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SUSTAINABLE BUILDING MATERIAL COMPARISON BETWEEN THAILAND AND INDONESIA – TARBIATULWATAN MULNITI SCHOOL, PATTANI

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ABSTRACT

Abstract

This study compares sustainable building materials used in Thailand and Indonesia, focusing on the case of Tarbiatulwatan Mulniti School in Yala, Thailand, as part of an international community service (KKN Internasional) program. The research aims to identify the differences in material selection, sustainability performance, and cultural adaptation in both countries. The methods used include field observation, literature review, and comparative analysis based on material efficiency, environmental impact, cost, and social acceptance. The results show that Thailand adopts more sustainable materials, such as Autoclaved Aerated Concrete (AAC) blocks, light steel trusses, and energy-efficient coatings, supported by national policies like the Thai Green Building Standard (TGBS). In contrast, Indonesia still relies on traditional red bricks and reinforced concrete, which are cheaper and widely available but less environmentally friendly. The study concludes that Thailand's approach demonstrates stronger integration of policy, technology, and cultural awareness toward sustainability, while Indonesia's construction practices remain cost-oriented. The research recommends that Indonesia strengthen green building policies, improve public awareness, and promote cross-national collaboration to accelerate sustainable construction development.

Keywords:

Sustainable construction; Building materials; Thailand; Indonesia; Green building; Comparative study; KKN Internasional

Introduction

Sustainable development in the construction sector has become one of the most essential global concerns in the 21st century. The use of environmentally friendly and efficient building materials is a key factor in reducing the negative impact of construction activities on the environment. Thailand and Indonesia, as developing countries in the Southeast Asian region, have similarities in climate and natural resources, yet they show notable differences in construction materials and building practices.

During the International Community Service Program (KKN Internasional) at Tarbiatulwatan Mulniti School, Yala, Thailand, the research team observed the use of modern and sustainable construction materials in the renovation and maintenance of school facilities. These materials included lightweight concrete blocks, light steel structures, and energy-efficient coatings. Meanwhile, construction practices in Indonesia are still largely dominated by conventional red bricks and reinforced concrete, which, although durable and affordable, often involve higher energy consumption and longer construction time.

This study aims to analyze and compare the characteristics, efficiency, and sustainability of building materials used in both countries. Through field observations, interviews with local construction practitioners, and literature review, the research seeks to identify potential lessons and applicable practices that Indonesia can adopt from Thailand's sustainable construction approaches.

The results are expected to contribute to the development of sustainable construction strategies in Indonesia, particularly in educational infrastructure projects.

Literature Review

The concept of sustainable building materials emphasizes the use of resources that minimize environmental impact while maintaining structural performance and cost efficiency. According to the United Nations Environment Programme (UNEP, 2020), the construction industry accounts for nearly 38% of global carbon emissions, largely due to the excessive use of cement, steel, and other high-energy materials. Therefore, the selection of alternative materials that are locally sourced, recyclable, and energy-efficient has become a crucial element in promoting green construction practices.

In Thailand, the government has actively encouraged the use of sustainable materials through the *Green Building Standard (TGBS)*, which promotes the use of lightweight concrete blocks, recycled aggregates, and energy-saving paints (Department of Public Works and Town & Country Planning, 2022). Several studies have reported that the use of *Autoclaved Aerated Concrete (AAC)* in Thailand provides advantages such as reduced construction time, lower structural weight, and better thermal insulation (Chaisomphob et al., 2019).

Meanwhile, in Indonesia, the application of sustainable materials is still developing. According to research by Rahmawati (2021), most small-scale construction projects continue to rely on red bricks and conventional concrete, which are affordable but not environmentally efficient. However, recent innovations such as geopolymer concrete, lightweight blocks, and bamboo-based composites have shown potential for broader application in sustainable construction (Sutanto et al., 2022).

