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The Use of Coconut Fiber as an Echo Absorbing Material in Green Technology-Based Building Renovation (Case Study of Dome Smesco Jakarta)

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Abstract

The application of green technology in sustainable building renovation requires environmentally friendly materials that provide effective technical performance while enhancing indoor environmental quality and occupant comfort. One of the primary challenges in public buildings is maintaining appropriate room acoustics, particularly by controlling excessive reverberation and improving speech intelligibility. This study aimed to evaluate the effectiveness of coconut coir fiber (cocofiber) as a natural sound-absorbing material in reducing reverberation time and improving perceived acoustic comfort. A quantitative descriptive-comparative approach was employed through a case study of the SMESCO Dome Building in Jakarta, Indonesia. Data were collected through reverberation time measurements conducted before and after the installation of coconut coir fiber acoustic treatment, supplemented by a structured questionnaire assessing users' perceptions of acoustic comfort and speech clarity. The acoustic measurements were evaluated with reference to Indonesian National Standard (Standar Nasional Indonesia, SNI) 03-6386-2011, while questionnaire responses were analyzed quantitatively to assess perceived changes in the indoor acoustic environment. The results indicated that the measured reverberation time decreased from 4.34 seconds to 1.93 seconds following the installation of the coconut coir fiber treatment, representing a reduction of approximately 55.5%. Although the post-installation reverberation time remained slightly above the recommended criterion, the measurements demonstrated a substantial improvement in reverberation control. Questionnaire findings further indicated that most respondents perceived improvements in acoustic comfort, particularly in speech clarity and reduced reverberation. These findings suggested that coconut coir fiber could serve as an effective natural sound-absorbing material for improving room acoustics in large public buildings. However, the observed improvements should be interpreted within the context of the case study, as the before-and-after design did not isolate the acoustic contribution of the material from other potential environmental or installation-related factors. Overall, coconut coir fiber demonstrated promising potential as a renewable, bio-based acoustic treatment material for sustainable building renovation and green construction applications.

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INTRODUCTION

Global climate change and growing awareness of environmental sustainability have encouraged the construction sector to adopt green technologies throughout building construction, maintenance, and renovation (Chen et al., 2024; Husainy et al., 2024; Jaradat et al., 2024). According to the United Nations Environment Programme (UNEP), the buildings

and construction sector accounts for a substantial proportion of global energy-related carbon dioxide emissions, with estimates approaching 36% depending on the reporting period and emissions accounting methodology. Consequently, the adoption of environmentally sustainable construction materials and practices has become increasingly important for reducing the sector's environmental footprint (Kibert, 2016). Within this context, renovating existing buildings is widely recognized as a potentially more sustainable alternative to demolition and new construction because it can extend the service life of existing structures, preserve embodied resources, and reduce construction and demolition waste (Power, 2008). Integrating renewable and bio-based materials into renovation projects may further enhance environmental performance while improving indoor environmental quality and occupant comfort.

One of the primary acoustic challenges encountered in buildings with curved roofs or dome-shaped structures is excessive reverberation and the potential concentration of reflected sound energy (Gangurde et al., 2025; Harrington, 2022). The geometric characteristics of domes can produce complex sound reflection patterns, including sound focusing and localized acoustic irregularities, which may compromise speech intelligibility and perceived acoustic comfort (Bradley, 2002). Although reverberation time is primarily influenced by room volume and total equivalent sound absorption rather than geometry alone, curved surfaces can contribute to uneven sound distribution and undesirable acoustic conditions. These challenges are particularly relevant in multifunctional dome-shaped buildings used for seminars, conferences, exhibitions, and performances, where effective speech communication requires appropriate reverberation control and adequate speech intelligibility. Consequently, the selection and installation of suitable sound-absorbing materials are essential considerations in the acoustic renovation of large enclosed spaces.

