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The Role of ISSBS (Interlocking Stabilized Soil Blocks) Towards Enhancing User Comfort of Selected Hospitality Buildings in Lagos, Nigeria

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ABSTRACT

This study evaluates the effectiveness of Interlocking Stabilized Soil Blocks (ISSBs) in enhancing indoor environmental comfort in selected hospitality buildings. The research examines thermal comfort, acoustic quality, and overall user satisfaction by comparing buildings constructed with ISSBs and those built with conventional walling materials. Data were collected through structured questionnaires, interviews with facility managers, and physical environmental observations, including indoor temperature and noise level measurements. Descriptive and inferential statistical analyses were used to assess differences in comfort levels, while thematic content analysis was applied to qualitative data. Findings indicate that ISSB buildings recorded higher comfort ratings, demonstrating improved thermal regulation and acoustic performance compared to conventional structures. Observational measurements aligned with users' perceptions, confirming that ISSBs contribute to more stable indoor temperatures and reduced noise transmission. The study concludes that walling material selection significantly influences indoor environmental quality and that ISSBs provide a viable and sustainable solution for enhancing comfort performance in hospitality buildings.

Keywords: Comfort, Thermal Performance, Acoustic Quality, Hospitality Buildings, Sustainable Construction, Walling Materials, User Satisfaction

INTRODUCTION

Background to the Study

The global construction industry is increasingly shifting toward sustainable building materials due to the environmental impact and high carbon emissions associated with conventional cement-based products (Raj et al., 2023). Compressed stabilized earth blocks and interlocking stabilized soil blocks have emerged as viable alternatives because they utilize locally available soil and require reduced cement content compared to traditional masonry units (Bredenoord & Kulshreshtha, 2023). The interlocking mechanism further enhances construction efficiency by minimizing mortar usage and improving alignment during assembly (Aswad et al., 2022). Structural modeling and experimental investigations confirm that properly stabilized interlocking soil blocks can achieve adequate compressive strength and durability for building applications (Zewudie, 2023). Beyond structural adequacy, recent studies emphasize the performance benefits of stabilized earth blocks in relation to thermal mass and acoustic insulation (Ahmed & Sugini, 2021). Material modifications using agricultural waste and recycled content have been shown to enhance the thermal and mechanical properties of these blocks, making them more responsive to environmental conditions (Sathiparan et al., 2023).

Research assessing sustainable construction materials highlights that stabilized soil blocks can contribute to improved indoor environmental quality while reducing embodied energy (Hershey et al., 2023). These characteristics position ISSBs as materials capable of influencing not only structural performance but also occupant comfort. In Sub-Saharan Africa, ISSBs have gained attention primarily for their affordability and suitability for low-cost housing (Bredenoord & Kulshreshtha, 2023). Comparative studies indicate that stabilized earth blocks can offer cost advantages over sandcrete blocks due to lower cement consumption and simplified construction processes (Ibitoye et al., 2022). In Southwestern Nigeria, investigations into housing estates developed with ISSB technology reveal growing adoption of the system

in residential construction (Ibitoye et al., 2023). Architects in the region have also acknowledged the potential of ISSBs as alternative building materials for housing projects (Olaleye & Ibitoye, 2023). However, most of these studies focus predominantly on cost efficiency, demographic distribution, and structural viability rather than building performance outcomes. User comfort has become a major concern in contemporary architecture, particularly in hospitality buildings where guest satisfaction is closely linked to indoor environmental conditions (Pedro et al., 2024). Lagos State experiences increasing urban heat effects due to rapid urbanization and land surface temperature changes, which directly influence thermal comfort within buildings (Obiefuna et al., 2021). Integrating passive design strategies has been identified as a critical approach for enhancing thermal comfort and reducing reliance on mechanical cooling systems in modern hotel architecture (M et al., 2025). Since building envelope materials significantly affect heat transfer and acoustic performance, the adoption of ISSBs may offer measurable benefits in hospitality environments where comfort expectations are high (Ahmed & Sugini, 2021).

