



Research Paper

Teaching Reform and Practice of Product Design Based on Crackless Bamboo Flattening Technology

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ABSTRACT: Starting from the introduction of the crack free bamboo flattening technology, the research background, research status, research ideas and technical characteristics of the crack free bamboo flattening technology is mainly introduced by the article, and discusses the problems existing in the teaching practice of bamboo products. It is found that the current bamboo product design teaching mainly has the following problems: the talent gradient of the teaching team is not obvious, the knowledge system of the teaching team is relatively simple, the teaching team lacks the ability of self-hematopoiesis. Therefore, a series of measures are put forward, such as the global recruitment of interdisciplinary talents, the enrichment of teachers' knowledge, the improvement of teachers' self-hematopoiesis ability, and the improvement of teachers' assessment mechanism system, to carry out the construction of product designers.

KEYWORDS: Bamboo flattening technology; Industrial design; Teaching practice; Teacher construction

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I. INTRODUCTION

As we all know, bamboo is widely distributed around the world and is known as the "second largest forest in the world". After years of development, China has been at the forefront of bamboo processing technology and product development. The traditional bamboo unit preparation process is complicated, not convenient for continuous production and low efficiency; many gluing surfaces, adhesive use, high cost and poor environmental protection are determined by the characteristics of bamboo itself, and the overall level of the bamboo industry is not high, and bamboo resources are far from being fully utilised [1]. Therefore, the "crack-free bamboo spreading" is an emerging technology that has received continuous attention, which refers to the use of high-temperature and high-moisture softening technology for bamboo, where the bamboo tube is heated to the glass transition temperature to soften the bamboo and enhance plasticity for spreading. At the same time, the splitting eyes can disperse and absorb the splitting forces generated by the spreading of the bamboo, which effectively prevents the extension of cracks in the bamboo.

In order to obtain a crack-free bamboo spreading plate, the concept of "high-temperature softening spreading" was first proposed by academician Zhang Qisheng in China, who carried out a systematic study of the relevant content of bamboo spreading plates. In addition, due to the special shape of bamboo hollow wall thin, in the process of bamboo flattening surface cracking has been an important reason to limit the application of bamboo flattening product development, bamboo efficient crack-free flattening technology is a worldwide problem. In the field of bamboo spreading technology, only Nanjing Forestry University and Zhejiang Agriculture and Forestry University have carried out preliminary research on this technology.

At the same time, little research has been done on the bamboo industry and the teaching of bamboo products. This paper will explore the reform and practice of bamboo product design teaching from the introduction of bamboo spreading and levelling technology, and provide theoretical references for the popularization and promotion of bamboo product teaching in the future.

II. CRACK-FREE BAMBOO SPREADING TECHNOLOGY

2.1 BACKGROUND OF THE BAMBOO SPREADING AND LEVELLING TECHNOLOGY STUDY

Today, over 90% of the materials available on the market are plastic, wood and other materials. However, as China's economic development level increases, the demand for wood is also rising, while the restriction of forest resources protection policies such as the "natural forest protection project" means that the supply is reduced. Because bamboo grows quickly and becomes timber early, it is in line with the low-carbon environmental protection concept advocated today, and is of great importance in alleviating the contradiction between supply and demand of timber in China and optimizing and protecting the ecological environment.

As we all know, bamboo belongs to the grass family and is widely distributed around the world, known as the world's second largest forest. At the same time, China, as the country with the most abundant bamboo resources, ranks first in the world in terms of bamboo forest area, bamboo species, production and export value, and bamboo timber accumulation. Its natural color, special texture, physical and chemical properties are all worthy of study and use.

Moreover, after years of development, China is at the forefront of bamboo processing technology and product development. However, the overall level of the bamboo industry is not high, and bamboo resources are far from being fully utilized. At present, bamboo products are manufactured as long as they are made from bamboo tubes partially divided into bamboo strips, which are planned, glued and pressed [2]. However, the production method of this bamboo composite material is made by dividing the bamboo tube into bamboo strips and manufacturing them through multiple processes. The production method has several drawbacks in terms of process, technology, planning volume and gluing, which makes the use of bamboo less cost-effective and seriously hinders the development and growth of the integrated bamboo industry [3].

In such a context, in view of the current trend that the exploitation of bamboo resources is developing in the direction of resource conservation, high-tech content and high added value, it is proposed to carry out research on the key technology of efficient crack-free spreading of bamboo timber, which can not only change the existing bamboo processing methods, but also improve the utilization rate of bamboo timber, contribute to the construction of a resource-saving society, alleviate the tension of timber, enhance the technological content of bamboo industry, increase the income of bamboo farmers, It is of great importance to increase employment, develop the economy of bamboo-producing areas and build a new socialist countryside.

