JEPARA WOOD WASTE UTILIZATION AND DEVELOPMENT INTO LIGHTING PRODUCT INSPIRED FROM INDONESIA INGENIOUS VISUAL AND CRAFT

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Abstract

Jepara recognized as the largest wooden furniture industrial city in Indonesia, faces challenges in managing wood waste generated from production. This study aims to develop derivative product designs, specifically lighting designs, that utilize surplus wood waste from production. The design creation methodology involves exploration of visual typology elements derived from Hindu-Buddhist temples, which serve as iconic landmarks of Indonesia, and integrates distinctive carvings characteristic of local craftsmen in Jepara. The result is the creation of lighting products that not only provide illumination but also function as decorative elements that reflect the cultural identity of the region. This research is expected to positively contribute to designers' awareness of the importance of sustainability principles in design, as well as to strengthen the local handicraft industry in Jepara by utilizing wood waste materials.

Key words: Wood-waste, lighting design, ingenious craft

INTRODUCTION

Jepara, a city located in the northern coastal area of Central Java, has historically been a strategic center for trade with India, China, and Arabia, significantly influencing the region's economic, cultural, and religious development. The influence of Hindu-Buddhist culture began to spread across Central Java and Jepara around the 6th century and the art of carving is one of the artistic skills possessed by the local people. The art of carving has been passed down through generations, started originating from the skills of ancestors in Central Java who adorned places

of worship during the Hindu-Buddhist era, as seen in the walls of Borobudur, Prambanan, and other ancient temples. The art of carving and the motif patterns produced by artisans in Jepara have undergone dynamic transformations. (Iswahyudi, 2017)

Presently, the distinctive carvings characteristic of Jepara exhibit intricate motifs and detailed designs, frequently drawing inspiration from local flora, fauna, and folklore. The carving media often used are stone and natural wood, one of the abundant natural materials in Central Java is teak wood. Teak wood has long been utilized by skilled craftsmen for various purposes in the Kalingga, Majapahit, Demak, and Mataram kingdoms since the 7th century. (Purnomo, 2009) The teak wood material also used to utilized as the construction of fishing boats along the coastal areas.

The production and use of teak wood have grown significantly, extending beyond structural needs for traditional houses to include furniture production. During the 19th century, Dutch colonizers targeted teak wood due to its superior quality, meeting the high demand for furniture and timber industries in Europe. As result the local community's wood carving skills were leveraged to produce highly decorative, classic-style chairs with exquisite craftsmanship.The aesthetic expression of Jepara carving art has evolved to meet evolving consumer demands, incorporating European-style furniture. (Muhajirin, 2019)

The craftmens of Jepara are renowned for their ability to create three-dimensional carvings with realistic depth and texture, frequently applied to wall decorations, and traditional carved doors known as 'gebyok'. The majority of wood carving technology in Jepara is still conventional and manual, resulting in slow production and product quality for the export market. (Marizar, 2020) This condition has also diminished the interest of younger generations in continuing the tradition, raising concerns about the regeneration of wood carving art among them.

On the other hand, the need for wood raw materials in furniture production continues to increase, accompanied by an increase in the amount of unused wood waste and of course it will be a new problem that needs to be solved. In order to be

managed wisely, environmental ethics and environmental legal awareness are needed so that this waste can be managed effectively. (Setiawan, 2023)

Over the past ten years, the furniture industry has needed around 3 to 3.8 million cubic meters of wood per year, with an estimated 10-20% of which is waste. This waste includes wood chips and sawdust, which are often unused for reasons of efficiency. Upon closer examination, this waste presents a significant potential opportunity for creating derivative products that support sustainable principles for the furniture industry, especially as the supply of solid wood continues to diminish.

The principles of sustainable design aim to minimize negative environmental impacts and reduce the use of non-renewable resources by lowering pollution, waste, energy consumption, and reliance on scarce materials. (Bhamra, 2007) Additionally, these principles promote a harmonious interaction between people and the natural environment. (Shouha, 2007) This study seeks to explore the potential of utilizing wood waste to create functional and decorative products by optimizing the use of small and medium-sized wood pieces.

It also examines the visual characteristics of cultural heritage, as reflected in artifacts like temples and historical buildings, which possess lasting aesthetic and cultural value. The integration of visual characteristics from Indonesia's cultural heritage, particularly the architecture and graphic arts found in ancient buildings and temples, aims to enrich design inventories while raising awareness of the importance of design exploration rooted in the past as an expression of cultural identity. By combining sustainable design principles with local wisdom, this approach offers creative inspiration to tackle environmental challenges within Jepara's furniture industry.