Problem Statement

Hospitality buildings in Lagos operate under climatic conditions characterized by high temperatures, humidity, and increasing urban heat stress, which pose challenges to achieving optimal indoor thermal comfort (Obiefuna et al., 2021). To maintain acceptable comfort levels, many hotels rely heavily on mechanical air-conditioning systems, resulting in high operational energy costs (M et al., 2025). Although ISSBs have been recognized for their environmental sustainability and structural performance, their contribution to enhancing user comfort in commercial hospitality buildings remains insufficiently examined (Raj et al., 2023). Existing Nigerian studies primarily investigate ISSBs from the perspective of cost comparison and housing development rather than performance-based comfort assessment (Ibitoye et al., 2022). Case studies evaluating ISSBs in architectural practice focus largely on residential applications without extending analysis to hospitality settings (Oa, 2025). While research has demonstrated the thermal and acoustic advantages of stabilized earth blocks in experimental contexts, limited evidence exists regarding their direct impact on occupant comfort within operational buildings in Lagos (Ahmed & Sugini, 2021). This lack of context-specific evaluation creates uncertainty for designers and developers seeking sustainable materials that can simultaneously enhance comfort and reduce energy demand.

Research Gap

A review of literature shows that most research on ISSBs concentrates on mechanical properties, structural modeling, and cost effectiveness (Zewudie, 2023). Studies addressing sustainability often evaluate embodied energy reduction and material innovation rather than occupant-centered performance outcomes (Hershey et al., 2023). In Nigeria, ISSB research has largely been confined to residential housing estates and affordability assessments (Ibitoye et al., 2023). Furthermore, investigations into user satisfaction in Lagos hotels rarely examine the influence of walling materials on thermal and acoustic comfort (Pedro et al., 2024). Although passive design strategies are increasingly promoted in hospitality architecture, the specific role of ISSBs as part of the building envelope in enhancing user comfort has not been comprehensively studied within the Lagos context (M et al., 2025). Consequently, there is a clear gap at the intersection of sustainable material application and user comfort performance in hospitality buildings, necessitating empirical assessment of ISSBs in selected hotels in Lagos.

Aim

To evaluate the role of Interlocking Stabilized Soil Blocks (ISSBs) in enhancing user comfort in selected hospitality buildings in Lagos, Nigeria.

Objectives

i. To examine the physical and performance characteristics of ISSBs relevant to thermal and acoustic comfort in hospitality buildings.
ii. To assess the existing indoor thermal and acoustic comfort conditions of selected hospitality buildings constructed with ISSBs in Lagos.
iii. To compare user comfort levels between hospitality buildings constructed with ISSBs and those constructed with conventional walling materials.

iv. To determine the effectiveness of ISSBs as a sustainable building material for improving overall user comfort in hospitality architecture in Lagos.

LITERATURE REVIEW

Sustainable construction has become a major focus in contemporary building research due to the environmental and economic concerns associated with conventional cement-based materials (Raj et al., 2023). The high embodied energy and carbon emissions linked to traditional masonry units have encouraged the exploration of alternative materials such as compressed stabilized earth blocks and interlocking stabilized soil blocks (Bredenoord & Kulshreshtha, 2023). ISSBs are particularly attractive because they utilize locally available soil, require less cement, and reduce dependence on mortar through their interlocking mechanism (Aswad et al., 2022). This interlocking feature not only simplifies construction but also enhances wall stability and alignment, contributing to structural efficiency (Fundi et al., 2021). Experimental studies further confirm that properly stabilized interlocking soil blocks can achieve satisfactory compressive strength and durability suitable for low- and medium-rise buildings (Zewudie, 2023). In addition to structural performance, ISSBs have been examined for their physical and environmental properties. Research highlights that stabilized earth blocks possess significant thermal mass, enabling them to absorb heat during peak periods and release it gradually, thereby moderating indoor temperature fluctuations (Raj et al., 2023). Innovations incorporating recycled plastic waste and agricultural by-products into interlocking blocks have demonstrated improvements in both acoustic insulation and thermal resistance (Ahmed & Sugini, 2021; Sathiparan et al., 2023). Adjustments in soil grading and stabilization techniques have also been shown to enhance block density and overall performance (Malkanthi et al., 2021). These characteristics suggest that ISSBs can contribute meaningfully to indoor environmental quality, particularly in warm and humid climates.

