

## Material Selection Strategies in Microlibrary Design to Support Environmental Sustainability

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### Abstract

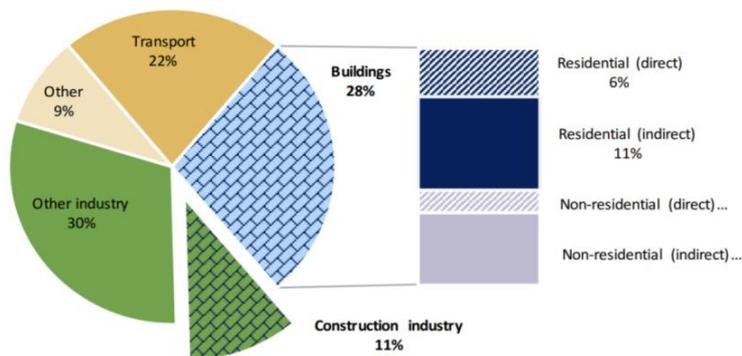
In facing the global climate crisis and the limitations of natural resources, material selection focuses not only on structural and aesthetic needs but also on efforts to reduce environmental impact through optimizing material life cycles, recycling potential, and contributions to building energy efficiency. This is particularly relevant considering that the construction sector contributes approximately 37% of global carbon emissions (UNEP, 2020). Material selection strategies become a crucial approach in microlibrary design, emphasizing efficiency, sustainability, and functional suitability to support environmental sustainability. This study aims to address how eco-friendly material selection strategies can be effectively applied in microlibrary design to support environmental sustainability. The research method uses a design experimental approach and literature review, collecting data related to the physical characteristics of materials, environmental impact, and their potential for reuse. Selected materials—such as glass blocks, steel structures, scaffolding, particle boards, and fabric—are evaluated based on their sustainability characteristics, including their ability to support natural lighting, modularity, durability, ease of reassembly, and recycling potential. The design approach is conducted through exploration that integrates environmental sustainability aspects with contextual and functional architectural expression. The study findings indicate that applying eco-friendly material selection strategies in microlibrary design not only enhances visual comfort, spatial functionality, and energy efficiency but also provides innovative solutions for small-scale public architecture that is inclusive and adaptive. This approach aligns with the Sustainable Development Goals (SDGs 11: Sustainable Cities and Communities) and opens opportunities for the development of environmentally conscious public facilities through the use of innovative and affordable materials. These findings provide both theoretical and practical contributions to the development of sustainable architecture and serve as a reference for designers and policymakers.

Keywords: Eco-friendly Material; Microlibrary; Sustainability

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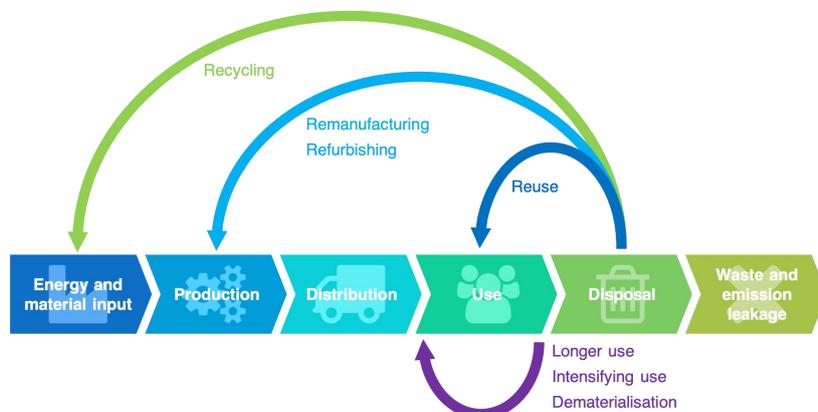
### INTRODUCTION

Global environmental challenges such as climate change, energy crises, and depletion of natural resources increasingly demand changes in architectural practice, especially in building material selection. Materials are now recognized not only as physical elements but as critical factors influencing energy efficiency, environmental sustainability, and spatial quality (e.g., Kibert, 2016; Zhang et al., 2020). This relevance is underlined by the construction sector's contribution of approximately 37% to global carbon emissions (UNEP, 2020). Figure 1 clearly shows the building sector's significant share in energy consumption and CO<sub>2</sub> emissions compared to transportation and industry. This calls for responsible design strategies, including selecting materials that are energy-efficient, functionally appropriate, environmentally friendly, and socially valuable (Addington & Schodek, 2018; Ding et al., 2019).



