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Igbo Indigenous Materials In Contemporary Architecture: A Critical Integrative Review

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Abstract

This paper examines how Igbo indigenous material knowledge can inform contemporary architecture in Southeast Nigeria. A qualitative integrative review synthesised 25 works cited in the review corpus, published between 1969 and 2024, spanning Igbo architectural history, material science, environmental performance, standards and conservation. The available manuscript records did not preserve database search dates or hit counts; the review is therefore presented as a purposive, traceable synthesis rather than an exhaustive systematic search. The evidence indicates that lateritic earth, bamboo, timber, palm fibres, thatch, stone and natural finishes function as interdependent material systems. Their reported benefits—low processing, thermal moderation, renewability and repairability—are conditional on moisture control, grading, treatment, fire safety and maintenance. The paper contributes a six-part adaptation framework linking provenance, characterisation, climate-responsive assembly, cultural review, maintenance and whole-life verification. The framework is a design synthesis derived from recurring evidence and constraints, not a measured performance result. It supports tested hybrid assemblies that sustain cultural continuity while meeting contemporary technical requirements.

Keywords: Igbo architecture; indigenous materials; earthen construction; bamboo; cultural identity; material adaptation; Southeast Nigeria; sustainable architecture

1 Introduction

The environmental burden of construction and the rapid visual homogenisation of Nigerian cities create a double design problem. Buildings must reduce the energy and emissions embedded in their materials while remaining intelligible within the cultures and climates in which they are built. Globally, buildings and construction account for roughly 37% of energy-related carbon dioxide emissions when operational emissions and building-material production are combined (United Nations Environment Programme [UNEP], 2023). In Southeast Nigeria, the ordinary

response to urban aspiration has often been a reinforced-concrete frame infilled with sandcrete blocks, finished with cement render and protected by long-span metal roofing. This assembly is familiar to regulators, lenders and contractors, yet it is energy-intensive, increasingly heat-prone, and only weakly connected to the material languages of Igbo settlements.

Igbo architecture historically developed through a close fit between land, seasonal rainfall, social organisation, ritual practice and locally available matter. Earth walls, timber posts, bamboo or cane latticework, palm products, grass thatch, stone bases and mineral or plant finishes formed buildings that could be repaired incrementally. The obi, compound threshold, courtyard, shrine, kitchen, barn and shaded veranda were not simply rooms. Their relative positions and material treatments communicated kinship, authority, hospitality, gendered work, sacred obligations and relations with ancestors (Dmochowski, 1990; Nsude, 1987; Okoye & Ukanwa, 2019). A mud wall bearing uli-derived linework or a carved timber door therefore performed technically and socially at the same time.

Colonial rule, missionary settlement, changing land tenure, imported materials, formal building standards and postcolonial status cultures altered this material order. Corrugated metal displaced thatch; cement render covered earth; concrete blocks displaced monolithic or coursed earthen walls; imported tiles and synthetic paints recoded prosperity. These substitutions were not irrational: they promised longer maintenance intervals, fire resistance, urban acceptance and standardisation. However, treating replacement as progress concealed the climatic intelligence and repair economy of indigenous systems. Recent studies by Onuorah, Agbonome and Obiadi (2022, 2023) document how Igbo finishes changed across precolonial, colonial and postcolonial periods and argue for their classification as a material-cultural archive.

Existing studies document Igbo building forms, finishes and cultural meanings, while technical studies separately report properties of earth, bamboo and other alternative materials. These strands establish the cultural importance of Igbo material practice and the potential of selected materials, but they are rarely brought together in a region-specific synthesis that connects cultural meaning, reported environmental evidence, failure risks and actionable design decisions.

This leaves practitioners without a clear way to distinguish preservation of historic fabric from adaptation of indigenous material knowledge to contemporary construction. This paper addresses that gap. It asks how Igbo material knowledge can be translated into safe, testable and culturally credible contemporary assemblies under conditions of intense rainfall, termites, fire risk, changing labour, tighter plots and code compliance. Its objectives are to interpret the cultural work performed by Igbo materials; synthesise reported environmental and technical potentials and

limitations using qualitative and selected quantitative evidence; and develop an adaptation framework for contemporary practice in Abia, Anambra, Ebonyi, Enugu and Imo States.