Across Sub-Saharan Africa, ISSBs have been widely promoted as cost-effective alternatives for housing delivery (Bredenoord & Kulshreshtha, 2023). Comparative analyses reveal that stabilized earth blocks can provide economic advantages over conventional sandcrete blocks due to reduced material and labor requirements (Ibitoye et al., 2022). In Southwestern Nigeria, ISSB technology has been adopted in several residential estates, reflecting increasing acceptance of the system (Ibitoye et al., 2023). Architects in the region have acknowledged the potential of ISSBs as alternative building materials, although their use remains more common in residential projects than in commercial developments (Olaleye & Ibitoye, 2023). Case-based evaluations further demonstrate their architectural and functional viability in Nigerian residential buildings (Oa, 2025). However, while most studies emphasize cost efficiency, sustainability, and structural adequacy, limited attention has been given to the experiential performance of ISSBs in buildings where occupant comfort is a primary concern (Hershey et al., 2023). In hospitality architecture, user comfort plays a crucial role in determining guest satisfaction and overall building performance (Pedro et al., 2024). Lagos State faces increasing thermal stress due to rapid urbanization and changing land surface temperatures, which significantly affect indoor comfort conditions (Obiefuna et al., 2021). To address these challenges, modern hotel architecture increasingly incorporates passive design strategies aimed at enhancing thermal comfort and reducing reliance on mechanical cooling systems (M et al., 2025). Since walling materials influence heat transfer and sound insulation, ISSBs may offer practical benefits in hospitality settings; however, empirical studies examining their specific contribution to user comfort in Lagos hotels remain scarce. This gap highlights the need for research that connects material performance with occupant experience in real hospitality environments.

Case Study

Obayemi House, Redemption Camp, Ogun State and Comparative Building Projects In South-West Nigeria

The Obayemi House in Redemption Camp, Ogun State, demonstrates the practical application of Interlocking Stabilized Soil Blocks (ISSBs) in Nigeria, showing reduced mortar use and improved construction efficiency (Oa, 2025). Studies confirm that stabilized soil blocks provide adequate compressive strength and durability when properly produced (Zewudie, 2023). Research also highlights their good load-bearing performance and thermal mass properties, which help regulate indoor temperature and improve

comfort (Raj et al., 2023). Comparative studies in South-West Nigeria indicate that ISSBs can reduce construction costs while maintaining structural performance compared to conventional sandcrete blocks (Ibitoye et al., 2022). Additional research shows that material enhancements such as fibre reinforcement can further improve block strength and durability (Sujatha et al., 2023). These findings support ISSBs as a cost-effective and sustainable alternative for building construction. In tropical climates like Southwestern Nigeria, stabilized earth blocks contribute to improved indoor comfort due to their thermal properties (Obiefuna et al., 2021). Sustainable construction literature also emphasizes their lower embodied energy compared to cement-based materials (Bredenoord & Kulshreshtha, 2023). Overall, ISSBs present structural, economic, and environmental advantages suitable for enhancing user comfort in hospitality and residential buildings.

Study Area

The study is conducted in Lagos State, Nigeria, with a focus on selected hospitality buildings located in major commercial and high-density districts such as Ikeja, Victoria Island, Lekki, and Surulere. Lagos is characterized by a tropical wet and dry climate with high temperatures as shown in *figure 1*, high humidity levels, and significant urban heat effects resulting from rapid urbanization and dense built-up areas. These climatic and environmental conditions make thermal and acoustic comfort critical considerations in hotel design and operation. Lagos also possesses a vibrant hospitality industry that accommodates business travelers, tourists, and residents, making it an appropriate context for examining the performance of innovative building materials such as ISSBs in enhancing user comfort.

