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Identification of Influential Attributes for Prioritizing Wall Material Selection in Low-Cost Housing

Wahyu Ari Pramono[1]✉, Setya Winarno[2], Sri Kusumadewi[3], Fitri Nugraheni[4]

[1, 2, 4] Department of Civil Engineering, Universitas Islam Indonesia, Yogyakarta, Indonesia
[3] Department of Informatics, Universitas Islam Indonesia, Yogyakarta, Indonesia

✉ **Corresponding Author :** Wahyu Ari Pramono (e-mail: wahyu.pramono@students.uii.ac.id)

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ABSTRACT

Selecting appropriate wall materials for low-cost housing is a complex decision-making process involving multiple technical, economic, social, and environmental considerations. This study aims to identify and prioritize the most influential attributes affecting wall material selection for affordable housing. A total of twenty-two attributes were derived from a comprehensive literature review and evaluated through a structured questionnaire survey involving 30 respondents, consisting of academics, decision-makers, and technical practitioners. A consensus-based weighting approach was applied using the mean value (μ_i), normalized weight (w_i), and relative ratio (r) to establish the priority structure of attributes. The results indicate that all attributes are considered relevant ($r > 0.1$), with the highest priorities assigned to structural strength and stability (T1, w = 0.060), initial wall cost (E1, w = 0.058), life-cycle cost (E2, w = 0.057), durability and weather resistance (T3, w = 0.056), occupant safety and perceived security (S4, w = 0.056), and embodied carbon and energy (L1, w = 0.053). At the aspect level, technical factors contributed 34% of the total weight, followed by economic (26%), social (21%), and environmental aspects (19%). These findings provide a quantitative attribute-weighting framework that can support the development of Multi-Attribute Decision Making (MADM) models for context-sensitive wall material selection in low-cost housing.

INTRODUCTION

One of the greatest challenges in many developing countries is meeting demand for sustainable, affordable housing, especially among masses of low-cost houses. Many reports show good housing quality does not solely through architectural design but also form materials selected, including the wall material as one of the most essential components of a building envelope. Some of the major contemporary challenges for social and inexpensive housing include issues related to affordability, energy efficiency, thermal comfort and climate change vulnerability. These issues clearly demonstrate the necessity to have rigorous and systematic, quantifiable, and sustainable approach towards material assessment (Muhammed et al., 2025).

The relevance of the assessment of wall materials is substantiated by evidence on its impact on compressive strength, structural stability, seismic mass, thermal and acoustic performance power, resistance to humid tropical environment and behavior in fire. Choosing the best wall material for affordable housing is a complicated issue since it has to consider technical performance, cost, social acceptance, and environmental implications all at once. Some of the authors have pointed out that the choice of wall material is not based solely on initial price in all cases, since many studies indicate that the construction sector consumes a lot of energy and emits large amounts of carbon into the atmosphere. Therefore, this issue is becoming increasingly critical (Li et al., 2025; Zhao et al., 2025).

Recent studies have shown different wall systems and construction techniques under frameworks on sustainability. Vinolas et al. (2025) conducted a study on eight wall alternatives for self-built homes in Brazilian informal settlements, revealing a significant correlation among cost, thermal efficiency, and environmental impact. Research conducted by Dormohmadi et al. (2024) and Meireles et al. (2024) indicates that the Life Cycle Assessment (LCA) and Life Cycle Cost (LCC) assessments of wall systems demonstrate that earth-based materials generally possess a reduced environmental impact compared to traditional brick and concrete. But they continue to struggle with durability and in meeting technical standards. Other research on the topic suggests that types of prefabricated wall systems could make a difference for the environment. However, companies continue to have a tough time finding the right workers and convincing people to buy their stuff (Cruz et al., 2025a).

In Indonesia, where earthquakes are frequent, the kind of material that is used to build walls affect how unsafe and weak buildings can become. This is particularly relevant in houses that are not earthquake-resistant, such as most of those built all over the world (Cruz et al., 2025a). Lightweight bricks, hollow bricks, cement blocks and baked clay bricks are also popular substitutes. Each has its own advantages and disadvantages. Burnt clay bricks are strong and favorite but the walls become heavier. Concrete blocks tend to be less expensive and are more readily available; it's up to individual as to whether he considers quality processes behind the manufacturing. Lightweight bricks, in contrast, offer reduced weight and good thermal performance, needing however special adhesives and reasonable workmanship to reach a sufficient performance (Michelini et al., 2023). Each one affects the stability of the structures, comfort and life-cycle costs while creating carbon footprints. As a result, Multi-Attribute Decision Making (MADM) techniques are now increasingly being promoted in recent literature as a way to use convenience transparently and accountably for the context of sustainable affordable housing? (Bajwa et al., 2025; Silva et al., 2024).