2 Conceptual Framework

2.1 Indigenous material knowledge as a living system

Indigenous knowledge is sometimes represented as a static inventory of objects. Such a view separates earth from the rules for choosing soil, bamboo from its harvest season and treatment, and thatch from the communal labour needed to renew it. A more useful interpretation treats material knowledge as a system comprising resource landscapes, craft skill, social protocols, spatial meanings, construction sequences and maintenance cycles. The sustainability of an earth wall, for example, does not reside in soil alone. It depends on particle grading, compaction or puddling, foundation separation, roof overhang, surface protection, drainage, occupancy and timely repair (Houben & Guillaud, 1994; Minke, 2006).

This systemic position also avoids a false opposition between tradition and innovation. Vernacular traditions have always changed through borrowing and experiment. Material adaptation becomes culturally credible when it preserves relationships that matter—local sourcing, visible craft, climatic mediation, communal use and reparability—even where the precise assembly changes. A compressed stabilised earth block can thus extend an earthen lineage, but only if the stabiliser content, production energy, soil extraction and surface treatment are assessed rather than assumed to be sustainable.

2.2 Cultural identity as use, meaning and workmanship

Architectural identity is not secured by pasting motifs onto a generic building. In Igbo settings it emerges through the conjunction of spatial practice and material expression: the threshold frames entry and recognition; the courtyard supports encounter; the obi locates collective authority; carved doors register status and memory; earth and pigment make surfaces available for renewal and narration. Uli-derived geometries are significant because their line, rhythm and asymmetry belong to a broader aesthetic practice, not because any zigzag pattern is automatically "Igbo" (Cole & Aniakor, 1984; Okeke-Agulu, 2015). Contemporary use therefore requires community-informed interpretation and attribution rather than visual extraction.

2.3 Environmental performance beyond low embodied carbon

A sustainable material decision must consider embodied energy and greenhouse-gas emissions, but it must also address service life, thermal and moisture behaviour, toxicity,

biodiversity, labour conditions, transport, repair and end-of-life recovery. Bio-based materials can be renewable while still driving forest loss. Earth can be recyclable while failing prematurely when used without rain protection. Cement stabilisation can improve strength and water resistance while increasing embodied emissions and obstructing future recycling. The appropriate unit of judgement is consequently the complete assembly over a defined service life, not the unqualified material name.

2.4 Integrative relationship between culture, adaptation and performance

The review is guided by a linked-system proposition: cultural identity informs which material relationships, spatial practices and craft knowledge merit continuity; material adaptation translates those relationships into assemblies suited to current codes, climate, labour and supply; and environmental performance tests whether the resulting assembly manages energy, moisture, durability, health, repair and end-of-life over a stated service life. The relationship is iterative rather than linear. Performance constraints may require a changed construction detail, while community interpretation may reshape the material or spatial expression. The unit of analysis is therefore the material assembly in use, with cultural meaning and environmental performance assessed together. Sections 4 and 5 present the documented and reported evidence; Section 6 distinguishes the author's resulting design synthesis from measured findings.

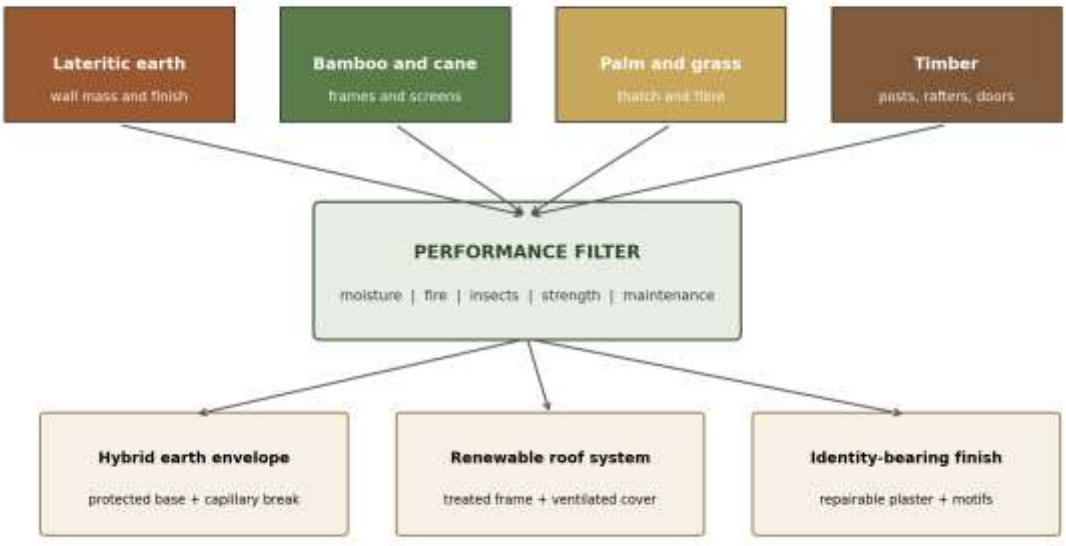


Figure 1. Performance-led reinterpretation of the indigenous Igbo material palette. Source: Author's synthesis, 2026.