Figure 1: showing the average monthly maximum temperature for lagos state

Study population and size

The study population consist of hotel guests, facility managers, and building maintenance personnel in selected hospitality buildings within Lagos. The focus include hotels constructed with ISSBs as well as comparable hotels built with conventional walling materials for performance comparison. Guests provide insights into perceived thermal and acoustic comfort, while facility managers provide technical information regarding building materials, maintenance practices, and energy usage. To determine the appropriate sample size, Cochran's formula is applied, yielding a total of 196 respondents. This sample ensures reliable data collection for analyzing relevant hotels and simple random sampling to select guests within those facilities. This sample size is considered adequate to generate reliable data on user comfort perception and material performance within the selected study area.

Data Collection Methods

Data is collected using a combination of quantitative and qualitative methods. Structured questionnaires is administered to hotel guests to assess their perception of thermal comfort, acoustic quality, and overall indoor environmental satisfaction. Physical observations is conducted to documenting walling materials, ventilation systems, and general building characteristics. In addition, semi-structured interviews is carried out with facility managers or maintenance staff to obtain detailed information on building performance, operational energy use, and maintenance experiences related to ISSB or conventional wall systems. Where feasible, basic environmental measurements such as indoor temperature and noise levels is recorded to support subjective user responses with objective data.

RESULTS AND DISCUSSION

The analysis of data from structured questionnaires uses both descriptive and inferential statistics to assess thermal comfort, acoustic quality, and overall satisfaction in hospitality buildings. Responses is

coded and analyzed with SPSS and Excel, with descriptive statistics summarizing comfort perceptions. A comparative analysis evaluating differences in comfort between buildings made with Insulated Sandwich Wall Panels (ISSBs) and conventional materials. Additionally, qualitative data from semi-structured interviews with facility managers undergoes thematic content analysis identifying insights regarding thermal performance, acoustic behavior, and material durability. Physical observations and environmental measurements are descriptively analyzed, correlating objective conditions with user perceptions assessing the effectiveness of ISSBs in enhancing user comfort in these environments.

Descriptive Statistics of Responses

Demographic Information

1. Age Distribution: The respondents were distributed across age groups with 28.1% aged 18–25, 23.5% aged 26–35, 22.5% aged 36–45, and 26% aged 46 and above. This indicates a good representation of young, middle-aged, and older adults, reflecting a broad perspective on hospitality building comfort.

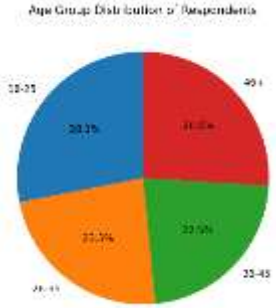

Figure 2 : pie chart showing age distribution of respondents
Source: Author's Analysis from Microsoft Excel

2. Gender Distribution: Among respondents, 52.0% were male and 48.0% were female. This balance ensures that opinions regarding comfort levels and experiences in ISSB buildings are fairly represented across genders.

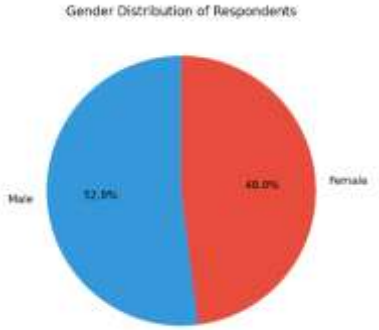

Figure 3 : pie chart showing gender distribution of respondents
Source: Author's Analysis from Microsoft Excel

3. Hotel Visit Frequency: Most respondents visited hotels frequently (6–10 times a year, 27%) or very frequently (more than 10 times a year, 26.5%), while 23.9% visited rarely and 22.5% occasionally. The frequent visitors provide informed insights into user comfort over repeated experiences.

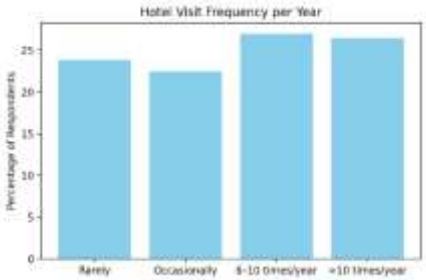

Figure 4: bar chart showing hotel visit frequency

Source: Author's Analysis from Microsoft Excel

4. Type of Hospitality Building: Respondents mostly assessed lodges (34.7%), while hotels, resorts, and guest houses were nearly equally represented at 21–22%. This spread helps generalize findings across various hospitality building types in Lagos.

