

Assessment of Sustainable Materials Specification in Working Drawings within the Nigerian Construction Industry

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Abstract: As the global construction sector moves toward environmentally responsible practices, the specification of sustainable materials in technical documentation has become crucial. In Nigeria, where the construction industry contributes over 60 percent of national capital projects but relies on outdated documentation practices, working drawings play a central role in translating sustainability goals into built form. This study used a quantitative survey of 605 construction professionals across five Nigerian regions to assess the extent and clarity of sustainable material specifications in working drawings. Results show that 78 percent of working drawings either fail to specify sustainable materials or do so vaguely, while only 22 percent provide detailed specifications. In addition, 48 percent of smart systems were introduced post-design as site improvisations, highlighting weak pre-construction coordination. Key challenges include the absence of standard templates (67 percent), insufficient training (54 percent), and outdated annotation practices (58 percent). The findings indicate that sustainable material documentation in Nigeria remains fragmented and inconsistent, undermining green construction goals. This research provides empirical evidence to an under-explored area of construction practice, contributes to knowledge in architectural documentation and construction management, and offers insights for policymakers, industry professionals, and academics seeking to improve standardization, training, and regulatory frameworks.

Keywords: Construction documentation, Nigerian construction industry, Specification practices, Sustainable materials, Building design communication, Working drawings

I. Introduction

The construction industry plays a central role in achieving global sustainability goals. Buildings account for more than 40 percent of energy use and nearly one-third of carbon dioxide emissions worldwide (United Nations Environment Programme [UNEP], 2021). In developing countries such as Nigeria, rapid urbanization, population growth, and infrastructural demand increase the urgency of adopting sustainable construction practices. Sustainable materials such as bamboo, recycled steel, fly ash concrete, and low-VOC finishes reduce environmental impact, improve building performance, and support global climate commitments (Kibert, 2016; World Green Building Council, 2020).

Working drawings are the primary medium through which these goals are translated from design intent into construction reality. They provide contractors, engineers, and project managers with material details, specifications, and performance expectations. However, in Nigeria, documentation practices remain weak. Studies show that working drawings often omit or vaguely present sustainability details, leaving contractors to substitute conventional materials or exclude innovations (Adebayo & Ojelabi, 2019; Olusegun, Ibrahim & Fashola, 2020). Outdated templates, limited interdisciplinary coordination, and weak regulatory enforcement further hinder the integration of sustainability into documentation.

Problem Statement

Despite global and local advocacy for sustainable construction, the Nigerian construction industry continues to struggle with fragmented and inconsistent documentation of sustainable materials. Specifications in working drawings are often incomplete, vague, or absent, undermining design implementation and compromising sustainability outcomes.

Research Gap

Over the past decade, the construction industry has shifted toward sustainability, with numerous studies focusing on environmentally responsible materials, energy-efficient design, and green practices (Kibert, 2016; Ghaffarianhoseini et al., 2017; Adeyeye & Alagbe, 2022). Scholars have highlighted the benefits of renewable, locally sourced, and low-emission materials, as well as the institutional reforms needed to encourage their adoption. At the same time, digital tools such as Building Information Modeling (BIM) have been praised for improving communication of sustainable design intentions (Jalaei & Jrade, 2015; Creswell, Zhang & Onuoha, 2019).

While these contributions are valuable, most adopt a broad, macro-level perspective that emphasizes policy, material science, or technology. What remains under-explored, especially in developing contexts such as Nigeria, is the practical communication of sustainability within construction documentation, specifically in working drawings and technical specifications. These documents are critical in translating sustainable design concepts into physical construction, yet few studies assess their clarity, content, or influence on site execution.

In Nigeria, studies suggest that sustainable materials are often excluded from working drawings or referenced only in vague, non-standard terms (Olusegun, Ibrahim & Fashola, 2020; Ede, Okonkwo & Salako, 2019). Architects and engineers may have sustainability goals, but these intentions are frequently lost due to outdated templates, weak standards, and poor collaboration during design.

Additionally, most academic discussions on sustainability and digitalization stop short of analyzing how effectively these ideas are documented for contractors, builders, and project managers. Since specifications guide procurement, approvals, and construction, this disconnect undermines the success of sustainable development.