3 Methodology

3.1 Research design

The study adopted a qualitative integrative review with a critical interpretive synthesis. This design was selected because the research question crosses architectural history, cultural interpretation, material science and environmental assessment, fields whose evidence is too heterogeneous for statistical meta-analysis. The method permits concepts, documented practices and measured properties to be read together while keeping their different evidential status visible (Snyder, 2019; Torraco, 2016). No interviews, surveys or laboratory tests were conducted for this paper; it does not present secondary observations as original field data.

3.2 Search and selection strategy

The search vocabulary recorded in the manuscript comprised combinations of "Igbo architecture," "Southeast Nigeria," "indigenous building materials," "laterite," "earthen wall," "compressed earth block," "bamboo," "timber," "thatch," "embodied energy," "thermal performance," "cultural identity," "conservation" and "adaptation." The retained corpus comprises the 25 works cited in this paper, published from 1969 to 2024. They cover direct documentation of Igbo buildings and finishes, Nigerian and tropical studies of vernacular or alternative materials, and technical references supplying test methods or comparative evidence. The supplied manuscript did not contain dated search logs, database names, or initial retrieval and screening counts. Those details cannot be reconstructed reliably from the retained references; accordingly, no database-specific or exhaustive-search claim is made. The review should be read as a purposive integrative synthesis with a traceable cited corpus. Works were included when their publication record was identifiable and they contributed regional documentation, material evidence, an applicable technical standard, or a relevant synthesis method. Promotional or unattributed numerical claims and works whose methods could not be assessed were excluded from quantitative comparison.

3.3 Analysis

For each retained work, the synthesis matrix recorded source type and region, material or assembly, cultural role, reported environmental or technical property, conditions and limitations, and implications for contemporary adaptation. The coding proceeded in two passes: first, descriptive extraction under provenance, cultural role, environmental benefit and failure mechanism; second, interpretive comparison to identify recurring relationships, disagreements and evidence gaps. Values were retained only with their reported unit and comparison context. They are reported as examples, not pooled or treated as Southeast Nigerian measurements, because

methods and conditions differ in density, moisture, stabiliser content, species, age, test direction and system boundary. The six framework stages were then derived by translating recurring decision needs across the matrix into a project sequence: sourcing, testing, assembly design, cultural review, care and whole-life appraisal. The framework is the author's recommendation; it is not itself an empirical finding.

3.4 Trustworthiness and limitations

Credibility was supported by comparing architectural documentation, material-performance studies and standards, and by retaining source types and evidence conditions in the material tables and citations. The synthesis is limited by the absence of the original dated search log and database retrieval counts, scarcity of environmental product declarations for Nigerian indigenous materials, limited monitoring of occupied earthen or bamboo buildings in the humid Southeast, and uneven documentation of women's and craftspeople's knowledge. The evidence base is purposive rather than exhaustive, and cultural meanings vary among communities; the synthesis should not be read as a single, fixed Igbo canon.

4 Reviewed Evidence on Igbo Indigenous Materials and Their Cultural Work

4.1 Lateritic earth and clay

Lateritic and clay-rich soils supplied walling, floors, plasters, pigments and sculptural surfaces. Their significance lay partly in proximity: the building emerged from the same ground on which social life occurred. Earth surfaces accepted periodic renewal and decoration, embedding maintenance in household and communal cycles. In the Owerri area, mbari architecture demonstrates the inseparability of earth, modelling, ritual obligation and collective production (Cole, 1969; Cole & Aniakor, 1984). Earth also moderated indoor conditions through thermal mass and hygroscopic exchange, although performance depended on wall thickness, shading and ventilation.

The familiar judgement that earth is temporary usually reflects exposed bases, short eaves, incompatible cement skins or neglected drainage rather than an inherent absence of durability. Dense cement render can trap moisture behind a relatively impermeable layer; cracks then admit rain and delay drying. A more compatible approach uses a raised and drained plinth, capillary separation, generous overhangs, breathable earth or lime render, stabilisation only where justified, and an explicit inspection cycle.