Coconut coir fiber (cocofiber) is a renewable natural material with considerable potential for use in sound-absorbing treatments. Previous studies have demonstrated that coconut coir-based acoustic materials can exhibit favorable sound absorption performance, particularly within the mid- to high-frequency range of approximately 1,000–4,000 Hz, depending on fiber density, material thickness, porosity, and installation configuration (Putra et al., 2013; Zulkifli et al., 2010). This frequency range includes important components of human speech, particularly those associated with consonant recognition and speech intelligibility. Furthermore, coconut coir fiber exhibits relatively favorable moisture tolerance and may offer durability advantages under appropriate treatment and installation conditions, although its resistance to fungal growth depends on environmental exposure and material processing (Asdrubali et al., 2015). As a lignocellulosic material, coconut coir is biodegradable under suitable conditions and provides a renewable alternative to conventional mineral fiber insulation products, such as stone wool and glass wool. However, its overall environmental advantages should be evaluated through life-cycle assessment, considering material processing, transportation, additives, service life, and end-of-life management.

Improving indoor acoustic quality is closely associated with occupant comfort, cognitive performance, and the functionality of built environments. Jahncke et al. (2011) demonstrated that unfavorable acoustic conditions, particularly distracting background noise, can impair

concentration and contribute to cognitive fatigue. Although noise exposure and excessive reverberation represent distinct acoustic phenomena, both can negatively affect the quality of communication and occupants' experiences within enclosed spaces. Additionally, the principles of biophilic design emphasize the integration of natural elements and materials into built environments to support human well-being and strengthen connections with nature (Kellert & Calabrese, 2015). From a socioeconomic perspective, utilizing coconut coir residues as construction materials may create value-added opportunities for coconut farmers, fiber processors, and local manufacturing enterprises (Figueiredo et al., 2011; Korjenic et al., 2011). Indonesia is among the world's leading coconut-producing countries, generating substantial quantities of coconut husks that could potentially be processed into higher-value products. Estimates suggesting that more than three million tons of coconut-derived residues are generated annually require clarification regarding the specific material category, measurement basis, and reporting period (BPS, 2023). Nevertheless, developing coconut coir-based acoustic products could contribute to resource efficiency, agricultural waste valorization, and the diversification of rural economic activities.

The application of coconut coir fiber as a sustainable acoustic material is consistent with circular economy principles, particularly resource recovery, material reuse, and the transformation of agricultural by-products into value-added construction products. Such applications may also contribute to several United Nations Sustainable Development Goals (SDGs), particularly SDG 9 (Industry, Innovation, and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production) (United Nations, 2015). However, existing investigations into the acoustic performance of coconut coir-based materials have largely emphasized laboratory-scale characterization, including sound absorption coefficient measurements under controlled conditions. Consequently, evidence regarding their performance in full-scale buildings, particularly those with complex architectural geometries and variable acoustic conditions, remains comparatively limited (Oldham, Egan, & Cookson, 2015). This distinction is important because laboratory measurements of material sound absorption do not necessarily predict the overall acoustic performance achieved after installation in occupied buildings. Field-based evaluations are therefore necessary to assess how coconut coir treatments influence room reverberation, speech-related acoustic conditions, and perceived occupant comfort under practical operating conditions.

Against this background, the present study aimed to evaluate the effectiveness of coconut coir fiber as a natural sound-absorbing material in reducing reverberation time within a dome-shaped building. The investigation focused on the acoustic renovation of the SMESCO Dome Building in Jakarta, Indonesia, using a comparative assessment of reverberation time measurements obtained before and after the installation of coconut coir-based acoustic treatment. The measured results were evaluated with reference to the applicable provisions of Indonesian National Standards (Standar Nasional Indonesia, SNI), including the cited SNI 03-6386 standard, and relevant findings from previous acoustic research. Particular attention was given to the suitability of the acoustic treatment for a multifunctional space, where reverberation control and speech intelligibility are important determinants of functional

performance and user comfort. The study also sought to provide practical evidence regarding the potential application of agricultural fiber-based materials in sustainable building renovation.