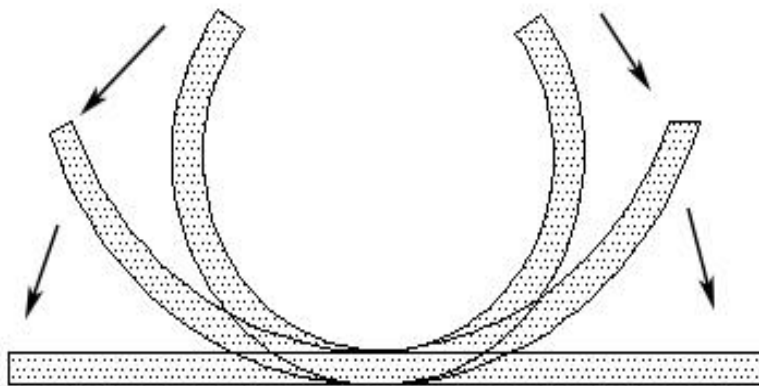


Fig. 1 Bamboo material spreading treatment diagram

2.2 CURRENT STATUS OF RESEARCH IN ZHANPING BAMBOO

In China, the concept of "high-temperature softening spreading" was first proposed by academician Zhang Qisheng and related research was carried out to systematically study the relevant content of bamboo spreading plates. In addition, due to the special shape of bamboo hollow wall thin, the surface cracking problem in the bamboo spreading process has been an important reason to limit the application of bamboo spreading product development, bamboo efficient crack-free spreading technology is a worldwide problem. At present, in the field of bamboo flattening technology, only Nanjing Forestry University and Zhejiang Forestry College have carried out preliminary research on this technology. In the previous period, the carriage floor product is the main direction of research and development, although after several years of research and development, the product has preliminary results, but the product is still in the laboratory stage, the product after processing bamboo yellow bamboo green, steam softening, high-temperature roller pressing process produced, was unfolded bamboo board in the longitudinal direction will produce through cracks, the product and then by drying, dipping glue, secondary drying, pressing process made of the desired product, suitable for carriage floor production The

product is then dried, glued, dried twice and pressed to produce the desired product, which is suitable for the production of carriage flooring. Zhejiang University of Agriculture and Forestry has been developing the product since 2000, using the method of increasing the temperature of the moso bamboo while increasing the moisture content of the moso bamboo.

Among the patented technologies, utility model CN2547484Y discloses a round bamboo unfolded bamboo board, in which the bamboo is cut off, the inner and outer knots, bamboo green, bamboo yellow, open seats are removed and then flattened. The problems are that the removal of bamboo yellow is very complicated, labor-intensive, difficult and inefficient to remove bamboo yellow, poor effect of bamboo yellow removal, resulting in uneven bamboo cylinder walls, low material utilization, high energy consumption, and unable to be applied on a large scale.

Chinese invention patent application CN101138851 discloses a bamboo spreading method, in which the bamboo tube is cut along the bamboo tube to obtain a bamboo block, and then the inner layer of the bamboo block is machined with a diagonal groove and spreading to obtain a bamboo sheet. The spreading method requires the processing of line grooves or guiding eyelets on the bamboo yellow, which is complicated and not easy to control, and the patent does not cover the various processes of bamboo spreading technology.

From the relevant information, most of the round bamboo will be cut off and divided into multiple pieces and then flattened, rarely with the whole section of the original bamboo flattening, and the success rate is very low, low production efficiency, large costs, it is difficult to large-scale production. Although there are some small bamboo samples on the market, there is almost no large-scale production, mainly in the production process cannot solve the equipment and key technical problems.

2.3 BAMBOO ZHANPING RESEARCH IDEAS

Due to the small diameter and large curvature of moso bamboo, the longitudinal and transverse strength ratio is 30:1, easy to crack laterally, to solve the compressive stress on the outer surface of the bamboo tube and the tensile stress on the inner surface of the bamboo tube, the semi-circular or even circular bamboo tube will be crack-free spreading is relatively difficult, bamboo efficient crack-free spreading technology because of its difficulty and at home and abroad is basically a blank. How to solve the problem of continuous crack-free spreading of moso bamboo, to achieve efficient processing and to develop special equipment related to bamboo spreading, is a major technical problem in the field of bamboo processing technology.

