

Impact of Maintenance Practices on the Longevity and Performance of Modern Materials: Nigerian's Perspective

Temitope R. Omiata¹, Olaniyi S. Ojo², Emmanuel C. Eke³

¹ Department of Building Technology, Federal Polytechnic Ado Ekiti,
Ekiti State, Nigeria

² Department of Building, University of Benin,
Edo State, Nigeria
Email: shigo12002@gmail.com

³ Department of Building Technology, Federal Polytechnic Ado Ekiti,
Ekiti State, Nigeria

ABSTRACT

The achievement of Sustainable Development Goals (SDGs) in the built environment is possible through the use of modern construction materials that prioritize sustainability in their production. However, maintaining these materials requires new maintenance management strategies and a deeper understanding to ensure their longevity and functionality. The research employed a descriptive approach, with a 90% response rate to the distributed questionnaires. The results indicated that maintenance checks are commonly practiced, as most organizations conduct them. A lack of sufficient funding was identified as a significant obstacle to maintaining modern building materials. Additionally, many respondents believe that regular maintenance enhances the efficiency and performance of these materials, this was indicated by 84.4% respondents that believe that regular maintenance improves material efficiency and 80% respondents strongly agreed that lifespan of building materials is shortened by maintenance neglect. The study concludes by stressing the importance for organizations to prioritize the upkeep of modern materials and highlights the role of training in achieving this goal. A regular maintenance policy is recommended to ensure ongoing success.

Keywords — Modern materials, Maintenance, Built professionals, performance.

1. INTRODUCTION

The construction industry plays a vital role in modern infrastructure, influencing the spaces where people live, work, and interact. As populations increase and urbanization intensifies, there is an ever-growing need for buildings that are durable, efficient, and sustainable. This heightened demand spurs ongoing innovations in building materials and maintenance practices, which are critical for ensuring the longevity and performance of

structures (Jacqueline, et al., 2008; Mohammad, et al., 2024). Historically, materials such as wood, stone, and brick have been favored for their abundance and essential characteristics (Radu, et al., 2020). However, these materials often have drawbacks, including vulnerability to weathering, limited strength, and greater maintenance requirements. In recent decades, the emergence of modern building materials has transformed the construction industry by overcoming many of these



challenges and offering improved performance (Jacqueline, et al., 2008).

Modern building materials cover a broad spectrum of products designed to meet particular performance needs, such as composites, smart materials, and environmentally friendly alternatives (Yonatan, 2024). Composites, for example, are engineered materials made from two or more distinct materials with differing physical or chemical properties. The combined result offers enhanced qualities, such as greater strength and durability (Mahesh et al., 2023). Notable examples of these materials include fiber-reinforced polymers (FRP) and concrete composites, both of which are commonly used in new constructions and renovation projects (Belarbi et al., 2016). Smart materials represent another key advancement, featuring the ability to respond to changes in environmental factors like temperature, pressure, and humidity. These materials include shape-memory alloys and thermochromic coatings, which are used in applications such as adaptive building facades and energy-efficient windows (Yu et al., 2024). Lastly, eco-friendly materials prioritize sustainability by reducing environmental impact through the use of recycled materials, lower energy consumption during production, and improved life cycle performance. Examples of such materials include bamboo, recycled steel, and green concrete (Bala and Gupta 2023).

Although the introduction of modern materials has greatly enhanced the quality and functionality of buildings, the role of maintenance management remains crucial. Proper maintenance is essential for ensuring that buildings stay safe, functional, and visually appealing throughout their expected lifespan (Hauashdh et al, 2024). Maintenance management is a structured process that involves planning, implementing, and assessing maintenance activities to preserve and increase the value of the building (Dzulkifli et al., 2021).

The construction industry is progressively adopting modern building materials, driven by the demands for sustainable development, superior performance, and better aesthetics. However, this shift introduces notable challenges in maintenance management. Traditional maintenance approaches, which were designed with conventional materials in mind, often fall short when applied to modern materials. This can lead to problems such as higher repair costs, shorter lifespan of structures, and diminished safety and functionality. While modern materials offer significant benefits like energy efficiency, durability, and environmental sustainability, they also require specialized maintenance strategies.