As the complexity of attributes involved in material selection assessment increases, MADM methods have been increasingly adopted to support material selection for buildings in general and for building envelope system. Siksnelyte-Butkiene et al. (2021) through a systematic review, showed that combinations of technical, economic, and environmental attributes are most frequently employed in selecting thermal insulation materials, with AHP, TOPSIS, and VIKOR identified as the most dominant methods. Although its applications are dispersed and heavily influenced by context, recent research by Bajwa et al. (2025) confirms that MADM has become a primary methodology in the selection of sustainable construction materials. Other case studies demonstrate the use of AHP/TOPSIS and fuzzy AHP-TOPSIS to select more environmentally and cost-effective materials. However, most of these studies are still limited to specific building types or elements, such as office building facades or thermal insulation material, and have not explicitly addressed the context of low-cost housing (Alfalah et al., 2024; Park et al., 2025; Reddy et al., 2024).

Several studies closely related to wall system evaluation reveal both development opportunities and inherent limitations. Štilić & Štilić (2022) applied MADM methods to rank eight external wall systems for multi-family buildings in Europe by considering cost, thermal performance, and other technical parameters. The results are less applicable to affordable housing in humid tropical regions because the setting under analysis was mid-rise buildings in temperate climates. Research on earth-based wall techniques for social housing emphasizes the importance of community skill levels, accessibility to local materials, and sustainability features. Nevertheless, most of these studies remain limited to specific countries or communities and have not yet produced an attributes framework applicable across regions (Kathambi et al., 2024; Vinolas et al., 2025). Meanwhile, MADM studies in social housing project are generally conducted at the project level, such as site selection or housing typology, rather than at the more specific stage of wall material selection (Castillo & Yepes, 2025; Nkurikiye & Ma, 2025).

Overall, previous studies reveal several critical challenges. First, many studies place greater emphasis on technical attributes, such us strength, durability, and thermal performance, as well as environmental aspects, including LCA and carbon footprints, while social dimensions such us cultural acceptance, perceived comfort, occupants' sense of safety, and local workforce readiness tend to be discussed only qualitatively or treated as secondary (López-Almansa et al., 2015; Roychowdhury et al., 2022). Second, more comprehensive economic considerations, such as material price stability, cost fluctuation risks, and long-term life-cycle costs, have not been systematically integrated into decision-making models, despite the high budget sensitivity of low-cost housing (Alfalah et al., 2024; Dormohamadi et al., 2024). Third, most studies have been conducted in Europe, the Middle East, or Latin America, making their finding difficult to generalized to the Indonesian context, which is characterized by a humid tropical climate, high seismic risk, wide diversity of local materials, and the dominance of non-engineered construction practices at the household level (Talaat et al., 2025).

In Indonesia, particularly for low-cost housing typically built through self-help processes or by local labour, wall material selection occurs under multiple constraints, including limited budgets, unequal material access across regions, variability in workspace quality, and the need for rapid and safe housing in earthquake and flood prone areas. Although discourse on green housing and the applications of sustainability principles in settlement development continues to grow, studies that specifically identify and assess the weighting of wall material selection attributes for low-cost housing across different regions remain limited. Currently, a systematic, well-defined, and reproducible attribute framework that can integrate technical, economic, and environmental factors, such as material availability, microclimatic conditions, and community socioeconomic profiles, while also being adapted to regional variations does not yet exist (Widyastomo et al., 2025).

With an emphasis on four main factors, technical, economic, social, and environmental, this study aims to identify and prioritize the most important factor influencing the choice of wall material for affordable housing. There are three primary objectives for this study. First, to formulate a clearly defined attribute framework grounded in the latest literature. Second, to analysed stakeholders' perceptions and preferences, including homeowners, small contractors, and/or experts, regarding the relative weight of each attribute. Third, to develop a systematic and objective guideline for wall material selection that can be integrated into a multi-attribute decision-making model to support the identification of the most optimal and context-appropriate wall materials for low-cost housing.