The bamboo material is first cut to a certain length according to the requirements of different target products, then treated with high efficiency in the form of bamboo knots, bamboo green and bamboo yellow, softened by high temperature and high humidity softening technology, and smoothed by special equipment, as shown in Figure 1. After drying and shaping and post-treatment techniques such as pressing and planning, dimensionally stable, mechanically sound and aesthetically pleasing bamboo panels without cracks on the surface are obtained. On this basis, the flattened bamboo panels can be used to develop a series of environmentally friendly products such as bamboo flooring, bamboo chopping boards and bamboo furniture.

Therefore, on the basis of the preliminary research, the invention of the original bamboo tube efficient floating quantitative de-knotting and de-greening processing equipment, to solve a certain range of taper, roundness and curvature of the coexistence of the bamboo tube to remove bamboo knots bamboo green layer technology bottleneck, to achieve the removal of bamboo knots bamboo green layer of high-speed cutting; at the same time, the use of high temperature and high humidity softening and spreading continuous technology to implement the crack-free bamboo spreading. The project uses saturated steam to heat the bamboo to 180°C to soften the bamboo and increase its plasticity, and then uses a spreading machine with a slotted knife to spread the bamboo in a high-temperature softened state without cracks, providing technical support to achieve bamboo panels without deformation and cracking. The project uses high-temperature, high-humidity softening and spreading technology, which belongs to the physical processing of bamboo materials, without any chemical treatment.

2.4 BAMBOO ZHANPING TECHNICAL FEATURES

Bamboo flattening technology is a practical technology for efficient processing and utilisation of bamboo timber in recent years [4]. It is a practical technology that can improve the utilisation of bamboo resources in recent years, enabling the utilisation of whole bamboo, reducing energy consumption and the amount of adhesive used, which further reduces product costs and improves product quality and overall utilisation efficiency. The processed non-cracked bamboo panels have a beautiful color and good physical and mechanical properties, and can be used in a wide range of applications, including the manufacture of bamboo multi-layer composite panels, bamboo-wood composite panels, bamboo flooring and decorative materials, which greatly expands the application areas of bamboo processing, and the technology has very broad market prospects [3]. The bamboo tube is heated to the glass transition temperature to soften the bamboo material and increase its plasticity for spreading; the splitting eyes are then machined on the yellow surface of the bamboo to

allow the inner diameter of the bamboo material to expand, and the splitting forces generated by the spreading of the bamboo material are dispersed and absorbed by the dispersed machined eyes, which effectively prevents the extension of cracks in the bamboo material [5].

The bamboo tube crack-free spreading process enables the whole bamboo to be utilized and the utilization rate to be improved, not only in terms of the utilization rate and added value of bamboo resources, but also for the bamboo product industry as a whole and for the enhancement of the technological content of the bamboo industry, all of which have a positive role to play [6].

III. PROBLEMS IN TEACHING BAMBOO PRODUCT DESIGN

3.1 NO SIGNIFICANT TALENT GRADIENT IN THE TEACHING FORCE

Firstly, as the teaching team is mostly made up of teachers graduated from major industrial design colleges, the composition is relatively homogeneous, and there is an acute shortage of teachers with forestry, wood science and other related interdisciplinary disciplines, so the talent gradient of the teaching team is not obvious.

3.2 THE FACULTY HAS A RELATIVELY HOMOGENEOUS BODY OF KNOWLEDGE

As most of them are teachers from industrial design professional background, and influenced by the Chinese industrial design education model, which has the problem of heredity and similarity significantly, so although the teachers come from different institutions, there is still a tendency of homogenization in the knowledge system to varying degrees, and the overall knowledge system is relatively homogeneous [4].

3.3 LACK OF SELF-BLOODING CAPACITY IN THE TEACHING FORCE

Due to the imperfect incentive policy of teachers, moreover, professional teachers now face greater pressure in terms of title promotion, research assessment and teaching assessment, and possess more restricted channels for capacity enhancement, resulting in the lack of a certain degree of self-blooding ability of the teaching team, and thus the overall teaching and research capacity of the teaching team is insufficient.

3.4 TEACHER APPRAISAL MECHANISM SYSTEM TO BE IMPROVED

Teachers are generally assessed on the basis of their research work, student college assessment and subject construction, but it is clear that the assessment of practice is inadequate, i.e., there is a lack of assessment of teachers' contribution to teaching practice. At the same time, there is a lack of reasonable and efficient incentive policies to encourage and support teachers in the teaching of bamboo products in practice, so the overall teacher assessment mechanism needs to be improved.

