

Survey of Elements and Components of Industrial Buildings in Onitsha Anambra State, Nigeria

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Abstract

Maintenance of industrial buildings is essential to the growth and stability of industrialized economy of any nation. This study examines the occurrence of deterioration prone activities and assesses the physical conditions of industrial buildings in Onitsha, Anambra State, Nigeria. A sampling technique was adopted to select ten (10) industrial buildings from three dominant industrial sectors: Chemicals and Pharmaceutical; Food, Beverages and Tobacco; and Iron and Steel Manufacturing respectively. Three personnel were selected per firm; these were the Factory manager, junior maintenance officer and senior maintenance officer. One hundred and twenty (120) questionnaires were administered on these officers in the identified (10) firms. The frequency distribution analysis of the occurrence of deterioration prone activities, showed that the conveyor lines were rated first with the index value of 3.83, the second was changing of machines defective parts with an index value of 3.78, while the least was the movements of cranes and jigs. This implies that, the floor slab and floor finishes are more prone to deterioration than other components. The analysis of the physical condition showed that the structural elements were rated in very good condition: roof beams (75.6%), roof carcass (67.1%), columns (62.1%), and roof covering (56.4%). Building components subjected to daily wear and tear were safely assumed to be in satisfactory condition: wall finishes (33.4%), doors and door frames (45.5%), floor finishes (31.1%), windows and window frames (35.5%), the mechanical and electrical components of the industrial buildings were in satisfactory condition (plumbing pipes, connectors and fittings (17.9%) and electrical conduit pipes and fittings (17.9%). The study showed that the physical condition of the industrial buildings elements and components signaled the existence of varying deterioration levels; making maintenance a priority in order to enhance their functionality and ensure a safe and conducive working environment.

Key words: Physical condition, Deterioration, Maintenance, Industrial buildings Building elements and components.

I. Introduction

Maintenance of industrial buildings is indispensable to the growth and stability of an industrialized economy, a fact that is particularly salient in rapidly urbanizing Nigerian cities such as Ibadan. The physical condition of such facilities directly influences their operational efficiency, service life, and contribution to socio-economic development (Adoghe et al, 2023). Yet current maintenance practices in Nigeria are characterized by a predominantly reactive approach, which accelerates the degradation of industrial facilities and increases operational expenditures (Dithebe et al, 2025). Adoghe et al (2022) underscore that a high proportion of Nigerian public structures, including healthcare facilities, are in poor condition because of the absence of structured maintenance systems. The observation mirrors the situation across industrial sectors, where preventive or predictive approaches remain understudied. Concurrently, occupant health is jeopardized by substandard maintenance: Ebiloma, Aigbavboa (2025) show, through an examination of Ibadan North-East, that inadequate maintenance promotes sick building syndrome, which impinges on physical, mental, and emotional well-being—a risk also faced by occupants of poorly maintained industrial facilities in Ibadan.

Possible solutions like the digital twin technology have been promoted in terms of technological solutions, but the adoption is low. Ebiloma and Aigbavboa (2025) document substantial barriers, including limited technological adoption capacity and insufficient professional expertise that perpetuate traditional, less effective practices. In terms of the policy framework, Ikudayisi and Adegun (2025) claim that the policy of maintaining the built assets is inconsistent and that there is a lack of institutional enforcement that contributes to the decline of building infrastructure in Nigeria. The analysis of the green building acceleration they conducted shows that the presence of policy gaps has an adverse effect on the implementation of sustainable construction practice,

an issue that can be reflected in the maintenance of industrial infrastructure.

Condition surveys are recognized as critical instruments for diagnosing building status and shaping maintenance decisions; however, their application is constrained in the Nigerian context, especially within industrial estates. According to Muoghalu (2025), over 70 % of buildings in most of the Nigerian major cities, such as Ibadan, are in a poor condition or in need of significant repairs, which hinders the evidence-based intervention.