4.2 Timber, bamboo and cane

Timber provided posts, beams, rafters, doors, shutters and carved elements. Bamboo and cane served as lightweight framing, lathing, screens, ceiling members and ties. Their high strength-to-weight ratios allowed work with hand tools and facilitated replacement of individual pieces. Their cultural value also resided in joinery and carving: the material carried marks of status, lineage, skill and encounter. Yet contemporary specification must confront species depletion, ungraded supply, fungal decay, termite attack and poorly controlled chemical treatment.

Bamboo is not a single engineering material. Properties change with species, culm age, radial position, moisture and loading direction. ISO 22156:2021 provides principles for structural bamboo design, while ISO 19624:2018 addresses grading of bamboo culms. For Southeast Nigerian applications, adoption should begin with species identification, managed cultivation, maturity criteria, preservative treatment with documented human and environmental safety, moisture-separated connections and designs that permit inspection and replacement.

4.3 Thatch, palm products and plant fibres

Grasses and palm leaves formed layered roofs, screens and boundary elements; raffia and other fibres supplied ties, mats and woven surfaces. Thick thatch combines low conductivity with a ventilated, breathable roof build-up. Its deep shadow and textured edge are also recognisable components of indigenous architectural character. The disadvantages are equally real: combustion, biological decay, variable workmanship, smoke accumulation and the social association of thatch with poverty. Contemporary reuse requires performance improvement rather than denial of these risks—fire-separated roof zones, spark arrestors, protected services, treated and densely compacted bundles, ventilated sub-roofs, accessible replacement panels and maintenance contracts.

4.4 Stone, pigments and composite finishes

Local stone and gravel were employed at vulnerable bases, in paving and in landscape works. Plant-derived dyes, mineral pigments, ash, clay slips and occasionally animal-derived binders produced finishes whose colour and symbolism were renewed over time. Onuorah et al. (2022, 2023) show that finishes form a particularly useful field for reinterpretation because they connect tactile performance, local resources and cultural representation without requiring every structural system to be reconstructed historically. Contemporary lime-earth plasters, terracotta screens and mineral-pigmented renders can continue this lineage if their formulations remain vapour-compatible and their motifs are developed with knowledgeable cultural participants.

5 Reported Environmental and Technical Evidence

5.1 Embodied energy and transport

Locally sourced, unfired earth generally avoids the high-temperature processing required for fired clay, cement and steel. In a widely cited Indian comparison, Reddy and Jagadish (2003) reported embodied-energy intensities of approximately 0.42 MJ/kg for stabilised soil blocks, 0.92 MJ/kg for concrete blocks, 2.94 MJ/kg for country-fired bricks and 3.75 MJ/kg for wire-cut bricks. Figure 2 reproduces these reported values as contextual—not Nigerian—evidence. They illustrate the potential order of difference but should not be transferred directly to Southeast Nigeria because electricity mixes, kiln fuels, cement contents, transport distances and block strengths differ.