2. METHODOLOGY

The research employs a descriptive survey design, which is well-suited for gathering data from a specific group of professionals within the construction industry. This design allows the researcher to obtain in-depth insights into the perceptions, practices, and challenges related to the maintenance of modern building materials. The study's population includes professionals such as architects, builders, civil engineers, town planners, quantity surveyors, and other relevant stakeholders. These individuals were chosen for their direct involvement in construction projects and material selection, both of which are central to the research's focus. A total of 50 professionals were targeted for participation.

A purposive sampling technique was applied to select respondents, ensuring they possessed the necessary experience and expertise in modern building materials and maintenance management. The selected participants were those who actively work on construction projects and are familiar with

the processes of selecting, using, and maintaining building materials. The study included professionals from both public and private sector organizations engaged in construction activities. Data were collected through an online questionnaire, distributed via Google Forms. The questionnaire was structured to gather information on respondents' demographics, current maintenance practices for modern materials, challenges faced in maintaining these materials, and their perceptions of how maintenance practices affect material longevity and performance.

3. RESULTS AND DISCUSSION

3.1. Current Maintenance Practices for Modern Building Materials

There are seven current practices identified in the literatures as practiced by built environment professionals. They are:

- i. Regular maintenance schedules for modern materials designated as A₁
- ii. Maintenance procedures are documented and followed consistently designated as A₂
- iii. Adequate resources are allocated for the maintenance of materials designated as A₃
- iv. Training is provided to maintenance personnel regarding modern materials designated as A₄
- v. Maintenance checks are conducted regularly to identify issues early designated as A₅
- vi. Technology is integrated into maintenance practices designated as A₆
- vii. Feedback from maintenance personnel is utilized to improve practices designated as A₇

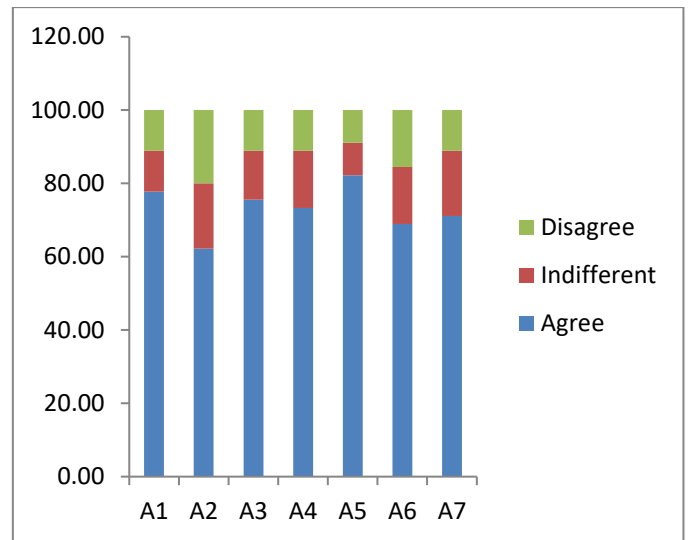


Figure 1: Current Practices by Built Environment Professional

The findings reveal a generally positive perspective on maintenance practices among the professionals surveyed. A notable 77.8% of respondents (35 individuals) reported that regular maintenance schedules are in place, indicating a strong organizational commitment to the upkeep of building materials and systems. In terms of support for maintenance staff, 73.3% of participants believe that adequate training is offered, and 75.6% agree that sufficient resources are dedicated to maintenance activities, though some respondents expressed uncertainty in these areas. Opinions on the integration of technology in maintenance were more varied, with only 68.9% (31 respondents) agreeing that technology is effectively utilized. This suggests that while some progress has been made, there is still significant potential to enhance maintenance strategies through better use of modern tools and technologies. Regarding training specifically on modern building materials, 73.3% (33 respondents) indicated that such training is

provided, reflecting organizational awareness of the importance of equipping staff with up-to-date knowledge. However, the 11.1% (5 respondents) who disagreed highlight possible shortcomings in training coverage that may warrant attention.

