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Evaluation of Building Condition and Maintenance as a Panacea for Preventing Building Collapse in Nigeria: The Case for Correctional Buildings

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Abstract: Buildings are constructed with the aim of lasting for a certain duration of time while achieving other ancillary benefits, such as functionality, aesthetics, affordability, comfort, and pleasure for the occupants. Over the years, correctional facilities and other buildings have become derelict within some period of construction due to a lack of adequate maintenance, which resulted in dilapidation and probably collapse. This paper evaluated the building condition and maintenance of correctional facilities. The objective is to reduce incessant building collapse in Nigeria. A survey approach was adopted in the collection of data from the relevant Niger State prison staff population of 120 workers, including staff in the maintenance unit, within a specific period. A stratified sampling technique was used to generate a sample that was used to collect data representing the entire population across the prisons. The results from the study identified poor maintenance of correctional facilities which could cause building deterioration and which could eventually pave way for the building to collapse. The study suggests continuous evaluation of maintained correctional facilities to ascertain their condition and performance levels.

Keywords: Building Condition, Building Collapse, Building Maintenance, Correctional Buildings, Nigeria

1. Introduction

Douglas [1] asserts that a structure is a crucial physical asset for every facility. Facilities management (FM) is the administration of constructed assets, such as buildings, in order to provide users with the best possible service. The building's performance, however, degrades when it is finished and put to use, so it does not last as long in good condition [2]. In terms of space, a building serves three main purposes: it shelters occupants from the elements, ensures their safety, and affords them privacy. As time passes, however, so does the progress of construction. To facilitate human activity in the modern world, a building has served several functions. As our activities evolved, the roles were rapidly shifting.

In Nigeria, the majority of public and private structures confront maintenance issues that cause deteriorations and eventual faults of varying degrees [3]. The 1974 version of BS 3811 defined building maintenance as work done to maintain a building or restore it to its original state or to a currently acceptable standard, as opposed to the 1984 version, which defined maintenance as the combination of all technical and associated administrative actions intended to retain an item or restore it to a state in which it can perform its required function. Because it is supposed to survive for around 60 years, a building may become worn out and need care after 5 years [4].

Moreover, issues like wear and tear or even user abuse may make ongoing maintenance necessary [1]. According to Emechebe & Eze [5] building exploitation without sufficient upkeep and evaluation led to deterioration and possibly collapse. Some factors and agents of building deterioration included ageing stock of building, obsolescence of building and environmental or climatic issues, moisture, selection of

materials, design maintainability seem predominant. Even the best-built buildings require ongoing maintenance, and if that repair is delayed, even something very little might swiftly escalate into an expensive man-made tragedy. Several studies show that bad maintenance culture is one fundamental component that can cause building collapse [6]. Building consultants, governments, developers, landlords, and users are all facing major issues as a result of the rise of building collapses in Nigeria [7].

Until now, there have been significant setbacks in Nigeria's correctional facility maintenance. This problem has led to outdated prison facilities, which are hazardous to the inmates' health. In addition to satisfying minimum standards for health, ventilation, floor space, heat, and lighting, prison facilities are also intended to be fit for purpose, secure against assault, aid in the rehabilitation of prisoners prior to their release, and consistent with current legal frameworks [8]. Several prisons in Nigeria face maintenance-related issues, including cell block neglect, sick building syndrome (itchy skin, headaches, stuffy nose, etc.), insufficient ventilation, and facility decadence. Due to insufficient funding from the appropriate authorities, it frequently happens that facility maintenance does not correspond to real maintenance demands. The reactive maintenance approach syndrome is mostly to blame for these issues.

The study used a survey research design and a literature review to assess the upkeep and condition of the Nigeria prisons' buildings. Sample questionnaires were sent to the building maintenance division, the staff and officer's quarters, and other participants in order to gather data. The outcome demonstrates a lack of upkeep of the prison facilities. In order to avoid collapse due to dilapidation, the study's objective is: (i) to investigate the building conditions and maintenance of the buildings (ii) To investigate the maintenance rate of the buildings. (iii) To highlight some possible causes of maintenance and dilapidation that eventually leads to collapse in buildings.

