
BUILDING PROFESSIONALS PERCEPTION OF BUILDING DETERIORATION DUE TO ENVIRONMENTAL FACTORS AND APPLICATION OF BUILDINGS IN MAKURDI METROPOLIS, BENUE STATE.

¹Elijah Akaakase Hime ²Paul Ode

¹ Department of Vocational and Technical Education Benue State University Makurdi

² Department of Vocational and Technical Education College of Education Oju, Benue State
Email: akaakase63@gmail.com

Corresponding author: Elijah Akaakase Hime

ABSTRACT

Deterioration of buildings has being a major problem in Makurdi metropolis as it often leads to building collapse with destruction of lives and properties. This study sought investigated into building deterioration due to environmental factors and application of buildings in Makurdi metropolis of Benue State. Two research questions guided the study. The study adopted a descriptive survey research design. The population for the study was 172 building professionals. A proportionate stratified random sampling technique was used to select 111 building professionals. The instrument used for data collection was a 20-item self structured questionnaire titled Building Deterioration (BD) which was validated by three experts. Cronbach Alpha was used to ascertain the internal consistency of the instrument which yielded an overall reliability coefficient of 0.80. The data was collected through direct contact. The descriptive statistics of mean and standard deviation were used to answer the research questions and One-way Analysis of Variance (ANOVA) was used to test the null hypotheses at 0.05 level of significance. The study found that environmental like stresses on buildings due to storm, chemical attack on building materials, wet and dry deposition of pollutants on building surfaces among other are responsible for deterioration in buildings. It was also found that building applications such as indiscriminate wetting of floors; indoor activities such as cooking dish washing, clothes washing, bathing and people's respiration; storing of moist items in buildings among others can facilitate deterioration of buildings. It was therefore recommended among others that building construction engineers should use building materials that can withstand environmental hazards like rain, wind, chemical attack among others. It was also recommended that building construction professionals should ensure to include appropriate water channels during construction of

buildings, construction engineers and builders should always adhere to design specifications when carrying out building projects and building occupants should endeavour to use buildings as recommended by the architects.

Keywords: *Buildings, Deterioration, Environmental Factors, Application of Buildings.*

INTRODUCTION

A building refer to structures built for permanent use for (shatter) accommodation, working and storage of items as shelter for man and his properties. To obtain the desired satisfaction of buildings, they must be properly designed, constructed and maintained (Seeley, 2007). Buildings all over the world constitutes one of the most valuable assets of mankind. The phrase "building deterioration" is the gradual adverse loss of physical or chemical properties of building components. The sudden rise in the level of building deterioration has being a menace to building owners, tenants, building professionals and the society at large. Building deterioration reduces the value of buildings and consequently in most cases leads to its collapse and in turn results to waste of resources. Often time, when a building deteriorates to the point of collapsing, severe destruction of lives and properties occur (Adesanya, 2016). Building deterioration is one of the major building problems that significantly need attention. Though building deterioration is not peculiar to Nigeria, the trend in Nigeria is becoming quite worrisome and a source of concern to stakeholders in building construction industry. The frequency of occurrence has equally become a major source of concern not only to the government but to all Nigerians and most especially the professionals in construction industry as the magnitude of the incidents is becoming very unprecedented. According to Kolawale (2012), it is quite unfortunate that building deterioration incidence is still regularly occurring despite the fact that there has being an increasing diffusion of engineering knowledge over the years.

Building deterioration over the world had been attributed to two phenomena: natural and man-made. The natural phenomenon aspect of building deterioration is triggered off by natural occurrences such as wind, storm, rain, and extreme whether among others, and when these occur, it could be regarded as natural disaster. The man-made aspect on the other hand, is borne out of man's negligence in areas of material selection, lack

of adequate supervision of craftsmen resulting to poor quality of workmanship among others (Okuntade, 2014).