II. Literature Review

The review examines the key components typically assessed in industrial buildings, such as walls, roofs, foundations, floors, and building services, followed by an analysis of common defects—cracks, leaks, corrosion, and finish failures—and their underlying causes, including material deficiencies, environmental factors, design errors and usage patterns. It considers the practical challenges encountered in assessing industrial structures, including accessibility limitations, inadequate maintenance records, and harsh environmental influences.

Overview of Building Condition Assessment

Building condition assessment (BCA) refers to the systematic process of evaluating the physical state of a building and its components to determine safety, performance and remaining service life (Dithebe et al., 2025). It involves the collection of qualitative and quantitative data on structural functionality, integrity, and compliance with building standards, providing a foundation for maintenance planning and decision-making (Ebihoma & Aigbavboa, 2025). Modern approaches emphasize not only identifying visible defects but also predicting potential failures using scientific methods and digital technologies such as Building Information Modeling (BIM) and digital twins (Ebiloma & Aigbavboa, 2025). The concept of condition assessment has evolved from basic visual inspections to comprehensive methodologies incorporating life cycle analysis (Onyike et al., 2025). It now integrates sustainability principles, recognizing the environmental and economic consequence of poorly maintained structures. In the Nigerian context, BCA is essential for reducing incidents of structural failure, which have been linked to poor maintenance culture and lack of regular assessments (Odumola et al., 2025).

Challenges in Assessing Industrial Buildings

Building condition assessment (BCA) in industrial facilities is essential but often constrained

by many challenges in developing contexts such as Nigeria. These challenges significantly affect the frequency, accuracy and efficiency of assessment processes. Access limitations remain a major obstacle during inspections. Industrial plants often have high-risk areas, locations with large machinery installations, restricted zones, making comprehensive physical inspection difficult (Ogunnaike et al. 2025). Safety protocols, operational constraints, and height-related access challenges further complicate evaluations, requiring specialized equipment or technologies that are often unavailable in Nigerian industries (Onyike & Onyenechere, 2025). A recurring problem in Nigerian building management is the absence of accurate maintenance records and as-built documentation (Adoghe et al, 2023). Many industrial buildings were constructed decades ago without proper documentation, resulting in precariousness regarding material specifications and previous repairs. This gap makes it difficult to predict deterioration patterns or plan preventive interventions (Dithebe et al, 2025).

Industrial buildings in are areas exposed to environmental stressors such as high humidity, temperature fluctuations, and chemical emissions from industrial processes. These factors accelerate corrosion, cracking, and structural fatigue, alter assessment because deterioration occurs faster than expected (Ikudayisi, Adegun, 2025). Harsh environmental conditions also hinder the use of some advanced diagnostic equipment, limiting accuracy in defect detection (Adoghe et al., 2023). Industrial facilities have intricate layouts with multiple functional zones, including production floors, storage areas, and hazardous sections. This complexity requires specialized knowledge for accurate assessment, particularly when integrating structural, mechanical, and electrical assessments (Muoghalu, 2025). Additionally, building information modeling (BIM) adoption, which could streamline such assessments, faces significant implementation barriers in Nigeria due to interoperability issues, high cost, and lack of technical expertise (Odumola et al. 2025).

III. Methodology

This study deployed survey research design, employing both qualitative and quantitative approaches to assess the physical condition of industrial buildings in Onitsha, Anambra state. Questionnaires were administered for data collection, supported by visual inspections and interviews with key facility personnel. The aim was to yield empirical evidence on the state of building components in selected industrial sectors and to

classify them according to established condition rating systems. This mixed-method approach enabled the collection of objective visual and structural data as well as immanent insights into the usage history, maintenance practices, and perceived defects of various building elements.

Onitsha was selected due to its significance as a historical industrial hub, housing numerous manufacturing companies spread across designated zones such as Ose, Fegge, Headbridge and others. These zones include a range of industries with diverse architectural typologies, ages, construction materials, and operational scales — making them suited for a broad condition assessment study.