**Figure 1.** Energy Use Distribution by Sector Related to CO<sub>2</sub> Emissions  
 Source: World Energy Statistics and Balances, IEA/OECD, 2017

To meet these challenges, scientific approaches such as Life Cycle Assessment (LCA) have been developed to evaluate environmental impacts comprehensively from extraction to recycling (ISO 14040, 2006; Shukla et al., 2023). Eco-friendly materials are characterized as durable, non-toxic, renewable, and supportive of circular economy principles (Kibert, 2016; Geissdoerfer et al., 2017). For example, Gong et al. (2020) showed natural clay bricks have lower embodied energy and emissions compared to conventional fired bricks. The use of local and bio-based materials such as adobe, hemp, and straw offers environmental benefits and strengthens cultural identity (Boufils et al., 2023; Pittau et al., 2018; Christoforou et al., 2016). Material choice also involves social and cultural contexts, requiring a balance of environmental, social, and economic factors aligned with the triple bottom line approach (Elkington, 2018). Effective material selection strategies also adopt circular economy models emphasizing waste reduction through reuse, repair, refurbishment, and recycling (Geissdoerfer et al., 2017), as visually summarized in Figure 2. This approach prioritizes materials like glass blocks, steel, scaffolding, processed wood, and textiles for their recyclability and ease of reuse.



**Figure 2.** The Circular Economy Concept  
 Source: Geissdoerfer et al., 2020

In the context of applying sustainability principles in practice, small-scale projects such as microlibraries serve as relevant case studies due to their spatial limitations, which encourage maximum resource efficiency. This study utilizes the microlibrary as a prototype to directly test eco-friendly material selection strategies through design decisions. Materials such as glass blocks, steel structures, and scaffolding installations were chosen based on considerations of sustainability, modularity, and ease of construction (Ching & Shapiro, 2014; Priyadarsini et al., 2018). Glass blocks are selected for their ability to maximize natural daylighting, in line with passive design principles (Lechner, 2015), while steel and scaffolding are favored for their durability and potential for reuse, consistent with cradle-to-cradle concepts (Braungart & McDonough, 2002). The effectiveness of glass blocks in reducing artificial energy consumption is also supported by studies on natural lighting (Edwards & Torcellini, 2002; Galasiu et al., 2007; Aguilera-Benito et al., 2021), whereas steel and

scaffolding outperform in terms of recyclability and lower carbon emissions compared to new materials (Brown et al., 2019; Dunant et al., 2018).

The implementation of microlibraries based on eco-friendly materials is also understood as a strategy for providing inclusive, efficient, and affordable public facilities. Beyond their spatial function, architecture here serves as an educational medium conveying sustainability values through materiality and building form (Salama, 2019; Habraken, 2000). Examples such as the Fibonacci and Taman Bima microlibraries by SHAU demonstrate how modular approaches, the use of recycled materials, and local community involvement form part of transformative design practices (Ecogradia, 2023; Arsitektur.asia, 2025). This approach aligns with the vision of the Sustainable Development Goals (SDGs), particularly SDG 11 on Sustainable Cities and Communities, which emphasizes the importance of providing inclusive and adaptive public facilities to support urban populations (IFLA, 2018; United Nations, 2015).

Considering these issues and urgencies, this study aims to explore how sustainability principles can be integrated into the building material selection process within small-scale public projects. The focus is on analyzing eco-friendly material characteristics through both theoretical and empirical approaches, as well as applying these insights in the design of a microlibrary prototype that is inclusive and efficient. Additionally, the study evaluates the contribution of materials to achieving environmental sustainability, energy efficiency, and socio-cultural relevance within the context of sustainable architecture.

## RESEARCH METHODS

This study employs a qualitative method with an experimental design approach to explore and evaluate strategies for selecting eco-friendly materials in microlibrary design. Focusing on the critical issue of sustainable building material selection, the research develops design proposals that support both environmental and social sustainability within small-scale public spaces. Conducted conceptually between March and August 2024, the study addresses the application of microlibrary designs adaptable to various locations with limited space and resources. Data collection includes analysis of the physical and environmental characteristics of building materials, literature reviews on eco-friendly materials and circular economy principles, and empirical evidence from case studies of microlibraries implementing sustainability practices. Primary data are gathered through design experiments involving form, spatial configuration, and material installations, which are then analyzed for their impact on energy efficiency, spatial quality, and social value. Secondary data are drawn from relevant literature, scientific journals, and project documentation focused on sustainable design and recycled material usage.

This research was conducted through several systematic stages designed to explore and test strategies for selecting eco-friendly materials in microlibrary design. Each stage plays a crucial role in ensuring that the research process proceeds in a structured manner, from problem identification to the visualization of the final design concept.