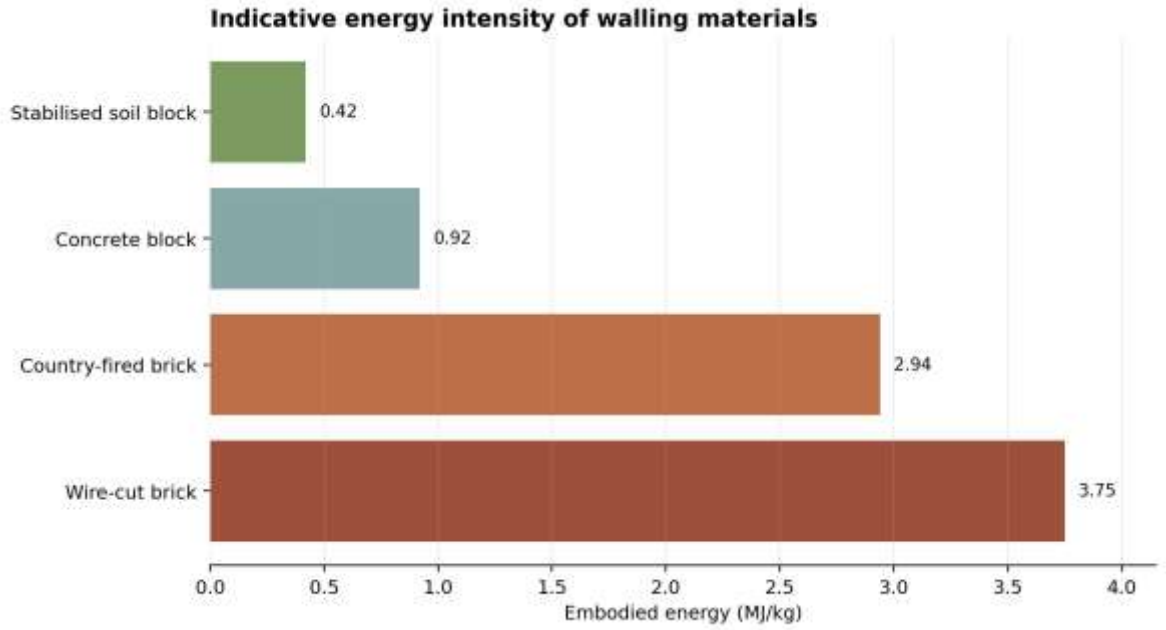


Figure 2. Reported embodied-energy intensity of selected walling materials. Source: Author's chart based on Reddy and Jagadish (2003). Values are contextual and not a like-for-like life-cycle assessment for Southeast Nigeria.

Transport can reverse some advantages. Morel, Mesbah, Oggero and Walker (2001) demonstrated that the environmental benefit of earth construction is highly sensitive to haulage and processing. The practical implication is a regional rather than merely national supply strategy: map suitable soils, bamboo stands, timber sources, treatment facilities and craft clusters within realistic project radii; test excavated soil from the site before importing material; and include vehicle type and distance in project carbon calculations.

5.2 Thermal and hygrothermal behaviour

Earthen walls are often described as insulating, but this is technically incomplete. Dense earth usually has moderate-to-high thermal conductivity compared with fibrous insulation; its

climatic value lies mainly in thermal capacity, time lag, temperature damping and moisture buffering. In a hot-humid climate with small day-night temperature swings, mass alone cannot ensure comfort. It should be combined with solar exclusion, cross-ventilation, shaded openings, ventilated roofs and low internal heat gains. Earth may stabilise short-term peaks, while a lightweight insulated or deeply shaded roof often governs daytime comfort more strongly.

Hygroscopic materials can absorb and release water vapour as indoor humidity changes. McGregor, Heath, Shea and Lawrence (2014) found that unfired earth can contribute meaningful moisture buffering, though performance varies with soil, fibre, density and coating. Vapour-open finishes preserve this capacity; impermeable paints and dense cement renders reduce it. The design objective is not to keep earth universally dry, which is impossible in a humid climate, but to prevent liquid-water loading and allow assemblies to dry safely.

5.3 Strength, durability and risk

Earthen construction must be matched to load, exposure and workmanship. Compressive strength improves through compaction, particle grading and stabilisation, but excessive cement undermines environmental benefits. Structural walls require verified soil classification, sample production, dimensional control, wet and dry strength testing, erosion or spray testing where relevant, and engineering design. Bamboo and timber similarly require species and grade control, protected bearings, termite management and connection design. The absence of testing should never be defended as authenticity.

Durability is best understood as a design-and-maintenance outcome. “Good boots and a good hat”—a drained foundation and protective roof—remains sound earthen-construction logic, but contemporary projects also need damp-proof courses, controlled service penetrations, flashings, accessible gutters and site drainage sized for intense rainfall. Figure 3 translates this logic into a conceptual wall section. It is not a construction detail and must be engineered for the site.

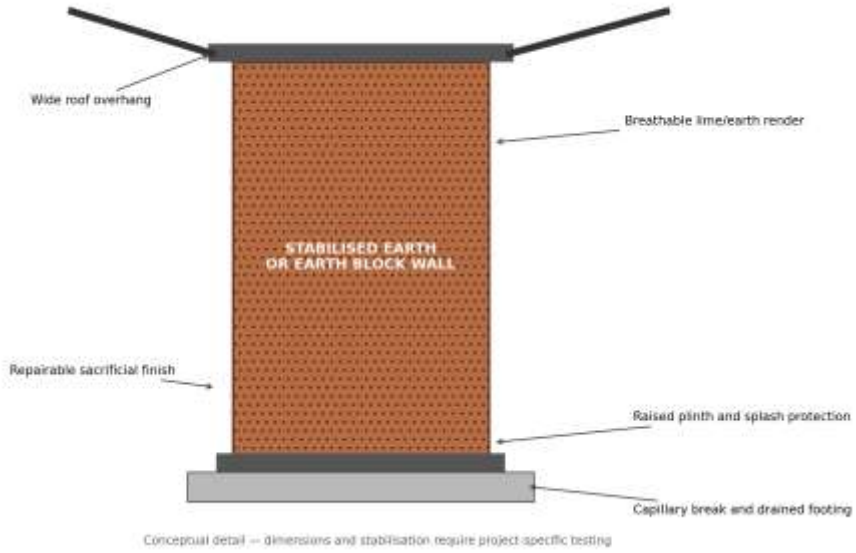


Figure 3. Conceptual moisture-safe adaptation of an earthen wall assembly. Source: Author's analytical illustration, 2026.