The target population comprised registered industrial manufacturing facilities within Onitsha. The sampling frame was built from multiple official sources:

- 40 manufacturing industries registered under the Manufacturers Association of Nigeria (MAN)
- 40 additional industries listed under the Ibadan Chambers of Commerce, Industry, Mines and Agriculture (ICCIMA)

Out of the 200 industries initially identified within Onitsha, only 40 were found to be actively engaged in physical manufacturing operations from identifiable industrial buildings. These 40 facilities were deemed eligible for sampling.

A purposive sampling technique was adopted to select a final sample of 10 industrial buildings. These 10 buildings were drawn from three dominant industrial sectors:

1. Chemicals and Pharmaceuticals.
2. Food, Beverages and Tobacco

3. Iron and Steel Manufacturing

These sectors were selected in Onitsha, due to their high physical infrastructure intensity, relatively consistent operation, and broader representation in industrial economy. Three sets of personnel were selected per firm; these were the plant manager, senior maintenance officer and junior maintenance officer. In essence, 120 questionnaires were administered on these officers in the identified (10) firms.

Data Collection Instruments and Techniques

Three main instruments were used for data collection:

Visual Condition Assessment Checklist

A structured list was developed to guide the visual inspection of building components. It covered the following component categories: floors, floor finishes, wall, wall finishes, doors and windows, roof structural members and roof covering, electrical fixtures and fittings, plumbing pipes and accessories. Each item on the checklist was scored using a 5-point condition rating scale.

Structured Questionnaire

A questionnaire was administered to facility managers, maintenance officers, or building supervisors.

Condition Rating System

The study employed a modified 5-point rating scale adapted from the Dutch Bridge Condition Assessment system by Ogunnaike (2025), and previous building condition survey models by Onyike, Onyenechere, (2025). The scale was interpreted as shown in Table 2

Table 2: Dutch Bridge Condition Assessment Guide

Rating	Condition	Interpretation
1	Very Good	No noticeable damage or defect. As-new performance.
2	Good	Minor signs of wear or early-stage damage.
3	Reasonable	Performance not significantly compromised.
4	Mediocre	Serious degradation affecting usability or safety.
5	Very Bad	Advanced damage with critical failure potential.

Each component assessed was assigned a condition rating based on visual observation and corroborated with feedback from factory staff.

IV. Data Analysis and Discussion of Results

The general information about the respondents to the questionnaires is presented in Table 3. The distribution of the types of industry shows that eighteen (3) were in the food, beverage and tobacco industrial sector representing 66.7% of the population, six (3) in chemical and pharmaceutical industrial sector representing 22.2% and three (4) in basic metal, iron and steel industrial sector representing 11.1%.

The academic qualification of the respondents showed that 44.3% were OND/HND holders, 44.3% were Bachelor's degree holders and 11.4% were Master's degree holders, based on these academic qualifications the respondents were deemed adequate to supply reliable data for this study. The working experience of the respondents revealed that 6.6% had less than two years working experience, 23.0% had between 2 – 4 years of working experience, 18.0% had 5 – 7 years working experience, 23.0% had 8 – 10 years of working experience while 29.0% had over 10 years working

experience; they have sufficient experience in industries and the information supplied by them would be reliable and dependable.

On the job designation Table 2 showed that 8.2% of the respondents were Quality Controller, 16.4% were Production Engineers, 50.8% were Supervisors, 16.4% were Mechanical Engineers while 4.9% were junior maintenance staffs. The result also shows that the respondents' holds requisite positions in their respective industries to enable them adequately respond to the need of the research.