**Table 1.** Stages of Research in Sustainable Material Selection for Microlibrary Design

Stage	Explanation	Output / Product
1. <b>Preparation</b>	Identifying the main issues related to limited access and the need for environmentally and socially friendly public facilities. Initial data collection and literature review are conducted.	Clear foundation for formulating material selection strategies
2. <b>Material Exploration</b>	Exploring and experimenting with material selection based on sustainability characteristics, modularity, ease of construction, and reuse potential.	Structure, façade, building envelope
3. <b>Design Analysis</b>	Analyzing form, spatial configuration, and material installations to assess their contribution to spatial quality, resource efficiency, and visual aspects.	Evaluation of functional and inclusive materials and designs
4. <b>Design Concept Development</b>	Developing the final design concept by integrating the results of material experiments and spatial analysis, emphasizing environmental and social aspects.	Holistic and sustainable microlibrary design concept
5. <b>Visualization</b>	Visualizing the design in 3D images using software such as SketchUp as a visual representation of the microlibrary concept.	3D design images serving as the final visual documentation

Source: Author, 2025

## RESULTS AND DISCUSSION

### *The Concept of Appropriate Material in Sustainable Architecture*

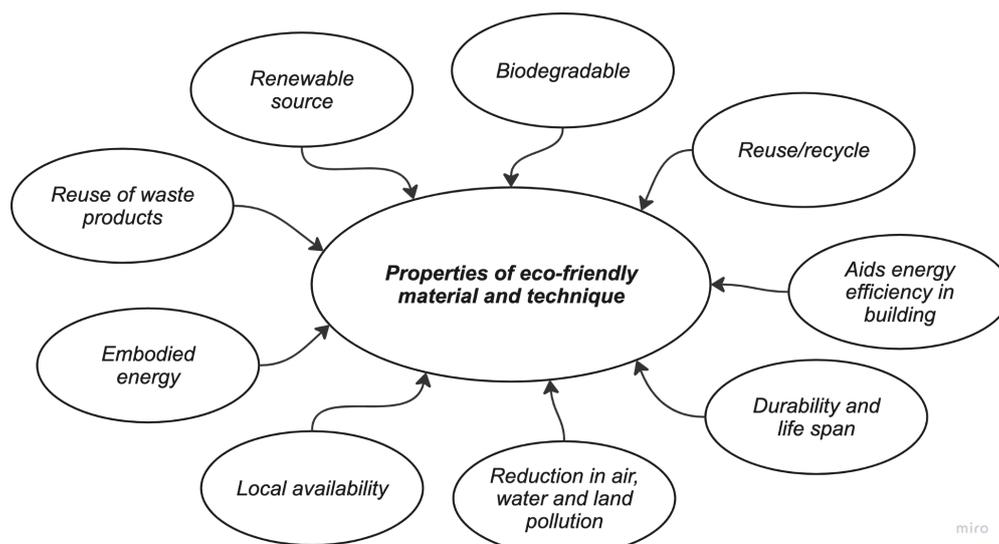
The concept of appropriate material use in sustainable architecture refers to the selection, utilization, and management of building materials that consider functionality, efficiency, affordability, and ecological impact. According to Salama (2019), material selection is not merely a technical decision but also reflects social, cultural, and sustainability values, thereby carrying multidimensional implications. This is particularly significant given that the construction sector contributes approximately 37% of global carbon emissions, with around 10% originating from the production of energy-intensive materials such as steel and cement (United Nations Environment Programme [UNEP], 2020). Therefore, the appropriate use of materials can serve as a significant strategy to reduce carbon footprints while promoting more sustainable development.

Within the framework of the Sustainable Development Goals (SDGs), particularly Goal 11 on Sustainable Cities and Communities, the concept of appropriate material use emphasizes the importance of creating inclusive, safe, resilient, and sustainable cities and settlements (United Nations, 2015). Its application is also aligned with national standards, such as SNI 03-6389-2011 on Sustainable Built Environment Planning and the Ministry of Public Works and Housing (PUPR) Regulation No. 21/PRT/M/2021 on Green Building Assessment, which highlight energy efficiency, water conservation, and the use of environmentally friendly materials. Kibert (2016) asserts that implementing the principles of reduce, reuse, and recycle (3R) in material use not only decreases environmental burdens but also reduces construction costs, making it an essential strategy for building resource management.

The Indonesian context reflects the same urgency. Data from the Ministry of Public Works and Housing (PUPR, 2020) records that the construction sector contributes around 30% of total national solid waste and 23% of energy-related carbon emissions. This highlights the need for sustainable material management, which has been formalized through national regulations such as SNI 03-6389-2011 on Energy Conservation in Building Systems and PUPR Regulation No. 21/PRT/M/2021 on Green Building Performance Assessment. On an international scale, ISO 21930:2017 – Sustainability in Building Construction establishes standards for Environmental Product Declarations (EPD) to ensure transparency in building material performance. Thus, the concept of appropriate material use is understood not only as a technical strategy for reducing carbon footprints but also as a policy instrument that balances technical efficiency, social equity, and ecological responsibility in sustainable development.