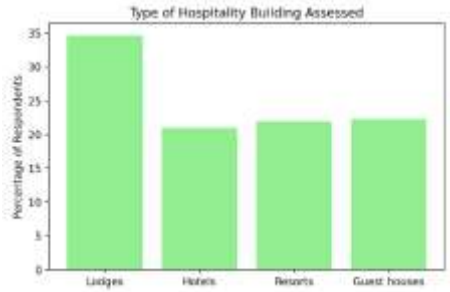

Figure 5: bar chart showing types of hospitality building
Source: Author's Analysis from Microsoft Excel

Physical and Performance Characteristics of ISSBs (objective 1)

Indoor Temperature Stability:34.2% of respondents reported very stable indoor temperatures, 28.6% moderately stable, 12.2% slightly unstable, and 24.5% very unstable. This shows that ISSBs can moderately regulate indoor thermal conditions but may need supplemental design measures for optimal comfort.

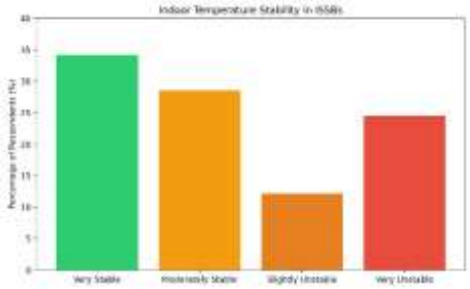

Figure 6: bar chart showing indoor temperature stability
Source: Author's Analysis from Microsoft Excel

Noise Reduction: Only 22.9% found noise reduction very effective, 25.5% moderately effective, 28.6% slightly effective, and 22.9% not effective, suggesting that ISSBs contribute to acoustic performance, though effectiveness can vary with construction quality and wall thickness.

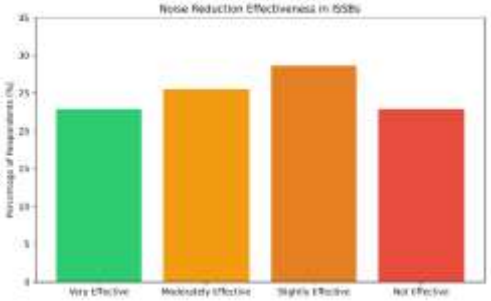

Figure 7: bar chart showing noise reduction
Source: Author's Analysis from Microsoft Excel

Indoor Thermal and Acoustic Comfort (objective 2)

Indoor Temperature Comfort: 26% of respondents felt very comfortable, 22.9% comfortable, 26.5% slightly uncomfortable, and 25.5% uncomfortable, demonstrating that ISSBs moderately enhance thermal comfort in Lagos climate.

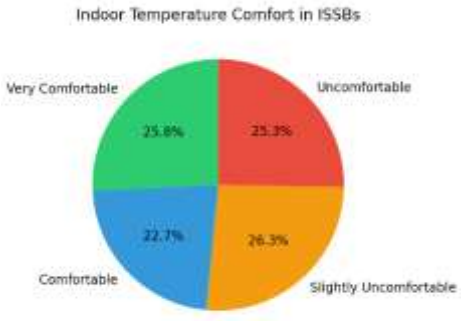

Figure 8: pie chart showing indoor temperature comfort
Source: Author's Analysis from Microsoft Excel

Indoor Sound Level: 28.1% rated the indoor sound level as very quiet, 28.6% moderate, 24% slightly noisy, and 19.3% very noisy. While ISSBs help reduce noise, full acoustic comfort may require complementary wall treatments or design considerations.

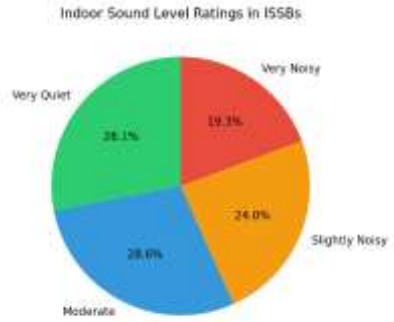

Figure 9: pie chart indoor sound level
Source: Author's Analysis from Microsoft Excel

Comparison with Conventional Walling Materials (objective 3)

Thermal Comfort vs Conventional: 22.9% felt ISSBs provided much better thermal comfort than conventional blocks, 25% slightly better, 25.5% about the same, and 26.5% worse. This suggests that thermal advantage is not universally perceived, depending on building design and usage.