Thus, limited research on how sustainable materials are documented in Nigerian working drawings, and the challenges professionals face in representing them consistently. This study addresses that gap by evaluating how well sustainable materials are specified, identifying documentation challenges, and proposing strategies for improving clarity in line with global best practices.

AIM

The aim of this study is to assess the extent and clarity of sustainable material specifications in working drawings within the Nigerian construction industry.

Research Objectives

This study seeks to:

1. Assess the clarity and adequacy of sustainable material specifications in working drawings in Nigeria.
2. Examine the level of integration and documentation of sustainable design elements in architectural and engineering drawings.
3. Identify the major challenges professionals face when specifying sustainable materials.
4. Propose strategies for improving documentation practices through standardization, training, and regulatory reform.

Significance of The Study

This study addresses the urgent need for sustainable construction in Nigeria. While buildings consume over 40 percent of global energy and produce nearly one-third of carbon emissions (UNEP, 2021), fewer than 25 percent of Nigerian working drawings include detailed sustainability specifications (Olusegun, Ibrahim & Fashola, 2020). Major barriers include lack of standard templates (67 percent) and inadequate training (54 percent). The findings provide evidence for industry to improve standardization and training, for policymakers to update documentation guidelines, and for academia to expand research on construction documentation in developing contexts.

II. Literature Review

A successful construction project is judged not only by stability or aesthetics but also by its alignment with environmental, economic, and social sustainability goals. This depends heavily on documentation, especially working drawings, which connect design to implementation. They are now expected to show environmental performance, life-cycle costs, and recyclability (World Green Building Council, 2021). The World Bank (2022) notes that in sub-Saharan Africa, weak specifications at the design stage remain a major barrier to green adoption.

In Nigeria, the gap between sustainability awareness and documentation is wide. Owolabi, Harry, Adewumi, Onamade and Alagbe (2024) observed that few professionals translate sustainable goals into detailed drawings, citing poor tools, weak regulation, and limited data. Hassan, Adewumi and Olukunga (2024) also stressed that siloed work weakens collaboration. Imported standards further complicate practice, as copied clauses often ignore local, low-impact materials like laterite or adobe (Akinwale & Ogunbiyi, 2022).

Internationally, countries such as the UK and Germany require performance-based documentation with EPDs and carbon data (Möller & Wüstenhagen, 2020). Nigeria lacks such systems, highlighting the urgent need for locally relevant frameworks.

Conceptual Review

The Nature and Role of Working Drawings

Working drawings bridge design and construction, including plans, sections, elevations, schedules, and specifications. They guide cost estimates, quality control, and serve as legal references (Chudley & Greeno, 2016; Arditi & Gunaydin, 1998). Beyond geometry, they are key tools for communication and coordination.

In sustainable construction, drawings must show not only what to build but also how it should perform. They should embed product data, environmental standards, and installation details (Ogundipe, Adeleye & Oladokun, 2023). Without this, sustainable features are often misinterpreted, improvised, or omitted. In Nigeria, documentation is mostly generic, with reused or foreign templates that ignore local realities (Owolabi, Harry, Adewumi, Onamade & Alagbe, 2024; Akinwale & Ogunbiyi, 2022). This weakens sustainable design intent and life-cycle goals. By contrast, global practice ties drawings to certification systems like LEED,

BREEAM, or EDGE, requiring precise data on materials and performance. Nigerian projects often fall short due to poor standardization (Emesiobi, Otuonuyo, Adewumi, Asaju & Onamade, 2024; World Bank, 2022). **Summary:** Global practice prioritizes performance-based, certification-ready documentation. Nigerian practice remains generic and fragmented, creating a gap between sustainable design intent and implementation.

