

Bamboo Craft at Sentra Industri ‘Bambu Kencana’: The History and Activity in Pre- and Post- Covid-19 Pandemic

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The goal of this project was to examine the bamboo craft activities at Sentra Industri's "Bambu Kencana" center and to suggest technological know-how for creating composite bamboo panels. The employees of the Mechanical Engineering Department at the Faculty of Engineering at Universitas Muhammadiyah Yogyakarta (UMY) Indonesia got the opportunity to visit the center in order to carry this out. Wulung (*Gigantochloa atrovioleacea*), apus (*Gigantochloa apus*), petung (*Dendrocalamus asper*), ampel (*Bambusa vulgaris* ssp.), and tutul (*Bambusa maculata*) were among the species found on the bamboo plantation at Jangkang Kidul, Sentolo. Apus is the species utilized for webbing. Day beds, chairs, and sofa settees are the center's primary focus. The entire production process is based only on the old-fashioned way of nailing and tying rattan furniture. A bamboo composite panel is manufactured and brought to the center. The Purwanto people in Jangkang Kidul, Sentolo, received instruction on how to make a bamboo composite. In an attempt to revive the bamboo craft activity, UMY created a prototype using the bamboo composite. By giving a discussion on the process of creating a bamboo composite, the community was introduced to a value-added technology.

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INTRODUCTION

The development of traditional bamboo furniture used in Indonesia is seen in terms of the quality and technique of making the furniture. A few examples of the furniture are sofa settee, day bed, blind curtain, long bench, and stool. The furniture is crucial for the intended attractiveness and atmosphere for ‘natural wood and bamboo restaurant’ themes. Every design plays a role within the society. Unfortunately, the usages of the designs are rarely discussed. When assessing the furniture quality, it is crucial to examine how each design contributes to the overall design of the furniture.

In this study, the aim was to investigate the various design strategies and usage of the bamboo materials by the community of Purwanto of Jangkang Kidul, Sentolo under Pemerintah Kabupaten, Kulon Progo, Indonesia. The researchers also explored the choice of species of the bamboo used by Sentra Industri 'Bambu Kencana' to transform bamboo into furniture. Ultimately, this study aimed to enhance the understanding of the technical aspects and cultural significance of the bamboo.

From a national community perspective, the traditional furniture made from bamboo in Indonesia can be accepted once the bamboo is fully treated. Bamboo is best used as a base material for the manufacture of a small restaurant and small house when viewed from the structure of the material. Bamboo from Indonesia is also widely used for musical purposes such as the angklung (Hamdan *et al.* 2022). The hollow form makes bamboo a good choice for resonator in musical instruments of that type. Bamboo was chosen for musical instruments because of its excellent sound applications (Wegst 2006). There is a lack of knowledge on the material and engineering of furniture made of bamboo. The species selection, bamboo tree selection, humidity/dryness, and the unstable sustainability were not publicized so far. The furniture produced from bamboo takes into accounts the density, moisture content, and age of the bamboo tree. As a novelty of this research, it aims not only to produce good furniture, stable and sustainable, but also to study the possibility to enhance and give added value to the furniture, which can serve as a guide for fabricating new technology bamboo furniture. Only then can the furniture produced be comparable to wooden furniture. Further research is needed to explore the technical and aesthetical of the bamboo product.