2. Literature Review

The general goals of the prison's reformative, corrective, and rehabilitative functions must be in line with the maintenance unit's goals and actions [9]. Planning, organising, monitoring, and analysing maintenance operations and their costs can be done in an organised and methodical way using maintenance management [10]. Additionally, it entails planning, organising, and carrying out maintenance procedures to guarantee the highest possible levels of facility availability and general efficiency of any plants, structures, or facilities [11]. Clear maintenance procedures and methods are part of the process, and they can be used to keep facilities operational while reducing breakdowns [12].

Building maintenance expenses could cost between 15% and 70% of the entire cost of production [13, 14]. After energy expenditures, this represents the second-largest portion of the operating budget. The expected cost of maintenance in the United States rose from $200 billion in 1979 to $600 billion in 1989 [15]. Maintenance operations account for an average of 28 percent of the total cost of finished goods [16]. The machinery has evolved to be highly automated and technologically complicated, which is one of the factors contributing to the maintenance costs making up such a large portion of the overall operating costs [9]. There are strategies or types used to ensure proper maintenance of a building.

Building collapse may be caused by either man-made factors, also known as human errors, as a result of poor design and construction methods due to poor or inadequate geospatial data, or by natural disasters such as earthquakes, hurricanes, or floods. According to Emiedafe [17], there are different types of maintenance (e.g., corrective, preventive, condition-based, emergency, and unpredictable) that should be done to prevent further deterioration and eventual collapse. However, man-made factors are typically the main cause of building collapses in Nigeria [3]. Lack of maintenance, a weak structural design, high-quality building materials, and human resources are some of the contributing reasons.

Tanko *et al*. [18] stated in the analysis of the study that quackery, poor supervision, poor materials, carelessness, and poor workmanship were the principal culprits in the reported building failures. The level of a building's performance is determined by these elements. Building condition assessment and performance evaluation could not be separated because a building's condition is usually used to gauge the building's performance [19]. A building's outward appearance can be used to roughly assess its capacity. Because of this, a building's state is increasingly used as a benchmark for assessing its performance. It has been connected because it is the ideal technique to gauge how well a structure is performing.