IV. REFINEMENT OF BAMBOO PRODUCT DESIGN TEACHING METHODS

4.1 CROSS-DISCIPLINARY GLOBAL RECRUITMENT OF TALENT

Design as an interdisciplinary discipline, for the intersection of disciplines research, is the discipline development of the inherent law. Therefore, in terms of discipline building, not only do we need teachers who have graduated in design, but we also need to actively recruit teachers from other interdisciplinary disciplines to strengthen our faculty, establish a teaching system featuring bamboo product design, fully exploit the combination of disciplines such as wood science, ecology and the design knowledge system, and refine the way we teach bamboo product design from a design perspective to produce new teaching outcomes.

4.2 ENRICHING THE BREADTH OF TEACHERS' KNOWLEDGE

As most of the teachers are from the background of industrial design, and influenced by the Chinese industrial design education model, it has a significant problem of heredity and similarity, so although the teachers come from different institutions, there is still a tendency of homogenization in the knowledge system to varying degrees, and the overall knowledge system is relatively homogeneous [7].

In addition to reserving knowledge in their own specialization, teachers in design disciplines should also be more exposed to and learn from the knowledge systems of other interdisciplinary disciplines, to a certain extent, leaning towards the "T"-shaped talents and enhancing their own knowledge. At the same time, the institution can also organize regular academic lectures and professional exchanges to provide opportunities for teachers from different disciplines to share their knowledge.

4.3 IMPROVING TEACHERS' ABILITY TO SELF-BUILD

It is important to enhance teachers' self-bloodedness and to cultivate their own initiative, so that some of the best talents have the ability to blossom and so that all kinds of talents can be put to good use. At the same time, it is important to relieve the pressure of personal advancement of the teachers concerned, so that they do not become less motivated by their teaching practice due to personal pressure. In order to improve teachers' self-

bleeding ability, a corresponding assessment mechanism can be established for teachers, but its fundamental purpose is not to reward or punish some teachers, but rather because without appropriate rewards and punishments, it is impossible to cause teachers to attach great importance to assessment, and assessment will not achieve the ultimate purpose of improving teaching standards, nor can it thus improve teachers' self-bleeding ability [8].

4.4 A SOUND SYSTEM OF TEACHER APPRAISAL MECHANISMS

The traditional teacher appraisal system can no longer meet the current teaching needs. It is necessary to establish and improve the teacher appraisal mechanism to establish a good reserve of talents for the construction of the discipline [9]. Firstly, the teacher recruitment, training, assessment, reward and punishment system should be improved and relevant incentive policies should be formulated, so as to better mobilize the enthusiasm and initiative of teachers. Secondly, establish a unique cultural management mechanism to enhance the cohesion between teachers and teachers, and improve their sense of identity. Finally, the relevant systems are constantly supplemented and improved, and the teachers concerned can conduct regular reports to improve the teaching mode of bamboo product design, adapt to the development needs of society, and constantly improve and develop the teaching force.

V. SUMMARY

Bamboo tube without cracks flattening process can realize the whole bamboo utilization, enhance the utilization rate at the same time, not only in terms of bamboo resources utilization rate and added value, for the whole bamboo products industry, for upgrading the bamboo industry technology content, have a positive role in promoting. Bamboo flat panels can replace some of the existing bamboo flooring, bamboo cutting boards, tea plates, fruit plates and other consumer goods and outdoor flooring, building facades and other outdoor landscape with materials, will be increasingly used in construction, decoration, furniture manufacturing, bamboo daily necessities and other fields, will be a rapid growth momentum, the development potential is huge. It is foreseeable that bamboo products made of bamboo non-cracked panels will take the international market by storm in the future. In the reform and practice of bamboo product design teaching, the construction of faculty teams plays a very important role in the training of talents. In addition to a clear understanding of bamboo product design production techniques, teachers need to develop their own professional skills. In the way bamboo product design is taught, emphasis should be placed on interdisciplinary aspects and teachers from relevant interdisciplinary disciplines should be widely recruited. At the same time, as there are certain specificities in the content of bamboo product design teaching, teachers need to give full play to students' subjective initiative in the teaching classroom, and to a certain extent allow students to do more hands-on practical work, but they also need to constantly guide students and enhance their insight and innovation [10]. Finally, in terms of ideas and goals, the school's philosophy should be clear, combined with the actual development of the region where the school is located, to implement a reasonable and effective teacher team building opinions and mechanisms, to enhance the core competitiveness of professional teachers and improve the quality of professional teaching, which is of great importance to the construction of the university design profession.

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