RESEARCH METHODS

The research methodology was designed as a quantitative study using a questionnaire-based survey to identify and assign weights to attributes influencing wall material selection for low-cost housing. This approach aligns with common practice in sustainable material selection research, where stakeholders' perceptions of the relative importance of each attribute are collected through structured questionnaires and subsequently transformed into numerical weights for Multi-Attribute Decision Making (MADM) analysis (Bui et al., 2025; Qian et al., 2024).

This study focuses on four main groups of attribute (Table 1), namely technical, (T1-T7), economic (E1-E5), social (S1-S5), and environmental (L1-L5), which were formulated based on a literature review in sustainable building material selection as well as relevant studies in the field of housing and construction materials (Bajwa et al., 2025). The research instrument was developed in a number of stages. We added a first point which refers to the formulation of features indicative on how to achieve sustainable construction (a task we performed by studying related work, and especially those providing guidelines or best practices for sustainable construction materials, and one that tells us how important are the technical, economic, social and environmental aspects in an evaluation material (Bui et al., 2025; Qian et al., 2024).

Table 1. Priority Attribute for Wall Material Selection

No.	Attributes	Aspect
1	T1: Structural Strength and Stability (Kristiawan et al., 2024)	Technical
2	T2: Density / Wall Self-Weight (Weber et al., 2024)	Technical
3	T3: Durability and Weather Resistance (Cruz et al., 2025b)	Technical
4	T4: Thermal Performance (Adeyemi et al., 2024; Alavez-Ramirez et al., 2024; Alfarawi et al., 2022; Jannat et al., 2020)	Technical
5	T5: Ease of Construction and Craftsmen Skill Requirements (Gurupatham et al., 2024)	Technical
6	T6: Acoustic Performance and Indoor Comfort (Neusser et al., 2023; Yin & Ai, 2024)	Technical
7	T7: Fire Safety Performance (Ghamari et al., 2024)	Technical
8	E1: Initial Cost_(Adeyemi et al., 2024; Dormohamadi et al., 2024)	Economic
9	E2: Life-Cycle Cost (Dormohamadi et al., 2024; Gurupatham et al., 2024)	Economic
10	E3: Availability of Local Material and Supply Distance (Vasic et al., 2023)	Economic
11	E4: Construction Time/Speed of Execution (Tanjung et al., 2025; Vinolas et al., 2025)	Economic
12	E5: Price Stability and Fluctuation Risk (Vasic et al., 2023)	Economic
13	S1: Social Acceptance and Cultural Preference (Khan & Niazi, 2025)	Social
14	S2: Available of Skill Local Labor (Bajwa et al., 2025)	Social
15	S3: Occupant Comfort (Subjective Perception) (Al-zuriqat & Obeidat, 2025)	Social
16	S4: Occupant Safety and Sense of Security (Cruz et al., 2025b)	Social
17	S5: Compliance with Regulations, Housing Programs, or Standards (Behr et al., 2021; Weber et al., 2024)	Social
18	L1: Carbon Footprint and Embodied Energy (Asdrubali et al., 2023)	Environmental
19	L2: Use of Local Material and/or Waste Materials (Ghamari et al., 2024; Sinha & Sudarsan, 2025)	Environmental
20	L3: Impact on Local Natural Resources (Dormohamadi et al., 2024)	Environmental
21	L4: Water Absorption and Moisture/Mold Potential (Cruz et al., 2025b)	Environmental
22	L5: Recyclability and Reuse Potential_(Gurupatham et al., 2024)	Environmental

We turned each of the following attributes into a single question that asked people to rank how important each one was when choosing wall materials for affordable housing: assigned from T1: Structural Strength and Stability to L5: Recyclability and Reuse Potential. The creation of the questionnaire items according to the recognized protocols for questionnaire development and validation delineated by Ranganathan et al. (2024), which prioritize language clarity, the elimination of ambiguous technical jargon, and the verification of logical consistency. The study employed a five-point Likert scale, which is frequently used in studies pertaining to material selection and sustainability evaluation (1 being extremely insignificant and 5 being very important).