Ogunmakinde *et al*. [20] asserted a wide range of elements (Figure 1) contribute to the need for maintenance work on buildings; as a result, it is important to understand the root causes and agents of building deterioration in order to prevent the development of these flaws. New materials and construction methods, bad workmanship, improper positioning of materials, substandard materials used, poor supervision of construction work, and a lack of quality control and monitoring are some of the main causes of maintenance issues [6]. A framework of the potential causes of building maintenance is shown in detail in Figure 1. The common factor of deterioration and the agent of deterioration are shown in the figure as the major variables, with various sub factors that lead to building maintenance falling under them.
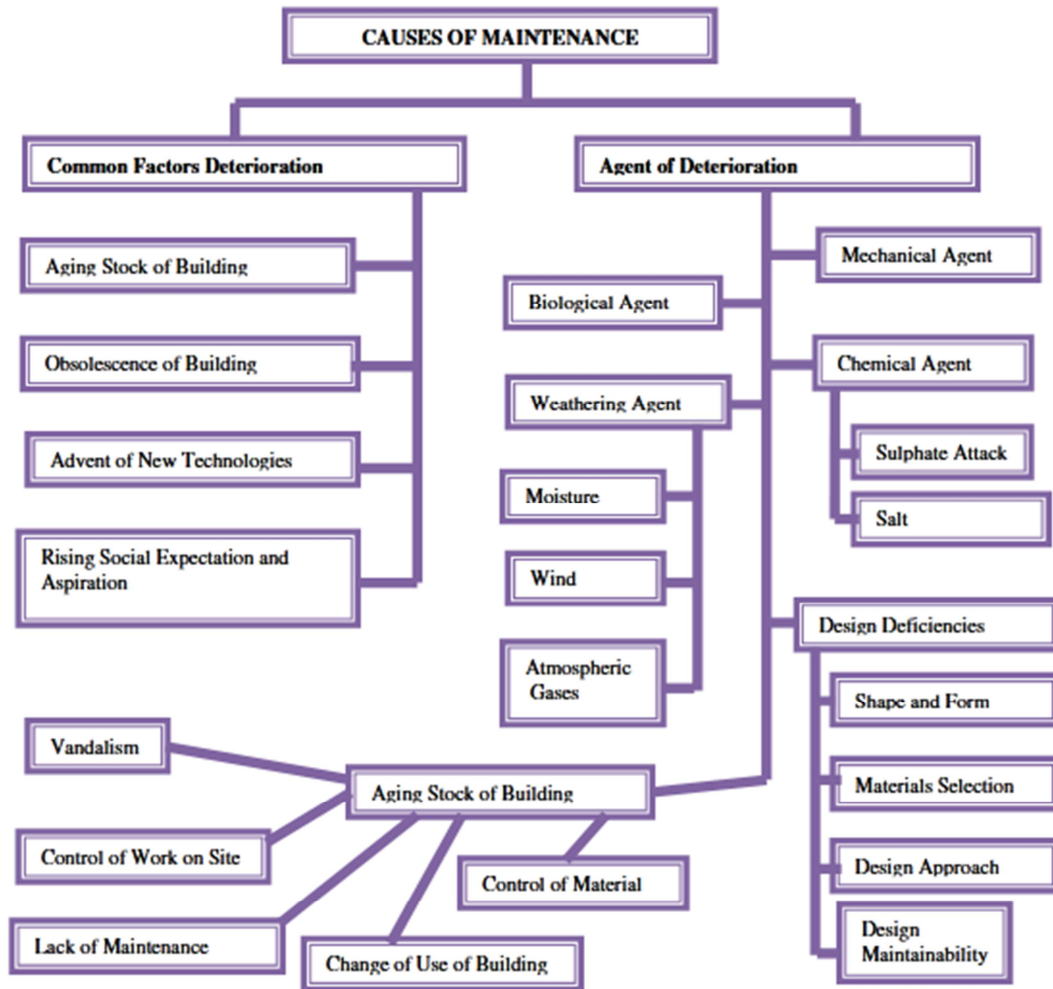
Source: Modified from Ogunmakinde *et al*. [20]

Figure 1. *Causes of Building Maintenance.*

Gibson [21] cited in Wahida *et al.,* [2] posited that building performance is correlated with a building's or building product's aptitude. It has been in use for a long time and only considers the user's wants and the goals set for the business process. Verifying the need and suitability of a building purpose, asset, facility, building product, or service seems to be a process from the outset. Building performance is clearly something that a building may attain through its use as a physical resource of facility management that has been targeted to the business process. Poor building performance can result to abandonment of the building that a result to collapse. Ayeni & Adedeji [22] reveals in their study that mitigation of building collapse can be achieved in Nigeria through collaborative efforts of all stakeholders involved and concludes that architectural education could serve a supportive role.

3. Research Methodology

The study area is Minna, the capital city of Niger State situated in the north central geo-political zone of Nigeria. It is a large community that connects Abuja, Kano, Ibadan and Lagos. It occupies a land mass of 76,363square kilometres. It is geographically located between longitude 6° 34' E and 6° 42'E and latitude 9° 33' N and 9° 45'N above the equator and east of the Greenwich Meridian respectively (Figure 2). The study adopted a survey research design conducted in the prison/correctional centre in Minna, Niger State, Nigeria. The study adopted a quantitative survey approach and utilized primary data. This primary data was obtained through a field survey and relied on a questionnaire as an instrument. The sampling frame for the study comprised the officers' and building maintenance departments.

