BUILDING PATHOLOGY: A TOOL FOR RESOLUTION OF DEFECTS IN BUILDINGS

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ABSTRACT

Buildings are essential part of human existence and ranks second to food. However, in spite of the crucial role of buildings to mankind, they are left to deteriorate as a result of negligence of building pathology and lack of building maintenance culture. This paper, therefore, defines and explores the term building pathology and evaluates building defects. The methodology involved survey research design, structured questionnaire and review of related literature. A questionnaire was administered to a convenient sample of respondents. Data generated were analyzed using frequency, percentages and mean score. The paper identifies a number of defects on buildings and their causative factors, effects and how to mitigate the defects. The study has revealed that building pathology is a tool that can be used to search and discover defects, their causes, consequences and mitigations. It also revealed that building pathology has a significant impact on building maintenance. The paper recommends among others, that building pathology be given substantial attention, and also be part of the procurement process of buildings. The study points to the need for designers, constructors and maintenance managers to acquire skills on critical aspects of building pathology.

Key words: building pathology, building defects, building maintenance culture, procurement.

INTRODUCTION

Buildings are designed and constructed to provide comfortable and healthy environment for man. A building, according to Ogunoh (2008), is regarded as an enclosure or “envelope” designed and constructed to provide minimum level of comfort and conveniences. He went further and emphasized that a building provides safety, protects human inhabitants, animals, material and equipment from the effect of weather, and provides internal comfort. Obiegbu (2003), states that buildings are enclosures for space, designed for specific uses, meant to control local climates, distribute services and evacuate wastes. Infact a building being an essential part of human existence, is regarded as a basic need of mankind and ranks second to food. It is a human imperative without which man's survival is inconceivable. This indicates that people and buildings are inseparable. This is in line with Mohamed (2005), who stated that adequate residential accommodation and related facilities constitute one of the essentials of good life and, therefore, a major requirement of an efficient and satisfied labour force.

Unfortunately, buildings depreciate with time and when necessary remedial measures are not applied or time, may lead to collapse of buildings (Iyagba, 2005). Construction materials, elements and components definitely have finite life, as they change and deteriorate. They also weather, corrode, oxidize, damage and also lose their structural integrity. By implications, this simply implies that by persistent neglect, a building continues to decay or depreciate and failure to effect necessary repairs would lead to disuse or collapse. Building in its broadest sense can be regarded as a

system with subsystems, such as elements, components and materials that act together to render the functions for which it was built. Hence, a building may be compared to a human system. As Iyagba (2005) puts it; “human heart, kidney, stomach and liver amongst others, these organs are grouped together to form the human body”. Likewise, he maintained that, a building with columns, beams and slabs forming the structural or skeletal elements of the building is like the brain, while the foundation is the heart of the building and death occurs if any one of these fails to function. Most often, man dies due to carelessness on the part of medical doctors or neglect due to improper maintenance of the body. In like manner, buildings are faced with various challenges, especially their maintainability in order to retain their economic, social and structural values. In analogy with health as the core condition for quality of human life, the health of housing accommodations stands for housing quality – or better performance – being the ability of residential buildings to fulfill adequate shelter for specified groups of residents and diseases stand for performance threatening deficiencies resulting in obsolescent and finally obliteration (Thomsen, 2014). However, for building to meet these basic requirements there is need to carryout building pathology.

Building pathology, as defined by Wiley (2000), is a scientific study of the nature of building failures, its causes, processes, development and consequences. Building pathology provides an inter-disciplinary approach to the study of defects and performance of buildings in order to develop remedial and managerial solutions. According to Chartered Institute of Building (CIB) Report of 1993, building Pathology is defined as the systematic treatment of building defects, its causes, its consequences and its remedies. Barry (2001) states that problems and failures in buildings can be caused by either defects or deterioration of materials. According to Thompsen, (2014), pathology studies are directed at the physical as well as the functional, social and economic performance of dwellings and to what extent they satisfy their stakeholders – residents as well as proprietors' demands.

Consequently, there has been a wrong assumption that buildings are to function effectively throughout their life span. Contrary to this assumption the moment construction of buildings are completed, they are subjected to ageing, wear and tear in the performance of their functions, and deteriorate by exposure to the operating environment. When necessary remedial actions are not taken on time, it will result to collapse of buildings. This implies that building pathology is an important tool for adequate maintenance and management of buildings. Thus, one can state that the building pathology is an important part of the maintenance process; although, it is a new area of study in the building construction. As emphasized by Thomsen (2014), housing pathology is both unmistakably a new name and potentially a new domain, but partly a new knowledge field. As a result of the growing importance of maintenance of existing building stock than constructing new ones, knowledge of building pathology is of immense economic, social and environmental importance. According to Thomsen (2010, 2012), that the on-going fundamental paradigm shift from new addition to maintenance and improvement of existing stock will, however, urge the need for more integrated interdisciplinary approaches and sooner or later to a comprehensive pathological domain. It is in the light of this that this paper is focused on the use of building pathology as a tool for

resolution of defects in buildings.