METHODS

This study employs a qualitative design exploration methodology, divided into several phases:

1. Data Collection and Analysis of Wood Waste Materials and

Visual Elements. The first phase involves analyzing the types of wood waste from furniture production in Jepara. The collected waste includes leftover wood pieces, corroded wood, and unused wood from the carving process. The waste materials are then categorized based on their size, texture, and potential use in the design process. Additionally, an analysis of visual elements from prehistoric temple buildings was conducted. Some temples located in Jepara have not been fully restored, making it difficult to define their visual elements. Therefore, Borobudur and Prambanan temples in Central Java, with their fully restored visual compositions, were used as reference objects. The design elements collected include lines, planes, volumes, form compositions, joinery systems, and key visual details of these heritage buildings.

2. Design Exploration
   The next phase involves design exploration by integrating visual elements from Hindu-Buddhist temple architecture as the primary form concept. The design exploration includes analyzing the visual elements of temple forms and structural patterns and translating them into product design concepts. The selection and adjustment of wood waste materials are carried out to match the design of the lighting products being developed. Additionally, traditional carving techniques of Jepara craftsmen are integrated into the designs to enhance the cultural authenticity of the products.

3. Design Simulation
   This phase involves the application and simulation of the products in a spatial context. Considerations include form principles, dimensional proportions, and the quality of lighting effects produced. Technical tests and observer feedback are gathered to evaluate the design, and based on these tests, further improvements are made to refine the design

4. Prototype Development

Based on the design exploration, several pendant lamp prototypes were developed using the collected wood waste. These prototypes are evaluated based on aesthetic and functional quality, with a focus on ensuring that the final products are visually appealing, structurally sound, and environmentally sustainable. The prototypes are produced to test the final outcomes of the designs.

RESULT

This study analyzes wood waste materials produced by the furniture industry in Jepara, alongside an examination of visual elements derived from ancient cultural artifacts in Jepara and the surrounding areas of Central Java.

The Wood Waste and Visual Elements

Regarding the wood waste materials, several types of waste generated by the industry in Jepara were identified. It is estimated that 10-20% of the wood used in each furniture or wood-based product production results in waste that can be repurposed. The types of industrial wood waste include wood offcuts, sawdust, and decomposed wood pieces, commonly referred to as corroded wood. The following images and tables provide a detailed breakdown of these waste types.

Figure 1. Industrial Waste: Offcuts, Sawdust, and Corroded Wood.
Source: Authors Data.

Table 1 – The Waste Study of Wooden Industry

Type of Waste			Description
Wood Waste	**Dimensions**	**Persentage**	
Off-cuts	Wood offcuts of various sizes	10-15%	These are wood pieces left unused during the cutting process. Sizes vary from small to medium, depending on the type of furniture being produced.
Sawdust	Fine wood particles (sawdust)	5-10%	Produced during the cutting, sawing, and sanding processes. Sawdust is typically generated in large quantities and is often repurposed as biomass fuel or for by-products like particle boards.
Branch and Log Pieces	Small branches or logs with irregular dimensions	8-12%	Unused parts of wood after the selection of primary materials, usually shaped as logs or branches that are too small to be used in large furniture production.
Wood Chips/Splinters	Irregular wood fragments or chips	3-5%	Splinters and chips produced during furniture manufacturing, such as precision cutting, often irregular in shape or too small to be used in main products.
Large Offcuts (Waste Slabs)	Large unused wood pieces	5-7%	Large pieces produced from the initial wood cutting stages that do not meet desired sizes or shapes. These are often in the form of slabs or blocks.
Unusable Wood	Damaged, broken, or cracked wood	2-4%	Wood that is unusable due to natural defects or because it became cracked or damaged during the production process. It is usually separated from the selected raw materials for high-quality products.
Corroded Wood	Unprocessed leftover wood that has been discarded and left to naturally decay	Not yet identified	Wood that is left unused and has undergone corrosion due to natural weathering and erosion, leaving behind parts of the wood structure that remain hard.

Based on literature studies on local culture, it was found that temple buildings are significant artifacts representing the rich artistic heritage of the socio-culture and religion of Javanese people. (Perdana,2022) The craftsmanship of wood carving is reflected in the grandeur of the temple structures and the

beauty of the carvings that adorn the temples, which served as places of worship for Hindu-Buddhist communities, particularly in the Jepara and Central Java regions. These carvings showcase the high level of artistic skill and symbolism possessed by the people of that era, making temples symbols of cultural and spiritual heritage.

