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Architectural solutions towards minimizing maintenance problems in the design of public theatres

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Abstract

Public theatres are important cultural landmarks and breeding grounds for artistic expression, but many suffer from rapid physical degeneration as a result of poorly applied maintenance approaches in Nigeria. Using Theatre design as a focal case, this study investigates how architectural design could serve as a proactive tool in minimizing maintenance challenges. It provides a critical analysis of design decisions, spatial organization, material specification, detailing, and site planning and the maintenance demands they create. Utilising as a primary approach a comparative analysis of existing theatres located in Lagos, Benin, and Makurdi, alongside field observations, checklist evaluations, and structured interviews, this study identifies some major design-based maintenance challenges.

Research conducted shows that bad detailing, closed service zones and the use of different materials not compatible with the environmental conditions are the three main causes of rapid degradation. To overcome the above limitations, the study suggests a maintenance-oriented typological framework that encompasses- climate responsive design, durability of materials, modular building systems, and opportunistic access. The results support a design approach that fosters maintainability from the conceptual stage to sustain building life, decrease operational expenditures, and promote the ongoing cultural relevance of the national theatres. The results present a provable model for sustainable theatre design in comparable socio-environmental conditions of Nigeria.

Keywords: Building maintenance; Public theatres; Architectural design; Maintenance challenges; Comparative analysis

1. Introduction

Theatres, as architectural landmarks, serve as cultural hubs and a testament to the artistic and historical identity of societies. The National Arts Theatre is one of several historically significant performing theatres that have stood in Nigeria as icons of national pride and artistic expression. But the reality of many of these buildings tell a sad story that of structural decomposition, neglect, and bad maintenance practices. Author [1] indicates that the rising costs of building maintenance is related to aging buildings and absence of a pre-planned strategy. This is true especially for theatres, which represent and encode symbolic and often complex architectural spaces.

According to [2], many Nigerian theatres are in sad states and this has affected their public appeal and usage. This is further substantiated by Eni [3] who explains this decay as a result of poor maintenance practice, and Ikpo [4] who describes the decay of public infrastructure as a result of neglect and indifference leading to the enterprise losing its cultural and functional value. The National Arts Theatre in Lagos is referenced as a prime model of a once defining edifice of national grandeur of pre-independence Lagos of Art and Culture now languishing into a model of a monument of governmental neglect.

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Although discourse on maintenance in the public building sector has often been framed in terms of policy and resource allocation, several researchers [5,6,7] have criticized the failure to address issues that must be considered at the project design stage. Poor architectural decisions, they argue on detailing, material specification, spatial organization and construction systems can have a significant effect on the life expectancy and maintenance demands of buildings. Studies [1,8] have, therefore, called for an integration of maintainability within design thought processes, claiming that maintenance problems can be mitigated early in the process, resulting in lower lifetime costs.

As such, architects are approaching the design phase in a way that mitigates maintenance issues. According to [9], realizing the end-user's proclivity for neglecting maintenance sound itself is the reason architects should produce buildings requiring little intervention. Though authors [10] believe maintenance-free architecture is not likely, it is important to note that fewer recurring issues can be avoided through quality design. [11] further call for designers to plan for maintainability in addition to aesthetics and functionality, designing buildings that are both expressive and sustainable.

The study presents springboard from which to reimagine theatre design in Nigeria. Identifying critical design-related maintenance challenges in existing theatres include poor drainage systems, wrong material specification, and inaccessibility for maintenance operations [12] as evaluated by existing theatres like the National Arts Theatre in Lagos, the Oba Akenzua Cultural Centre in Benin, and the Aminu Isa Kontagora Theatre in Makurdi. From these findings, these are the processes that focus on convenient architecture, mature material uses and rational space planning, as well as responsive construction methods.

The paper seeks to contribute to the emerging architectural discourse on sustainable design solutions that reduce the maintenance demand thereby promoting sustainability and conserving both cultural heritage and the long-term utility of Nigeria's theatre infrastructure.