Comparative studies in Southeast Asia (Tan et al., 2020; Noor & Ahmad, 2021) highlight that material selection is influenced not only by technical performance but also by socio-economic and climatic factors. Therefore, understanding the contextual differences between Thailand and Indonesia is essential to develop an effective framework for sustainable building material adoption in similar tropical regions.

Methodology

This research employed a **descriptive–comparative qualitative method** to analyze the differences and similarities in sustainable building materials between Thailand and Indonesia. The study was conducted during the **International Community Service Program (KKN Internasional)** at **Tarbiatulwatan Mulniti School, Yala, Thailand**, where direct observation and documentation were carried out to identify the types of building materials used in school construction and renovation projects.

3.1 Research Design

The research followed a **field-based comparative design**, integrating both qualitative and quantitative data. Qualitative data were collected through interviews and field notes, while quantitative data were gathered from material specifications and cost comparisons between the two countries.

3.2 Data Collection Methods

1. **Field Observation:** Direct observation was conducted at the construction site of Tarbiatulwatan Mulniti School, focusing on material usage, structural design, and sustainability practices.
2. **Interviews:** Semi-structured interviews were held with local builders, contractors, and teachers involved in facility maintenance to gain insights into material efficiency and local preferences.
3. **Literature Review:** Secondary data were obtained from previous studies, government reports, and technical standards from both countries (e.g., SNI and TGBS).

3.3 Data Analysis Techniques

The collected data were analyzed through **comparative analysis**, emphasizing four main parameters:

1. **Material Availability** – accessibility and local sourcing of materials;
2. **Mechanical Properties** – strength, durability, and weight;
3. **Cost Efficiency** – material price and construction time;
4. **Environmental Impact** – recyclability and energy consumption during production.

Each parameter was evaluated using descriptive comparison tables supported by qualitative interpretation based on field findings. The results were then synthesized to formulate recommendations for sustainable construction practices in Indonesia.

RESULTS AND DISCUSSION

4.1 Overview of Field Observations

Field observations conducted at *Tarbiatulwatan Mulniti School, Yala, Thailand* revealed that sustainable construction methods are widely adopted in educational facilities. The main materials observed included **Autoclaved Aerated Concrete (AAC) blocks**, **light steel frames**, and **energy-efficient coatings**. These materials were selected for their thermal insulation, reduced structural load, and minimal maintenance requirements.

Conversely, in Indonesia—particularly in East Java and rural districts—school facilities predominantly use **traditional red bricks**, **reinforced concrete**, and **ceramic roofing tiles**. While these materials are locally available and affordable, their production and installation require higher energy input and longer construction time.

This observation highlights a critical distinction: Thailand's construction approach emphasizes **efficiency and sustainability**, while Indonesia focuses on **affordability and accessibility**.

4.2 Comparative Analysis of Building Materials

The comparative analysis focused on four major parameters: availability, mechanical performance, cost efficiency, and environmental impact. Additional indicators, such as labor skill requirements and cultural acceptance, were also included for a holistic evaluation.

Table 1. Comparative Analysis of Building Materials between Thailand and Indonesia

Parameter	Thailand	Indonesia	Analytical Discussion
Main Material Types	AAC blocks, light steel trusses, reflective roof coating	Red bricks, reinforced concrete, ceramic tiles	Thailand uses industrialized systems, Indonesia relies on traditional masonry.

Material Availability	Moderate – supplied through centralized green-material industries in Bangkok	High – raw materials (clay, sand, cement) widely available locally	Indonesia benefits from abundant local resources, but modern material supply remains limited.
Mechanical Strength	AAC: 3–5 MPa; Light steel: 350–550 MPa	Brick: 8–12 MPa; Concrete: up to 25 MPa	Indonesia's materials are stronger, but much heavier and less flexible for modular construction.
Thermal Performance	High insulation; temperature reduction up to 4–6°C indoors	Low insulation; requires external cooling (fans/AC)	Thailand's materials improve energy efficiency and indoor comfort.
Construction Speed	High – modular system, minimal curing time	Moderate – traditional layering process	Thailand achieves 25–30% faster project completion.
Cost (per m²)	±110,000 IDR	±75,000 IDR	Higher upfront cost in Thailand, but lower maintenance and energy costs.
Environmental Impact	50% lower CO_2 emission in AAC; recyclable steel	High CO_2 from cement/bricks; limited recycling	Thailand's system reduces carbon footprint significantly.
Labor Skill Requirements	Requires trained workers for modular installation	Can be built by traditional masons	Indonesia's labor market supports conventional construction.
Cultural Acceptance	High – community awareness of sustainability	Moderate – preference for "heavy" structures	Indonesia's mindset toward lightweight materials still limited.