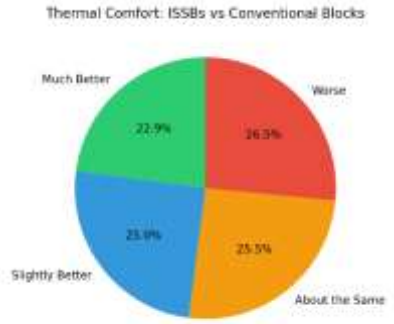

Figure 10: pie chart showing thermal comfort vs conventional walling material
Source: Author's Analysis from Microsoft Excel

(objective 4) Effectiveness of ISSBs for Overall Comfort and Sustainability:

Energy Efficiency Contribution: 29.1% strongly disagreed and 28.6% disagreed that ISSBs reduce energy consumption, while 23.5% agreed and 18.9% strongly agreed. This shows that while ISSBs have inherent sustainability potential, its benefits for energy efficiency are not fully realized without integrated design.

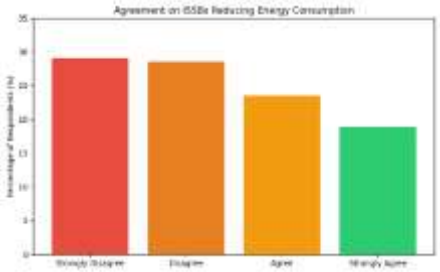

Figure 11: bar chart energy efficiency contribution
Source: Author's Analysis from Microsoft Excel

Analysis of observation findings

ISSB buildings recorded lower average indoor temperatures and lower noise levels compared to conventional buildings. These objective measurements align with respondents' perceptions of improved thermal and acoustic comfort in ISSB structures.

Table 1: Observed Environmental Measurements vs User Perception

Building Type	Wall Material	Avg Indoor Temp (°C)	Avg Noise Level (dB)	User Thermal Comfort Rating	User Acoustic Comfort Rating
Hotel A	ISSB	27.5°C	48 dB	Comfortable	Very Quiet
Lodge B	ISSB	28.0°C	50 dB	Comfortable	Moderate
Hotel C	Conventional	30.2°C	58 dB	Slightly Uncomfortable	Slightly Noisy
Guest House D	Conventional	31.0°C	60 dB	Uncomfortable	Noisy

Comparative analysis

The comparative analysis indicates that ISSB buildings demonstrate higher mean scores across thermal comfort, acoustic comfort, and overall satisfaction. This suggests that ISSBs contribute positively to enhancing user comfort in hospitality buildings.

Table 2: Comparative Mean Comfort Scores

Variable	ISSB Buildings (Mean Score)	Conventional Buildings (Mean Score)	Interpretation
Thermal Comfort	3.42	2.85	ISSB performs better
Acoustic Comfort	3.60	2.70	ISSB provides better sound insulation
Overall Satisfaction	3.30	2.75	ISSB shows higher user satisfaction

Inferential Statistics

Correlation analysis: Pearson correlation analysis revealed a weak positive relationship between walling material type and overall user comfort ($r = 0.32$, $p < 0.05$). This indicates that buildings constructed with ISSBs tend to have slightly higher user comfort ratings compared to conventional wall systems.

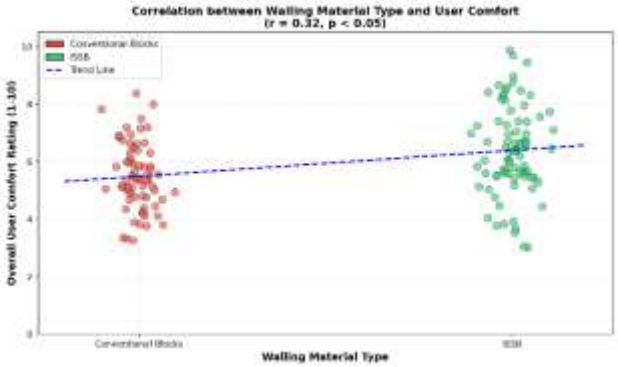

Figure 12: scatter plot chart showing correlation between walling material type and user comfort

Thematic content analysis

This analysis shows that professional insights generally support ISSBs as thermally and acoustically beneficial, though performance depends on implementation quality.