Excessive reverberation in dome-shaped buildings presents a practical challenge because large enclosed volumes, insufficient sound absorption, and complex reflection patterns can produce prolonged sound decay and reduced speech intelligibility. Curved architectural surfaces may additionally cause sound focusing, resulting in uneven acoustic conditions across different listening positions. Addressing these problems requires acoustic treatments that provide adequate sound absorption while remaining compatible with the building's architectural characteristics and functional requirements. Despite the availability of coconut coir as an agricultural by-product, its application in Indonesia's construction and building renovation industries remains relatively limited compared with its traditional uses in ropes, mats, mattresses, automotive upholstery, and geotextiles. This underutilization suggests an opportunity to develop higher-value acoustic products from locally available natural fibers. However, the economic benefits for coconut farmers and processors would depend on production costs, processing capabilities, market demand, and the commercial feasibility of acoustic material manufacturing. Accordingly, evaluating coconut coir fiber under actual building conditions could help address the gap between laboratory-based material research and practical acoustic renovation applications while providing preliminary evidence to support sustainable material innovation and agricultural resource valorization.

METHOD

This study employed a quantitative, descriptive-comparative approach using a before-and-after case study design at the multipurpose SMESCO Dome Building in Jakarta, Indonesia. The investigation examined changes in room acoustic performance following the installation of acoustic treatments reportedly incorporating coconut coir fiber (cocofiber) panels. The primary acoustic parameter was reverberation time (RT60), measured before and after renovation. As the project documentation also referenced acoustic plaster, the precise composition of the installed treatments and their individual contributions to acoustic performance could not be independently established. The study also assessed users' perceptions of acoustic comfort through a structured questionnaire administered to 30 purposively selected participants, comprising tenants, employees, and visitors familiar with the building's acoustic conditions. The nonprobability sampling method limited the representativeness of the survey findings.

Data were collected through site observations, technical documentation reviews, reverberation time measurements, and a structured questionnaire using a five-point Likert scale. Site observations examined room geometry, reflective surfaces, and existing acoustic conditions. Reverberation time measurements were conducted before and after renovation using acoustic measurement equipment, with reference to Indonesian National Standard (Standar Nasional Indonesia, SNI) 03-6386-2011 and ISO 3382-1. The documented room temperatures ranged from 25°C to 28°C during the measurement conditions. The questionnaire assessed perceived reductions in reverberation, speech clarity, acoustic comfort, environmental

acceptance, and perceived improvements in the suitability of the space for various activities. Survey responses were categorized using the five-point response scale presented in Table 1. However, the available documentation did not specify measurement locations, equipment calibration procedures, repeated measurement protocols, or questionnaire validity and reliability assessments. Accordingly, these procedures could not be independently verified.

Data were analyzed descriptively by comparing reverberation time measurements obtained before and after renovation and calculating the absolute and percentage reductions. The reported RT60 decreased from 4.34 seconds before renovation to 1.93 seconds afterward, representing an absolute reduction of 2.41 seconds, or approximately 55.5%. The post-renovation value was compared with the 0.6–0.8-second reference range cited in the manuscript, although the applicability of this benchmark to the building's volume and intended functions required further verification. Questionnaire responses were summarized using frequencies, percentages, and mean scores to evaluate perceived acoustic improvements. No inferential statistical tests or controlled comparisons were documented. Consequently, the findings were interpreted as descriptive evidence of improved acoustic conditions and favorable user perceptions rather than definitive proof that coconut coir fiber alone produced the observed changes. The study's conclusions were further limited by the single-building design, purposive sampling, and incomplete documentation of the acoustic measurement procedures.

Table 1. Likert Scale Value Interval

Value Interval	Perception Category
1,00 – 1,80	Strongly Disagree
1,81 – 2,60	Disagree
2,61 – 3,40	Neutral
3,41 – 4,20	Agree
4,21 – 5,00	Strongly agree

Source: Adapted from the Likert scale category

RESULTS AND DISCUSSION

Overview of Research Locations

The research was conducted on a multipurpose building in Jakarta with a fairly large volume of space, namely the SMESCO Dome Building. The curved shape of the dome tends to produce multiple sound reflections that cause relatively long echoes. This condition has the potential to reduce the comfort of the space, especially for activities that require sound clarity such as seminars, conferences, and art performances.

Field Measurement Results

Echo measurements are carried out twice, namely before and after the installation of the cocofiber panels. The measurement results are shown in Table 2.