A strong emphasis on proactive maintenance is evident, with 82.2% (37 respondents) confirming that routine checks are conducted to detect issues early. This proactive stance is crucial for preventing minor problems from developing into major ones, and only 8.9% (4 respondents) disagreed with this approach. Lastly, 71.1% (32 respondents) agreed or strongly agreed that feedback from maintenance personnel is actively used to refine practices. This reflects a positive organizational culture that values employee input and supports continuous improvement, although the 11.1% (5 respondents) who disagreed suggest that there is still room to strengthen feedback mechanisms.

3.2. Challenges faced in Maintaining Modern Building Materials

Maintaining a modern material are usually faced with challenges. They are highlighted below:

- i. Lack of knowledge about modern building materials among personnel as B₁
- ii. Inadequate funding impacts maintenance effectiveness as B₂
- iii. Difficulty in sourcing replacement materials as B₃
- iv. Environmental factors significantly affect maintenance efforts as B₄
- v. Environmental factors significantly affect maintenance efforts as B₅

vi. Communication gaps hinder maintenance efforts as B₆

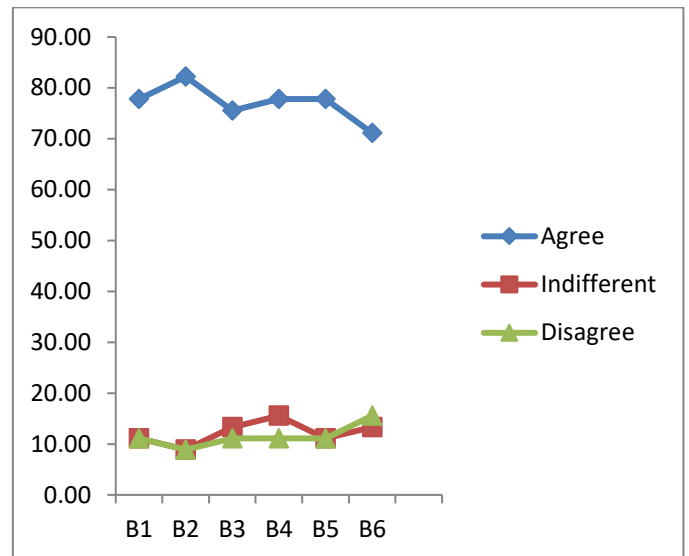


Figure 2: Responses to Challenges in Maintaining Modern Building Materials

The survey analysis reveals several key challenges encountered by personnel in maintaining modern building materials. One of the most pressing issues is a lack of knowledge about these materials, identified by 35 respondents as a significant concern. This highlights an urgent need for focused training programs and educational initiatives to build the necessary expertise among maintenance staff. Inadequate funding also emerged as a major obstacle, with 37 respondents indicating that financial limitations hinder effective maintenance. Budget constraints not only affect the availability of necessary resources but also limit opportunities for training and timely procurement of materials. Sourcing replacement materials was another commonly reported issue, with 34 participants rating it as a significant challenge. This points to persistent supply chain issues that can cause delays in maintenance operations. Environmental conditions

were also seen as a substantial factor affecting maintenance performance, with 35 respondents citing them as impactful. Elements such as harsh weather and pollution can compromise both the effectiveness and durability of maintenance efforts. Additionally, 35 respondents reported that insufficient time allocated for maintenance activities poses a significant challenge. Time limitations can lead to rushed or neglected tasks, which may affect the overall integrity of building systems. Communication gaps within organizations were also highlighted by 32 respondents as a significant issue. Ineffective communication can lead to miscoordination and reduced efficiency, suggesting a need for clearer, more structured communication processes to support maintenance operations.