On the nature of business set up, the analysis revealed that 3.3% of the industries sampled were sole proprietorship, 4.9% were partnership, 52.5% were Limited Liability Company while 39.3% were Public Liability Company. The result show that the industries sampled were licensed and incorporated under the Companies and Allied Matters Act 1990 to practice in the country and fit to adequately provide useful information germane to the success of the research

Table 3: Respondents General Information

Respondents	Frequency	Percent
Types of industry		
Chemical and Pharmaceutical	3	22.2
Food, Beverages and Tabacco	3	66.7
Metal production	4	11.1
Academic Qualification		
OND/HND	27	44.3
B.Sc	27	44.3
M.Sc	7	11.4
Working experience		
Less than 2years	4	6.6
2-4years	14	23.0
5-7years	11	18.0
8-10years	14	23.0
Above 10years	18	29.4
Job designation		
Builder	Nil	0
Quality Controller	5	8.2
Estate Manager	Nil	0
Material Engineer	2	3.3
Production Engineer	10	16.4
Supervisor	31	50.8
Mechanical Engineer	10	16.4
Junior Maintenance Staff	3	4.9
Nature of business set up		
Sole proprietorship	2	3.3
Partnership	3	4.9
Limited Liability Company	32	52.5
Public Liability Company	24	39.3

General Information about the Unit Operation

The general information about the respondents' response to questions bothering on the unit operation in the production area is presented on Table 4. 80.0% of the respondents sampled operate on shift while 19.7% did not, in respect of the number of people working per day. 6.6% operates with less than 10 people, 6.6% operates with 11 – 20 work force, 8.2% operates with 21 – 30 work force, 14.8% operates with 30 – 40 workforce, 13.1% operates with 41 – 50 work force while 50.7% operates with more than 50% work force respectively.

The analysis of the unit operation further revealed that 21.3% of the industries operate manually while 67.2 operates automated system, as regards mode of moving finished products from the production area to storage, 72.1% of the respondents

used forklifts while 27.9% moved finish products manually. 62.3% of the respondents experienced vibration of machines during the unit operations while 37.7% responded otherwise. 23.0% of the respondents experienced gas pollution during unit operation while 77.0% don't, 57.4% experienced spillage of chemicals, grease and oil while 44.3% answered negatively. With respect to the spillage of hot water and steam during unit operation, 55.7% of the industries experienced steam and hot water spillage while 44.3% doesn't. 83.6% of the industries experienced noise pollution while 21.3% don't. 78.7% industries experienced installation of additional machines and 21.3% don't. 83.6% of the industries experienced the removal of obsolete machines while 16.4% don't. 29.5% experienced spatial expansion of the production area while 70.5% don't.

Table 4: Unit General Information of Operation

Respondent	Frequency	Percent
Work shift capability		
Yes	49	80.3
No	12	19.7
Numbers of people working per day		
Less than 10	4	6.6
11 - 20	4	6.6
21 – 30	5	8.2
31 – 40	9	14.8
41 – 50	8	13.1
More than 50	31	50.7
Mode of plant operation		
Manual	13	21.3
Automated	41	67.2
Others	7	11.5
Mode of moving finished products to store		
Forklift	44	72.1
Manual	17	27.9
Others	Nil	
Do you experience vibration of the machines?		
Yes	38	62.3
No	23	37.7
Do you experience spillage of chemicals, grease and oil?		
Yes	35	57.4
No	26	42.6
Do you experience steam, hot or cold water spillage?		
Yes	34	55.7
No	27	44.3
Do you experience noise pollution?		
Yes	51	83.6
No	10	16.4
Have you experienced bringing additional machine?		
Yes	48	78.7
No	13	21.3

Have you experienced the removal of obsolete machines?		
Yes	51	83.6
No	10	16.4
Have you experienced spatial expansion of the production area?		
Yes	18	29.5
No	43	70.5

It could be deduced from Table 4 that industrial activities within the study zone were enormous and varied (working of machines, movement of forklifts, emission of pollutant gases, spillage of grease and oil amongst her activities) according to the size of the industry in terms of the products and services being offered.