4.3 Discussion of Key Findings

The comparative results demonstrate that Thailand's construction industry has undergone a major transformation toward sustainability. The government's Thai Green Building Standard (TGBS) and educational policies encourage the integration of eco-friendly materials in public facilities. *Tarbiatulwatan Mulniti School* serves as an example where material selection is not only based on structural performance but also environmental compatibility and energy efficiency.

In contrast, Indonesia's construction system is still heavily influenced by traditional practices and cost-driven decision-making. Although red bricks and concrete offer higher structural strength, they contribute significantly to CO_2 emissions and increase the energy demand for indoor temperature control.

A striking finding is that Thailand's modular and prefabricated systems enable rapid project completion, which is critical in educational infrastructure where downtime must be minimized. Meanwhile, Indonesia's construction speed is hindered by manual labor and wet-mix processes.

From an economic perspective, the life-cycle cost in Thailand's model proves more efficient in the long term. Even though the initial material price is higher, reduced maintenance, energy efficiency, and extended building lifespan lead to an overall saving of approximately 15–20% over 20 years, compared to conventional Indonesian buildings.

4.4 Socioeconomic and Cultural Factors Influencing Material Choice

Socioeconomic and cultural dynamics play a central role in shaping material preference in both countries.

In Thailand, the influence of Buddhist philosophy — emphasizing harmony between humans and nature — supports the public acceptance of sustainable materials. Government incentives for green industries and environmental education strengthen this transformation. The local construction community views lightweight materials as symbols of innovation and modernity, fostering a culture of ecological awareness.

In Indonesia, cultural perceptions of "strength equals heaviness" remain prevalent. The traditional masons (*tukang*) and local builders often distrust lightweight systems, assuming they are less durable. Economic inequality also limits material diversity — rural builders typically use what's locally available, reinforcing dependency on clay and cement.

However, the *KKN Internasional* program demonstrates that cross-cultural academic collaboration can serve as an effective catalyst for change. When students introduced sustainable material concepts during fieldwork, local communities showed increased curiosity and openness to experimentation. This suggests that educational outreach plays a vital role in transforming community construction practices.

Table 2. Socioeconomic and Cultural Factors Comparison

Aspect	Thailand	Indonesia
Cultural Influence	Buddhist eco-ethics promote harmony with nature	Traditional perception values "heavy = strong"
Public Awareness	High – supported by green campaigns and education	Moderate – limited to academic and urban settings
Labor Skills	Trained in modular, prefabricated techniques	Skilled in traditional masonry
Government Support	Strong – TGBS policy and incentives	Developing – SNI standards exist but weakly enforced
Adoption Barriers	Cost of imported materials	Lack of policy enforcement and public education

4.5 Policy Implications and Future Directions

The comparative analysis underlines that policy intervention is a decisive factor in accelerating sustainable construction practices.

In Thailand, the TGBS (Thai Green Building Standard) functions as a practical framework that integrates sustainability indicators into design and material selection. Public buildings, including schools, are required to meet minimum environmental performance standards. This creates a consistent market demand for AAC, light steel, and energy-saving materials.