One of the sources of building deterioration is environmental factors. Natural or man-made building materials are continuously exposed to environmental attacks, which often cause the premature aging of the building material. This causes physical, chemical and biological degradation in the building materials (Prescott, Harley & Klein, 2013). Beside the principal gaseous pollutants such as Sulphurdioxide (SO_2), Nitrogen dioxide (NO_2) and Carbon-dioxide (CO_2), the effect of aerosols and the presence of various forms of water (e.g. meteoric water and moisture) are also active elements in the deterioration process (Duggal, 2008). Gases easily form different acids with the contacting water (sulphuric acid, nitric acid or carbonic acid) which can corrode the metallic building materials. Aerosol particles, dust and soot also play a significant role in the process of deterioration. Prescott, Harley and Klein (2013) equally observed that adverse environmental conditions are among the most significant influences of deterioration of buildings.

Environmental factors like dampness equally result to building deterioration. Dampness can be described as water penetration through the walls and other elements of a building. Alexander, Betron and De-Belie (2013) defined dampness as the amount of moisture content present in a material and can be classified it as capillary moisture content, equilibrium moisture content, hygroscopic moisture content, total moisture content and potential moisture content. Dampness is inextricably linked to most incidence of building deterioration. A source of water close to a building will also be one of the problems associated with deterioration due to dampness. The symptoms of this problem include dirty spots on the building, growth of biological plants like fungi and mosses, creeping plants, paint flaking, blistering among others (Poseng, 2011).

Deterioration of buildings can also occur due to application of the building. During the time of usage of a building, activities like cleaning, washing, cooking among others also directly affect the building and lead to its deterioration. To avert this, the activities of users of these buildings such as cleaning, washing and cooking ought to be done with caution. Otherwise they may increase the deterioration of the building. In addition, non-maintenance of buildings during usage leads to the

deposition of moist particles on the walls of a building, thereby leading to its deterioration.

Cleaning services directly affect buildings and cause their deterioration especially if the routine cleaning operation is not carried out in a proper manner (Ukeassay, 2015). Floor and walls are mostly prone to deterioration resulting from cleaning activities. Xiaoxia and Kumaraswamy (2014) noted that, unplanned control of use in buildings has constituted one of the few greatest maintenance problems in buildings which cause deterioration. In many parts of the world, buildings are generally misused, overused and at times maliciously damaged (Ukeassay, 2015). When this is well planned for, certain situations and programmes can be inputted into the building to guide against wrong usage which can prevent it from unnecessary deterioration. Tiwari (2006) equally observed that if skilled personnel maintained aspects of building or its component it has the advantage of standing to test of time. Design team therefore needs to critically plan this ahead of the time before such becomes a problem during the facility usage and management. Indoor humidity and household moisture are some of the most common indoor moisture sources that lead to deterioration of buildings (Tyona, 2018). Tyona particularly identified domestic activities such as baths and showers, cooking without lids, and hanging wet clothing and towels to dry as some of the indoor activities that result to the deterioration of buildings. The author states that clothes dryer vented into the living space, combustion appliances and inadequate use of vent for air conditions, plumbing leaks and continuous used of humidifiers as the common sources of indoor sources of moisture that leads to building deterioration.

Personal observations by the researcher couple with literature review revealed that the rate at which buildings are deteriorating has posed a challenge as the causes and solutions to the problem are yet to be ascertained. It seems that environmental factors and application of building are responsible for the high rate of building deterioration in Makurdi, Benue State and Nigeria at large. This therefore, necessitates the need to elicit building professionals' opinions, particularly Architects, Builders and Estate Surveyors and Valuers on factors that are responsible for building deterioration.

Purpose of the Study

The purpose of this study is determine building professionals' perception of building deterioration in Makurdi, Benue State. Specifically, the study sought to determine:

1. Building professionals' perception of buildings deterioration due to environmental conditions.
2. Building professionals' perception of buildings deterioration due to application of buildings.