5.4 Circularity and repair

Indigenous assemblies were often dismountable or materially simple: a damaged thatch zone could be renewed, a timber member replaced, and an earth finish remixed. Contemporary construction frequently substitutes composite products bonded with irreversible adhesives. Reinterpretation should recover repair as a design criterion. Mechanical fixings, readable layers, accessible junctions and material passports can support future maintenance. Unstabilised earth can potentially return to soil; lightly stabilised blocks may be crushed for fill; untreated bio-based components can be repurposed or biodegrade safely. These possibilities depend on avoiding hazardous preservatives and documenting every treatment.

6 Synthesis and Framework for Contemporary Material Adaptation

The evidence reviewed in Sections 4 and 5 repeatedly links material choice to source conditions, workmanship, climate exposure, cultural use and maintenance. The following six principles are the author's design synthesis of those linked requirements. They are proposed decision steps for project teams and require project-level verification; they are not findings from field testing in this study.

6.1 Principle 1 Provenance before appearance

Specify where a material comes from, who processes it, whether extraction is regenerative and how far it travels. A bamboo screen imported across continents may resemble indigenous craft

but contribute little to the regional material economy. Conversely, a locally made earth block can be culturally mute if its production excludes local knowledge and its surface is concealed. Provenance connects environmental accounting with cultural agency.

6.2 Principle 2 Test the material that will actually be built

Generic claims about "mud," "bamboo" or "thatch" should be replaced by project-specific evidence. Earth requires particle-size distribution, plasticity, shrinkage, strength and erosion tests. Bamboo requires species, age, moisture, visual or mechanical grading, treatment and connection verification. Thatch requires source quality, bundle density, pitch, fastening, fire strategy and renewal planning. Mock-ups should be weathered and inspected before large-scale procurement.

6.3 Principle 3 Detail for the Southeast Nigerian climate

The region's warm-humid conditions and heavy seasonal rainfall demand shade, air movement and rapid shedding of water. Appropriate measures include elevated and drained bases, wide eaves, ventilated roof voids, shaded openings, cross-ventilation paths, rain-screen principles at highly exposed faces and separable sacrificial layers. These strategies reinterpret the protective logic of indigenous roofs and compounds without requiring literal reproduction.

6.4 Principle 4 Make cultural meaning legible

Identity should be developed through spatial hierarchy, material honesty, craft and participation. A contemporary civic building may reinterpret the obi as a shaded deliberative hall and the courtyard as a climate-moderated public room. Carved timber, terracotta relief, woven bamboo and earth pigments may communicate local narratives when their makers and meanings are acknowledged. Designers should record provenance and obtain consent where motifs have lineage, ritual or community ownership.

6.5 Principle 5 Design for replacement and care

A low-carbon material that fails without an available maintenance system is not sustainable. Specifications should state inspection frequency, replaceable zones, repair mixes and responsible trades. Roof edges, splash zones, bamboo ends and service penetrations should remain visible or accessible. Procurement can include training and a maintenance period so that skill transfer is part of project delivery.

6.6 Principle 6 Verify the whole-life outcome

Design teams should compare hybrid options using a declared functional unit, service life and boundary. At minimum, assessment should include cradle-to-gate carbon, transport, operational-energy implications, replacement intervals, biogenic-carbon assumptions, end-of-life scenarios, cost and local labour. The best option may be a mixed system—for example, an engineered frame with non-loadbearing earth infill, a ventilated metal weather roof above renewable ceiling layers, or compressed earth blocks at protected walls and durable masonry in persistently wet zones.

7 Discussion

7.1 From material substitution to material translation

Across the reviewed sources, cultural documentation explains why materials and spatial practices matter, while technical studies show that performance depends on specific material properties and assembly conditions. These strands converge on a practical conclusion: material substitution alone cannot deliver either cultural continuity or reliable environmental performance. For example, the contextual embodied-energy comparison in Section 5 suggests a potential advantage for stabilised soil blocks over fired products in the study from which the values were drawn, but it does not establish a Nigerian project outcome. Likewise, moisture buffering and thermal mass are conditional benefits, not substitutes for shading, ventilation and rain protection. Material translation therefore means carrying forward relationships among material, climate, labour, meaning and care while adapting technical form and verifying the result locally.

