Entrepreneurship and Application Analysis of Bamboo in the Field of Product Design

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Abstract. In product design, design is not an isolated concept. From concept formation to concrete realization, the choice of material constitutes basic elements of product, it is related to the final color, form, performance, and various other factors of the product. It is an important part of product design to fully combine materials properties with product characteristics and give full play to the greatest strengths of materials. The article analyzes the processing technology of bamboo materials through the research of bamboo material properties and basic elements and studies the application and transformation of traditional bamboo culture in modern product design from aspects of traditional cultural connotation, modernization needs, aesthetic characteristics, and cultural elements. The article also elaborates characteristics of bamboo materials and bamboo products from the perspective of environmental protection; analyses the status quo and trends of bamboo cultural product design; combs aesthetic characteristics of bamboo design from the perspective of modeling, color, artistic conception, and material systematically. Meanwhile, types of bamboo cultural elements are discussed, and the development direction of bamboo cultural product design and the perspective of innovative application are proposed.

Keywords: bamboo material; material properties; product characteristics; product design

1 Introduction

Bamboo is a typical material for traditional Chinese and even Eastern products. The study of bamboo culture and its elements will help to give full play to its design advantages in resources, ecology, and culture. It has theoretical, practical, economic, and cultural strategic significance. Bamboo culture injects humanistic care into the product, which not only improves the added value and market competitiveness of the product, but also provides richer inspiration and expression for the design. While meeting people's material and spiritual needs, it also advocates a green and healthy lifestyle. The further development and utilization of bamboo cultural products plays a positive role in promoting people's aesthetic level and promoting social and economic development. At the same time, in the context of the national strategy of "One Belt One Road", applying bamboo cultural elements to product design is the embodiment of the spirit of the new Silk Road and the propaganda of good character. Deeply digging the connotation of bamboo culture and exploring the manifestation of that in the new era is helpful to spreading and carrying forward Chinese culture and accelerating the transformation of traditional cultural resources into cultural soft power[1]. Bamboo art is nourished by the excellent Chinese traditional culture and condenses the ingenuity and feelings of the Chinese working people. It is a socialist material form that integrates science, technology and art.

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With the rapid economic and social development and the continuous transformation of lifestyles and production methods, people's demand for various practical functions of bamboo handicrafts has begun to be greatly weakened. Modern innovative technology is endowed with an era value connotation and artistic vitality of Chinese traditional national culture. Bamboo cultural elements are gradually becoming the core competitiveness of bamboo products. The various physiological and ecological characteristics of bamboo give it a design expression that other materials cannot match. The spiritual connotation of bamboo culture is consistent with modern people's values and aesthetics. The spread of bamboo culture has greatly explored the potential of bamboo materials in product design.

2 Bamboo performance analysis

2.1 Examples of bamboo varieties

Bamboo forest resources are very rich in China, most of which are distributed in areas south of 40 degrees north latitude, especially in Sichuan, which is rich in bamboo. From the Bashania fangiana bamboo, August bamboo, and solid bamboo that giant pandas love, to black bamboo, Buddha belly bamboo, phoenix tail bamboo, ruo bamboo, brown bamboo and so on.

(1) Ci bamboo

The main trunk is 5-10 meters high, with a slender top and a curved shape, which is curved and drooping like a fishing line, and is 3-6 cm thick. It is mainly distributed in southern China: Shanxi, Hubei, Hunan, Guangxi, Sichuan, Guizhou, Yunnan, and other places. It can be used for treating tuberculosis injury and vomiting blood and making bamboo crafts. Ci bamboo is widely used to make bamboo weaving crafts[2].

(2) Arrow bamboo

Widely distributed from Foping on the southern slope of the Qinling Mountains, through Nanping, Pingwu, Beichuan, and Baoxing on the northern boundary of the Sichuan Basin, and finally to southern Sichuan, the Leibo county, arrow bamboo is distributed in an arc in the mountains on the western edge of the Sichuan Basin, growing at an altitude of 2000-2800m, the edge of the coniferous forest. The forest area of arrow bamboo is quite large, the accumulation is rich, and it has many uses. It is the main food source of the giant panda (the national first-class protected animal in China)[3].

(3) Dan bamboo

Each branch of Dan bamboo has 4-8 leaves, the leaves are linear-lanceolate, 20cm long, 2cm wide, thin in texture, and glabrous or sparsely hairy on the back. It is mainly produced in Guangdong and introduced in Guangxi province. Dan bamboo is commonly planted on the slopes of gardens, courtyards, roads, and overpasses[4].

(4) Four-season bamboo

Four-season bamboo is a scepter, a plant of the genus Tang bamboo with woody veins. The pole is 5 meters high; the sheath is green; the ears are faint, ovoid or occasionally sickle; the first glume is often not obvious. The second glume is larger when it exists, purplish red with long

cilia on the back of the palea. Four-season bamboo shoots from May to October, and blooms in May[3].