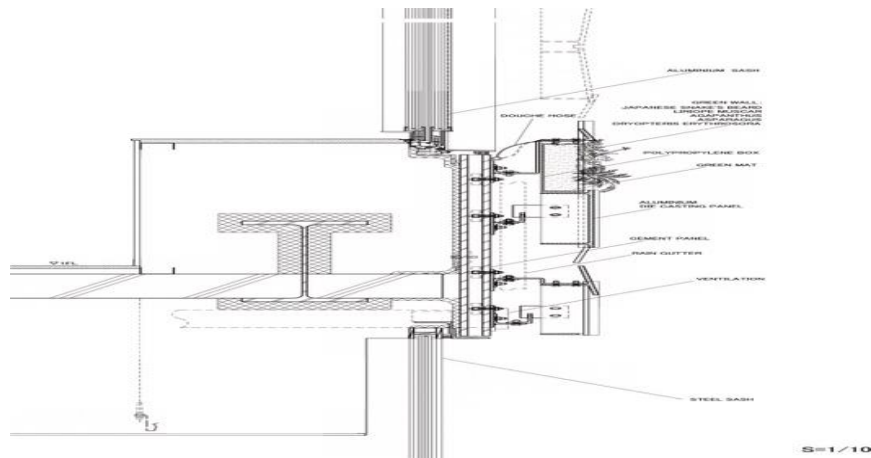


Figure 1. A Picture of detail of Architectural Working Drawing with Building Section

Adapted from *Green Cast / Kengo Kuma & Associates* (image 15), by Kengo Kuma & Associates, 2012. Image courtesy of ArchDaily. <https://www.archdaily.com/245156/green-cast-kengo-kuma-associates>

Understanding Sustainable Materials in Construction

Sustainable materials minimize environmental impact across their life-cycle, from extraction and processing to use, maintenance, and eventual disposal. Key attributes include resource renewability, low embodied energy, recyclability, minimal emissions, and support for local economies (Kibert, 2016; UNEP, 2021).

Examples include:

- Natural materials like rammed earth, adobe, bamboo, and straw bale
- Recycled content such as crushed concrete, reclaimed steel, and plastic composites
- Low-toxicity finishes like lime-based plasters or zero-VOC paints
- Energy-saving products like double-glazed windows or phase-change insulation

			
Bamboo	Cellulose insulation	Plastic lumber	Silicate Paints
			
Living plants walls	Solar cells	Carpet tiles	Natural stone
			
Injection wells	Lightning fixtures	Certified lumber	Bio bricks
			
Steel studs	Permeable pavement	Geo polymer concrete	High performance glass

Figure 2. A Picture of Examples of Sustainable Building Materials used in Construction

Adapted from *Research on the Sustainability in Green Building* (p. 6), by Y. Wang, 2022, *Proceedings of the International Conference on Green Building*. Available at ResearchGate. <https://www.researchgate.net/publication/360486716>

Their specification is crucial in Nigeria's hot-humid climate, where passive cooling, daylighting, and moisture resistance are key (Okonkwo, Adegbite & Ogunlusi, 2021). Yet sustainable materials are often underrepresented in drawings. Adebayo and Ojelabi (2019) noted that while architects discuss sustainable goals early, they rarely appear in working drawings. Vague terms like "eco-friendly roofing" leave room for cheaper, non-sustainable substitutions. By contrast, South Africa and Kenya have green codes and specification guides (GIZ & IFC, 2022). Nigeria lacks a green manual or BIM library, relying instead on generic annotations that weaken adoption.

Smart Building Technologies and Documentation Needs

Smart systems such as HVAC optimization, smart lighting, BMS, and occupancy controls improve efficiency and safety but require detailed documentation (Ghaffarianhoseini et al., 2013; Oyedele, Olawumi & Akinade, 2021). Early specification is vital for coordination (Jalaei & Jrade, 2015). In Nigeria, integration is often an afterthought. Hassan, Adewumi and Olukunga (2024) observed that smart systems are usually added late, raising costs. Globally, BIM protocols aid integration, but in Nigeria, training gaps and weak regulation limit adoption.

Specification Writing and Standardization

Research highlights sustainability and BIM as key to green practice (Kibert, 2016; Ghaffarianhoseini et al., 2017; Adeyeye & Alagbe, 2022; Jalaei & Jrade, 2015; Creswell, Zhang & Onuoha, 2019). Yet in Nigeria, sustainable materials are often omitted or described vaguely (Olusegun, Ibrahim & Fashola, 2020; Ede, Okonkwo & Salako, 2019). Outdated templates and poor collaboration mean sustainability goals are frequently lost in documentation. Since specifications guide procurement and construction, this gap undermines outcomes. This study therefore examines how sustainable materials are represented in working drawings, the challenges faced, and strategies for improving specification clarity.