2. Literature review

2.1. Building maintenance: concepts and classifications

Building maintenance refers to all the tasks designed to keep a building function, performance, and appearance over time. According to [13], it is work that is done to preserve or recover a building and its fittings to an adequate condition for ongoing usage. According to [14, 15] the British Standards Institution (BS 3811, 1984) grouped maintenance activities into planned and unplanned activities, which covers preventive and corrective. Preventive maintenance is undertaken to prevent failures from happening, while corrective maintenance resolves defects after they have happened [16]. According to [17], there are three main stages in building maintenance: the planning and design stage, the construction phase, and the post-occupancy phase. One of the important conclusions drawn from this classification is that long-term maintenance is determined during the early stages of the design process, hence, reinforcing the importance of pre-emptive maintenance planning at architectural level

2.2. Relationship between design and maintenance

Several researchers have thoroughly examined the connection between design and maintenance, emphasizing that building defects, as well as material performance and durability over time, are largely influenced by design decisions [18]. Unfortunately, [5,19] complains that maintenance is rarely planned from the design stage, and hence constant problems re-occur during post occupancy stages. Some called for maintainability to be an integral part of design. This includes [20], who believes appropriate design can reduce maintenance work and long-term costs. On the same note, Lam [21] argue that maintenance problems are commonly due to poor design from inception. Data sets used by [22], prove the inverse relationship between higher quality of design and higher frequency of maintenance, thus proving the direct cause-and-effect relationship.

2.3. Architectural design factors affecting maintenance

Based on the above reasons, a conceptual model of the various building factors and elements from the design stage as shown in Figure 1 which has been developed through review of literature will be studied to possibly minimize the maintenance problems at the post occupancy stage of a building.

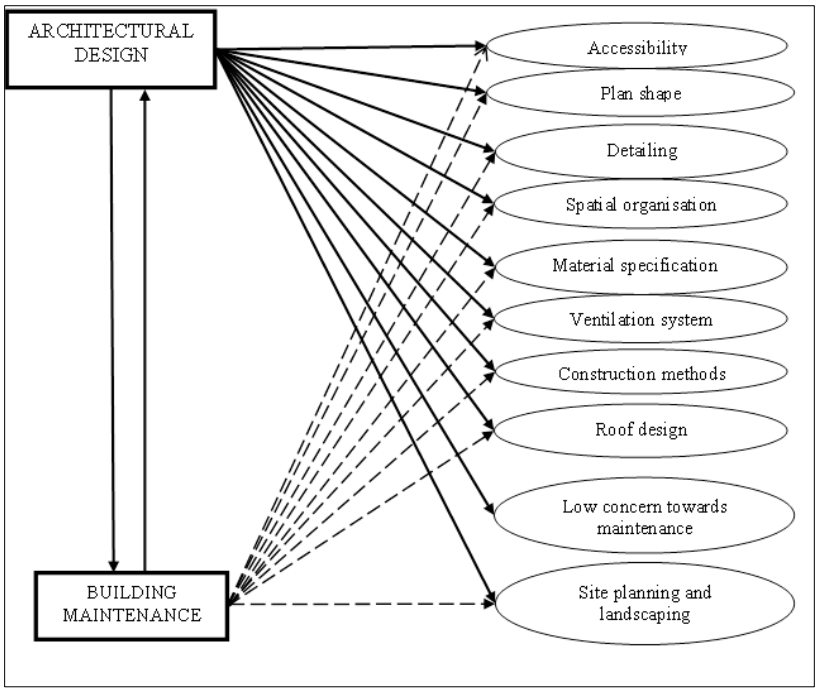

Figure 1 Conceptual frameworks of architectural Design and maintenance

- Accessibility. [23] highlights a poor access level to necessary areas of a building (e.g., roof spaces and facades) as a major cause for deferring building maintenance. The absence of key features such as catwalks make maintenance difficult and costly
- Building Form and Complexity. Modelling Form and Complexity of building geometries according to [24,25], add to both initial construction cost and future maintenance requirement. Public buildings such as theatres often have visual impact due to their size and placement; the surrounding land of a successful piece of architecture can often create a "Noisy" form like Ikpo [4] described that can decrease performance efficiency on a surface level, but a visually "noisy" design is usually chosen for symbolic or aesthetic reasons.
- Detailing and Construction Documentation. Defects and poor execution are a result of poor detailing and incomplete design specifications. According to [23], insufficient drawings can lead to misinterpretation at the time of construction causing permanent damage to the structure
- Spatial Organisation. Spatial inefficiencies such as narrow corridors or inaccessible service zones are known to increase wear and tear, while reducing access to maintenance operations [8].
- Material Specification. One such misconception is that materials are the most common cause of defects when in reality this arises from an unsuitable material property being used in a particular climate or usage condition [26]. [9,27], note environmental interactions, including UV radiation, moisture, and temperature variation, as critical options during material selection. In public occupying spaces, such as with theatres, materials also have to pass performance requirements [16,28].
- Ventilation. Ventilation components in buildings such as windows, exhausts and ventilation ducts and air passages, serve as the respiratory organs and passages for buildings. According to [23,29] when certain areas in a building are not provided with adequate fenestrations it creates a room for thick moulds and fungal growth.
- Roof Design. According to Heath [30], complex roof designs increase the need for valley gutters to drain adjacent slopes, making them more susceptible to leaks. The study also found that roofing laid at a low pitch, especially in exposed areas, may allow rainwater penetration. Guyer [31] emphasized that sloped roofs, which effectively shed water, are less prone to leaks and require less maintenance than flat roofs.
- Site Planning and Landscaping. Author [32] advocates for sustainable landscaping using low-maintenance plants and paving systems to reduce the life cycle costs of external environments.
- Low Concern toward Maintenance. Author [33] noted that aesthetic considerations often override functionality during material selection. Designers often prioritize appearance over durability, thereby inadvertently increasing maintenance requirements.

