
<td>0.459</td>
<td>98.1</td>
<td>65.3</td>
<td>32.8</td>
</tr>
</tbody>
</table>

2. Recombinant Bamboo

Recombinant bamboo is a new kind of artificial bamboo composite material made from bamboo as raw material. Bamboo is the first loose reticular fiber bundles interconnected bamboo congest into full-length and kept the original fiber orientation, drying, sizing, assembling, and through molding glue has a certain shape and size of section of the pressed plate or lumber and other forms of material. Bamboo has natural
wood texture, surface texture and some like straight strip diameter cut, some like Yamagata tangential lines. The material is also varied, which can be made of pale yellow (ecru) or tan (coffee), and can also be made of a zebra with tan and yellowish brown. According to product modeling needs, you can also dye it all kinds of wood color. Reconstituted Bamboo and wood texture, warm and amiable, smooth and pleasant; bamboo has good mechanical properties, physical properties, and the utilization rate of up to 90%. The traditional furniture tenon joint can be used, and the modern connecting structure can also be adopted. The production process is as follows: bamboo → to bamboo green, bamboo → truncated → seam processing → heat treatment → dipping → drying → billet → hot pressing → cutting edge.

3. A bamboo LVL

Radial bamboo from bamboo green to change the physical and mechanical properties of bamboo. Bamboo density, strength and modulus are higher, but with the resin bonding performance is poor, low water resistance; inner although the intensity is still high, but good water resistance, low density, low modulus. According to the characteristics of bamboo, bamboo will be divided into four levels, a level close to the bamboo layer, the average density of bamboo is higher than that of 0.8g/cm³ thickness 0.6mm-0.8mm, D close to the average density of less than 0.6g/cm³ inner layer, the thickness of about 2.4mm, in order to improve the physical properties of the sheet, a bamboo pick the highest intensity, near the green bamboo 1.5-2.2mm bamboo and bamboo materials. The manufacturing process is as follows: bamboo collection → grading → section → bamboo processing → bamboo grading → bamboo curtain preparation → drying → dipping → drying → billet → pressing → trimming.

4. Bamboo Veneer Laminated Lumber

The basic unit of bamboo veneer laminated timber is bamboo fiber reinforced bamboo veneer. Bamboo bamboo veneer is fibrosis of split bamboo to the section, and then through the fiber separation technology to form a mesh structure composed of woven bamboo bundle bamboo bundle curtain, the bamboo bundle curtain comprises bamboo, bamboo pulp and inner three parts, and the bamboo bundle curtains on the surface are respectively provided with wax siliceous layer and layer peeling bamboo layer and inner layer, so that not only save the bamboo layer of high strength and high modulus, also save the advantages of good water resistance tabasheer layer, the utilization rate of bamboo is as high as 90% to 95%. Bamboo veneer lumber material manufacturing process is as follows: bamboo → section → section → ease → drying → dipping → glue drying → billet → hot pressing → conservation.

<table>
<thead>
<tr>
<th>Table 2: Comparison of Physical and Mechanical Properties of Four Kinds of Bamboo Wood - based Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plate type</strong></td>
</tr>
<tr>
<td>Bamboo Glue Lam</td>
</tr>
<tr>
<td>Recombinant Bamboo</td>
</tr>
<tr>
<td>A bamboo LVL</td>
</tr>
<tr>
<td>Bamboo Veneer Laminated Lumber</td>
</tr>
</tbody>
</table>

It can be seen from table 2 bamboo veneer material performance in all aspects are stronger than bamboo integrated timber, recombinant bamboo and A bamboo LVL. This has expanded the bamboo panels.

IV. FURNITURE MADE OF BAMBOO AND OTHER MATERIALS

Diversified world, a single material furniture may be difficult to meet the psychological needs of consumers, especially in this piece of bamboo furniture. In order to adapt to the market trends, to cater to the consumer's favorite and aesthetic concepts, bamboo and other materials combine to form another flavor of furniture. Among them, the most common combination furniture includes bamboo and wood furniture, furniture made of bamboo and metal materials.