Table 2 – Visual Study of Cultural Artifacts

Cultural Artifact				Visual Elements
Borobudur Temple	Magelang, Central Java	8th Century CE (760-830 CE)	Buddhist	• Square, rectangular, and circular base • Radial symmetry • Tiered and expanding • Parallel line elements • Carvings of gods, humans, flora, fauna, and mythology
Mendut Temple	Magelang, Central Java	9th Century CE (824 CE)	Buddhist	• Square base • Symmetrical • Tiered and towering • Parallel line elements • Carvings of gods, humans, flora, and fauna
Pawon Temple	Magelang, Central Java	9th Century CE	Buddhist	• Square, rectangular, and circular base • Radial symmetry • Tiered and towering • Parallel line elements • Carvings of gods, humans, flora, fauna, and mythology
Prambanan Temple	Sleman, Central Java	9th Century CE (850 CE)	Hindu	• Square base • Tiered and towering • Parallel line elements • Carvings of gods, humans, flora, fauna, and mythology
Angin Temple	Jepara, Central Java	9th-10th Century CE	Unidentified	• Square base • Tiered and towering • Unidentified carvings
Bubrah Temple	Jepara, Central Java	9th-10th Century CE	Unidentified	• Tiered • Towering • Unidentified carvings

Aso Temple	Jepara, Central Java	9th-10th Century CE	Unidentified	•	Flat base • Unidentified carvings
Bentar Temple / Gapura / Gerbang Terbelah	Jepara and Central Java Region	Unidentified	Unidentified	•	Rectangular base • Symmetrical • Balanced • Tiered and towering • No carvings

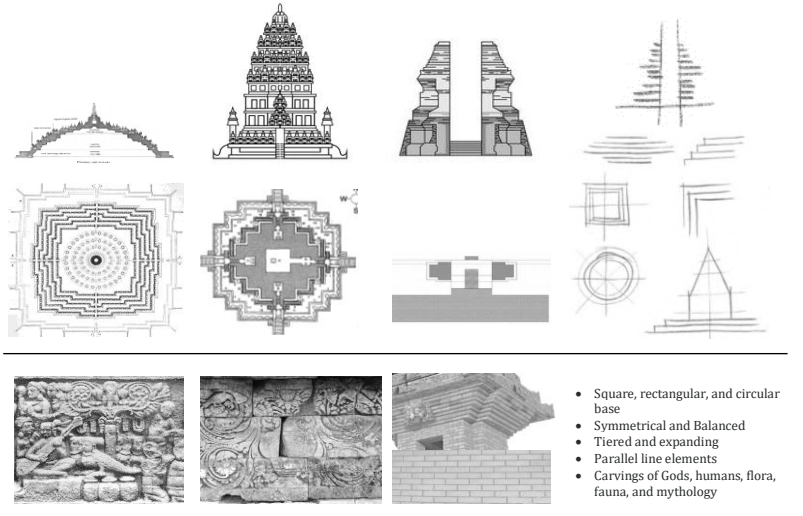

Figure 2. Typology of Temple and Visual Element Forms
Source: Internet Access, 2024.

From the visual study of ancient temple building artifacts, several notable visual characteristics were identified. These include foundational shapes such as squares or circles with radial symmetry, tiered structures, forms that either expand outward or tower upward, and parallel line elements (Table 2). Additionally, organic carving elements are often present. These visual elements will serve as key assets in the development of lighting products using previously mapped industrial wood waste materials. Subsequent design explorations will be based on the unique characteristics of each finding.

Design Concept and Exploration

The utilization of wood waste to create new products is centered on principles of sustainability. The integration of artisans' carving skills and the wealth of visual elements derived from historical architecture adds significant value in enriching the design exploration. These concept showcase visual elements inspired by Hindu-Buddhist temples as historical artefatc, combined with the traditional craftsmanship skills of Jepara artisans. The whole concept are illustrated in the diagram below.