3. Methodology

- Research Design. This study employs qualitative case study methodology to analyse how architectural design solutions could have alleviated maintenance problems in the design of public theatres. This methodology facilitates an analysis into the spatial, material, and structuring forces that impact theatre architectural maintainability. It is designed to facilitate the evaluation of existing design facilities, assessments of the maintenance issues, and the proposal of design interventions.
- Case Study Selection. Three case studies were purposely selected, the choice of which was influenced by their geographical relevance, architectural typology and functionality. These include:
    - The National Arts Theatre, Lagos
    - Oba Akenzua Cultural Centre, Benin City
    - Aminu Isa Kontagora Theatre, Makurdi

Selection criteria included geographical spread, performance type, building age, usage and maintenance issues reported.

- Data Collection Techniques. Data collection was conducted using visual survey, structured checklists and interviews.
- Visual Survey. Observational site visits were carried out to recognize architectural components impacting maintainability. These consist of roofing systems, facade finishes, access routes, drainage systems, and material degradation patterns.
- Checklist Assessment. Literature on building maintainability was used for structured checklist design, and the chosen checklists were subsequently used to evaluate spatial organization, material specification, roof design, and accessibility. The checklist guided the assessment in all three case studies
- Structured Interviews. Experiences of working staff at these theatres including facility managers, architects, and maintenance personnel interacting directly with daily operations were determined through interviews. The questions were directed towards maintenance irregularities, recurring challenges, and perception of design factors involved in building deterioration
- Variables of Analysis. The study focused on the following architectural variables, each linked to documented maintenance issues:
    - Building Form and Complexity
    - Material Specification and Environmental Suitability
    - Accessibility for Maintenance
    - Roof and Drainage Design
    - Ventilation and Thermal Comfort Systems
    - Spatial Organization
    - Site Planning and Landscaping
- Data Analysis. To ensure accuracy and depth, data obtained from the checklists, interviews, and visual surveys were triangulated. Finally, an applied comparative analysis across the three theatres looking for common patterns of maintenance and the design decisions behind them. The architectural strategies proffered for the design of future theatre, were informed by key findings.

4. Results and Discussions

Overview. The study assessed the architectural elements of existing theatre buildings in Nigeria with a focus on maintenance implications, particularly the National Arts Theatre, Lagos, serving as a precedent case for the design of a new theatre in Abuja. Using tools such as visual surveys, checklists, and structured interview.

Spatial Organization. Spaces like backstage areas, maintenance access paths, and high-level lighting zones lacked accessibility features. Dead spaces were underutilized as shown in Figure 2, encouraging neglect and increasing cleaning and surveillance costs.

(Source: Author's survey, 2014)

Figure 2a and 2b Poor state of maintenance within dead zones at the National Art Theatre, Lagos and Aminu Isa Kontagora Theatre

- Structure and Materials. The use of flat roofs with insufficient pitch and detailing led to persistent leakages (Figure 3).

(Source: Author's survey, 2014)

Figure 3 The deterioration of exterior walling material at the National Art Theatre, Lagos

Walling and ceiling materials as reflected in Figure 3 and 4 showed extensive deterioration due to poor material specification and lack of protective finishes against harsh weather conditions as shown in Figure 5 .

(Source: Author's survey, 2014)

Figure 4a and 4b The deterioration of exterior walling material at the Aminu Isa Kontagora Theatre, Makurdi.

(Source: Author's survey, 2014)

Figure 5 Exposed roof area to harsh weather conditions

5. Interview conclusion

Interview data from theatre facility managers highlighted poor material choices, limited access for maintenance, and overly complex aesthetics as recurring problems.