(5) Phoebe bamboo

Different from the moso bamboo, the phoebe bamboo is the most precious, practical, and economical bamboo among the moso bamboos. Among more than 300 species of grassy bamboo plants in China, it is the bamboo species with the fastest growth, the best material, the most uses, the greatest economic value, and the largest planting area[5].

2.2 Analysis of the ecological value of bamboo materials

Table 1. Evaluation of Bamboo Material's Ecological Adaptability

Judging criteria for bamboo materials	2010-2015	2015-2020	2020-now
Living environment is under pressure: landscape, garbage	40%	30%	10%
Impact on human health	10%	10%	10%
The final treatment of waste materials without pollution	0%	0%	0%
Can be reused after use or disassembly	40%	60%	100%
Does not consume resources excessively	70%	80%	95%
Raw materials can be recycled	40%	70%	90%
No pollution during material production	30%	20%	10%
Large consumption of non-renewable resources	40%	15%	5%
Energy required for the material production process	80%	50%	30%
Large consumption of non-renewable resources	10%	10%	5%
Break the cycle of renewable resources	10%	10%	5%

With the development of science and technology, the ecological adaptability evaluation of bamboo materials is also changing.From the analysis of the ecological adaptability of bamboo（Table 1）, bamboo itself does not cause great pressure on the environment, and the energy consumption required in the production process of the material is extremely low compared with other materials, which can achieve its own energy conversion. Through the application of technology such as burning bamboo branches, the heat generated by bamboo scraps can meet the energy required in processes such as bamboo carbonization or bleaching. Under the existing scientific and technological conditions, in the process of reprocessing bamboo materials, it is necessary to add synthetic materials such as adhesives and preservatives, and these materials may cause certain pollution to the environment. However, from the ecological adaptation analysis of bamboo materials, bamboo itself meets the various indicators of material ecological adaptability. It is a very good ecological material[6].

2.3 SWOT analysis of bamboo material

Table 2. SWOT analysis table of bamboo material

S（Strengths）	W （Weaknesses）	O（Opportunities）	T （Threats）
The maturity period of bamboo is only 4-6 years, and the maturity of a tree is at least 20 years. Bamboo has become an important resource to replace wood, and the production of bamboo packaging can make full use of bamboo resources. Bamboo poles can be used as bamboo panels and turning tools. Packaging, bamboo shoots can be used for woven bamboo packaging or raw bamboo packaging. Bamboo packaging is mostly manual craftsmanship in the production process. Therefore, bamboo packaging not only protects forest resources, but is also green and environmentally friendly.	It is prone to insects and mold and will deform and crack due to environmental influences.	Natural biological materials such as wood, bamboo woven materials, sawdust, linen cotton fabrics, wicker, reeds, crop stalks, rice straw, wheat straw, etc. are easily decomposed in the natural environment; they do not pollute the ecological environment, and the resources are renewable, and the cost is low. Bamboo materials can be reduced, reused, and recycled. In line with the environmental awareness of contemporary life, it is a representative of new environmentally friendly materials.	The growth cycle of bamboo materials is longer than that of artificial materials, and the areas where the raw materials can be obtained are limited. The processing technology of bamboo materials is limited, which is relatively difficult compared to other materials.

It can be seen from the SWOT analysis table of bamboo material in（Table.2）that bamboo material is an ecological material with good ecological adaptability. The development, utilization and design of bamboo materials are in line with green design ideas. According to its special shape and physical and chemical properties of bamboo, the use of bamboo materials in the field of product design can better realize the introduction of detachable design, recyclable design, and replaceable design in product design.

3 Characteristics of bamboo and bamboo products

Table 3. Traditional use of bamboo materials

The characteristics of bamboo	Bamboo products
Has good splitting	It can be used to weave living utensils, such as bamboo curtains, fan bones, bamboo mats, bamboo sheds, bamboo fences, umbrella bones, etc.
Has a strong load capacity	It can be used for furniture design, such as: drying poles, bamboo chopsticks, flag poles, stretchers, scaffolding, bamboo beds, beam pillars, doors and windows, floors, bamboo bridges, bamboo rafts, etc.
Bamboo strips have strong elasticity	Used for special products with elasticity: bows, fishing rods, etc.
Bamboo material is resistant	Used in daily necessities: bedposts, machine feet, walking sticks, umbrella handles, poles, bamboo nails, bamboo hoops, etc.
Bamboo strips have the characteristic of being hollow in weaving	Used in daily necessities: waterwheel, bucket, water pipe, chimney, fire tube, bamboo bottle, flute, etc.
Bamboo material products look good	Used for special cultural and creative products: bamboo ropes, bamboo basket, handicrafts, toys, etc.