The selected correctional centre was examined to understand the level of maintenance on the listed items used in the questionnaire. In obtaining the data for the assessment of the building, regarding the views on the maintenance for sustainability of the buildings, reference was made to addressing the wards and maintenance department for a proper assessment. Out of 150 questionnaires administered, 138, which represent 92% of the questionnaires, were recovered, and 120 were retrieved for analysis, which is why 18 questionnaires were invalid.
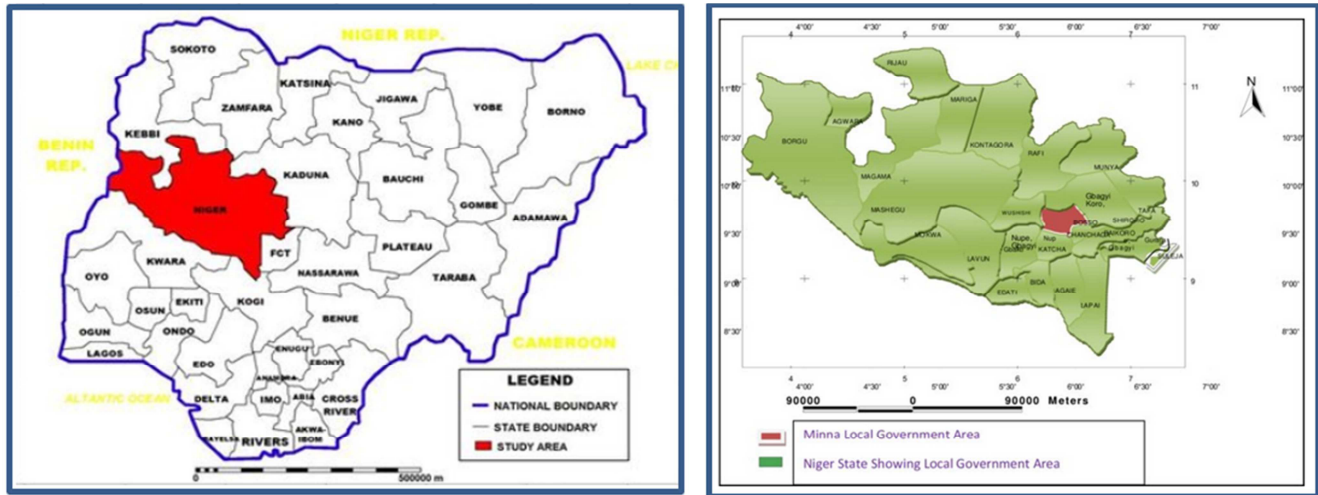
Figure 2. Map of Nigeria showing Niger State and Map of Niger State showing Minna.

Statistical Package for Social Sciences (SPSS) version 16.0 was used in analysing the data in order to provide accurate and realistic results obtained from the respondents. Descriptive statistical analysis tools were employed. Data were also summarised using tables for interpretation. Statistics were based on frequencies, percentages, and mean scores. The results were ranked and commented on. 150 questionnaires were distributed among the respondents, and 120 were returned. This represents a response rate of 80%. The response rate obtained substantial information due to the higher number of respondents, and adequate information was obtained. Also, the response is higher than other studies, which recorded 57.5% in the study conducted by [23] and 77% in another study conducted by Akande *et al.,* [24].

4. Findings and Discussion

The characteristics of the buildings were classified using the building's age and functions. The prison warders, maintenance manager, and their team in charge were assessed. From Table 1, the data shows that the building stayed for over 30 years and above with a frequency of 107 and 89.25 percent, buildings from ages 26–30 with a frequency of 3 and 2.5%, buildings from ages 21–25 with a frequency of 2 and 1.7%, buildings from ages 16–20 with a frequency of 5 and 4.2%, and buildings from ages 11–15 with a frequency of 3 and 2.5%. According to Zubairu [25] whose study focused on office buildings stated that 50 years and above as expected life span of the external material of a building before dilapidation. This implies that buildings need to be constructed with quality materials that can enable the building stay up to the number of years. The specific function the buildings visited were shown. From the data, there are total number of 117 public buildings visited with 97.5%. The result shows that the building is a public building known as correctional centre.

Table 1. Years in building.