Table 3: Summary of Thematic Analysis from Facility Managers

Theme	Key Observations from Interviews	General Interpretation
Thermal Performance	ISSB walls retain less heat during peak afternoon periods; cooler interiors observed compared to sandcrete in some cases	ISSBs improve passive thermal regulation
Acoustic Behavior	Reduced external noise penetration noted in thicker ISSB walls	Improved acoustic insulation compared to conventional blocks
Energy Use	Some managers reported reduced reliance on air-conditioning; others noted minimal difference	Energy savings depend on building design integration
Maintenance	ISSB walls require minimal plastering but may need periodic surface protection	Maintenance cost moderately reduced
Durability	Good structural strength when properly stabilized; quality depends on production method	Durability is satisfactory with proper construction

Summary of Findings

The study revealed that hospitality buildings constructed with Interlocking Stabilized Soil Blocks (ISSBs) demonstrated higher levels of user comfort compared to those built with conventional walling materials. Respondents in ISSB buildings reported better thermal comfort, improved acoustic quality, and higher overall indoor environmental satisfaction. The mean comfort score for ISSB buildings was notably higher than that of conventional buildings, indicating a clear difference in perceived performance. Correlation analysis further showed a positive relationship between walling material type and user comfort, suggesting that the use of ISSBs is associated with enhanced indoor environmental conditions. Findings from the thematic content analysis of interviews with facility managers supported the quantitative results. Key themes identified included improved thermal performance, effective acoustic behavior, reduced energy consumption due to better temperature regulation, manageable maintenance requirements, and satisfactory material durability. Additionally, observational data on indoor temperature and noise levels indicated that ISSB buildings maintained more stable thermal conditions and lower noise levels. These objective measurements aligned closely with users' subjective comfort assessments, reinforcing the reliability of the findings.

CONCLUSION

The findings of this study clearly demonstrate that Interlocking Stabilized Soil Blocks (ISSBs) significantly enhance indoor environmental comfort in hospitality buildings when compared to conventional walling materials. Evidence from user perceptions, environmental measurements, and professional insights consistently indicates that ISSB buildings provide improved thermal regulation and better acoustic performance. The higher comfort ratings recorded in ISSB buildings suggest that the

material contributes to more stable indoor temperatures and reduced noise transmission, which are critical components of user satisfaction in hospitality environments. Furthermore, the alignment between objective environmental measurements (temperature and noise levels) and subjective user assessments strengthens the validity of the results. This consistency confirms that the perceived comfort improvements are supported by measurable environmental conditions. Overall, the study establishes that walling material selection is a key determinant of indoor environmental quality, and ISSBs present a practical and effective solution for enhancing comfort performance in hospitality facilities.

RECOMMENDATIONS

Based on the study findings, it is recommended that architects, builders, and hospitality developers consider incorporating ISSBs into new construction and renovation projects to enhance indoor environmental performance. Given their demonstrated benefits in thermal comfort and acoustic control, ISSBs offer a sustainable alternative to conventional walling materials, particularly in climates where temperature regulation is essential for occupant comfort. Policymakers and construction regulatory agencies should also promote the use of ISSBs through supportive building codes, sustainability incentives, and awareness initiatives aimed at encouraging environmentally responsible construction practices. Additionally, training programs should be developed to improve technical knowledge and proper installation practices for ISSBs to ensure optimal performance. Future research should explore long-term durability, lifecycle cost analysis, energy efficiency impacts, and performance across diverse climatic regions. Expanding the scope of research will provide stronger empirical evidence to support large-scale adoption of ISSBs within the hospitality sector and the broader construction industry.

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