Because Google Form makes it simple to distribute questionnaires, allows us to reach people in different locations, and facilitates us to quickly export data for additional analysis, we used it to collect data online. Similar approaches have been used in survey-based studies and research on sustainable material selection in the building and education industries (Manggaberani & Darlis, 2024). The survey involved 30 respondents, mainly 95%, came from Java Island, the most populous island in Indonesia. Ten decision-makers (homeowners, small-scale developers, or representatives of housing-related institutions), ten academics in the fields of civil engineering, architecture, or construction management, and ten technical practitioners (small contractors, site supervisors, seasoned craftsmen, or technical consultants) with knowledge of low-cost housing construction practices. This number of respondents is considered adequate for expert-based evaluation studies, particularly in MADM research, where panels typically range between 10 and 30 experts to capture diverse professional perspectives while maintaining analytical consistency (Pham et al., 2024). Following recommendations from multi-stakeholder studies in material selection and construction projects, this composition was written to ensure a balanced representation of policy, academic, and practical viewpoints.

A small group of people participated in a pilot test to determine how easy it was to read, how clear the terms were, and how long it would take to complete before it was distributed to a large number of people. Subsequently, according to standard survey data management procedures, data from valid questionnaires were transferred to data processing software such as Microsoft Excel for data cleaning. This involved checking that all answers were complete, searching for unusual answers (e.g., when all items have the same answer pattern), and handling missing data (Ranganathan & Caduff, 2024).

We also used a consensus approach to examine the data. This is a method of decision making that includes everyone and seeks to forge agreement through discussion and cooperation. That made both sides acceptable to all concerned as conclusions were reached. Consensus-gathering methods aim to introduce a diversity of points of view in order to produce more balanced outcomes reflecting diverse interests. In contrast to voting procedures, majority's preferences are not always the most important. Because it allows you to consider technical, economic, social, and environmental factors simultaneously, this method is particularly helpful when selecting wall materials. By fostering shared ownership and group commitment, it also makes decisions more sustainable. Additionally, it makes the process more inclusive and less prone to conflict. However, objective or semi-objective weighting methods based on data from the decision matrix may be considered as additional options when reaching exact agreement on attribute weighing proves difficult among decision-makers (Hatefi, 2019).

According to Eq. (1), the questionnaire data is arranged into an Evaluation Matrix (M) that is m x n. In the first step of aggregation, the mean (μ_j) was used as a measure of central tendency, as explained in Eq. (2), to obtain a number that is representative of each factor.

$$M = \begin{bmatrix} w_{11} & w_{12} & \cdots & w_{1n} \\ w_{21} & w_{22} & \cdots & w_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ w_{m1} & w_{m2} & \cdots & w_{mn} \end{bmatrix} \tag{1}$$

$$\mu_j = \frac{1}{m}\sum_{i=1}^{m} x_{ij}, \quad j = 1,2,\dots,n \tag{2}$$

Where:
m = number of respondents_(m=30)
n = number of attributes_(n=22)
x_{ij} = Likert score assigned by respondent i to attribute j, where x_{ij} {1, 2, 3, 4, 5}

To begin the analysis, descriptive statistics were calculated for each attribute, including the mean (μ_i), median, and standard deviation, based on each participant's five-point Likert scale (1–5) response. The expert panel's mean significance for each attribute was indicated by the μ_i. As recommended in multi-actor material selection studies, respondent groups (decision-makers, academics, and technical practitioners) conducted descriptive analyses to identify potential differences in preferences among stakeholder groups. The initial weights (w_i) were then obtained by dividing each μ_i by the sum of the mean values of all attributes, as provided in Eq. (3). Such a simple linear normalizing function is frequently applied in MADM for weight transformation process from the relevance score to attribute weight (Bajwa et al., 2025).

$$w_i = \mu_i \,/\, \Sigma\, \mu_i \tag{3}$$

so that $\Sigma\, w_i = 1$

The consensus-based approach and the attribute selection process are implemented by a ratio measure which is associated with maximum weight in this study. The initial w_{max} is the first attribute. Then, Eq. (4) is to determine the relative ratio (r) between any two properties for each property. This is an indication of how near an attribute's relevance level is to the maximum value that was ascribed by respondents (w_{max}). This indicates the proximity of an attribute's level of importance to the maximum value selected by respondents.