Bamboo has been known widely as a material for construction. Bamboo was earlier used for flooring and walls, and later for furniture. The layered structure of bamboo wall fibers exhibits non-uniform density in the radial direction. Thus, the elastic moduli in the parallel and perpendicular directions to the bamboo fibers are distinct. Bamboo's aligned natural fibers give it exceptional strength. Compressive strength is around 40 to 80 MPa, flexural strength (bending) is approximately 50 to 150 MPa, and tensile strength (parallel to fibers) is approximately 100 to 400 MPa. Young's modulus, or elastic modulus, ranges from 10 to 30 GPa, with the outer areas (close to the skin) being stiffer because of the higher fiber density. The density is 600 to 900 kg/m³ (Wegst 2006). Because of its high specific stiffness and strength, bamboo has excellent structural efficiency. Failure behavior is usually brittle under tension, gradually failing under compression (buckling of the fiber), and absorbing energy well under bending. The tensile strength and tensile modulus of bamboo composites, which incorporate bamboo fibers in polymer matrices, were found to be between 150 and 500 MPa and 15 and 40 GPa, respectively. The flexural modulus is 10 to 30 GPa and the flexural strength is 100 to 300 MPa. Impact resistance is typically superior to inexpensive glass fiber composites. It is beneficial for panels and automotive components due to its high energy absorption capacity. The studies of bamboo furniture and structure are very limited. Previous works on bamboo furniture were done by Deng *et al.* (2023) and Oentoro and Wiyatiningsih (2021) on a traditional bamboo species. The objective of this study is to document bamboo craft activities, species selection, and manufacturing practices at a traditional industrial center, and to introduce bamboo composite technology for value addition.

EXPERIMENTAL

The Choice of Bamboo Species, Bamboo Tree Selection and the Natural Treatment

A field visit and observational study was conducted at Sentra Industri ‘Bambu Kencana’ on 16 December 2023 at Jangkang Kidul Sentolo, Indonesia. The bamboo farm in Jangkang Kidul, Sentolo, keeps a wide variety of bamboo species, each of which has been carefully chosen for its special qualities and useful uses.

Wulung (*Gigantochloa atrovioleacea*), apus (*Gigantochloa apus*), petung (*Dendrocalamus asper*), ampel (*Bambusa vulgaris subspecies*), and tutul (*Bambusa maculata*) are some of the species that are grown in the farm. In addition to promoting ecological balance on the farm, this diversity enables farmers and craftspeople to select the best bamboo for particular applications. Wulung bamboo is especially prized for its eye-catching, nearly black hue, which makes it ideal for ornamental pieces and upscale handicrafts. Apus bamboo, on the other hand, is particularly well-suited for weaving and webbing applications such as baskets, mats, and furniture components because of its long fibers, flexibility, and ease of splitting. One of the biggest varieties, petung bamboo is perfect for construction uses like flooring, pillars, and scaffolding because of its huge diameters and thick walls. While Tutul bamboo stands out for its naturally speckled surface and is frequently used in beautiful crafts and artistic products, ampel bamboo is more adaptable and frequently utilized for daily uses. The bamboo’s age is a major factor in determining whether or not it is suitable for various uses. Apus bamboo is taken at a young age, usually between 6 and 12 months, for webbing or weaving. The fibers are still elastic and supple at this point, making it simple to turn them into thin strips without breaking them. On the other hand, it is picked for construction or craft manufacture when it has matured for more than three years.

Mature bamboo is more resilient for prolonged usage due to its greater density, strength, and wear resistance. In order to maximize bamboo quality, harvesting procedures are also precisely timed. Cutting bamboo is best done in the evening. This is based on the conventional wisdom that this time of day has a lower sap content, which includes sugars and carbohydrates. Because termites and borers are less drawn to bamboo with a lower nutritional value, lower sugar levels help reduce the danger of pest infestation.

To prolong the bamboo’s life after harvesting, preservation treatment is crucial. The base or bottom portion of the bamboo culm is treated with kerosene after it has been cut. Termites are kept from attacking the bamboo from below by this first treatment, which serves as a barrier. After that, a preservative solution, typically boric acid is poured into the hollow space at the top of the bamboo. By penetrating the bamboo’s interior structure, this chemical treatment offers defense against fungal deterioration and insects. Because untreated bamboo is extremely vulnerable to biological destruction, these post-harvest treatments are essential. The application of boric acid and kerosene greatly increases the bamboo’s durability, making it appropriate for a variety of uses, from more demanding structural applications to traditional weaving and handicrafts. Overall, the farm’s sophisticated bamboo management system is demonstrated by the combination of species selection, appropriate harvesting age, ideal timing, and efficient preservation methods. Table 1 shows the species available in the bamboo plantation. As the primary resource in this bamboo-based company, Mr. Sumardi claimed to have started the business as early as 1984.