Purpose/Objectives of the Paper

The purpose of this paper is to create the awareness and understanding of the need for building pathology among the stakeholders in the building industry. To this end, the specific objectives of this paper include:

- to provide a greater understanding and definitions of the key issues.
- to identify the factors responsible for building defects.
- to highlight the effects of building defects on the users.
- to determine strategies on how to mitigate building defects.

Concept of Building Pathology

There is no gain saying the fact that the quality of human life is generally dependent on the quality of buildings and their environment. This view holds strong validity in the sense that, when building becomes dilapidated and unhealthy, reduction of the quality of life follows with the attendant promotion of irresponsible social behaviours and value loses (Akingbohungbe, 2002). Building pathology is therefore a scientific and systematic study of building defects, their causative factors and remedies. The term pathology has its origin in the medical science (Long, 1965). The word is derived from the Greek word 'pathos', meaning pain or disease (Thomsen, 2014). He defined pathology as the systematic study of diseases with the aim of understanding their causes, symptoms and treatment and that it is derived from the medical context similar to its methodical and often forensic practice. Watt, (2007) therefore, defines building pathology, both as a term and as an overall concept, as the holistic approach to understand in building and, consequently, building diseases and deficiencies.

Building pathology, also referred to as forensic building technology, is a CIB – acknowledged professional knowledge field, generally applied for real estate property owners, insurance companies, to assess the causes, remedies and responsibilities in cases of serious building deficiencies or disasters. This scenario reinforces the importance of building pathology in all ramifications, as it can offer information on buildability and maintainability, cost of defects, quality assurance, insurance and building code. This perhaps informed why Thomsen (2014) defined housing pathology in a broader way as a holistic approach to understanding the nature and life cycle of residential buildings and their environment, in order to identify, investigate and diagnose deficiencies, specify preventive measures, profer remedial interventions and evaluate their effects.

Building Defects

Buildings provide the needed infrastructural base for mankind and perform a variety of functions. Consequently, all elements and components of buildings deteriorate at a greater or lesser rate depending on number of factors. According to Roddis (1993), a defect is described as a limited deflection in a building causing certain amount of cracking or distortion. Building defects can also be seen as faults, problems and other inadequacies that affect building performance. Citing from Felemu and Adewole (2006), factors that cause building defects include; unsuitable materials, incorrect assessment of loads, inadequate appreciation of conditions of use and assessment of exposure to rainfall, direction of prevailing winds; microclimate, atmospheric pollution, and height of buildings.

Building defects may generally be caused by poor design, poor

construction, function and use of building, age, lack of maintenance culture, use of non-professionals and absence of practice of building pathology. Stressing further, on this Ahmed (1994) listed five main factors that cause building defects to include:

a. Climatic Condition
b. Location of Building
c. Building type and change of use
d. Maintenance approach to building
e. Building age

Cracks, dampness, mould stains, leaking roof plant growth on the roof, plant growth on the roof, broken plumbing fittings, etc, are common manifestations of defects as shown in plates 1-7. Emerging from the above is the indication that building defect affect occupants of buildings and the society at large; contribute to building failures which may result to loss of lives. Defects also cause direct and indirect high maintenance cost and Sick Building Syndrome (SBS).



Plate 1:
Plant growth on the roof



Plate 2:
Plant growth on the window



Plate 2:
Plant growth on the window



Plate 4:
Longitudinal crack and dampness



Plate 5:
Cracked on the wall



Plate 6:
Cracks and dampness



Plate 7:
Cracks and dampness

Building Maintenance

It has been suggested that on the bases of anecdotal evidence, building pathology has a significant impact on building maintenance. This implies that building pathology is a function that involves maintenance. Building maintenance is not only essential in the life cycle of a building, but also to the life of building occupants. The performance of any building can be affected by decisions taken and actions performed at any stage of a building projects from initial conception to final demolition (Son and Yuen, 1993). This, according to them indicates that maintenance is needed throughout the entire period the building remains in use or occupation such that the various facilities are kept to a standard consistent with overall policy.