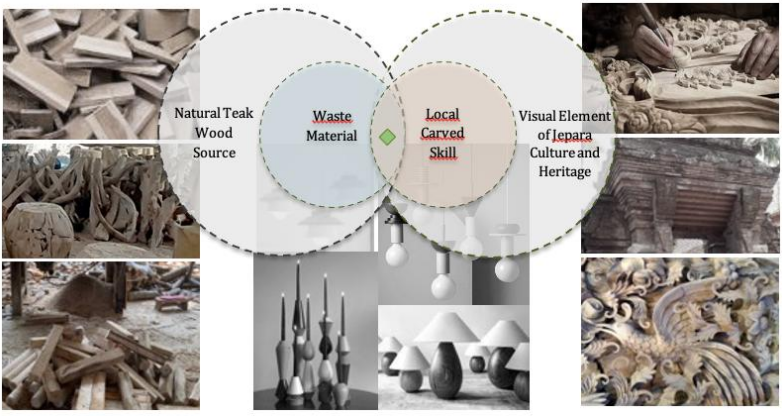

Figure 3. Concept of Developing Wood Waste Design into New Products
Source: Authors Data.

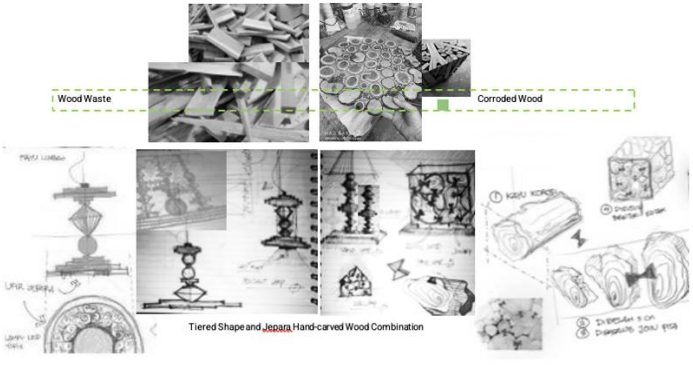

Figure 4. Exploration of Wood Waste Design into Lighting Products
Source: Authors Data.

The Designs

The results of this study demonstrate the successful creation of lamps utilizing wood waste materials while integrating Indonesia's cultural heritage into their designs. The exploration revealed four design types that utilize materials such as wood off-cuts, branch/trunk segments, and corroded wood. The wood waste materials in the form of sawdust and smaller wood pieces were not further explored, as their processing requires a different method, specifically pressing to create boards from the wood particles. By selecting the appropriate types of wood waste and combining them with various visual elements and techniques, four chosen designs were developed, which will be detailed in the following table:

Table 3 – Design Exploration Result

Design	Waste Types	Visual Element	Tecnical	Function
Design 1	Wood Off-cuts	Temple Visual Outline: • Square base • Tiered • Parallel lines • Rising upward	Joinery System: Compact Slip; interlocking Finishing Material: Natural	Pendant Lamp Dimensions: 25x25x15
Design 2	Wood Off-cuts Wood Chips/Splinters Branch Cuts	Temple Visual Element: • Square base, rectangular • Tiered • Parallel lines • Rising upward • Jepara carved with flora	Stacking Installation Technique	Pendant Lamp Dimensions: 32x32x17
Design 3	Wood Off-cuts Wood Chips/Splinters Branch Cuts	Visual Elemen Candi: • Temple Visual Element: • Circular base, Raounded • Tiered • Parallel lines • Rising upward • Jepara carved with flora	Stacking Installation Technique	Pendant Lamp Dimensions: 22x22x17
Design 4	Wood Off-cuts Wood Chips/Splinters Branch Cuts	Visual Element: - • Square base, rectangular • Tiered • Abstract and organic elements	Joinery System: Dove-tail to expose desired detail	Table Lamp Dimensions: 35x35x40

Design 1	Design 2	Design 3	Design 4

Four designs with distinct characteristics were selected. Design 1 prioritizes the visual outline of the temple structure, while Designs 2 and 3 emphasize the tiered and upward-reaching forms, incorporating repetitions of parallel lines, along with radial and circular elements. The arrangements in Designs 2 and 3 lend a slightly contemporary visual style suitable for casual spaces. To enhance aesthetic value, characteristic Jepara carvings, specifically floral motifs, were also applied. The final design explores corroded wood waste, transformed into a table lamp to highlight the unique character and texture of the material.

Additionally, dovetail joinery was incorporated to strengthen the structure. The selected designs will proceed to the production of working drawings, which serve as a guide in the prototyping process. These working drawings are meticulously crafted to include the dimensions and shape details of each product element, as well as the technical information necessary for assembly. By incorporating clear specifications, the working drawings not only ensure that all design aspects are accurately implemented but also facilitate collaboration among the various parties involved in the production process.