Table 1. The Bamboo Species as Found in the Bamboo Plantation

Local Name	Species Name
Wulung	<i>Gigantochloa atrovioacea</i>
Apus	<i>Gigantochloa apus</i>
Petung	<i>Dendrocalamus asper</i>
Ampel	<i>Bambusa vulgaris Ssp.</i>
Tutul	<i>Bambusa maculata</i>

Experience over many years has allowed the farm staff to develop an effective approach to bamboo species selection. The scent of freshly cut bamboo is used in selection, instead of rigorous scientific testing. While some smells may suggest lower material quality or pest susceptibility, others may indicate stronger, more resilient bamboo.

The growth environment is one of the most important considerations when choosing bamboo. Because it is more susceptible to termite attacks, bamboo collected from low-lying, muddy, or valley locations is seen as less suited. On the other hand, bamboo that is grown in hilly or higher elevations tends to be denser and more pest-resistant, which makes it better for long-lasting products. After being picked, the bamboo is dried to lower its moisture content and increase its longevity. For about a day, the culms are kept in an oven chamber. This regulated drying procedure aids in avoiding biological deterioration, bending, and cracking. The bamboo is chopped, shaped, and constructed in accordance with the specified design after drying, signifying the change from raw material processing to product manufacturing.

At its height, the enterprise used about 4,000 bamboo trees a year, which came from 4,000 hectares of agricultural land. This implies a sizable amount of manufacturing capacity and a comparatively wide supply network before external disturbances. However, the sector was severely impacted when the COVID-19 pandemic broke out in 2019. The annual production of bamboo trees fell sharply from 4,000 to just 500. Numerous variables, including decreased market demand, labor shortages, supply chain interruptions, and mobility constraints, may be responsible for this fall. The fact that the sector has not been able to return to its pre-pandemic output levels is noteworthy and suggests that long-term operational and economic issues are still affecting its viability.

The effort of reviving the bamboo craft activity by Universiti Muhamadiyah Yogyakarta (UMY) was demonstrated by introducing a value-added technology to the community by delivering a talk on the know-how to produce a bamboo composite. The community of Purwanto of Jangkang Kidul, Sentolo was taught to produce a bamboo composite. Figure 1 showed the (a) bamboo composite panel and (b) bamboo composite handle while Fig. 2 showed the prototype produce by UMY using the bamboo composite.

The following are the preparation steps of hybrid composite sheets (Harini *et al.* 2024). To get rid of dirt sticking to the slat surfaces, the as-received bamboo slats were submerged in water for five days and then dried. Polyester (75 vol.%) with eggshell powder (5 vol.%) was reinforced with woven apus bamboo slats and woven glass fiber (20 vol.%). The mold (17 cm x 9 cm x 3.2 mm) was filled with a mixture of polyester and eggshell powder after woven bamboo slats and glass fiber were put in a 1:2 ratio. Afterwards, it was placed in the press machine for mechanical bending and physical water absorption testing. The hybrid composite used for commode chair invention and modification is based on the testing findings.