Chanter and Swallor (1996) posited that maintenance is work undertaken in order to keep, restore or improve every facility; that is every part of the building, its services and surrounds to currently acceptable standard to sustain the utility and value of the facility. In a similar vein, maintenance can also be defined as a systematic cure of (or all works undertaken to keep) a building to a state of preservation and acceptable standard in order to last long. Obviously, for buildings to continue to function effectively they need adequate and constant maintenance management. Maintenance impacts on a building's ability to contribute in fulfilling the purpose of its intended use.

Methodology

This study adopted survey research approach. A questionnaire was developed from primary and secondary data and administered on a sample of professionals in the Building Industry. The questionnaire was aimed at obtaining representative views of respondents on the subject matter. Professionals in the Building Industry

compromising of Architects, Builders and Civil Engineers formed the population of the study sample. Purposive sampling techniques, was used to select 30 respondents. Structural questionnaire were distributed to 25 respondents using stratified random sampling method, as shown on table 1.

Out of 25 questionnaires administered, 21 were completed and returned and this corresponds to a response rate of 84%.

The data generated were analyzed with appropriate statistical techniques involving frequency, percentages and mean.

Findings and Discussions

The findings are shown in tables 1 to 6 respectively.

Table 1: Questionnaire Distribution

SN	Respondents	No of Questionnaires Distributed	%	No Returned	%
1	Architects	10	40	8	38
2	Builders	7	28	6	29
3	Civil Engineers	8	32	7	33
	Total	25	100%	21	100%

Table 2: Responses on Working Experiences of Respondents

Item	Variables	Responses	Percentages (%)
(a)	1 – 5 years	2	10
(b)	6 – 10 years	3	14
(c)	11 – 15 years	5	24
(d)	16 – 19 years	4	19
(e)	20 years and above	7	33
	Total	21	100

Table 2 reveals that 33% of respondents (7) have worked in the industry for 20 years and above, followed by 5 respondents 24% and 4 respondents 19% who have worked between 11-15 years and 16-19 years respectively. These findings indicate that respondents have enough working experience and as such, can provide informed opinion about building defects.

Table 3: Ranking of Defects on Building Elements/Component by the the Respondents

S/N	Defects	Strongly Agree (5)	Agree (4)	Un-decided (3)	Disagree (2)	Strongly Disagree (1)	Mean Score	Ranking	Remark
a	Crack	12	5	1	2	1	4.20	1	Agree
b	Dampness	7	5	4	3	2	3.20	6	”
c	Settlement of foundation	6	4	5	4	2	3.40	4	”
d	Broken floor tiles/holes	12	5	1	2	1	4.20	1	”
e	Mould stains	10	6	2	2	1	4.10	2	”
f	Sagging of Beams	5	4	6	4	2	3.30	5	”
g	Roof Leakages/ decay of Timber	10	5	3	2	1	4.00	3	”
h	Growth of Weeds on the roof	2	2	7	6	5	2.70	7	Disagre
i	Paint defects	10	5	4	1	1	4.00	3	Agree
j	Burnt electrical fittings	11	6	2	2	-	4.20	1	”
k	Broken plumbing fittings	10	5	4	1	1	4.00	3	Agree

Table 3 indicates that respondents strongly agreed that are defects on building elements/components which ranked highest with mean scores of 4.20 respectively. These are followed by mould stains, roof leakages/decay of timbers, paint defects and broken plumbing fittings with mean scores of 4.10 and 4.00 respectively. Responses from respondents also indicated that foundation settlement sagging of beams, and dampness, with mean scores of 3.40, 3.30 and 3.20 respectively, ranked between 4th, 5th and 6th, while respondents disagreed on growth of weeds on roof/decay of timber which ranked lowest. It is obvious from the responses of respondents that if not repaired, these defects may result to building failure.

Table 4. Responses on the Ranking of Factors Responsible for Building Defects

S/N	Factors	Strongly Agree (5)	Agree (4)	Und-ecided (3)	Disagree (2)	Strongly Disagree (1)	Mean Score	Ranking	Remark
a	Deterioration due to age and environment	10	7	2	1	1	4.10	4	Agree
b	Lack of maintenance culture	12	5	1	2	1	4.20	2	”
c	Wear and tear	10	8	-	2	1	4.14	3	”
d	Poor design	14	4	-	1	2	4.30	1	”
e	Poor construction	14	4	-	1	2	4.30	1	”
f	Function and use of building	12	5	1	2	1	4.20	2	”
g	Use of non professionals	12	5	1	2	1	4.20	2	”
h	Use of wrong construction materials	10	8	-	2	1	4.14	3	”
i	Lack of buildability and maintainability analysis	10	7	2	1	1	4.10	4	”
j	Absence of practice of building pathology	12	5	1	2	1	4.20	2	”

Table 4 represents ranking of ten (10) significant factors responsible for building defects. The result revealed that poor design and poor construction are major factors. They ranked first among the factors with mean scores of 4.30, followed by lack of maintenance culture, function or use of buildings, use of non professionals and absence of practice of building pathology; all ranked 2nd with mean scores of 4.20. Wearing and use of wrong construction materials ranked 3rd, with mean scores of 4.14., while lack of buildability and maintainability analysis ranked 4th on the list with mean score of 4.10.