Assessment of the Physical Condition of Industrial Buildings

The analysis of the physical condition of the industrial buildings is presented in Table 5. Table 4 shows that the structural elements were rated in very good condition (columns (62.1%), roof carcass (67.1%), roof beams (75.6%) and roof covering (56.4%). Building components subjected to daily wear and tear as a result of their

involvement and interaction with unit operation were safely assumed to be in satisfactory condition (floor finishes (31.1%), wall finishes (33.4%), doors and door frames (45.5%), windows and window frames (35.5%) , the mechanical and electrical components of the industrial buildings were also rated to be in satisfactory condition (plumbing pipes, connectors and fittings (17.9%) and electrical conduit pipes and fittings (17.9%)

The ranking of the physical condition of the building elements and components shows that the roof beams were in the best state of structural health with an index value of 4.645 while wall finishes with an index value of 3.641 came last (12th). The implication of this is that the structural components were healthier than others fabrics than others.

Table 5: Analysis of the Physical Condition of Industrial Building Elements and Components

Building elements and components	Very good	Good	Satisfactory	Fair	Poor	Index	Rank
Roof beams	76%	13%	11%	0%	0%	4.645	1
Roof carcass	67%	16%	11%	6%	0%	4.45	2
Columns	62%	22%	11%	4%	0%	4.422	3
Floor slab	33%	53%	13%	0%	0%	4.2	4
Roof covering	56%	13%	23%	8%	0%	4.179	5
Wall	38%	31%	24%	7%	0%	4	6
Electrical conduit pipes and fittings	36%	36%	18%	10%	0%	3.974	7
Plumbing pipes, connectors and fittings	39%	28%	18%	15%	0%	3.898	8
Floor finishes	27%	36%	31%	7%	0%	3.824	9
Door and door frames	19%	33%	46%	2%	0%	3.69	10
Windows and window frames	21%	35%	36%	9%	0%	3.676	11
Wall finishes	24%	29%	33%	13%	0%	3.641	12

Table 6: Frequency Analysis of the Occurrence of Deterioration Prone Activities

Industrial activities	Very infrequent	Infrequent	Average	Frequent	Very frequent	Index	Rank
Processing of products through conveyor line	9%	11%	18%	17%	46%	3.83	1
Changing of machines defective parts	4%	9%	20%	34%	32%	3.78	2

Movement of forklift	13%	9%	16%	25%	38%	3.69	3
Machine servicing	7%	11%	20%	32%	30%	3.67	4
Spillage of chemicals, grease and oil	10%	12%	18%	29%	31%	3.59	5
Spatial expansion of production area	11%	18%	29%	27%	16%	3.22	6
Vibration of machines	21%	14%	12%	26%	26%	3.19	7
Addition of new machines	13%	24%	31%	20%	11%	2.89	8
Noise pollution	27%	18%	27%	13%	16%	2.76	9
Removal of obsolete machines	23%	31%	30%	7%	9%	2.48	10
Gas pollution	31%	29%	23%	13%	5%	2.35	11
Spillage of steam, hot or cold water	20%	38%	33%	7%	2%	2.33	12
Movement of crane and jig	38%	32%	14%	4%	11%	2.15	13

The frequency distribution analysis of the occurrence of deterioration prone activities within the production hall is presented in Table 6, the relative important index of this activities showed that the processing of products through conveyor lines had the index value of 3.83 and rated 1st amongst the deterioration prone industrial activities, followed by changing of machines defective parts with an index value of 3.78, the least of the deterioration prone industrial activities is the movements of cranes and jigs. The implication of this is that the floor slab and floor finishes are more prone to deterioration than other components. Movement of cranes and jigs according to Muoghalu (2025) causes fatigue stress in columns and roof beam which incidentally is the least rated frequently occurring industrial prone activity as viewed by the respondents this could be due to the fact that the industries been studied are not into the production of heavy equipment that needs to be hoisted using cranes.

V. Conclusion

The maintenance survey of the industrial buildings in the study area revealed that the industries varied unit operations involving movement of raw and finished products using automated and manual systems, forklifts and crane movements, vibration of machines, removal and replacement of obsolete machines, occasional pipes burst, walls and the roof structure, extension of production area induced wear and tear on the floor and floor finish. The assessment of the physical condition of the industrial buildings elements and components indicates the existence of varying deterioration levels thus making the prioritization of

the maintenance of these buildings a necessity in order enhance their functionality and ensure a safe and conducive working environment.

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