$$r = w_i / w_{max} \quad (4)$$

This ratio indicates the relative importance of each attribute compared to the most influential attribute identified by respondents. In this study, an attribute was considered significant when r > 0.1. This threshold was adopted following simplified consensus-based attribute screening approaches in MADM studies, where attributes with extremely small relative contributions are excluded to maintain model interpretability and avoid insignificant criteria influencing the final decision model (Hatefi, 2019; Saha et al., 2025). Therefore, attributes with r ≤ 0.1 would be considered negligible and removed from further analysis, whereas attributes with r > 0.1 are retained as relevant factors.

Based on the mentioned concept, an analytical approach can be defined through several subsequent steps. First, all Likert scale (1-5) assessment data for each attribute and respondent are collected into Evaluation Matrix shown in Eq. (1). Second, the mean value *(μ_i)* is calculated for each attribute, either for the full sample or separate each responder group for differentiation, as shown in Eq. (2). Third, these mean values are combined to indicate the consensus, either using a simple average or a weighted average if different responder's groups are assigned varying priority ratings. The aggregated μ_i values are normalized to get the attribute weights *(w_i)*, based on Eq. (3). Fourth, identify the maximum weight *(w_{max})* and compute the relative importance ratio *(r)* using Eq. (4). Attributes with r < 0.1 are eliminated to maintain only the most significant aspects. Using these practices, a refined collection of significant characteristics is generated, complemented by normalized weights that reflect the expert-panel consensus on the most influential factors related to low-cost housing wall material selection. In order for the next stage of the research to rank various wall materials, the generated weights are then entered into the selected MADM framework.

RESULTS AND DISCUSSION

Stakeholders' ranking of attributes when selecting wall material for affordable housing is demonstrated through the comprehensive presentation of research data and discussion. Thirty respondents evaluated twenty-two attributes using a five-point Likert scale (1–5). These attributes were classified into four main aspects: technical, economic, social, and environmental. Table 2 presents the ranking results obtained from the consensus-based analysis. The mean values *(μ_i)* range from 2.17 to 4.90, indicating that all attributes are perceived as relevant by respondents. None of the attributes were eliminated because all ratio values exceeded the threshold (r > 0.1). However, clear differences in priority levels were observed across attributes.

Table 2. Factor Ratio Test

Attributes	**Ranking**	**Mean *(μ)***	**Weight Normalization *(w)***	**Ratio Test *(r > 0,1)***	
				Ratio	**Test Results**
T1	1	4.90	0.060	1.000	Significant
E1	2	4.70	0.058	0.959	Significant
E2	3	4.63	0.057	0.946	Significant
T3	4	4.57	0.056	0.932	Significant
S4	5	4.53	0.056	0.925	Significant
L1	6	4.33	0.053	0.884	Significant
T4	7	4.30	0.053	0.878	Significant
E3	8	4.27	0.052	0.871	Significant
S1	9	4.17	0.051	0.850	Significant
T2	10	4.10	0.050	0.837	Significant
T5	11	3.80	0.047	0.776	Significant
T7	12	3.77	0.046	0.769	Significant
E4	13	3.70	0.045	0.755	Significant
L2	14	3.60	0.044	0.735	Significant
S2	15	3.57	0.044	0.728	Significant
E5	16	3.53	0.043	0.721	Significant

S5	17	2.83	0.035	0.578	Significant
L3	18	2.77	0.034	0.565	Significant
L4	19	2.63	0.032	0.537	Significant
T6	20	2.33	0.029	0.476	Significant
S3	21	2.23	0.027	0.456	Significant
L5	22	2.17	0.027	0.442	Significant

This pattern shows that those who are involved in affordable housing selections think that structural safety, durability, occupant safety, cost (both short- and long-term), and fundamental environmental impact are all especially important factors. These results align with other Multi-Criteria Decision Making (MCDM) studies that affirm safety, affordability, and long-term sustainability as the "Three Main Pillars" of material prioritization, especially in low-cost and social housing settings (Bajwa et al., 2025; Villalba et al., 2024). Furthermore, the importance of both initial and life-cycle costs is consistent with the research results of Dormohamadi et al. (2024) and Valencia-Barba et al. (2021), who observed that in low-income housing, the combined effect of construction costs and long-term operational expenses tends to dominate material preferences over additional features. Figure 1 shows a detailed priority ranking of all wall material selection attributes.