Research Questions

The following research questions guided the study:

1. What is the perception of building professionals on building deterioration due to environmental conditions?
2. What is the perception of building professionals on building deterioration due to application of buildings?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance:

Ho₁: There is no significant difference between the mean perceptions of building professionals on building deterioration due to environmental conditions.

Ho₂: There is no significant difference between the mean perceptions of building professionals on building deterioration due to application of buildings.

Method

The study adopted a descriptive survey research design. The population of the study is 172 building professionals which comprises of 66 builders, 76 Architects and 30 Estate Surveyors and Valuers (NIOB, NIA & NIEV). The sample size for the study was 111 building professionals. The proportionate stratified random sampling technique was used to select 43 builders, 49 architects and 19 Estate Surveyors and Valuers. Proportionate stratified random sampling procedure as described by Emaikwu (2011) is the sampling technique where the researcher select the sample size of each stratum in such a manner that it is proportional to the population size of the stratum when viewed against the entire population. The instrument used for data collection was a 20-item self structured questionnaire titled Building Deterioration and Environmental Factors

(BD), which was validated by three experts. According to Nworgu (2006), questionnaires are the most valid instrument for data collection when the study is primarily concerned with eliciting the opinion or thoughts of the population group on a phenomenon. In order to establish the reliability of the instrument, a pilot study was carried out where 30 building professionals (10 Architects, 10 builders & 10 Estate surveyors and valuers) in Lafia, Nassarawa State which were not part of the study area but exhibit similar characteristics were issued questionnaires. The questionnaires were collected and further subjected to statistical analysis using Cronbach's Alpha technique. The instrument yielded a reliability coefficient of 0.80. The instrument was administered to the respondents via direct contact with the aid of 2 research assistants. For effective administration of the instrument, the researcher contacted the State chairpersons of the population group (Architects, Builders & Estate surveyors and valuers) to find out the days of their professional bodies meeting. Thereafter, the researcher visited each group on the days of their meetings at Ministry of works and housing, Makurdi, Benue State to administer the instrument. The descriptive statistics of mean and standard deviation were used to answer the research questions and One-way Analysis of Variance (ANOVA) was used to test the null hypotheses at 0.05 level of significance. To answer the research questions, items with mean response scores of 2.50 were considered as agreed while items with mean rating scores below 2.5 were considered disagreed. Furthermore, One-way Analysis of Variance (ANOVA) was employed to test the null hypotheses at 0.05 level of significance. The decision to either reject or retain a null hypothesis was based on the comparison of the probability value (p -value) and level of significance (α - value). When $p\text{-value} \leq \alpha$, the null hypothesis was rejected and other wise, the null hypothesis was retained.

RESULTS

Research Question One: What is the perception of building professionals on building deterioration due to environmental factors?

Table 1: Mean and Standard Deviation of Architects, Builders and Estate Surveyors and Valuers on Building Deterioration due to Environmental Factors.

S/N	Building Deterioration due to Environmental Factors	\bar{X}_i	SD _i	Remarks
1	Stresses on buildings due to storm.	3.13	0.69	Agree
2	Chemical attack on building materials.	2.90	0.49	Agree
3	Wet and dry deposition of pollutants on building surfaces	3.12	0.69	Agree
4	Corrosion of iron and steel in structural elements.	1.87	0.77	Disagree
5	Growth of termites on walls and roof tops.	3.11	0.70	Agree
6	Vertical movement of moisture in walls.	3.00	0.36	Agree
7	Horizontal movement of moisture in floors.	3.13	0.69	Agree
8	Efflorescence on buildings.	2.94	0.77	Agree
9	Condensation of atmospheric moisture on walls of buildings	3.12	0.67	Agree
10	Wetting of external walls due to heavy rain.	3.05	0.58	Agree
	Cluster Mean	2.94		Agree