Table 2. Results of Reverberation Time Measurements at the SMESCO Dome

Space Conditions	Echo (RT60)	Room Temperature	Location
Before installation of cocofiber panels	4.34 seconds	25–28°C	Hall Dome SMESCO
After installation of the cocofiber panel	1.93 seconds	25–28°C	Hall Dome SMESCO

Source: Field Data (2025)

These results showed a significant decrease in echo from 4.34 seconds to 1.93 seconds after the installation of the cocofiber panels. In percentage terms, there was a reduction of 55.5%, which indicates the high effectiveness of the use of this natural material.

Comparison with Indonesian National Standards (SNI 03-6386-2000)

Based on SNI 03-6386-2000 on Noise and Echo Levels in Buildings and Housing, the recommended echo for meeting rooms, courtrooms, or auditoriums with a capacity of 250–500 seats is in the range of 0.6–0.8 seconds. The initial condition before the renovation (4.34 seconds) far exceeded the standard limit and caused annoying echoes, while the condition after the installation of cocofiber (1.93 seconds) was still above the SNI standard, but it was close to the threshold and much better than the initial condition.

The persistence of differences with the SNI standard can be caused by several technical factors, including the geometric characteristics of dome-shaped spaces that tend to produce the centering of sound reflections, the area of the absorbent field that does not cover the entire reflective surface, and the limited thickness and distribution of absorbent materials at the initial renovation stage. The relatively large volume of space also contributes to the still high echo, because large volume spaces require a more significant area of absorption material to achieve optimal standards. Thus, although it has not fully met SNI standards, the application of cocofiber has proven to be effective in reducing echo substantially and shows the potential to achieve standards if advanced design optimization is carried out, such as increasing the area of absorbent panels, setting the material layout, or combining with other elements.

Analysis of Cocofiber Material Effectiveness

The results of the test prove that cocofiber is able to function effectively as a natural dampening material. The porosity and complex structure of the fibers allow the absorption of sound waves at medium to high frequencies, in line with the findings of Putra et al. (2013) and Zulkifli et al. (2010) who stated that cocofiber has a high sound absorption coefficient in the range of 1000–4000 Hz, which is the dominant frequency of human conversation. Compared to conventional materials such as rockwool or glasswool, cocofiber has several advantages: (1) environmentally friendly because it is biodegradable; (2) economically valuable because it is based on abundant agricultural waste in Indonesia; and (3) it is not harmful to health, in contrast to synthetic materials that have the potential to cause skin and respiratory irritation.

Discussion of Research Results Based on Literature

The findings of the study show that the use of coconut fibers provides a significant reduction in spatial echo, although the final result does not fully meet the optimal standard of SNI 03-6386-2011. These results are in line with previous research that states that natural fiber-based materials have quite good sound absorption capabilities, especially at medium to high

frequencies. Zulkifli et al. (2010) and Putra et al. (2013) explained that the porous structure of coconut fibers allows the dissipation of sound wave energy through the friction mechanism of air inside the pores of the material, thereby effectively reducing sound reflection. The findings regarding improving the comfort of space users are also consistent with Banbury and Berry (2005) who show that excessive noise and echo can reduce work concentration and increase mental fatigue, and Jahncke et al. (2011) who affirm that better quality of workspace contributes to improved focus, psychological comfort, and user productivity.

However, the results of this study are not fully aligned with several other studies that show that natural fiber materials can achieve optimal performance if designed with a certain configuration. Asdrubali et al. (2015) stated that the effectiveness of natural fiber materials is greatly influenced by the thickness of the panels, material density, and the area of absorption field. In the context of this study, the geometric shape of the dome with a large volume of space has the potential to cause sound focusing, so even though cocofiber has been installed, the echo has not fully reached the recommended standard. Several other studies have also shown that synthetic materials such as glasswool or mineral wool still have a higher sound absorption coefficient in a certain frequency range than natural materials (Schiavoni et al., 2016), which suggests that the technical performance of cocofiber remains dependent on the design of the application and the combination of other materials in the space system.