7.2 Productive hybridisation

The reviewed evidence supports hybridisation as a practical route, provided that each component has a defined role and its performance is checked. A protected earthen infill within an engineered frame, a drained plinth below a breathable wall, or a ventilated roof that combines a weather-resistant outer layer with a renewable inner layer may address constraints that historic assemblies did not face in the same way. These are design options inferred from the evidence, not assemblies tested by this review. Their acceptability depends on calculations, mock-ups, code approval, cultural participation and maintenance planning.

7.3 Barriers to adoption

The synthesis identifies connected implementation barriers: low client confidence and status stigma; limited supply of graded, warrantied materials; gaps in professional training and test

data; and approval practices that favour familiar industrial products. These barriers explain why evidence of material potential does not by itself produce adoption. They also show where the proposed framework can help: provenance and testing address supply uncertainty; assembly and whole-life checks address technical and approval concerns; cultural review and maintenance planning address legitimacy, skill and care. The framework organises responses to barriers, but policy support, local testing capacity and demonstrated projects remain necessary.

7.4 Institutional and policy implications

Universities, professional bodies and state agencies can respond through demonstration projects, climate-exposure sites, shared testing facilities and open regional material data. Public procurement can require transparent option studies comparing local assemblies with standard construction, while building-control agencies can publish performance-based approval routes for alternative walling and renewable structural materials. Heritage policy can support occupied, evolving buildings and craftspeople's livelihoods alongside monument conservation. These measures are implementation proposals arising from the synthesis; their effectiveness requires evaluation.

8 Recommendations

For architectural practice, the material brief should precede schematic design and include soil, fibre, timber and craft mapping within the project region. At least one full-scale envelope mock-up should be built for institutional projects using earth, bamboo or thatch. Specifications should define tests and acceptance criteria, not rely on generic labels. Moisture and termite strategies should be drawn at junction level, while maintenance obligations should appear in handover documentation.

For research, the priority is an open, multi-state evidence programme across Abia, Anambra, Ebonyi, Enugu and Imo. It should combine oral histories and craft documentation with laboratory tests, outdoor weathering and post-occupancy monitoring. Comparable studies should report soil grading, stabiliser percentage, density, moisture, wall thickness, orientation, ventilation and weather conditions. Whole-life carbon datasets should use Nigerian electricity, cement, fuel and transport factors rather than importing foreign inventories without adjustment.

For education and policy, architecture and construction curricula should treat indigenous material systems as contemporary technical knowledge. Apprenticeship partnerships can connect universities with earth builders, carvers, bamboo workers, roofers and finishers. State pilot

projects—community halls, markets, visitor centres and school pavilions—can provide the monitored evidence needed to normalise approval and insurance.

9 Conclusion

This review synthesised 25 cited works on Igbo architecture and relevant material, environmental and technical evidence. Within that corpus, the clearest supported conclusion is that earth, timber, bamboo, plant fibres, stone and natural finishes carried cultural meaning through their sourcing, workmanship, spatial use and cycles of repair. The technical literature also shows that reported benefits are conditional: earthen performance depends on moisture-safe detailing and material quality; bamboo and timber require grading, protection and reliable connections; and plant-fibre roofing requires fire and renewal strategies. The quantitative energy values discussed in this paper come from a comparative study outside Nigeria and should be treated as contextual evidence, not local measurements.

The paper's original contribution is an integrative, six-part design framework—provenance, characterisation, climate-responsive assembly, cultural review, maintenance and whole-life verification—that makes the relationships among cultural continuity, adaptation and performance explicit. This framework is a proposed practice tool, not a validated model. Its application should be tested through regionally sourced material studies, monitored occupied buildings, whole-life carbon inventories and community-led documentation across Southeast Nigeria. The review is limited by a purposive cited corpus and the absence of the original dated search log, database names and screening counts. These gaps, together with limited local performance data and unevenly documented craft knowledge, define the next research priorities. The framework offers a disciplined starting point for tested hybrid architecture grounded in Igbo material knowledge.

Acknowledgements

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Conflict of Interest

The author declares no conflict of interest.

Data Availability

No new dataset was generated. All evidence used in the synthesis is available in the cited publications.

Ethical Statement

The study was based on published literature and did not involve human participants, personal data or animal subjects; institutional ethical approval was therefore not required.