6. Checklist assessment

A checklist was used to assess the level of reflection of various factor based on a five-point scale ranging from very low-1point, low-2point, average-3point, high-4point and very high-5point.

Table 1 Checklist for the Assessment of Design and Maintenance at the National Art Theatre, Iganmu, Lagos

S/N	variables	Checklist	Level of application					Remark
			1	2	3	4	5	
1	Building Form	Complexity of design					✓	Building form indicated too complex which posed great challenges to maintenance.
		Poor detailing				✓		
		Drainage layout based on the form			✓			
2	Material	Suitability to the surrounding and climate of the region			✓			Materials used indicated averagely suitable to climate and usage.
		Suitability in relation to usage				✓		
		Availability of building materials			✓			
3	Site planning and landscaping	Use of low maintenance landscape element				✓		High use of low Maintenance materials.
		Poor drainage layout			✓			
4	Construction system	Flexibility of construction method			✓			High rigidity in the construction method
		Suitability to climate and environment			✓			
5	Spatial organization	Utilization of spaces			✓			The spatial organization were properly zoned
		Proper zoning of activities				✓		
6	Accessibility	Easy accessibility to various facilities			✓			few access routes provided

Table 2 Checklist for the Assessment of Design and Maintenance at the Oba Akenzua Cultural Centre, Benin, Edo State

S/N	Variables	Checklist	Level of application					Remark
			1	2	3	4	5	
1	Building Form	Complexity of design			✓			Although the design was averagely complex poor detailing was however high
		Poor detailing				✓		
		Drainage layout based on the form		✓				
2	Material	Suitability to the surrounding and climate of the region			✓			Availability of material was seen to be very high which can be easily sourced
		Suitability in relation to usage				✓		
		Availability of building materials					✓	
3	Site planning and landscaping	Use of low maintenance landscape element			✓			Poor consideration to site planning
		Poor drainage layout				✓		
4	Construction system	Flexibility of construction method		✓				High suitability of construction method to climate
		Suitability to climate and environment				✓		
5	Spatial organization	Utilization of spaces			✓			utilization of spaces was noted to be average
		Proper zoning of activities				✓		
6	Accessibility	Easy accessibility to various facilities					✓	Very high accessibility

Table 3 Checklist for the Assessment of Design and Maintenance at the Aminu Isa Kontagora Theatre, Makurdi

S/N	variables	Checklist	Level of application					Remark
			1	2	3	4	5	
1	Building Form	Complexity of design		✓				Poor detailing and drainage layout based on form indicated to be high
		Poor detailing				✓		
		Drainage layout based on the form		✓				
2	Material	Suitability to the surrounding and climate of the region			✓			availability of materials was seen to be high
		Suitability in relation to usage			✓			
		Availability of building materials					✓	
3	Site planning and landscaping	Use of low maintenance landscape element		✓				Low consideration was given to site planning and landscaping
		Poor drainage layout				✓		
4	Construction system	Flexibility of construction method		✓				Poor suitability of construction method to climate
		Suitability to climate and environment		✓				
5	Spatial organization	Utilization of spaces		✓				Presence of dead spaces and the poor planning of spaces.
		Proper zoning of activities		✓				
6	Accessibility	Easy accessibility to various facilities				✓		Easy accessibility based on low headroom

7. Summary of findings from case studies

- Building Form: Two key aspects were evaluated under building form: inappropriate detailing and drainage layout. In terms of detailing, both the National Art Theatre in Lagos and the Oba Akenzua Cultural Centre in Benin showed an average level of appropriateness. However, all three case studies exhibited significant issues with poor drainage layouts due to the building forms.
- Material: Regarding material use, the climate suitability of materials was found to be average across all three locations. When considering suitability based on usage, the National Art Theatre and the Oba Akenzua Cultural Centre both performed well, while the Aminu Isa Kontagora Theatre showed an average rating. The availability of materials at the National Art Theatre was also rated as average on a five-point scale.
- Site Planning and Landscaping: This aspect focused on the use of low-maintenance landscape elements and drainage layout. The Aminu Isa Kontagora Theatre was rated poorly in terms of landscape maintenance, while the Oba Akenzua Cultural Centre and National Art Theatre scored average and good, respectively. However, drainage issues were again a concern, with both the Oba Akenzua Cultural Centre and Aminu Isa Kontagora Theatre showing a high level of inadequacy.
- Construction System: All three case studies revealed limited flexibility in form. The National Art Theatre, in particular, demonstrated a high level of unsuitability in its construction method for the local climate, with building materials being overly exposed to the hot humid environment and acidic rainfall.
- Spatial Organization: In terms of space utilization, both the National Art Theatre and the Oba Akenzua Cultural centre scored 4 out of 5, reflecting effective use of space. In contrast, the Aminu Isa Kontagora Theatre scored only 2, indicating poor space utilization.
- Accessibility: Maintenance accessibility varied across the buildings. The National Art Theatre was rated poorly in this regard. Conversely, the Oba Akenzua Cultural Centre performed well, with access facilitated through staircases and open units like courtyards. The Aminu Isa Kontagora Theatre was rated average, benefiting from its low ceiling heights, which eased access for maintenance.