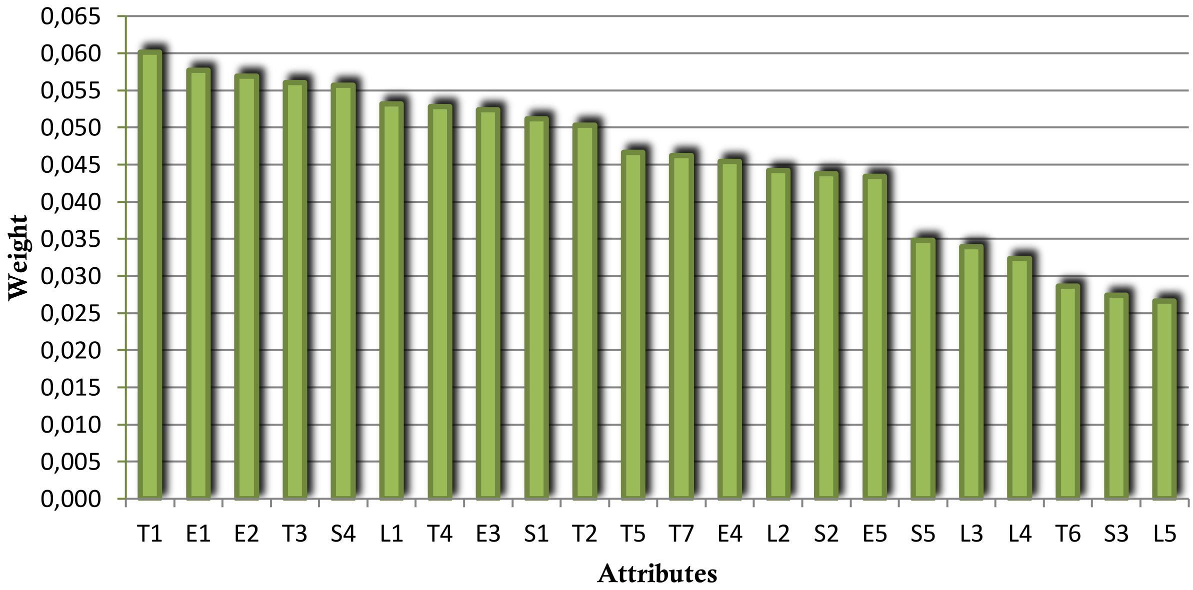

Figure 1. Overall Ranking of Wall Material Selection Attributes

The results reveal that T1: Structural Strength and Stability (w = 0.060) is the most influential attribute in wall material selection. This finding can be critically interpreted within the Indonesian housing context, where a large proportion of residential buildings are constructed using non-engineered construction practices. In many rural and peri-urban areas, houses are often built incrementally by homeowners or small contractors without strict structural design supervision. Consequently, respondents tend to prioritize structural strength to ensure the basic safety and stability of buildings. This concern is further reinforced by Indonesia's high seismic vulnerability, where past earthquakes such as the Yogyakarta (2006), Lombok (2018), and Cianjur (2022) events have demonstrated that inadequate wall materials and construction practices can significantly increase building damage and casualties. Therefore, the prominence of structural strength reflects a rational response to perceived structural risks in earthquake-prone environments.

Economic attributes also received very high priority, particularly E1: Initial Cost (w = 0.058) and E2: Life-Cycle Cost (w = 0.057). This result reflects the financial constraints typically faced in low-cost housing development. In Indonesia, affordable housing projects and self-built houses are often developed under strict budget limitations, where households prioritize materials that minimize both construction costs and long-term maintenance expenses. The high weighting of life-cycle cost indicates that respondents are not only concerned with the initial affordability of materials but also with their durability and maintenance requirements over time. In many cases, low-income households prefer materials that reduce repair costs and replacement frequency, which explains why life-cycle considerations become nearly as important as initial costs. Similar patterns have been reported in studies on affordable housing material selection, where cost efficiency and durability are consistently identified as dominant decision criteria (Dormohamadi et al., 2024; Valencia-Barba et al., 2021).