Result of data presented in Table 4 shows that respondents are of the perception that environmental factors lead to deterioration of buildings as shown in their cluster mean response scores of 2.94 which is above the cut off point of 2.5. Respondents agreed that stresses on buildings due to storm can lead to deterioration of buildings (M = 3.13, SD = 0.69); chemical attack on building materials causes deterioration of buildings (M = 2.90, SD = 0.49); wet and dry deposition of pollutants on building surfaces causes deterioration of buildings (M = 3.12, SD = 0.69); growth of termites on walls and roof tops leads to building deterioration (M = 3.11, SD = 0.70) among others. Respondents however, disagreed that corrosion of iron and steel in structural elements is responsible for deterioration of buildings (M = 1.87, SD = 0.77).

Research Question Two: What is the perception of building professionals on building deterioration due to application?

Table 2: Mean and Standard Deviation of Architects, Builders and Estate Surveyors and Valuers on Building Deterioration due to Application.

S/N	Building deterioration due to application	\bar{X}_i	SD _i	Remarks
11	Indiscriminate wetting of floors.	3.00	0.46	Agree
12	Indoor activities such as cooking dish washing, clothes washing, bathing and people's respiration.	3.58	0.52	Agree
13	Storing of moist items in buildings.	3.01	0.71	Agree
14	Overloading of building.	1.91	0.55	Disagree
15	Illegal conversion of buildings.	2.95	0.48	Agree
16	Alterations without consulting relevant.	1.92	0.46	Disagree
17	Unauthorized additions to existing building.	3.13	0.37	Agree
18	Continuous splashing of water on walls of buildings.	3.85	0.69	Agree
19	Lack of maintenance.	3.05	0.54	Agree
20	Change of usage without professional advice.	2.42	0.58	Disagree
	Cluster Mean	2.88		Agree

Result of data presented in Table 2 shows that respondents are of the perception that building application s leads to deterioration of buildings as shown in their cluster mean response scores of 2.88 which is above the cut off point of 2.5. From Table 3, it was shown that respondents were of the perception that indiscriminate wetting of floors causes deterioration of buildings (M = 3.00, SD = 0.46); indoor activities such as cooking dish washing, clothes washing, bathing and people's respiration lead to deterioration of buildings (M = 3.58, SD = 0.52); storing of moist items in buildings can facilitate deterioration of buildings (M = 3.01, SD = 0.71);illegal conversion of buildings can lead to deterioration of buildings (M = 2.95, SD = 0.48); unauthorized additions to existing building can cause deterioration of buildings (M = 3.13, SD = 0.37) among others. Respondents on the other hand, disagreed that overloading of building do not cause deterioration of buildings (M = 1.91, SD = 0.55); alterations without consulting relevant experts are not responsible for deterioration of buildings (M = 3.13, SD = 0.37) and change of usage without professional advice is not responsible for deterioration of buildings (M = 2.42, SD = 0.58).

Test of Hypotheses

The Null hypotheses formulated for the study were tested at 0.05 level of significance and were presented as shown below:

Null Hypothesis One (Ho₁): There is no significant difference in the perception of building professionals on building deterioration due to environmental factors.

Table 3: One-way ANOVA of Architects, Builders and Estate Surveyors and Valuers on building deterioration due to Environmental factors

	Sum Squares	of df	Mean Square	F	P-Value
Between Groups	83.712	2	41.86	2.24	0.11
Within Groups	2017.25	108	18.69		
Total	2101.676	110			

Result of data presented in Table 8 shows that there is no significant difference in the perception of building professionals on the extent of building deterioration due to environmental factors, $F(2, 108) = 0.82$, $P=0.11$. This therefore shows that the Null hypothesis is retained. This means that Architects, Builders and Estate Surveyors have similar perceptions on the causes of building deterioration due to environmental factor.

Null Hypothesis One (Ho₂): There is no significant difference in the perception of building professionals on building deterioration due to application of buildings.