### *Design Concept*

The selection of building materials plays an essential role in realizing sustainable architecture. The characteristics of environmentally friendly building materials encompass various aspects, such as the use of renewable resources, utilization of waste as raw materials, low embodied energy content, local availability, the ability to reduce air, water, and soil pollution, durability and long lifespan, contributions to building energy efficiency, potential for reuse or recycling, and biodegradability (ENVIS Centre, 2007; Kibert, 2016). These principles serve as the foundation for material selection to ensure that buildings not only function optimally but also exert minimal impact on the environment.



**Figure 3.** Characteristics of Environmentally Friendly Building Materials  
 Source: ENVIS Centre, 2007

Based on this theory, this study selected several materials applied to the microlibrary building design, including steel as the main structure, scaffolding as spatial dividers and partition walls, glass blocks for the façade and building envelope, fabric as an interior element, and engineered wood for stair partitions, shelves, and other functional components. A further explanation of the relationship between environmentally friendly characteristics and the selected materials is presented in the following table.

**Table 2.** Implementation of Eco-Friendly Material Properties in Building Elements

Eco-Friendly Property	Selected Materials	Application Elements	Urgency / Explanation
Reuse / Recycle	Steel, Scaffolding, Fabric	Main structure, space partitions, interior elements	Steel and scaffolding can be recycled/reused, reducing the need for new materials; fabric can be repurposed into decorative elements.
Durability & Life Span	Steel, Glass Block	Structure, façade, building envelope	Steel and glass blocks have high durability, extending the building's lifespan and enhancing sustainability.
Local Availability	Scaffolding, Engineered Wood	Partitions, stairs, shelves, walls	Easily available in local markets, thus reducing transportation energy and supporting the local economy.
Aids Energy Efficiency	Glass Block	Façade / building envelope	Glass blocks allow natural lighting, reducing electricity consumption for illumination.
Renewable Source	Fabric (natural fiber), Engineered Wood	Interior, stairs, shelves, partitions	Fabric made from natural fibers and wood are sourced from renewable resources, supporting sustainability.
Biodegradable	Fabric, Engineered Wood	Interior elements, partitions, furniture	Naturally biodegradable without polluting the environment at the end of their life cycle.
Low Embodied Energy	Engineered Wood	Stairs, shelves, partitions	The production process of engineered wood is relatively more energy-efficient compared to steel or concrete.

Source: Author, 2025

### **Implementation of Material Strategies in Microlibrary Design**

The results of the design exploration and eco-friendly material selection strategy in the microlibrary design are based on a sustainability approach that considers energy efficiency, ease of construction, potential for reuse, and the social value of the materials used. The study was conducted through an analysis of form, spatial configuration, and material integration, which not only supports the building's technical performance but also strengthens the function of the microlibrary as an inclusive and adaptive public facility. The discussion focuses on how material characteristics such as glass blocks, steel, and scaffolding were selected and processed to create a bright, flexible learning environment aligned with circular economy principles and social sustainability. This design strategy is

presented through the analysis of several architectural elements, starting with the building layout, which explains the distribution of spatial functions and inclusive circulation flow, followed by the building façade that demonstrates the optimization of natural lighting through the use of glass blocks as both visual and functional elements. Furthermore, the façade details are analyzed to illustrate modularity and ease of construction, while interior elements such as furniture, stairs, bookshelves, and railings are reviewed in terms of material efficiency, ease of assembly, and recycling potential. Each component contributes to creating a public space that is not only efficient and environmentally friendly but also holds high social value and is capable of adapting to the needs of urban communities.

A summary of these findings is presented in the following table, showing the relationship between design elements, the sustainability concepts applied, the types of materials used, and descriptions of their functions and contributions to sustainability goals.

**Table 3.** Summary of Design Findings and Eco-Friendly Material Strategies in the Microlibrary

Design Element	Eco-Friendly Material Concept	Materials Used	Description
Floor Plan/Layout	Space efficiency and multifunctionality to maximize material use	-	Flexible and open spaces minimize the need for partitions and additional materials
Building Elevation	Reducing energy consumption by maximizing natural lighting	Glass Block	Transparent material allows light to enter without excessive heat
Building Façade	Use of modular systems that are easy to assemble/disassemble and reusable	Glass Block, Scaffolding, Light Steel	Façade can be reassembled, suitable for fast construction with minimal waste
Stair Detail	Utilization of durable recycled materials	Reused Plywood, Reused Steel	Stairs as permanent structures with an open and lightweight aesthetic
Bookshelf Detail	Functional optimization using processed and leftover materials (reduce)	MDF, Processed Wood, Reused Plywood	Shelves integrated with walls, reducing the need for additional support structures
Furniture Detail	Knock-down design for logistic efficiency and ease of recycling	Glass Block, Reused Plywood, MDF	Easy to disassemble and reassemble, suitable for long-term use
Railing Detail	Combination of safety function and aesthetics using recycled metal	Glass Block, Reused Hollow Steel	Minimal use of new materials, industrial look with an open and simple design