The relatively high ranking of T3: Durability and Weather Resistance (w = 0.056) further highlights the importance of long-term material performance in tropical environments. Indonesia's humid tropical climate exposes building envelopes to heavy rainfall, high humidity, and temperature fluctuations. Materials with low durability may experience rapid deterioration, moisture penetration, and mold growth, which can compromise indoor comfort and structural integrity. Therefore, respondents likely perceive durability as a critical factor to ensure that housing remains functional over extended periods despite environmental stresses.

Another highly ranked attribute is S4: Occupant Safety and Sense of Security (w = 0.056). In the context of low-cost housing, this attribute is closely related not only to structural safety but also to perceived security and protection. In many communities, wall materials are expected to provide a sense of physical safety against environmental hazards, intrusions, and external disturbances. The relatively high weight assigned to this attribute indicates that housing decisions in developing countries often integrate both technical safety and perceived psychological security, reflecting broader social considerations in housing design.

Environmental attributes also appear among the higher-ranking factors, particularly L1: Carbon Footprint and Embodied Energy (w = 0.053). Although environmental criteria are generally less dominant than technical and economic factors, the relatively strong weight assigned to embodied carbon suggests an increasing awareness of sustainability issues among stakeholders. This trend is consistent with recent global research emphasizing life-cycle assessment (LCA) in building material evaluation (Park et al., 2025; Vinolas et al., 2025). However, in the Indonesian affordable housing context, environmental considerations are often balanced with practical constraints such as cost, material availability, and construction feasibility.

Conversely, attributes such as L5: Recyclability and Reuse, S3: Comfort of the Occupant (Subjective Perception), T6: Indoor Comfort and Acoustic Performance as for attributes ranking, potential is the least important. They are still matter because their ratio remains above 0.442. This finding reflects the reality that households with limited financial resources often prioritize basic functional needs, such as safety, durability, and affordability, over advanced environmental or comfort features. This difference is big, in contrast with the literature on green building and circular economy that highlights better acoustic performance and easy recycling as a future design projects necessity (Castillo & Yepes, 2025). This gap between sustainability ideals and practical housing priorities highlights the need for policies and educational programs that gradually promote environmental awareness and improved indoor environmental quality in affordable housing.

When aggregating attribute weights at the aspect level, technical factors account for approximately 34% of the total weight (∑wi = 0,341), followed by economic aspects (26%), social aspects (21%), and environmental aspects (19%). This composition represents the common trade-offs involved in low-cost housing. Stakeholders tend to prioritize attributes that ensure structural safety and economic feasibility, while still considering social acceptance and environmental performance.

The dominance of T1, T3, and T4 indicates that respondents are well-aware of the impacts of seismic loads, humid tropical weather conditions, and thermal comfort on the long-term performance of wall envelopes, while the high weights assigned to E1 and E2 confirm that both initial and life cycle are important benchmarks for material feasibility. These finding are consistent with LCA-LCC research on various affordable housing wall systems, which reveal that homeowners and small developers prefer wall configurations that minimize the combined effects of construction costs and environmental impacts during the building's life period (Villalba et al., 2024; Vinolas et al., 2025).

In terms of social-economic perspective, the relatively high weights for S1: Social Acceptance and Cultural Preference, E3: Availability of Local Material and Supply Distance signify that to some extent perceptual safety are becoming an integral part in selection criteria of wall material while people are beginning to pay attention on the cultural preference as well as how easy it can be obtained locally. This result in social housing is consistent with MCDM studies, where it is highlighted the importance of including local context and social features that complement with large-scale technical-environmental variables (Bajwa et al., 2025; Rocha-Tamayo et al., 2025).

Significant agreement and minor differences in priority were found in the analysis by respondent group. T1 consistently ranked first among the three groups (decision-makers, academics, and technical practitioners). The top five attributes were consistently E1, E2, T3, and S4. This indicates that people from all socioeconomic backgrounds concur that when selecting wall materials, safety, cost, durability, and security for the occupants of the house are all crucial factors to consider. However, there are significant differences in secondary priorities. Decision-makers give E1 and E4 (construction speed) a little greater weight, which shows that the project needs to be done on schedule and within budget. Academic respondents, in line with their studies on decarbonization and the utilization of vernacular materials, prioritize L1 and L2 (carbon footprint and exploitation of local/waste resources). On the other hand, technical practitioners put more weight to T5 (easy of building and craftsman skill needs). This is because materials that work well in theory may be hard to use if the people and tools in the area are not up to par. This pattern involving multiple actors is comparable to what social housing evaluations and MCDM studies of construction have found. These studies show that while the major qualities usually stay the same, the importance of secondary characteristics changes depending on the roles and interests of the stakeholders (Aghazadeh et al., 2022).