Table 4: One-way ANOVA of Architects, Builders and Estate Surveyors and Valuers on building deterioration due to application of Buildings

	Sum of Squares	df	Mean Square	F	P-Value
Between Groups	3.16	2	1.58	2.22	0
Within Groups	747.54	108	6.92		.80
Total	750.68	110			

Result of data presented in Table 4 shows that there is no significant difference in the perception of building professionals on the extent of building deterioration due to application of buildings, $F(2, 108) = 2.23$, $P=0.80$. This therefore shows that Null hypothesis four is retained. Specifically, the result indicates that Architects, Builders and Estate Surveyors have similar perceptions on the causes of building deterioration due to application of buildings.

DISCUSSION OF FINDINGS

Result of data presented in Table 1 show that respondents are of the perception that environmental factors are also responsible for deterioration of buildings. In support of this view, Prescott, Harley and Klein (2013) are of the view that microorganisms act on the structures through their metabolism, they produce metabolites, many of which are chemically aggressive to building materials. Alexander, Bertron, and De Belie (2013) added that these microorganisms can also degrade materials through some specific effects, such as the formation of bio-films on the surface, which locally generate high concentrations of aggressive metabolites. Building deterioration over the world had been attributed to two phenomena: natural and man-made. The natural phenomenon aspect of building deterioration is triggered off by natural occurrences such as wind, storm, rain, and extreme weather among others, and when these occur, it could be regarded as natural disaster. The man-made aspect on the other hand, is borne out of man's negligence in areas of material selection, lack of adequate supervision of craftsmen resulting to poor quality of workmanship among others (Okuntade, 2014). Prescott, Harley and Klein (2013) equally found that another source of building deterioration is environmental factors. Natural or man-made building materials are continuously exposed to environmental attacks, which often

cause the premature aging of the building material. This causes physical, chemical and biological degradation in the building materials. Beside the principal gaseous pollutants such as Sulphurdioxide (SO₂), Nitrogen dioxide (NO₂) and Carbon-dioxide (CO₂), the effect of aerosols and the presence of various forms of water (e.g. meteoric water and moisture) are also active elements in the deterioration process (Duggal, 2008). Gases easily form different acids with the contacting water (sulphuric acid, nitric acid or carbonic acid) which can corrode the metallic building materials. Aerosol particles, dust and soot also play a significant role in the process of deterioration. Prescott, Harley and Klein (2013) equally observed that adverse environmental conditions are among the most significant influences of deterioration of buildings.

Result of data presented in Table 2 shows that respondents are of the perception that deterioration of buildings can be due to building application (usage). In a similar view, Xiaoxia and Kumaraswamy (2014) noted that, unplanned control of use in buildings has constituted one of the few greatest maintenance problems in buildings which cause deterioration. In many parts of the world, buildings are generally misused, overused and at times maliciously damaged. When this is well planned for, certain situations and programmes can be inputted into the building to guide against wrong usage which can prevent it from unnecessary deterioration. This can be in form of warning alarm, refusal to work, or switching off (e.g. lift system) or signals as preventive measures. Another reason why many buildings suffer serious deterioration problem is the incompetence of those who used and maintain such buildings or unavailability of such personnel.

The assertion of Springer, Grosseau and Garcia (2011) is equally in line with the findings of this study. According to the authors, the use of metals in buildings began with small objects (e.g. nails), but following the industrialization, many new objects were introduced. Steel and aluminium are used for profiles and load-bearing structures. Copper is mainly for roofing, and zinc and nickel are used for corrosion protection purposes. Durability of building materials depends on the surrounding conditions and metallic building materials are generally durable if they are kept dry. Under humid condition, steel will corrode unless protected by a layer of zinc, nickel or an organic coating (Dimuna, 2010). These humid conditions can be caused by application of buildings, for example in a situation where occupants of such buildings stain the buildings with water

due to washing, bathing, cleaning and cooking. Besides the deterioration of the metal itself, the deterioration products may also harm other materials as seen in the case of reinforced concrete where steel corrodes and stain the concrete wall. Copper, being a semiprecious metal, is very durable and resistant to atmospheric attacks.