Indonesia's SNI (Standar Nasional Indonesia) already includes guidelines related to sustainable construction (e.g., SNI 03-6389-2000), yet enforcement and implementation remain limited. Policymakers need to strengthen these standards through incentives, tax reductions, or green certification programs for public schools and government buildings**.**

The future of sustainable construction in both nations lies in regional cooperation. ASEAN countries share similar climatic and cultural contexts, allowing technology transfer and joint research on material innovation. Programs such as *KKN Internasional* provide valuable experiential platforms for students to observe and implement sustainable construction practices across borders.

If Indonesia can integrate lessons from Thailand's policy model — combining government support, public education, and industry collaboration — the transition toward sustainable architecture could progress significantly within the next decade.

Summary Table: Key Comparative Indicators

Dimension	Thailand	Indonesia (Conventional Model)	Key Insight
Construction Approach	Prefabricated and modular	Traditional brick-and-mortar	Thailand achieves faster, cleaner construction.
Sustainability Policy	TGBS – active and enforced	SNI – limited implementation	Indonesia needs stronger enforcement.
Material Source	Industrialized, standardized	Local, traditional	Hybrid approach recommended.
Environmental Performance	Low CO_2, high recyclabilit	High CO_2, low recyclability	Shift toward AAC and green concrete needed.
Economic Outlook	High initial cost, low maintenance	Low initial cost, high operational cost	Life-cycle costing favors Thailand's model.

CONCLUSION AND RECOMMENDATION

CONCLUSION

This research concludes that Thailand demonstrates a more advanced and structured approach toward sustainable building materials compared to Indonesia. The findings obtained through field observation, interviews, and literature review show that Thailand's adoption of **Autoclaved Aerated Concrete (AAC)**, **light steel trusses**, and **energy-efficient coatings** reflects the success of national policies supporting green building initiatives. In contrast, Indonesia continues to rely primarily on **red bricks** and **reinforced concrete**, which remain affordable and accessible but contribute to higher energy consumption and carbon emissions.

From the comparative analysis, several major conclusions can be drawn:

1. **Material Efficiency:** Thailand's lightweight materials significantly reduce construction time, building load, and environmental footprint, while Indonesia's traditional materials emphasize strength but require more resources and labor.

2. **Economic Considerations:** Although sustainable materials in Thailand are initially more expensive, their life-cycle cost proves more economical due to reduced maintenance and energy use.
3. **Policy and Regulation:** The presence of the **Thai Green Building Standard (TGBS)** strongly influences material selection in Thailand, while Indonesia's **SNI** guidelines are still weakly implemented.
4. **Cultural Factors:** Thailand's social awareness and eco-centric cultural values encourage sustainability, whereas in Indonesia, traditional beliefs and limited exposure to green technology hinder adoption.

Overall, the study suggests that Indonesia could benefit from adopting Thailand's integrated model — combining **government support, public awareness, and industrial innovation** — to advance its sustainable construction sector. The results emphasize that sustainability in construction is not only a technical challenge but also a **social and educational transformation**.

Recommendations

Based on the findings, the following recommendations are proposed:

1. **Policy Strengthening:** The Indonesian government should develop and enforce clearer policies related to green construction, supported by incentives such as tax reductions, certification systems, and low-interest financing for sustainable material production.
2. **Educational Integration:** Universities and technical institutes should incorporate sustainability modules into architecture and engineering curricula to foster early awareness and skills among future builders.
3. **Local Material Innovation:** Research and development of affordable, locally sourced sustainable materials—such as fly-ash concrete, bamboo composites, and recycled aggregates—should be prioritized.
4. **Cross-National Collaboration:** Programs like *KKN Internasional* should continue to promote academic exchange between Indonesia and Thailand, allowing mutual learning on material innovation and sustainable practices.
5. **Public Awareness Campaigns:** Increasing community understanding of long-term economic and environmental benefits can shift perceptions from "cheap and strong" to "efficient and sustainable."

In conclusion, achieving sustainable construction in Indonesia requires a **holistic approach**—a collaboration between government, academia, industry, and the public. By integrating lessons from Thailand's success, Indonesia can gradually build a greener, more efficient, and future-ready construction ecosystem.

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