The general conclusion that can be drawn from table 4 is that most of these factors that cause building defects can be avoided during the design and construction phases of building.

S/N	Statements	Strongly Agree (5)	Agree (4)	Undecided (3)	Disagree (2)	Strongly Disagree (1)	Mean Score	Ranking	Remark
a	Very poor and deplorable condition of building	14	6	1	-	-	5.00	1	Agree
b	Causes stress	11	6	2	1	1	4.20	3	"
c	Economic and social effect	12	5	1	2	1	4.10	4	"
d	Poor indoor air quality (humidity)	10	4	4	1	2	3.90	5	"
e	Poor aesthetics and psychological appeal	11	6	2	1	1	4.20	3	"
f	Sick building syndrome (SBS)	12	5	1	2	1	4.10	4	"
g	Building failure	15	5	1	-	-	4.70	2	"

On the ranking of statements on the effects of building defects on users, table 5 shows that very poor and deplorable conditions of buildings which ranked 1st with mean score of 5.00 mostly affect users of buildings. They are followed by building failures with mean score of 4.70 and ranked 2nd. The table also revealed that the effect of building defects on users causes stress, poor aesthetics and psychological displeasure. They ranked 3rd with mean values of 4.20 while economic and social effects, and sick building syndrome (SBS) all ranked 4th in list with mean values of 4.10. Poor indoor air quality (humidity) ranked least with a mean score of 3.90. The results reveal that if these defects are not attended to, buildings cannot function effectively and this could lead to Sick Building Syndrome (SBS) and possible building collapse

Table 6.0: Strategies on how to Mitigate Building Defects

SN	Mitigation	Responses	Percentages %
1	Periodic inspection of buildings	2	9.50
2	Proactive approach to maintenance	3	14.00
3	Carrying out site and soil investigation before design and construction	1	5.00
4	Engagement of right professionals	2	9.50
5	Ensuring of adequate standard workmanship	3	14.00
6	Use of standard building materials	2	9.50
7	Practice of building pathology	3	14.00
8	Enforcement of National Building Code	2	9.50
9	Production of buildability and Maintenability Analysis by Builders	1	5.00
10	Adequate funding of maintenance	2	9.50
	Total	21	100%

On the issue of strategies on how to mitigate Building Defects, the results in table 6 indicate that the majority of the respondents representing 3 (14.00%) affirmed that proactive approach to maintenance, ensuring of adequate standard workmanship and practice of building pathology are the most significance. This is followed by 2(9.50) respondents who ticked periodic inspection of buildings, engagement of right professionals, use of standard materials, enforcement of National Building Code (NBC) and adequate funding of maintenance work respectively. The remaining respondents representing 1(5.00%) maintained that strategies on how to mitigate building defects include carrying out site and soil investigations before design and construction of buildings and the production of buildability and maintainability analysis by builders. The results imply that the functional levels of buildings can be enhanced if these strategies are followed.

Conclusions and Recommendations

This study has revealed a number of issues that include defects on building components factors responsible for these defects, their effects on the users of the buildings and strategies on how to mitigate these defects. Most important, the study revealed that building pathology is a tool that can be used to search and discover defects, their causes, consequences and mitigations. This is in line with the findings in earlier studies by Molnarka (2000) which revealed that during the building maintenance process, the task of an expert performing pathological examination is to explore failures, to name their causes and to suggest solutions for repairs. It shows that building pathology has a significance impact on building maintenance and, as such, complement each other. The submission of this paper is that the study has further defined and explored the term; Building Pathology, as a new area of study in the Construction Industry. According to Thomson (2014), housing pathology is both unmistakably a new name and potentially a new domain, but partly a new knowledge field.

It is therefore recommended that building pathology be given substantial attention in the industry, in order to address issues of building defects. Building professionals and other stakeholders in the Building or Construction Industry should create the awareness on the importance of building pathology particularly, its role in building maintenance, building survey and maintenance manual etc. It is also recommended that building pathology should be part of the procurement process. This will enhance the design, construction and maintenance of building.

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