8. Design responses

Based on findings from Lagos and other case studies, a proposed theatre design should integrate several architectural features aimed at minimizing maintenance challenges:

8.1. Site Planning Enhancements

The landscape design should be paved surfaces with defined water drainage slopes and gravel-based lawns to reduce vegetation overgrowth and ponding.

Route demarcation can be achieved with durable interlocking pavers, simplifying wayfinding and reducing landscape wear.

8.2. Spatial and Accessibility Solutions

The spatial layout should enabled be easily accessible to high-level systems through suspended ceilings and demountable roof panels.

Clustering of wet areas (restrooms) minimized plumbing runs, reducing leak potential and repair complexity

8.3. Material Specification and Environmental Adaptation

Selection of materials should be chosen based on climatic suitability, including the use of low-emissivity glass, thermally stable roof finishes, and UV-resistant coatings

External finishes should incorporate weather-tolerant paints and cladding to reduce fading, flaking, and microbial growth.

8.4. Roofing and Drainage Detailing

A sloped roofing system should endure fast runoff and prevented water accumulation.

Roof members should be designed for easy dismantling using bolted steel frames to simplify periodic inspections.

8.5. Flexibility and Long-Term Use

Flexible construction components allow for reconfiguration and future adaptations, reducing demolition or invasive repairs.

Openings and cross-ventilation designs promote passive airflow, lowering the dependence on HVAC systems and reducing mechanical wear.

9. Summary

This study investigated the underlying architectural principles that have led to maintenance problems in Nigerian theatres with an exploration of the connection between design decisions in architectural buildings and the long-term maintenance performance of public performance buildings. An evaluation of architectural attributes pertaining to site planning, spatial organization, building form, material specification, detailing and maintenance accessibility through a comparative analysis of three selected case studies—the National Arts Theatre, Lagos, Oba Akenzua Cultural Centre, Benin and Aminu Isa Kontagora Theatre, Makurdi.

The key findings are that maintenance challenges in these theatres are primarily derived from design decisions made at the drawing board level. Some of the most common causes of failure include lack of detailing (e.g., insufficient drainage systems), use of wrong materials unsuitable for local climatic conditions, service zones which are not accessible, and emphasis on aesthetics over functionality and maintainability. This research showcased that by implementing maintenance-conscious related approaches early in the design stage will minimize degradation, as well as resources used over time, in addition to savings in operating costs.

10. Conclusion

The study found that the architectural design is one of the most important determinants for the maintainability of a building, especially for theatres with functional and symbolic importance in city centres. At the design stage, failing to take maintenance aspects into account has aggravated the rapid deterioration of existing facilities. Architects sometimes focus on lifespan and desire to create iconic forms that have long term need for maintenance, which leads to a high demand of maintenance and early degradation of the structure. Thus, theatre design must entirely consider the environmental advice, material selection, ease of access for maintenance, and functional spatial configuration right from the very beginning, to uphold sustainable performance.

Recommendations

From the research conducted, the major findings suggests that with a comprehensive study by the architects from the drawing board, a better recourse to address the issue of defects, particularly with respect to how these problems and defects can be managed and avoided in future. Therefore, the following recommendations should be applied;

- Enlightening architectural professionals that design goes beyond just lines and forms but also involves futuristic projections and adopting a more open-minded approach toward maintenance during the design stages of building. Special care therefore should be taken since the design stage has a vital effect on the amount of maintenance work that will be needed after the building is completed.
- Performing art theatres should integrate facilities for a much wider spectrum of users. These edifices should not only serve as venues for performances, but should serve recreational purposes, conferencing, educational and commercial purposes as well. This helps to avoid the negligence of various facilities due to non-utilization

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