From a green building perspective, the findings of this study support the concept of using local and renewable materials as part of sustainable development strategies. Korjenic et al. (2011) assert that natural fiber materials have a lower carbon footprint than synthetic materials and contribute to improving indoor environmental quality. However, some literature also reminds that the sustainability of materials is not only determined by the source of the material, but also by the processing process, durability, and long-term maintenance costs (Cabeza et al., 2014) an important note for the further development of cocofiber materials for construction applications.

Overall, the findings of this study show that the use of coconut fiber has significant potential in reducing echoes and improving the comfort of space users, although its effectiveness is still influenced by space design factors, material installation configurations, and building characteristics. The results of this study strengthen the literature supporting the use of natural materials in building acoustics, while demonstrating the need for design optimization and integration of material systems in order for technical performance to be closer to recommended standards.

Contextual Discussion

The use of cocofiber as a panel not only provides technical benefits in reducing echoes, but also supports the principle of green technology in building renovation. The use of coconut fiber waste provides economic added value for local farmers, while reducing dependence on imported synthetic materials. In the context of the SMESCO Dome case study, the measurement results show that although the post-renovation echo has not yet reached SNI's ideal standards, the achievement of a reduction of more than 50% can already be considered significant. This confirms that cocofiber has great potential for further development, either through increasing the thickness of the panels, combining with other materials, and optimizing

the installation layout.

Effectiveness of Coconut Fiber in Reducing Echoes

The measurement results showed a reduction in echo from 4.34 seconds to 1.93 seconds (55.5% reduction). This proves that coconut fiber is effective as a natural damper material. Although the final result is still above the SNI standard (0.6–0.8 seconds), this significant reduction improves sound clarity and reduces echo interference in the dome chamber, consistent with the findings of Putra et al. (2013) and Zulkifli et al. (2010).

Increased Comfort and Productivity of Space Users

Improving the quality of space conditions has an impact on the comfort and concentration of space users. According to Bradley (2002), excessive echo interferes with oral communication, while echo reduction is close to the standard of improving sound clarity. The study of Jahncke et al. (2011) also revealed that good acoustic conditions are directly related to work productivity. Thus, although it has not reached the ideal standard, the use of cocofiber in the renovation of the SMESCO Dome can be said to have improved the quality of workspaces, events, and public activities carried out in it.

Challenges and Implementation Potential in Indonesia

Some of the challenges faced in the application of coconut fiber as an echo absorbing material include:

1. The perception of the construction industry that still doubts the durability of natural materials.
2. Limitations of regulations regarding alternative materials in national construction standards.
3. Consistency of raw material quality because coconut fiber is produced from varied manual processes.

However, the potential it has is huge:

1) Indonesia is the largest coconut producer in the world (BPS, 2023).
2) The material is easy to obtain, cheap, and environmentally friendly.
3) In accordance with the green building and circular economy agenda.

This is in line with the findings of Srinivasan et al. (2020) who stated that agricultural waste-based biomaterials can be a substitute for conventional materials that are expensive and risky to health.

Development and Replication Strategies

In order for the use of cocofiber to be developed more widely, several strategies were formulated:

1) Technical optimization: advanced research on panel thickness, combination with other materials (e.g. bamboo or natural resin), as well as installation layout to achieve SNI standards.
2) Policies & regulations: encourage the government to include cocofiber in the list of eco-friendly materials in the national green building standards.
3) Local empowerment: involving coconut farmers and cocofiber processing MSMEs in the construction material supply chain.
4) Project replication: starting from public buildings such as schools, government offices,

and meeting halls before expanding to the private sector.

This strategy is in line with the concept of the Triple Bottom Line (People, Planet, Profit), where the use of cocofiber supports social, environmental, and economic sustainability simultaneously (Elzeyadi, 2011).

Respondent Characteristics

The characteristics of the respondents aim to provide an overview of the profile of the space users who participated in the questionnaire. The respondents numbered 30 people, who were space users in the SMESCO Jakarta Dome Building. The identification of respondent characteristics is important to understand the social and professional conditions of the respondents that can affect their perception of the acoustic quality of the space after the application of cocofiber materials. A summary of the characteristics of the respondents is shown in Table 3.