Our results offer a unique framework for inexpensive housing in developing nations, contrasting with previous research on building envelopes and wall material choices. For example, the BIM-TOPSIS approach developed by Jangam et al. (2025) demonstrates that the most important factors in residential buildings in hot climates are energy consumption and operating expenses. However, neither the availability of local materials nor societal acceptance are considered. Although more comprehensive LCA-MADM frameworks for educational buildings consider a number of technical, financial, and environmental considerations, they frequently overlook the limitations of low-cost housing's limited technical and financial resources. By using affordable housing as the primary unit of analysis and adding behavioral attributes and craftsmanship skill requirements to the framework, this study overcomes these shortcomings and produces attribute weights that more closely reflect actual situations. Therefore, it is possible to see the weight frameworks for T1-T7, E1-E5, S1-S5, and L1-L5 as a link between the general MADM framework and the particular requirements for material selection in the context of low-cost building in Indonesia.

From a methodological point of view, using a five-point Likert scale, mean aggregation, weight normalization, and $r > 0.1$ strikes a good compromise between being easy to use and being helpful. This method creates a clear priority framework that can be used directly in later MADM models to rank different types of wall materials. Other researchers and practitioners can readily apply it again without requiring specialized software or high-caliber mathematical abilities. Two weaknesses of the approach are that it does not directly model uncertainty as fuzzy MADM approaches (Aghazadeh et al., 2022) and cannot perform inferential statistical testing to compare attribute weights across groups of respondents. These issues point to promising lines of future research, such as increasing sample sizes and exploring disparities in different spatial contexts.

Overall, the results and the discussion demonstrate that the selection of wall material for low-cost housing is no longer only a technical decision. Today, the choice is one of social acceptance, environmental impact, cost, and safety. This leaves us with the characteristic weights that we need to do decision support systems for local governments, small contractors, and homeowners. When these weights are combined with performance matrices of material alternatives (e.g., fired clay brick, concrete blocks, lightweight brick, GRC panels, engineered bamboo, and other wall materials), users can obtain more rational and transparent material ranking, rather than relying solely on tradition or subjective perceptions. In addition, the contribution of this study lies in providing an attribute framework and weight structure specifically design for to low-cost housing in Indonesia, which can used as a valuable reference for the development of technical guidelines, housing assistance programs, and further research on optimizing wall material selection across regions with diverse socio-economic and environmental characteristics.

CONCLUSION

This study successfully achieved the three primary objectives established for identifying and analyzing the most influential attributes in prioritizing wall material selection for low-cost housing. First, a wall material selection attribute framework comprising twenty-two attributes (T1-T7, E1-E5, S1-S5, L1-L5) was clearly formulated based on recent literature on sustainable construction material selection and the application of MADM in the building sector. Second, the study demonstrated that the most important considerations when selecting wall material for affordable housing are Structural Strength and Stability (T1), Initial Cost (E1), and Life-Cycle Cost (E2), based on the perception-based weighting of thirty respondents (decision-makers, academics, and technical practitioners). The focus on technical and financial details shows how important safety, long-term durability, and affordability are when resources are limited. Because of this, Recyclability and Reuse Potential (L5) and Subjective Comfort (S3) are not as important. But the emphasis on Embodied Energy and Carbon Footprint (L1), Local Material Availability and Supply Distance (E3), and Social Acceptance and Cultural Preference (S1) shows that local people are starting to think about sustainability in a more complete way. Third, in a practical manner, the attribute weights obtained provide contractors and local government with a quantitative means to develop transparent decision support tools that can be used for material selection. This research offered a complete and contextually specific attributes framework for affordable housing in developing countries, filling the important gap in existing literature, and thus could lay the groundwork of technical guidelines and housing policies more adapted to local socioeconomic situation.

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