Source: Author, 2025

The representation of floor plans and building elevations is used as an analytical instrument to examine the relationship between material selection, spatial organization, and sustainability strategies applied in the microlibrary design. The floor plan below illustrates a two-story microlibrary designed with an open and inclusive spatial approach. On the first floor, spaces are programmed as public areas accessible to the wider community, including a public plaza, exhibition space, playground, green area, and reading space. The layout of the ground floor is flexible and multifunctional, serving not only literacy activities but also recreation, social interaction, and community events. The presence of a reading space on the ground floor, which also functions as a circulation path leading to the second floor, reinforces the role of the plan as a transitional space between public and semi-private areas. Meanwhile, the second floor functions as the main library space with a quieter atmosphere, equipped with a balcony as an open reading area and a void that enhances natural lighting and visual connections between floors. This floor plan concept supports the idea of appropriate material use, where space is not only efficient in terms of function but also maximizes the potential for interaction, natural lighting, and circulation.



**Figure 4.** Microlibrary Building – First and Second Floor Plans  
 Source: Author, 2025

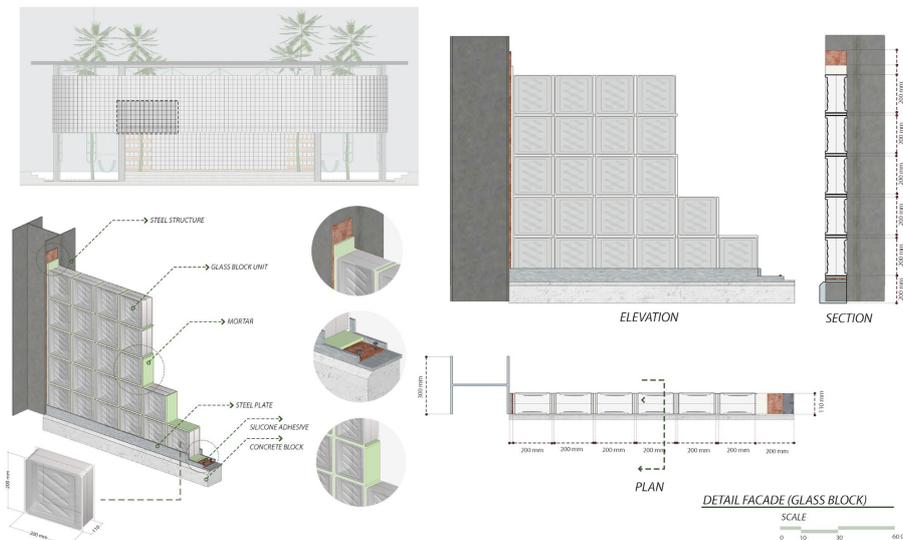
The design results show that the elevation of the microlibrary visually represents the application of environmentally friendly material principles as previously described. On the façade, the use of glass blocks functions not only as an aesthetic element that provides light texture but also allows natural daylight to enter the space, thereby reducing reliance on artificial lighting. Scaffolding elements are employed as secondary structures while forming flexible façade patterns, demonstrating the adaptability of simple construction materials for architectural purposes. In the interior, engineered wood is applied to stairs, shelves, and partitions, providing a warm and environmentally friendly impression, while the use of fabric adds visual softness and enhances the acoustic quality of the space. The overall building elevation composition reflects the integration of function, aesthetics, and sustainability, where material selection contributes to an architectural identity consistent with the microlibrary concept as an inclusive and environmentally conscious public space.



**Figure 5.** Microlibrary Building Elevation  
 Source: Author, 2025

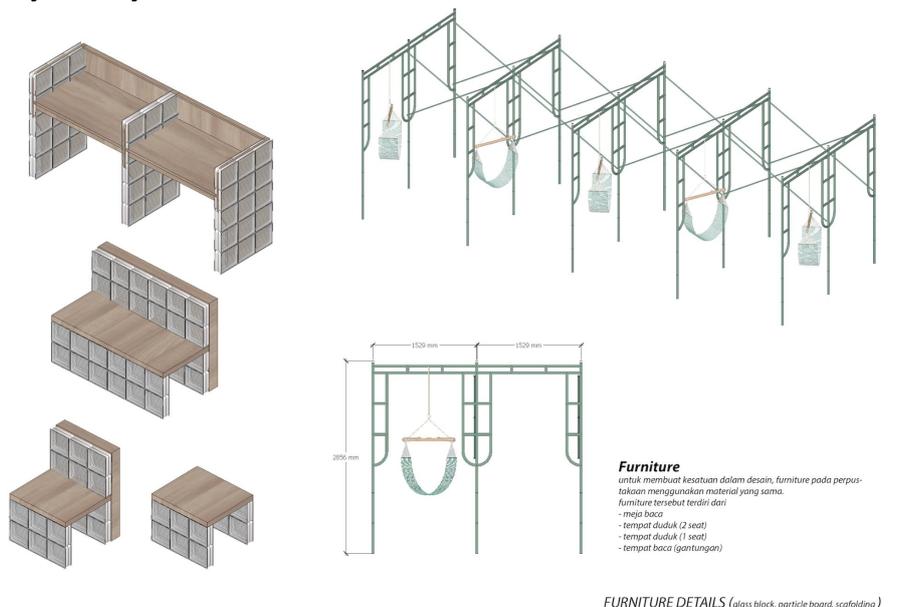
The use of glass blocks in the microlibrary building serves a dual role, functioning both as a wall element and as a façade that emphasizes functional and aesthetic values. This material allows natural light to penetrate the interior, thereby reducing the need for artificial lighting while creating a bright and comfortable atmosphere. From a construction perspective, the glass block wall system is supported by a steel frame as the primary structure, providing strength and stability. Each glass block unit is assembled with mortar as the bonding agent between blocks, reinforced with steel plates at the joints to enhance structural rigidity. Silicone adhesive is applied to ensure airtightness and watertightness while maintaining flexibility at element junctions. Meanwhile, the bottom part of the wall is reinforced with concrete blocks as a foundation base. The technical details of these assembled