Building Age		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	11-15 Years	3	2.5	2.5	2.5
	16-20 Years	5	4.2	4.2	6.7
	21-25 Years	2	1.7	1.7	8.3
	26-30 Years	3	2.5	2.5	10.8
	30 Years and Above	107	89.2	89.2	100.0
	Total	120	100.0	100.0	
Function of The Building		Frequency	Percent	Valid Percent	Cumulative Percent
	Public Building	117	97.5	97.5	97.5
	2.00	3	2.5	2.5	100.0
	Total	120	100.0	100.0	

To evaluate the building condition and maintenance of correctional services to prevent building collapse, respondents were asked if there was any building maintenance manager employed to identify the maintenance needs of the building. The results of the respondents are shown in Table 2. The results show that the correctional centre lacks a maintenance manager, which was reviewed by 57% of the respondents. The buildings lack proper maintenance, which is the key to keeping the correctional centre fit for use by both prison guards and prisoners in general. Olatunji [26] stated that buildings require someone to manage their maintenance. In the study, there are maintenance operators. This implies that adequate attention should be given to having a good maintenance manager identify some maintenance needs in the building.

Table 2. *Any building maintenance manager employed to identify the maintenance needs of the building.*

		Frequency	Percent	Valid Percent	Cumulative Percent
	Yes	9	7.5	7.5	7.5
	No	18	15.0	15.0	22.5
Valid	No	51	42.5	42.5	65.0
	4.00	42	35.0	35.0	100.0
	Total	120	100.0	100.0	

Table 3 shows that 64.1% of the respondents revealed that there had been no proper assessment of the building's performance since it was built. This indicates that the building lacks adequate maintenance. Assessment and performance are lacking within the correctional center and are not carried out as they should be to check the level of default within the buildings for proper maintenance on them. Ajayi *et al.*, [8] stated that the condition of buildings or facilities is a measurement maker, and a typical way is to measure and predict the performance of facilities.

Table 3. *Any condition assessment performed for this building since built.*

		Frequency	Percent	Valid Percent	Cumulative Percent
	Yes	6	5.0	5.1	5.1
	No	19	15.8	16.2	21.4
Valid	No	58	48.3	49.6	70.9
	4.00	34	28.3	29.1	100.0
	Total	117	97.5	100.0	
Missing	99.00	3	2.5		
Total		120	100.0		

From Table 4, it shows that 19.2% of the respondents consider the correctional centre uses work orders for maintenance, while a lower percentage (80.4%) agreed that no work orders were used at the centre.

Table 4. *Organization use work orders for maintenance work activities.*

		Frequency	Percent	Valid Percent	Cumulative Percent
	Highly Extent	3	2.5	2.5	2.5
	To Some Extent	20	16.7	16.8	19.3
Valid	Less Extent	58	48.3	48.7	68.1
	None	38	31.7	31.9	100.0
	Total	119	99.2	100.0	
Missing	99.00	1	.8		
Total		120	100.0		

Respondents were asked if there were plans for major repairs in the future. The result shown in Table 5 indicated that 16.6% of respondents believed that major repair plans were in advance, while 83.5%, to a lesser extent, believed major repairs were not planned in advance.

Table 5. *Shutdowns and major repairs planned in advance.*

		Frequency	Percent	Valid Percent	Cumulative Percent
	Highly Extent	1	.8	.9	.9
	Generated	18	15.0	15.7	16.5
Valid	Less Extent	57	47.5	49.6	66.1
	None	39	32.5	33.9	100.0
	Total	115	95.8	100.0	
Missing	99.00	5	4.2		
Total		120	100.0		

Table 6, shows that yearly maintenance goals and objectives shared maintenance personnel is not frequent. While, 81.7% shows that such program is not in place to check mate the buildings.

Table 6. *Yearly maintenance goals and objectives shared with maintenance personnel.*

		Frequency	Percent	Valid Percent	Cumulative Percent
	Highly Extent	1	.8	.9	.9
	To Some Extent	20	16.7	17.4	18.3
Valid	Less Extent	62	51.7	53.9	72.2
	None	32	26.7	27.8	100.0
	Total	115	95.8	100.0	
Missing	99.00	5	4.2		
Total		120	100.0		

Table 7 shows that the management does not follow up and review the housekeeping with maintenance with the maintenance personnel.