Theoretical Review

The study applies the Information Clarity and Execution Efficiency Model, which holds that construction success depends on the clarity of documentation.

- **Input:** Sustainable and smart design intentions
- **Process:** Clear, complete drawings and specifications
- **Output:** Accurate interpretation by site professionals
- **Outcome:** Effective or flawed results depending on documentation clarity

This model reflects Ghaffarianhoseini et al. (2013) and Jalaei and Jrade (2015), who stressed the importance of clear documentation, and Creswell, Zhang and Onuoha (2019), who linked poor documentation to sustainability failures. In Nigeria, outdated or vague drawings cause substitutions and neglect, showing that the issue is not material availability but weak documentation. Thus, the model provides a relevant lens for analyzing Nigeria's challenges.

Empirical Review

Nigerian Context

Empirical studies in Nigeria highlight a consistent gap between the intended use of sustainable materials and their actual documentation. Poor coordination, outdated templates, and limited training are major causes.

- Olusegun, Ibrahim and Fashola (2020) surveyed 85 firms in Lagos and Abuja and found that only 38 percent regularly included sustainable specifications in working drawings. Most relied on generic formats with little performance detailing.
- Onwuka and Babalola (2017) reported that while 78 percent of architects were aware of sustainable materials, only 32 percent incorporated them into documentation. Barriers included lack of templates and digital skills.
- Ede, Okonkwo and Salako (2019) examined 12 government buildings and found that fire detection systems, solar panels, and automation modules were omitted at design stage and added later as expensive retrofits.
- Akinola (2021) observed that young firms promoting green materials faced regulatory resistance, as older authorities often rejected unfamiliar specifications.
- Bamidele and Jimoh (2022) reviewed 50 public projects and found that only 10 percent documented sustainability or smart integration. They linked this to inadequate training among drafters and absence of national standards.

These findings show that in Nigeria, awareness of sustainability does not translate into practice. Documentation remains the weak link.

International Context

By contrast, international studies highlight structured systems that improve sustainable adoption.

- Jalaei and Jrade (2015) found that embedding sustainability goals early in BIM increased implementation by 75 percent.
- Creswell, Zhang and Onuoha (2019) argued that digital tools are effective only when supported by interdisciplinary workflows and training.
- Adeyeye and Alagbe (2022) showed that imported formats often fail in African cities such as Nairobi, Accra, and Lagos because they ignore climate and local supply chains.
- Gideon and Möller (2023) documented German and Scandinavian practices where drawings included lifecycle labels, carbon scores, and Environmental Product Declarations (EPDs), making sustainability visible in procurement.

These examples show that robust specification systems lead to stronger sustainability outcomes, unlike Nigeria's fragmented approach.

Synthesis

The evidence shows a clear contrast. In Nigeria, sustainable intentions are undermined by vague and outdated documentation. Internationally, structured systems and digital tools ensure sustainability goals are achieved. This study builds on that gap, focusing on how documentation clarity can improve adoption in Nigeria.

Taken together, the reviewed studies highlight a strong contrast between global practices, where specification systems are structured, standardized, and digitally enabled, and the Nigerian context, where documentation remains fragmented and inconsistent. To illustrate these differences more clearly, a comparative summary is presented in Table 1

Aspect	Global Best Practice	Nigerian Context
Specification Systems	BIM-linked libraries (NBS, MasterFormat)	Generic, recycled clauses dominate
Sustainability Standards	Use of EPDs, lifecycle scores, performance specs	Vague references, little performance data
Smart Technologies	Integrated early in BIM models, standardized templates	Often added late, poorly coordinated
Local Materials	Emphasis on contextual adaptation	Reliance on imported standards, neglect of indigenous materials
Regulation	Strong enforcement frameworks	Weak or absent regulatory push

Table 1. Comparison of Documentation Practices: Global Best Practices and the Nigerian Context

As shown in Table 1, the Nigerian construction industry faces systemic barriers to effective documentation, particularly in areas of standardization, regulation, and contextual adaptation. These challenges provide the foundation for identifying persistent gaps in practice, which are further elaborated in the next section.