elements are illustrated in the construction detail drawing, which demonstrates the integration of structural function and visual performance in the glass block façade system.



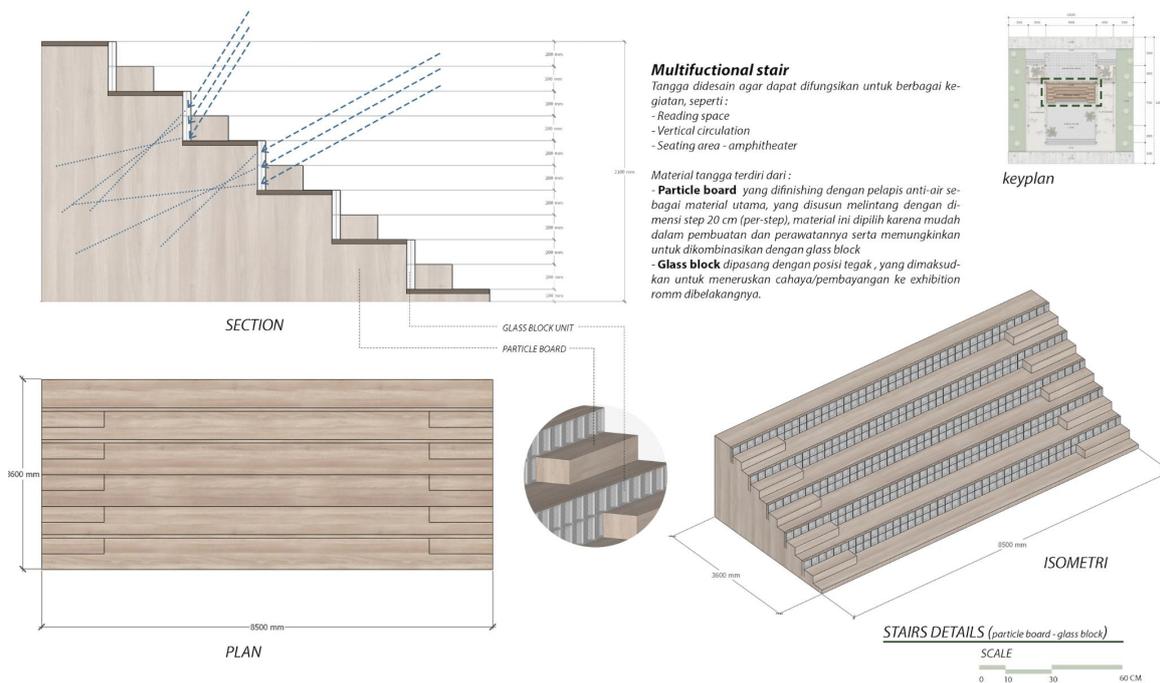
**Figure 6.** Microlibrary Building Façade Detail  
 Source: Author, 2025

In the interior design of the microlibrary, furniture is not only understood as a functional element but also as an integral part of the sustainability strategy. Seating and tables are designed from modular arrangements of glass blocks, which not only provide structural strength but also introduce qualities of light transparency, aligning with the principle of energy efficiency in buildings by maximizing natural lighting. Meanwhile, scaffolding is utilized as a spatial partition element as well as a multifunctional attribute, such as book racks and reading areas, reflecting the concepts of reuse/recycle and local availability by employing construction materials that are readily accessible and reusable. All furniture in the library incorporates the same materials as the building’s primary architectural elements—glass blocks, scaffolding, steel, and engineered wood—thereby supporting design consistency while reducing the need for new materials. Thus, the microlibrary furniture not only functions ergonomically and aesthetically but also reinforces the implementation of environmentally friendly material characteristics at the interior scale.