Table 4. Modern uses of bamboo materials

Classification of bamboo processing wood-based panels	Specific products
Bamboo material processing particle board	Commonly seen in particle board, fiberboard, bamboo silk board
Bamboo material processing plywood	Commonly used are bamboo plywood and bamboo laminate
Bamboo material processing floor	Commonly include bamboo-plastic composite board, three-layer board, and cross-cut panel
Bamboo material processing composite board	Veneer decorative panels and composite panels commonly used in architectural decoration

Based on original bamboo structure, it can be seen from the data analysis in （Table 3）and （Table.4） that the mechanical properties of the bamboo material have been analyzed. The purpose of rough processing of raw bamboo is to obtain more refined and distinctive bamboo materials and to provide necessary preparations to produce bamboo products. Bamboo has some

physical and chemical properties that are different from other materials. Most of them are presented in the original manual processing process. For example, bamboo is splitable, elastic and flexible. Some are advantages of bamboo; however, some are its defects. In the processing of bamboo materials and the subsequent design and production process, product designers need to refer to some positive factors in existing bamboo products, to maximize strengths and to avoid weaknesses, and better exert the performance of bamboo material[7].

4 The diversified actual needs of bamboo products

Only innovative technology can give traditional culture a higher connotation of the times and stronger vitality. With the progress and development of my country's economy and society and the reform and transformation of lifestyles and daily use of production methods, people's practical and functional requirements for bamboo handicrafts have been greatly weakened. Bamboo crafts play an important historical, cultural and artistic value in the development of tourism cultural products. More and more designers extract design elements from traditional bamboo culture; enrich their design creativity and aesthetic characteristics and improve the design of bamboo products. The connotation satisfies the aesthetics of modern people. The application of domestic bamboo products is mainly bamboo products with bamboo craft pulp paper, bamboo fiber, bamboo craft food, bamboo craft furniture, bamboo construction, bamboo daily necessities, bamboo craft making and handicrafts, etc.(Fig.1)shows the application analysis of the bamboo material market

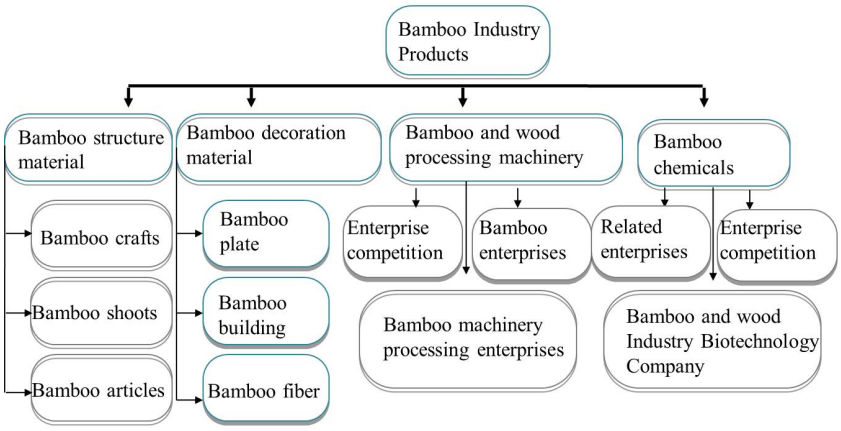

Fig. 1. Market application analysis of bamboo materials

5 Innovative application analysis of bamboo products

(1) Combine cultural elements with bamboo material production technology; use the natural characteristics of bamboo itself to make bamboo into a distinctive container. With the transformation of modern people's lifestyles and the acceleration of the pace of life, people no longer

urgently need its application functions. The shape of these utensils and people's perception of traditional bamboo products can no longer satisfy the society's demand for the unique aesthetic and cultural value of bamboo products. Combining ethnic cultural elements with bamboo materials to design rural daily necessities is a new trend to suit for modern people's aesthetics, such as tea trays, kettle boxes, coasters, fruit tea baskets, fruit chairs and other products.

(2) In bamboo architecture, the toughness of bamboo materials to combine intangible cultural heritage with traditional folklore can be made full use of; an indoor space with folklore characteristics can be created. In modern home decoration, the configuration of traditional daily production and daily life bamboo utensils, such as bamboo baskets, ovens, food boxes, bamboo baskets, etc. can increase the idyllic taste of the indoor space.

(3) Diversified bamboo product materials. With the development of modern technology and processing technology, bamboo product design materials should be diversified, for example, combined with metal, stone, wood, plastic, glass, etc., to give materials and innovation to the traditional culture of the product, and the product will bring more contemporary connotations and vitality.

6 Conclusion

Through the SWOT analysis of the variety, growth characteristics and ecological value of bamboo materials, this paper discusses the industrial use of bamboo materials. From the characteristics of bamboo itself to the formation of bamboo products, data analysis from physical and chemical properties, the article also puts forward the method in the innovative design of bamboo products, which offers new interpretation for future product designers. With the development of the times and the continuous improvement of people's aesthetics, bamboo culture in the continuous enrichment and self-renewal, the use of bamboo materials in product design is a circular, sustainable development and will become an inexhaustible source of design.

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