Challenges in Documenting Innovation

Lack of Interdisciplinary Collaboration: Architects, engineers, and IT consultants often work in silos, which leads to fragmented system integration and inconsistencies in drawings (Olayemi, Bolarinwa & Ajayi, 2021).

Outdated Drawing Practices: Heavy reliance on 2D CAD without linking specifications or performance data makes it difficult to validate drawings against sustainability targets (UN-Habitat, 2022).

Absence of Regulation: Nigeria lacks national guidelines for embedding sustainability and smart features into documentation, creating inconsistent practices (Emesiobi, Otuonuyo, Adewumi, Asaju & Onamade, 2024).

Limited Professional Training: Many practitioners lack exposure to digital specification tools and sustainable detailing methods.

Client Resistance: Clients often resist innovative systems because of unfamiliarity or fear of higher costs.

Together, these barriers explain why sustainable documentation in Nigeria remains fragmented and inconsistent, despite growing awareness. They also highlight the importance of this study, which investigates how working drawings can be restructured to bridge the documentation gap.

III. Methodology

Research Design

A quantitative survey design was adopted, using structured questionnaires to gather standardized data from construction professionals. This enabled response comparison and statistical analysis of specification practices.

Population and Sampling

The study targeted architects, engineers, quantity surveyors, project managers, and consultants involved in drawings and specifications. Stratified random sampling ensured representation across Nigeria's five geopolitical zones. Using Yamane's (1967) formula, a minimum of 384 was required; 650 questionnaires were distributed, and 605 valid responses were obtained.

Instrument and Validation

The questionnaire covered demographics, sustainable material specification, and documentation challenges. Content validity was established through expert review, while a pilot with 30 professionals refined structure. Cronbach's Alpha values above 0.75 confirmed reliability.

Data Analysis

Data were analyzed with SPSS (Version 26). Descriptive statistics summarized responses, while chi-square, correlation, and regression tested relationships between professional background, training, and specification practices.

IV. Findings

Table 1: Representation of Sustainable Materials in Working Drawings

Response Option	Frequency	Percentage
Clearly specified with details	134	22.1%
Mentioned vaguely without performance data	285	47.1%
Not mentioned at all	186	30.8%
Total	605	100%

Discussion:

Nearly 78 percent of working drawings either omitted sustainable materials or specified them vaguely. This supports Owolabi, Harry, Adewumi, Onamade and Alagbe (2024), who found that while Nigerian professionals acknowledge sustainability, they often lack tools to translate it into documentation. According to the Information Clarity and Execution Efficiency Model, vague inputs reduce execution clarity and encourage substitutions. This aligns with Adebayo and Ojelabi (2019), who also noted weak specification practices.

Table 2: Smart Technology Specification in Design Documentation

Inclusion of Smart Systems	Frequency	Percentage
Clearly specified during design	157	26.0%
Added post-design (site improvisation)	292	48.3%
Not included at all	156	25.7%
Total	605	100%

Discussion:

Only 26 percent reported that smart systems were specified during design, while nearly half indicated they were improvised on-site. This supports Hassan, Adewumi and Olukunga (2024), who showed that Nigerian projects adopt innovations too late to be effective. Theoretically, this represents a breakdown in the "process" stage of the model. Jalaei and Jrade (2015) showed that early embedding of smart systems in BIM increases success by 75 percent, underscoring Nigeria's performance gap.

Table 3: Challenges in Interpreting Drawings

Challenge	Frequency	Percentage
Vague or missing legends	203	33.6%

Inconsistent annotation styles	146	24.1%
No sectional/detail drawings	122	20.2%
Ambiguous/outdated symbols	87	14.4%
No challenges	47	7.7%
Total	605	100%

Discussion:

Interpretation challenges were widespread, especially vague legends and inconsistent styles. This supports Emesiobi, Otuonuyo, Adewumi, Asaju and Onamade (2024), who noted that absent national standards cause fragmented practices. According to the theoretical model, poor translation of design intent weakens execution, echoing World Bank (2022) concerns about documentation clarity in Africa.