Table 7. Organization tracks of its total maintenance expenditures and costs.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Highly Extent	2	1.7	1.7	1.7
	Extent	14	11.7	12.1	13.8
	Less Extent	65	54.2	56.0	69.8
	None	35	29.2	30.2	100.0
	Total	116	96.7	100.0	
Missing	99.00	4	3.3		
Total		120	100.0		

Table 8, represents the majority (90.8%) agreed the organization does not prevent breaking down of the buildings and prevent failure from occurring.

Table 8. Organization prevention of breakdowns and failures from occurring.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Highly Extent	1	.8	.9	.9
	To Some Extent	5	4.2	4.3	5.2
	Less Extent	61	50.8	53.0	58.3
	None	48	40.0	41.7	100.0
	Total	115	95.8	100.0	
Missing	99.00	5	4.2		
Total		120	100.0		

From Table 9, 94.7% agreed that, the organisation does not put schedule of work in place to prevent breakdown and failure from occurring.

Table 9. Organization schedule of work to prevent breakdowns and failures from occurring.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Highly Extent	1	.8	.9	.9
	To Some Extent	5	4.2	4.3	5.2
	Less Extent	61	50.8	53.0	58.3
	None	48	40.0	41.7	100.0
	Total	115	95.8	100.0	
Missing	99.00	5	4.2		
Total		120	100.0		

Table 10 shows that exterior finishes on the wall by the respondents is poor with average of 87.5%. The roof of the building also shows that 75.8% agreed with poor maintenance on the buildings. The maintenance is only carried out when it has fully collapsed. From Table 12, it also shows that windows, doors, and paintings are poorly maintained, at 81.7%, 78.3%, and 77.5%, respectively. Olanrewaju & Anifowose [3] stated that Lack of proper maintenance on the exterior and interior parts of the building may result in its collapse. This calls for adequate maintenance measures to mitigate future damage.

Table 10. The structure; base/foundations.

		Frequency	Percent	Valid Percent	Cumulative Percent
Base/foundations					
Valid	Good	20	16.7	16.9	16.9
	Fair	60	50.0	50.8	67.8
	Poor	38	31.7	32.2	100.0
	Total	118	98.3	100.0	
Missing	99.00	2	1.7		
Total		120	100.0		
Floors					
Valid	Excellent	3	2.5	2.5	2.5
	Good	25	20.8	21.0	23.5
	Fair	58	48.3	48.7	72.3
	Poor	33	27.5	27.7	100.0
	Total	119	99.2	100.0	
Missing	99.00	1	.8		
Total		120	100.0		
Exterior Finishes; Walls					

		Frequency	Percent	Valid Percent	Cumulative Percent
	Excellent	2	1.7	1.7	1.7
	Good	11	9.2	9.3	11.0
Valid	Fair	54	45.0	45.8	56.8
	Poor	51	42.5	43.2	100.0
	Total	118	98.3	100.0	
Missing	99.00	2	1.7		
Total		120	100.0		
Exterior Finishes; Windows					
	Excellent	4	3.3	3.6	3.6
	Good	8	6.7	7.3	10.9
Valid	Fair	66	55.0	60.0	70.9
	Poor	32	26.7	29.1	100.0
	Total	110	91.7	100.0	
Missing	99.00	10	8.3		
Total		120	100.0		
Exterior Finishes; Doors					
	Excellent	1	.8	.9	.9
	Good	20	16.7	17.4	18.3
Valid	Fair	48	40.0	41.7	60.0
	Poor	46	38.3	40.0	100.0
	Total	115	95.8	100.0	
Missing	99.00	5	4.2		
Total		120	100.0		
Exterior Finishes; Paintings					
	Excellent	2	1.7	1.7	1.7
	Good	21	17.5	18.1	19.8
Valid	Fair	52	43.3	44.8	64.7
	Poor	41	34.2	35.3	100.0
	Total	116	96.7	100.0	
Missing	99.00	4	3.3		
Total		120	100.0		

Table 11 shows that interior finishes on the buildings by the respondent is poor with average of 54.2% on floors and coverings, walls, ceiling, doors, stair case and paintings. The roof of the building also shows that 66.7% agreed poor maintenance on the buildings. Also, the electrical, HVAC and other mechanical system, plumbing; domestic water distribution were also in a poor condition, 54.2%, 75%, and 65.8% respectively.