A. Bamboo and Wood Furniture

Bamboo and wood furniture, as its name suggests, is a kind of furniture made of bamboo and wood. It is a new form of furniture. At present, in China's furniture market, bamboo and wood furniture fully embodies the concept of low carbon and environmental protection home life. It preserves the natural decorative effect of bamboo materials to the utmost. Most of bamboo is made up of two traditional forms: frame and bamboo.
In the traditional bamboo furniture, made of bamboo is mostly in the wood, bamboo wood and sheet form, so the maximum node edge structure of traditional bamboo furniture retains natural bamboo and bamboo parallel straight lines. However, from the bamboo and wood furniture as a whole, in the design of bamboo and wooden furniture, the main structure of the wire is still used. The formation of wire rod is mainly through the aggregation of line group and the gap between lines and lines to show the structure of line groups at different levels. To reflect a strong sense of rhythm through the change in density and the effect of staggered grid line. This sense of rhythm is the characteristics of bamboo and wooden furniture wire space.

The use of modern bamboo furniture materials are almost all through the manufacturing process of machining and other materials, this process is the natural bamboo processed, processed into bamboo gluelam, then use the laminated bamboo wood furniture manufacturing. This kind of furniture has the anticorrosion, insect prevention and moth prevention characteristics better, but also made of bamboo wood furniture has the advantages of high strength, dimensional stability, not easy to crack. The production process of bamboo furniture production process of bamboo wood furniture is the main timber used, thus the modern bamboo gluelam furniture is the main space twice the length and width of the material composed of three-dimensional shape, having a flat thin and extended sense. But compared with the general furniture, bamboo gluelam furniture because the cause of the material, the surface of a dense straight natural texture, and the production cost is not high, so the laminated bamboo wood furniture in structural and aesthetic characteristics are satisfactory.

B. Furniture Made of Bamboo and Metal Materials

Bamboo and steel furniture is an organic combination of two kinds of materials: bamboo, laminated metal and metal, which are developed for the use of modern young people. Some parts are made of steel and furniture, and bamboo laminated wood and bamboo artificial boards are made of panels or plywood. Some parts are made of bamboo as the basic framework and decorated with steel materials. This kind of furniture is concise in style and caters to modern aesthetics. The materials are in sharp contrast and conform to the contemporary aesthetic tendency.

V. DEVELOPMENT DIRECTION OF BAMBOO FURNITURE DESIGN

A. The design of bamboo furniture should highlight the natural nature of bamboo

In the rapid development of the world today, a variety of environmental problems out of the lead, in the bustling downtown, fast life festival together with work pressure, people desire a quiet nature. However, furniture as an important part of the indoor environment, to meet people's desire is also a part of it. Therefore, in the design of bamboo furniture, we should highlight the natural texture, color and texture of bamboo, and meet the psychological needs of people through the natural characteristics.

B. The design of bamboo furniture should reflect the cultural characteristics

Culture is a spiritual connotation, is the soul of furniture. Especially in today's society, the material form and function of furniture has been difficult to meet the needs of consumers, consumers need a spiritual sustenance, the value of culture has been highlighted here. China's bamboo culture has a long history and is rich, and it has become a trend to draw bamboo culture to the design of bamboo furniture.

C. The design of bamboo furniture should embody information technology

In the global information, multi polarization world today, the market competition is becoming increasingly fierce, furniture products are the same. In the past most design furniture products are in a closed or semi closed state, when the market changes, it is often difficult to even the product design changes to meet the new market, leading to a lot of problems. However, the use of modern information technology to build a knowledge network, so that everyone can participate in product development, manufacturing, management, and improve production efficiency and market competitiveness.

D. The design of bamboo furniture should be individualized

When young people become the mainstream of furniture consumption, furniture with a single style is becoming more and more difficult to meet the needs of modern people. The younger generation, who pursues individuality and convenience, does not give up his individuality. Therefore, the design of bamboo furniture should break the tradition, combine environment, crowd, ergonomics, etc., from the aspects of modeling, color, structure, etc., to increase the aesthetic feeling of bamboo furniture to show individuality.

Summary

Bamboo can ease the demand for wood furniture, give full play to the advantages of bamboo resources, the use of new processes for bamboo materials processing, improve its use
value. Through different bamboo materials, according to the needs of the market, designed with cultural characteristics, meet the needs of contemporary times, to meet consumer favorite furniture products.

References