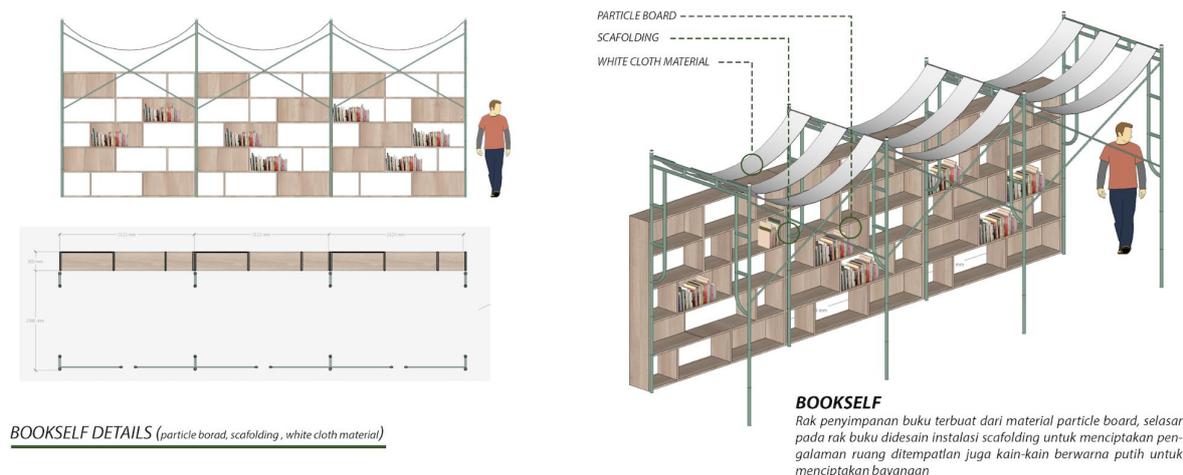
**Figure 7.** Furniture Detail  
 Source: Author, 2025

In the microlibrary design, the staircase is not only intended as a vertical circulation element but also designed to be multifunctional as a reading space, seating area, and amphitheater for communal activities. The primary material used is particle board arranged transversely, with each tread dimensioned at approximately 20 cm, then finished with a waterproof coating to enhance resistance to moisture and extend the material's lifespan. This aligns with the characteristics of environmentally friendly materials that emphasize durability and life span as well as local availability, since particle board is an engineered wood product widely available locally and produced from wood waste. In addition, the application of vertically oriented glass blocks along the side of the staircase serves to transmit natural light and shadows into the exhibition room behind it. This strategy supports energy efficiency in buildings by reducing reliance on artificial lighting during the daytime. The integration of structural function, user comfort, and the application of eco-friendly material principles makes the staircase an important element that reinforces the sustainability concept in the microlibrary design.



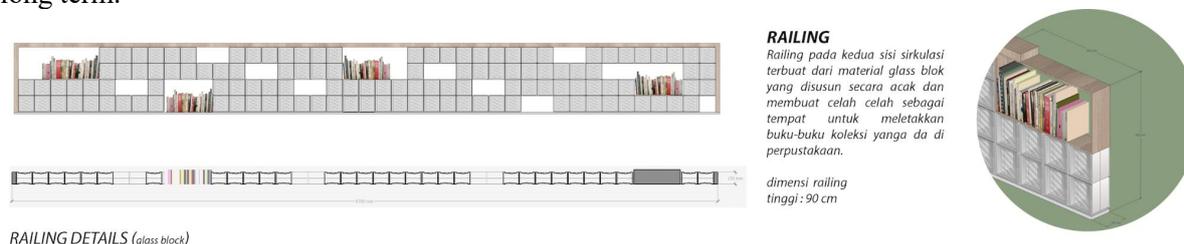
**Figure 8.** Staircase Detail  
 Source: Author, 2025

In the microlibrary, the storage racks are designed not merely as functional elements for organizing book collections but also as mediums that enrich the spatial experience. The main structure of the racks is made of particle board, an engineered wood material that utilizes wood residues or waste, thereby aligning with the principles of reuse of waste products and local availability. To strengthen the spatial identity, scaffolding installations are integrated along the rack corridor, serving as structural elements while also evoking an adaptive industrial aesthetic consistent with reuse/recycle characteristics. In addition, white fabric suspended around the racks creates dynamic shadows within the interior, offering a more poetic atmosphere while supporting energy efficiency in buildings, as the shadows help regulate the intensity of natural light indoors. This material combination not only reinforces sustainability through the use of eco-friendly resources but also demonstrates how interior design can simultaneously embody functional, aesthetic, and ecological values.