Table 11. Analysis of the Interior of the Correctional Centre.

		Frequency	Percent	Valid Percent	Cumulative Percent
Walls, Ceiling, Doors, Stairs & paintings					
	Excellent	51	42.5	44.0	44.0
alid	Poor	65	54.2	56.0	100.0
	Total	116	96.7	100.0	
Missing	99.00	4	3.3		
Total		120	100.0		
Roof					
	Excellent	38	31.7	32.2	32.2
Valid	Poor	80	66.7	67.8	100.0
	Total	118	98.3	100.0	
Missing	99.00	2	1.7		
Total		120	100.0		
Electrical					
	Excellent	52	43.3	44.4	44.4
Valid	Poor	65	54.2	55.6	100.0
	Total	117	97.5	100.0	
Missing	99.00	3	2.5		
Total		120	100.0		
HVAC and other mechanical systems					
	Excellent	25	20.8	21.7	21.7
Valid	Poor	90	75.0	78.3	100.0
	Total	115	95.8	100.0	
Missing	99.00	5	4.2		
Total		120	100.0		
Plumbing; Domestic Water Distribution					
Valid	Excellent	39	32.5	33.1	33.1

		Frequency	Percent	Valid Percent	Cumulative Percent
	Poor	79	65.8	66.9	100.0
	Total	118	98.3	100.0	
Missing	99.00	2	1.7		
Total		120	100.0		

Table 12 shows that, the general exterior was very poor with percentage of 63.3% and general interior 73.3% in poor state. According to the obtained data, 31.7% acknowledges that the external finishes are done excellently while 63.3% agrees that the external work are poorly maintained. Also, the interior finishes and maintenance of the building were accessed. The data reveals that 20% agrees that the interior finishes are maintained while 73.3% acknowledges poor maintenance of the interior facility.

Table 12. *Analysis of the maintenance of interior and exterior finishes of the building.*

Exterior Finishes		Frequency	Percent	Valid Percent	Cumulative Percent
	Excellent	38	31.7	33.3	33.3
Valid	Poor	76	63.3	66.7	100.0
	Total	114	95.0	100.0	
Missing	99.00	6	5.0		
Total		120	100.0		
Interior Finishes		Frequency	Percent	Valid Percent	Cumulative Percent
	Excellent	24	20.0	21.4	21.4
Valid	Poor	88	73.3	78.6	100.0
	Total	112	93.3	100.0	
Missing	99.00	8	6.7		
Total		120	100.0		

5. Conclusions

This paper evaluated the building condition and maintenance of correctional facilities. The objective is to reduce incessant building collapse in Nigeria. Based on this study, the correctional centre's maintenance receives little to no attention. As a result of this, the building could deteriorate which may eventually result to collapse. The study also demonstrates a lack of basic structural maintenance, which should be the primary concern of any organisation or institution when it concerns their buildings. It is crucial to maintain buildings for good output from users in order to ensure effective staff performance and a healthy environment for the prisoners. The study also identified a number of maintenance-related causes, maintenance-related categories, frequent causes of building deterioration, and maintenance-related decisions in correctional facilities. It argued that a lack of trained labour to carry out maintenance operations, poor designs, and abuse of buildings after they are completed, and inadequate financial support for maintenance work are key variables influencing the decision to carry out maintenance work. The prevalence of condition-based, corrective, and emergency types of maintenance was once more demonstrated. Finally, built environment professionals should plot action toward more advocacy, policy, and awareness on the essence of maintenance in buildings and dangers associated with them when neglected. This research is important because facility management and upkeep play an important role in ensuring the safety of inmates and personnel. As a result, future study would need to look into a more rigorous facility maintenance schedule, which might have a significant impact on jail and prison safety and operations.

Acknowledgements

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