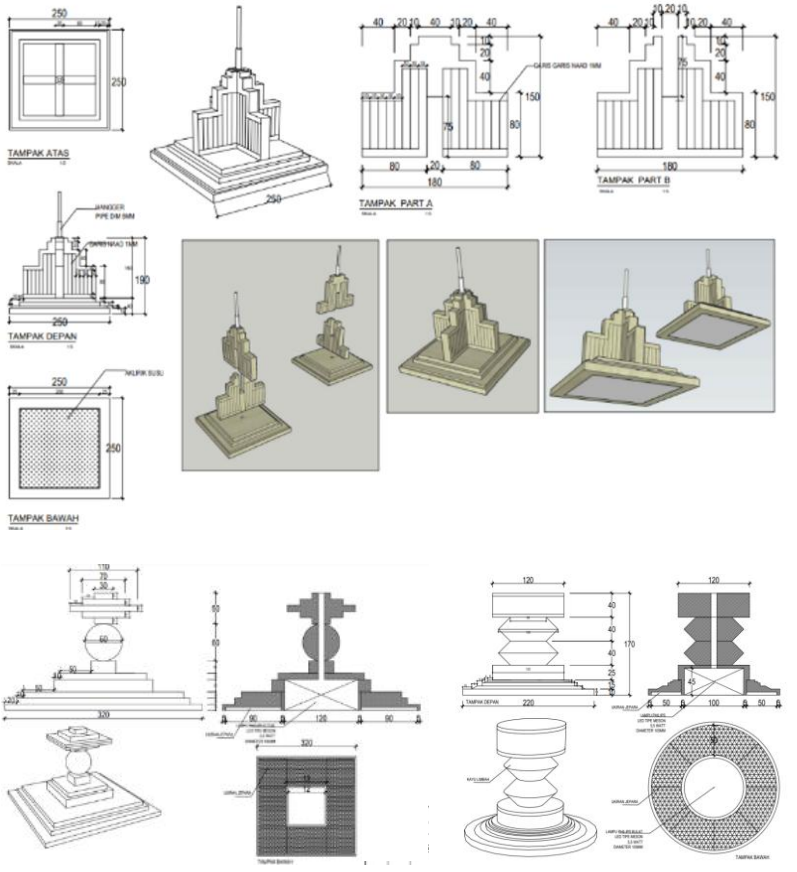

Figure 5. Working Drawing: Design 1, 2, and 3
Source: Authors Data.

Design Simulation

The lamp design simulation was conducted to evaluate the product's compatibility with interior environments, using the 3D digital model of traditional Joglo building as the primary reference. The simulation results indicate that the developed lamp design aligns well with the characteristics of Joglo interiors, where wooden elements and traditional carvings serve as the main focal points. Additionally, the application of this lamp design is deemed suitable for other interior concepts,

such as classic, eclectic and contemporare styles for public or private space.

Figure 6. Carving Process for Lamp Fixture Designs 2 and 3
Source: Authors Data.

Prototype Making

In the prototyping process, the technical aspect of selecting materials from wood waste is a crucial consideration. Choosing suitable wood waste for specific design types is essential. Therefore, sorting the wood waste must be carried out before entering the production stage. This ensures that only appropriate and high-quality materials are utilized, leading to an optimal final product. Additionally, several tools such as planners, lathes, cutting machines, as well as chisels, hammers, and sandpaper are needed to support the production process.