Table 3. Respondent Characteristics (Demographics, Education/Occupation, and Space Use Behavior)

Categories	Sub-Categories	Quantity	Percentage
Gender	Male	16	53%
	Women	14	47%
Age	< 25 Years	8	27%
	25 – 34 Years	10	33%
	35 – 44 Years	11	37%
	45 – 54 Years	1	3%
Education	High School/Vocational School	5	17%
	D3	5	17%
	S1	12	40%
	S2/S3	8	26%
Jobs	Tenants	10	33%
	Visitors	10	33%
	Employees	10	33%
Length of Work/Activity	< 1 Year	2	7%
	1 – 3 Years	16	53%
	4 – 6 Years	9	30%
	> 6 Years	3	10%
Room Type	Meeting Room	14	47%
	Individual Workspace	10	33%
	Open Space	6	20%
Frequency of Use	Every day	12	40%
	3–4 times/week	17	57%
	1–2 Times/Week	1	3%

Source: Data Processed (2025–2026)

Based on demographic profiles, respondents are dominated by men (53%) with a relatively balanced composition compared to female respondents (47%). Most of the respondents are in the productive age of 35–44 years (37%) and 25–34 years (33%). In terms of education, the majority of respondents with S1 (40%) and S2/S3 (26%) education, show a relatively high level of education so that they are expected to be able to provide a more objective and rational assessment of the acoustic condition of the space. Judging from the type of work, respondents are evenly divided between tenants, visitors, and workers (33% each), reflecting the diversity of space user groups with different interests and activities.

In terms of space use behavior, the majority of respondents have been active in the building for 1–3 years (53%) and use meeting rooms or classrooms as the most common type of space (47%), with a frequency of use 3–4 times per week (57%). The high frequency and length of space use experience shows that respondents have adequate direct experience of room conditions before and after the application of cocofiber materials, so that the perception assessment given can be seen as quite credible and representative.

Results of the Space User Perception Questionnaire on the Application of Cocofiber Materials (Quantitative Analysis)

The analysis of space users' perceptions was carried out using a descriptive quantitative approach using a five-level Likert scale questionnaire instrument, measuring the level of respondents' approval of statements related to space comfort, acoustic quality, environmental sustainability, and their impact on space user activities. The average value of each indicator was interpreted using the Likert scale category interval as shown in Table 1 (interval of 0.8 per category, from 1.00–1.80 strongly disagree to 4.21–5.00 strongly agree).

Based on the results of the processing of questionnaire data on 30 respondents, in general, all research indicators showed an average score in the category of agree to strongly agree. In the indicator of acceptance of environmentally friendly materials, the average score was above 4.5 (strongly agreed), indicating a very positive perception of the use of coconut fibers as a natural material that supports green technology. In the aspect of environmental sustainability, more than 90% of respondents gave a positive assessment with an average of 4.6–4.8, indicating that respondents viewed cocofiber as a material innovation that provides technical as well as ecological and social benefits.

In terms of space comfort, statements related to reduced echo, reduced noise, and increased clarity of conversational voice obtained an average of above 4.4 (strongly agree); most respondents stated that the condition of the post-renovation space felt more comfortable than before. In terms of psychological comfort, the average score was above 4.3, indicating that the majority of respondents felt that the space conditions were more conducive to activities. Meanwhile, on the work productivity indicator, the average was in the range of 4.2–4.5 (agree to strongly agree), indicating a tendency to positively perceive that improved acoustic quality has the potential to support more effective work activities although these results are subjective perceptions and do not directly prove a causal relationship between the application of cocofiber and increased productivity.

In the social and economic context, the indicator of pride in working or doing activities in buildings that apply environmentally friendly principles also obtained a high average (above

4.5). Respondents assessed that the use of agricultural waste-based materials such as coconut fiber not only provides environmental benefits, but also has the potential to support the economic empowerment of local communities; some respondents even identified coastal areas such as Pangandaran, Lombok, and Bali as areas with great potential as producers of cocofiber raw materials. Overall, the results of the quantitative analysis of the questionnaire showed that the application of cocofiber materials received a very positive response from space users, both in terms of environmental sustainability, space comfort, and perception of acoustic quality, strengthening the conclusion that cocofiber is technically effective as well as well received socially as part of the application of green technology in buildings.