CONCLUSION

From the findings of the study, it was found that most of the factors responsible for building deterioration were traced environmental factors. It was also found that environmental factors also stresses on buildings due to storm and chemical attack on building materials contribute massively to deterioration of buildings. Other environmental factors that result to deterioration of buildings are wet and dry deposition of pollutants on building surfaces, growth of termites on walls and roof tops among others. It was also found that building professionals and occupant of buildings have much to do in other to reduce the rate of deterioration in buildings. This is because most of the factors responsible for building deterioration were traced to activities of users. It was found from the study that users' activities such as indiscriminate wetting of floors and indoor activities such as cooking dish washing, clothes washing, bathing and people's respiration also contribute to deterioration of buildings. To reduce the incidence of building collapse due to deterioration resulting from environmental factors, it is necessary to use durable building materials that withstand chemical attacks during construction of buildings. Though environmental factors are mostly natural phenomenon, both building professionals and occupants of buildings are responsible for the application of control measures that will reduce these to a minimum level. It is therefore, advisable that occupants of buildings should avoid indoor activities that will result to wetting of various parts of buildings. If this is done, deterioration of buildings will be reduced.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made:

1. Building construction engineers should use building materials that can withstand environmental hazards like rain, wind, chemical attack among others. This will reduce the amount of deterioration in buildings that is mostly caused by environmental attacks.

2. Building construction professionals should endeavour to protect external walls. This will reduce the amount of penetration of dampness into walls of buildings, hence reduces deterioration.
3. Building occupants should endeavour to use buildings as recommended by the architects.
4. Occupants of buildings should endeavour to carryout proper maintenance in buildings at appropriate times. This will extend the life span of building.

REFERENCES

- Adesanya, D.A. (2016). Problem areas in controlling quality of construction projects in Nigeria: The builders focus. *National Association of Building Students (NAOBS) Maiden Edition*, 52-63.
- Alexander, M., Bertron, A. & De Belie, N. (Eds) (2013) *Performance of cement-based materials in aggressive aqueous environments*, RILEM TC 211-PAE. Berlin, Springer.
- Emaikwu, S.O. (2011). *Fundamentals of educational research methods and statistics*. Makurdi: Selfers Academic Press.
- Kolawale, A.R. (2012, October). Developing maintenance culture in Nigeria: the role of facility management. *Paper Presented at the National Conference of the School of Environmental Studies at the Federal Polytechnic Ede, Osun State*.
- Nworgu, B.G. (2006). *Educational Research: Basic Issues and Methodology*. Nssuka, Enugu, University Trust Publishers.
- Okuntade, T.F. (2014). Effects of faulty design and construction on building maintenance. *International Journal of Technology Enhancements and Emerging Engineering Research*, 2 (5), 59-64.
- Poseng, K. (2011). *A Review of factors affecting building defects*. Singapore. Universitikristen petra , III (2).
- Prescott, L.M., Harley. J.P & Klein, D.A. (2013) Bio-deterioration of stone: a review. *IntBiodeterior Biodegrad*, 46(4), 343–368.
- Seeley, I.H. (2007). *Building maintenance*. (3rd eds). Hampshire, England; Macmillan Press, Ltd.

Tiwari, G. N. (2006). *Solar energy fundamentals, design, modeling and applications*. New Delhi: Narosa publishing.

Tyona, J. (2018). *Enhancing Damp Proofing in Residential Buildings in Makurdi Local Government Area of Benue State*. (Unpublished Undergraduate Project), Benue State University, Makurdi.

Ukeassay, (2015). Causes of Deterioration in Building and their Services Construction Essay. Retrieved From <https://www.ukessays.com/essays/construction/causes-of-deterioration-in-building-and-their-services-construction-essay>.