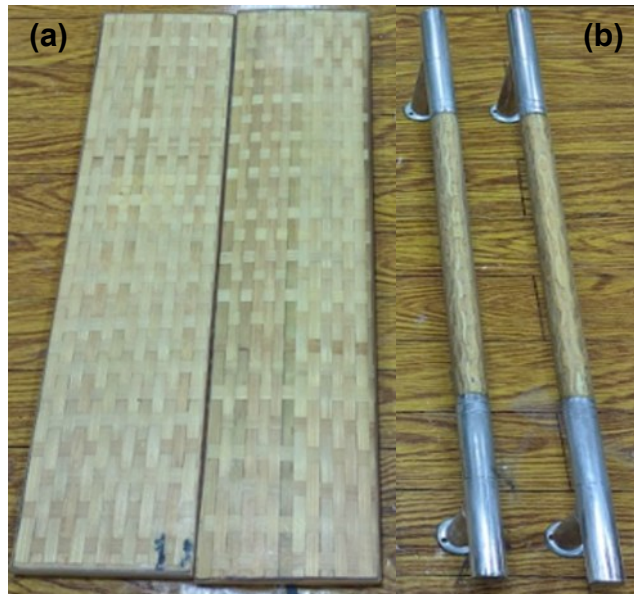


Fig. 1. (a) The bamboo composite panel; and (b) bamboo composite handle produced by Universiti Muhamadiyah Yogyakarta (UMY) (Sosiati *et al.* 2024)



Fig. 2. The prototype produced by Universiti Muhamadiyah Yogyakarta (UMY) using the bamboo composite (Sosiati *et al.* 2024)

RESULTS AND DISCUSSION

Figures 3 and 4 showed the small structure of a restaurant and a *mushola* (small praying room) made from bamboo at Puncak Saka. In Fig. 3 the whole structure (except the roof) was built from bamboo. Included in the Fig. 3 are the roof trust, lamp shades, tables and chairs made completely from ampel (*Bambusa vulgaris subsp.*) bamboo. Figure 4 shows the (a) outside and (b) inside views of the *mushola* wall made from the same bamboo species. In general, a bamboo structure could be produced by nailing and tying with rattan. Figure 5 showed the bamboo used for a day bed and sofa settee made from a wulung (*Gigantochloa atrovioleacea*) bamboo frame. Figure 4 clearly showed the used of nailing whereas Fig. 5 showed the used of rattan for tying.



Fig. 3. The roof truss, lamp shade, tables and chairs are fully made from Ampel (*Bambusa vulgaris* subspecies) bamboo



(a)



(b)

Fig. 4. Outside (a); and inside (b) views of the *mushola* wall made from ampel (*Bambusa vulgaris* subspecies) bamboo



Fig. 5. A day bed and sofa settee made from Wulung (*Gigantochloa atrovioleacea*) bamboo frame

The prototype produced by Universiti Muhamadiyah Yogyakarta (UMY) using the bamboo composite was an effort of reviving the bamboo craft activity within the community of Purwanto of Jangkang Kidul, Sentolo. The community was introduced to a value-added technology and taught to produce a bamboo composite by delivering a talk on the know-how to produce a bamboo composite. This product also allows the community to produce different structures based on their need, creativity, and demand. For example, many bamboo structures can be converted into bamboo composite structures such as mainstream sport equipment such as skating boards and surfing board panels. The effort to extract bamboo composite panels into various structures can be extended to other structures such as boat building, bicycle frame, and children's toys. This can help to preserve the bamboo craft industries for future generations to study and appreciate. In addition to preserving the bamboo tree, the study can also help to promote greater understanding and appreciation of diverse perspectives of bamboo composite. A deeper appreciation of the richness and diversity of bamboo composite structure can be developed for better understanding by Pemerintah Kabupaten, Kulon Progo, Indonesia.

CONCLUDING COMMENTS

A study visit was made to the Sentra Industri 'Bambu Kencana' on 16 December 2023 at Jangkang Kidul Sentolo, Indonesia. The purpose was to make a record of traditional practices involving several bamboo species.

1. This investigation found notable uses of bamboo, especially for the constructions of structures, using traditional methods. The structures included *mushola* (small mosque), tiny buildings like eateries, and furnishings such as tables and chairs.
2. A standard soaking technique and furnace drying were used to cure the bamboo.
3. An added-value method for creating bamboo composite structures was shown. Such composites are not just for everyday use, like the disabled person's toilet chair (Sosiati *et al.* 2024), but can also be expanded for sporting goods, such as skate boards and surf boards.
4. Other structures including boat components, bicycle frames, and kid's toys can benefit from the endeavor to extract bamboo composite panels.

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