Table 4: Platforms Used for Working Drawings

Platform	Frequency	Percentage
BIM (e.g., Revit)	121	20.0%
AutoCAD (2D only)	241	39.8%
Manual (hand-drawn/scans)	74	12.2%
Mixed (AutoCAD + BIM)	169	28.0%
Total	60	100%

Discussion:

Only 20 percent consistently used BIM, while over 50 percent relied on AutoCAD or manual drawings. This digital gap limits sustainability documentation, since BIM supports embedded performance data (Ogundipe, Adeleye & Oladokun, 2023). Creswell, Zhang and Onuoha (2019) also stressed that without digital workflows, communication suffers.

Table 5: Regional Exposure to Sustainable Documentation

Region	High Exposure	Low Exposure	Total
Lagos	117	26	143
Abuja	92	28	120
Port Harcourt	75	41	116
Other urban	61	78	139
Rural/semi-urban	32	55	87
Total	377	228	605

Discussion:

Lagos, Abuja, and Port Harcourt showed higher exposure, reflecting training opportunities, larger client budgets, and international collaborations. Rural and semi-urban regions showed weaker exposure and fewer tools. This agrees with Adeyeye and Alagbe (2022), who argued that imported standards often fail when not adapted to local contexts.

Overall Discussion and Implications

Across all objectives, the findings show that sustainable and smart documentation in Nigeria is inconsistent and fragmented. Using the Information Clarity and Execution Efficiency Model, the study explains how unclear inputs (poor specifications) and weak translation (outdated tools, inconsistent annotations) lead to poor construction outcomes.

The results align with Nigerian studies (Owolabi, Harry, Adewumi, Onamade & Alagbe, 2024; Hassan, Adewumi & Olukunga, 2024) while extending them with national-scale empirical data. Compared to international contexts, Nigeria's reliance on outdated methods and weak regulation remains a major obstacle to green construction.

Implications for Policy and Practice

1. Introduce national standards mandating detailed documentation of sustainable materials.

2. Develop BIM-linked libraries featuring locally appropriate, sustainable materials.
3. Implement professional training programs in digital specification tools.
4. Support regional equity through targeted capacity-building in underserved areas.
5. Mandate early specification of smart systems at the design stage.

By connecting the findings to both theory and practice, this study provides an empirical basis for policy reform and professional training that can enhance sustainable construction outcomes in Nigeria.

Limitations of The Study

The study focused only on Nigerian professionals and relied on self-reported survey data, which may introduce response bias. Experimental validation of documentation practices was beyond its scope. In addition, the concentration of respondents in urban centers such as Lagos, Abuja, and Port Harcourt may limit generalization to rural areas.

Suggestions for Future Research

Future studies should test BIM-based sustainable specification systems in Nigerian projects to measure performance outcomes. Longitudinal research could track the effects of training and regulatory reforms, while comparative studies with other African countries may provide broader regional insights.

V. Conclusion

The study found that:

1. Sustainable materials are poorly specified in Nigerian working drawings, with over 70 percent either omitted or vaguely included.
2. Smart systems are often introduced late, causing inefficiencies and added costs.
3. Documentation challenges such as vague legends, inconsistent symbols, and outdated tools remain widespread.
4. Regional disparities exist, with urban professionals better exposed to sustainable practices than those in rural areas.

VI. Recommendations

1. National Standardization: The Nigerian Institute of Architects and the Nigerian Building and Road Research Institute (NBRRI) should develop and enforce national templates for sustainable specifications within 3 years.
2. Capacity Building: ARCON and COREN should deliver annual Continuing Professional Development (CPD) programs on BIM-linked specifications.
3. Digital Adoption: Firms should be incentivized, through tax breaks or procurement benefits, to adopt BIM platforms by 2027.
4. Policy and Regulation: The Federal Ministry of Works and Housing should embed sustainability documentation into building approval processes within 2 years.

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