3.3. Impact of Maintenance Challenges on the Longevity and Performance of Modern Building Materials

The maintenance challenges as obtained from the literatures are:

- i. Maintenance challenges negatively affect the longevity of modern building materials (C₁)
- ii. Performance issues arise frequently due to inadequate maintenance practices (C₂)
- iii. The overall quality of building projects suffers from maintenance challenges (C₃)
- iv. Investment in proper maintenance significantly enhances material longevity (C₄)
- v. The lifespan of building materials is shortened due to neglect in maintenance (C₅)
- vi. Frequent repairs are required due to poor maintenance practices (C₆)
- vii. Consistent maintenance improves user satisfaction with building performance (C₇)

viii. Regular maintenance improves efficiency (C₈)

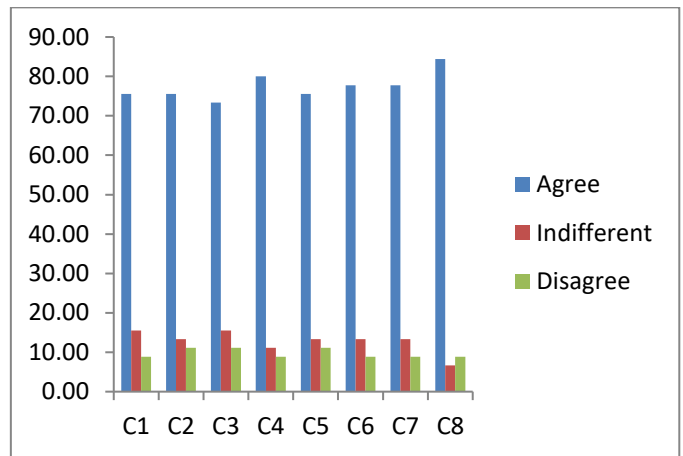


Figure 3: Respondent perspective to impact of Maintenance Challenges on Performance of Building Materials

The findings from the survey reveal significant insights into the relationship between maintenance challenges and the longevity of modern building materials. A substantial 76% of respondents (34 individuals) agree or strongly agree that maintenance challenges negatively impact the durability and lifespan of these materials, highlighting a consensus that neglecting maintenance plays a critical role in reducing their longevity. Additionally, 75.6% of respondents believe that performance issues frequently arise due to inadequate maintenance, with only a small fraction (11.1%) expressing disagreement. This suggests that poor maintenance directly contributes to operational challenges in buildings. Furthermore, the quality of building projects is perceived to suffer due to maintenance challenges, as indicated by 73.3% of respondents (33 individuals) who agree or strongly agree with this statement. This underscores the importance of proper maintenance in ensuring the long-term quality of construction. A noteworthy 80% of respondents

(36 individuals) affirm that investing in proper maintenance significantly enhances the longevity of building materials, suggesting a strong recognition among stakeholders of the need to allocate resources toward maintenance efforts.

The consequences of neglecting maintenance are also evident, with 75.6% of respondents (34 individuals) believing that it shortens the lifespan of materials. This perception emphasizes that failure to maintain materials leads to premature deterioration, ultimately increasing repair costs. In terms of operational efficiency, 77.8% of respondents (35 individuals) agree that frequent repairs are necessary due to poor maintenance practices, indicating a direct correlation between inadequate maintenance and the need for recurring repairs, which further inflates maintenance expenses. Moreover, the survey indicates that consistent maintenance positively influences user satisfaction with building performance, as affirmed by 77.8% of respondents (35 individuals). This finding highlights that properly maintained materials not only extend longevity but also enhance the functional experience for building users. Lastly, an impressive 84.4% of respondents (38 individuals) agree that regular maintenance improves the efficiency and durability of modern materials, reflecting a clear understanding that sustained maintenance efforts are essential for enhancing both the performance and longevity of building components.

4. CONCLUSION

In conclusion, the study emphasizes the critical role of effective maintenance management in extending the lifespan and improving the performance of modern building materials. The

results reveal that inadequate maintenance can undermine material durability and lead to higher costs and operational difficulties. Respondents consistently pointed to the need for organizations to prioritize maintenance, invest in staff training, and allocate sufficient resources to overcome key challenges. Promoting a proactive maintenance culture and addressing issues such as limited funding and poor communication can support the sustainable and efficient use of modern materials in construction projects.

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