The relevance of these findings to the formulation of the research problem can be affirmed as follows: first, the effectiveness of cocofiber in reducing echoes is proven to be real through a 55.5% reduction in buzz time; second, the increase in comfort and productivity of space users is reflected in the consistently high perception score on all dimensions of the questionnaire; third, implementation challenges (industry perception, regulation, consistency of raw materials) are identified side by side with Indonesia's great potential as the world's largest coconut producer; and fourth, development strategies technical optimization, policies, local empowerment, and project replication provide concrete direction for the wider application of cocofiber in public and private buildings in Indonesia.

As a concluding note, although the results of the echo reduction in the SMESCO Dome have not fully reached the SNI standard threshold of 03-6386-2000 (0.6–0.8 seconds), the achievement of a reduction of more than half of the initial value is a strong indication that cocofiber deserves to be considered as a key component or support in the acoustic damping strategy of dome buildings in Indonesia. Further research on material combinations, optimal panel thicknesses, and installation layouts will be very useful to push cocofiber performance closer to ideal standards, while strengthening its contribution to the green building agenda, circular economy, and economic welfare of coconut farmers in Indonesia.

CONCLUSION

The renovation of the SMESCO Dome Building in Jakarta was associated with a substantial reduction in measured reverberation time (RT60), from 4.34 seconds before renovation to 1.93 seconds afterward, representing an absolute decrease of 2.41 seconds, or approximately 55.5%. This reduction indicated a considerable improvement in reverberation control compared with the baseline acoustic conditions, although the post-renovation reverberation time remained above the 0.6–0.8-second reference range cited in the original manuscript. However, the suitability of this reference range should be evaluated in relation to the building's volume, intended functions, and applicable acoustic standards. A purposive survey involving 30 building users also revealed favorable perceptions of speech clarity, acoustic comfort, and the environmental sustainability of the renovation materials. Collectively, these findings suggested that the acoustic renovation improved the indoor sound environment and was positively received by users. Nevertheless, the specific contribution of coconut coir fiber (cocofiber) panels could not be conclusively isolated from the effects of other installed acoustic treatments, including acoustic plaster. Therefore, the findings provided

evidence of improved room acoustic performance following renovation rather than definitive proof of the independent effectiveness of coconut coir fiber.

Future research should verify the specifications and composition of the installed acoustic materials, document equipment calibration procedures, and conduct repeated reverberation time measurements at standardized locations and across relevant frequency bands in accordance with applicable acoustic measurement standards. Comparative investigations should also examine the effects of coconut coir panel thickness, density, surface coverage, sound absorption coefficients, durability, moisture resistance, and installation costs relative to conventional acoustic absorbers. Furthermore, subsequent studies should employ validated questionnaires, report instrument reliability and validity, and incorporate longitudinal assessments of user perceptions and acoustic performance, preferably with appropriate comparison conditions. Architects, building designers, construction industry stakeholders, and public institutions may consider coconut coir-based acoustic products as potential renewable alternatives for sustainable building renovation. However, broader implementation should be supported by reproducible acoustic performance measurements, documented material specifications, life-cycle environmental assessments, maintenance considerations, and economic feasibility analyses. These efforts would provide a stronger empirical foundation for evaluating coconut coir fiber as a sustainable sound-absorbing material within green building technologies.

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CONFLICT OF INTEREST

The authors state that there is no conflict of interest in the research, writing, or publication of this article.

AUTHOR CONTRIBUTION

All authors contributed to the preparation of this article. Author 1 (Ade Ranny Ratnaningsih) played a role in the conceptualization of the research, played a role in data collection and analysis, played a role in the interpretation of the results and the preparation of the manuscript, while the other authors contributed to the review, editing, and final approval of the manuscript.

GENERATIVE ARTIFICIAL INTELLIGENCE USAGE STATEMENT

The author states that no generative artificial intelligence was used in the preparation of this article.

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