Tables

Table 1. Indigenous material systems, cultural roles and contemporary adaptation opportunities. Source: Author's synthesis.

Material system	Documented role	Principal opportunity	Critical risk	Adaptation direction
Earth/laterite	Walls, floors, plaster, modelling, pigment ground	Low-process walling; thermal mass; moisture buffering	Rain erosion, capillary rise, incompatible coatings	Tested CEB/rammed earth; raised base; wide eaves; breathable finish
Timber	Posts, beams, rafters, carved doors and columns	Renewable structure and identity-bearing craft	Deforestation, termites, decay, ungraded supply	Certified source; grading; dry details; replaceable joints
Bamboo/cane	Lattice, frame, ceiling, screen, ties	Lightweight frames, shading and ventilation	Splitting, insects, fire, unsafe treatment	Species/age control; boron-based or approved treatment; protected ends
Thatch/palm fibre	Roofing, mats, screens, ties	Low-conductivity, ventilated and repairable layers	Fire, decay, social stigma, maintenance	Dense treated panels; fire separation; accessible replacement
Stone/gravel	Bases, paving, drainage edges	Durable splash zones and landscape infiltration	Quarry impacts; poor detailing	Selective local use; drained plinths; permeable paving
Earth/mineral/plant finish	Surface renewal, colour, uli-related expression	Low-toxicity finish and cultural narration	Weathering; appropriation; inconsistent recipes	Mock-ups; vapour-open mixes; maker attribution; maintenance plan

Table 2. Indicative performance characteristics and verification needs. Sources: Berge (2009); Houben and Guillaud (1994); ISO 19624 (2018); ISO 22156 (2021); Minke (2006); Reddy and Jagadish (2003).

System	Useful performance	Reported/indicative evidence	Project verification
Stabilised soil block	Low processing energy; thermal capacity	0.42 MJ/kg in one comparative study; value is system-specific	Soil grading, stabiliser dose, density, dry/wet strength, erosion, carbon
Concrete block	Familiar supply and approval pathway	0.92 MJ/kg in the same comparative study	Strength, cement content, curing, transport, thermal bridge effects
Fired clay brick	Durability and modularity	2.94–3.75 MJ/kg for two brick routes in the same study	Kiln fuel, firing efficiency, source distance, strength
Bamboo culm	High strength-to-weight; rapid renewability	Properties vary strongly by species, age, moisture and direction	Species, maturity, grading, preservative, joints, fire strategy
Thatch layer	Low conductivity; ventilated roof potential	Performance depends on species, thickness, density and moisture	Pitch, bundle density, fixing, ignition resistance, decay and renewal

Table 3. Six-stage decision framework for material adaptation. Source: Author's synthesis.

Stage	Decision question	Minimum evidence	Design output
1 Provenance	Is the resource locally appropriate and responsibly obtained?	Source map, harvest/extraction method, transport distance	Material provenance schedule
2 Characterisation	What is the actual material quality?	Laboratory/field tests; grade; moisture; treatment record	Acceptance criteria and rejected-use limits
3 Assembly	How will layers manage load, heat, water, insects and fire?	Calculations, junction drawings, mock-up tests	Coordinated performance specification
4 Cultural review	Whose meaning and labour does the design carry?	Stakeholder/craft consultation; motif provenance	Cultural narrative and attribution record
5 Maintenance	Can components be inspected, repaired and replaced?	Access plan, repair recipes, skills and cost	Maintenance manual and replacement zones
6 Whole life	Does the option perform over the defined service life?	Carbon, cost, replacement and end-of-life scenarios	Transparent option appraisal

Table 4. Priority research agenda for Southeast Nigeria. Source: Author's synthesis.

Research need	Suggested method	Core variables	Intended outcome
Regional earth atlas	Sampling and geotechnical/mineral testing across five states	Grading, plasticity, shrinkage, strength, erosion	Suitability maps and mix-design ranges
Occupied-building performance	12-month post-occupancy monitoring and interviews	Temperature, humidity, air speed, energy, comfort, maintenance	Climate-calibrated design guidance
Bamboo supply and durability	Species inventory, grading trials and exposure racks	Age, moisture, treatment, connection, fungal/insect attack	Certified supply and safe treatment protocols
Whole-life carbon	Nigeria-specific process and transport inventory	Energy, fuels, cement dose, distance, replacement, end of life	Comparable environmental product data
Cultural continuity	Community-led case studies and craft documentation	Spatial use, terminology, motif ownership, labour and gender	Ethically governed design knowledge repository

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