**Figure 9.** Bookshelf Detail  
 Source: Author, 2025

The railing along the circulation path of the microlibrary is designed not only as a safety element but also as part of a multifunctional furniture system. Both sides of the circulation employ glass blocks arranged in a staggered pattern, creating gaps that can be utilized as storage niches or book placement areas. With a height of approximately 90 cm, the railing complies with ergonomic standards while offering additional functional value. The use of glass blocks as the primary material reflects the characteristics of durability and long life span as well as aids energy efficiency in buildings, since their properties allow natural light to penetrate into the surrounding areas. This design strategy not only provides a unique visual expression but also reinforces sustainability principles through the application of eco-friendly materials that are efficient, multifunctional, and durable in the long term.



**Figure 10.** Railing Detail  
 Source: Author, 2025

### 3D Visualization of the design concept

The 3D visualization of the micro-library design illustrates a bright, open, and welcoming spatial atmosphere, resulting from the contextual and functional application of environmentally responsible material strategies. Natural lighting is maximized through the use of glass blocks on the building façade, creating a warm translucent effect during the daytime while minimizing excessive heat gain. The building structure, predominantly composed of lightweight steel and reused scaffolding components, conveys a sense of lightness and modularity. This approach not only accelerates the construction process but also reduces material waste. Within the interior, elements such as bookshelves and furniture are constructed from recycled particle boards and finished with fabric upholstery, enhancing visual comfort while fostering a child-friendly and community-oriented environment. Details including the open staircase and railings fabricated from reclaimed metal further reinforce the industrial character of the space, while emphasizing the principles of circular economy embedded in the design strategy. Overall, the atmosphere presented in the 3D visualization reflects not only a contemporary architectural aesthetic but also demonstrates how environmentally conscious material strategies can generate an inspiring, adaptive, and sustainable small-scale public space.



**Figure 11.** Visualization of the design concept  
Source: Author, 2025

This study found that the implementation of eco-friendly material selection strategies significantly contributes to the creation of microlibrary designs that are not only energy-efficient but also adaptive, easily replicable, and well-suited for small-scale public space needs. The key findings include:

- Energy Efficiency through Natural Lighting  
The use of glass blocks on the façade proved effective in optimizing natural daylight within the reading space without causing excessive heat. This finding suggests that transparent materials can reduce reliance on artificial lighting, contributing to overall energy savings.
- Modularity and Ease of Construction  
Materials such as scaffolding and lightweight steel offer modular construction solutions that are fast, efficient, and low-waste. This knock-down system allows the structure to be disassembled and reassembled in other locations, enhancing the long-term usability of materials.
- Recycling and Reuse of Materials  
The use of reused materials such as particle board, MDF, and hollow steel for interior details (bookshelves, railings, furniture) demonstrates that production waste can be repurposed into functional and aesthetically pleasing design elements. This supports the principles of a circular economy.
- Visual Comfort and Spatial Functionality  
The selection of fabric-based materials for furniture and interior elements creates a warm and inviting atmosphere, particularly for children and community users. This finding emphasizes that sustainability can also be applied at a micro scale to enhance comfort and inclusivity in public spaces.
- Design Replication for Small-Scale Public Facilities  
The microlibrary design developed through this material strategy is conceptual and prototypical, making it applicable in various locations with limited space and resources. This opens opportunities for similar design implementations as sustainable architectural solutions in both urban and rural contexts.

## CONCLUSION

This study emphasizes that the construction sector significantly contributes to global carbon emissions, making the sustainable management of building material selection crucial. Theoretically, this research strengthens the concept of sustainable architecture by highlighting the importance of selecting eco-friendly materials and their appropriate use as key strategies to reduce carbon footprints, enhance energy efficiency, and support sustainable material life cycles. These findings align with various international and national regulations, such as ISO 21930:2017, the Sustainable Development Goals (SDGs), the Ministry of Public Works and Housing Regulation No. 21/PRT/M/2021, and the Indonesian National Standard (SNI) for green buildings, providing a strong scientific basis for implementing sustainable materials in architectural practice.

Empirically, this study demonstrates how materials such as glass blocks, lightweight steel, and scaffolding can be effectively applied in microlibrary designs to create inclusive, adaptive, and environmentally friendly public spaces. The results show that the use of transparent elements like glass blocks is an effective eco-friendly alternative in terms of natural lighting and technical performance, while modular and recycled materials have significant potential to reduce construction waste. This contributes tangibly to minimizing the environmental impact of the construction sector while improving the quality of public spaces.

Furthermore, this research addresses a gap concerning the implementation of eco-friendly material selection strategies in small-scale public facilities, which has received limited attention, especially in the context of microlibraries as community learning spaces. The novelty of the study lies in its experimental approach that integrates both technical and social aspects in material selection and applies circular economy principles to an adaptive and easily replicable public architectural design. Therefore, this research not only contributes theoretically to the advancement of sustainable architecture but also offers a practical model that can serve as a reference for designers and policymakers in supporting sustainable development agendas.

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