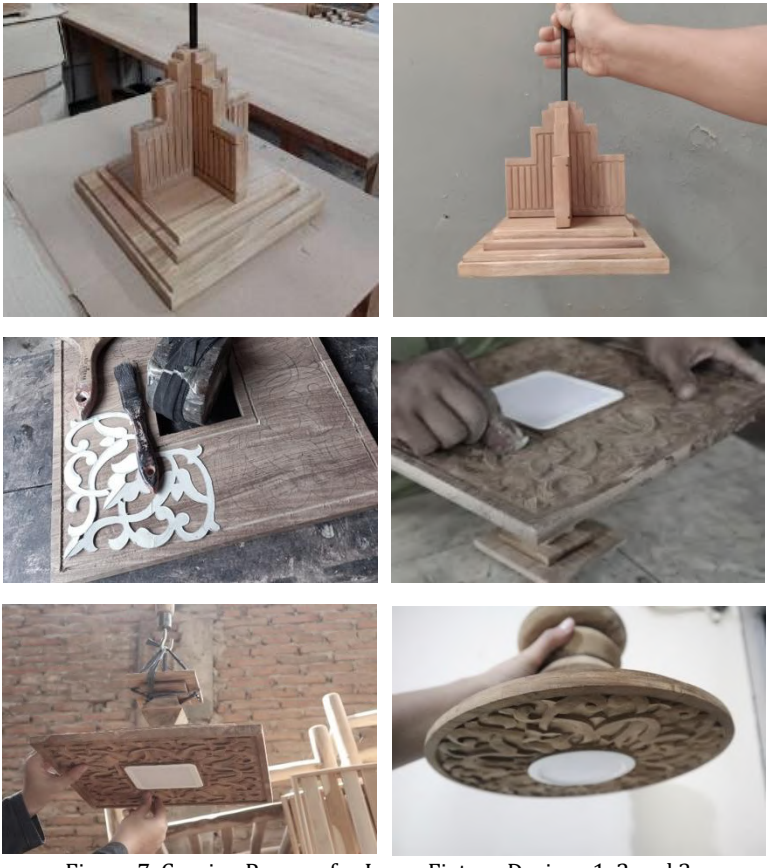

Figure 7. Carving Process for Lamp Fixture Designs 1, 2 and 3
Source: Authors Data.

In the prototype production process, local carvers are relied upon. These artisans are residents of Jepara who possess skills in teak wood carving and are accustomed to creating intricate carvings for chairs and “gebyok” panels, which are one of the hallmark products of Jepara's carving artistry. The work is carried out manually, emphasizing the carvers' craftsmanship and skill in the carving process.

The lamp designs developed in this study are inspired by Indonesia’s indigenous visual and craft heritage, particularly the visual elements found in Jepara’s artifacts and Javanese culture.

owever, critical aspects such as production costs, marketing strategies, and other logistical considerations have yet to be thoroughly investigated. Further research is essential to establish an effective and efficient production system, particularly for large-scale industrial manufacturing. This would also necessitate addressing human resource management and potentially incorporating advanced technologies. Ultimately, the lamp designs will be tested and refined to align with the intended ambiance, particularly for interior designs in classical, traditional, or eclectic styles.

CONCLUSION

This research demonstrates the potential of utilizing wood waste from the industry in the development of lighting products. Several types of wood waste were identified, including off-cuts, sawdust, and corroded wood. Off-cuts and corroded wood are further developed in this paper, while sawdust requires special treatment before processing, specifically by undergoing a compression process to create panel boards. Through analysis based on cultural artifacts such as ancient temples and other crafts, the visual elements including lines, planes, and forms were identified as the ingenious visual and utilized as design components, resulting in innovative outputs that reflect the distinctive visual heritage of Indonesia.

The lamp designs produced in this study serve as examples of sustainable design that not only address environmental issues but also promote local craftsmanship and the unique carving identity of Jepara. By enhancing awareness of sustainability principles in design, this research contributes to broader discussions regarding the role of designers in exploring visual elements and design from a cultural perspective, as well as creative collaboration with local industries to confront global challenges.

REFERENCES

Bhamra, T. (2007). Design for sustainability. . https://doi.org/10.4324/9781315576664.

Iswahyudi. (2017). THE RE-DOCUMENTATION OF JEPARA'S CARVING MOTIFS: AN EARLY STUDY. Journal of Social Studies (JSS). https://doi.org/10.21831/JSS.V13I1.16972.G9977.

Muhajirin, M. (2019). ESTETIC EXPRESSIONS OF JEPARA CARVING IN EFFORTS TO DEAL WITH THE MARKET DEMANDS. Corak. https://doi.org/10.24821/CORAK.V8I1.2779.

Marizar, E., Mutiara, M., & Irawan, A. (2020). Development of wood carving furniture technology in Jepara. IOP Conference Series: Materials Science and Engineering. https://doi.org/10.1088/1757-899x/852/1/012146.

Purnomo, H., , M., & Irawati, R. (2009). Furniture and people: a photo journey from market to forest. . https://doi.org/10.17528/CIFOR/002895.

Perdana, A. B. (2022). Memunculkan Kembali Tatanan Vāstu: Kajian Elemen Arsitektural Candi Mataram Kuno berdasarkan Perbandingan Tipo-morfologis dan Tekstual. Tesis. UI

Setiawan, D., Hidayat, A., Supriyadi, S., & Lestari, W. (2023). Environmental Ethics Policy in Jepara: Optimization of Handicraft Designs from Wood Waste in the Furniture Industry. Journal of the Korean Wood Science and Technology. https://doi.org/10.5658/wood.2023.51.5.392.

Shouha, H. (2007). Design and Practice in the Sustainable Development. Art and design.