CSID Journal of Infrastructure Development

http://jid.eng.ui.ac.id

CSID Journal of Infrastructure Development, 3(1): 40-50 (2020)
ISSN 2407-4438

FACTORS INFLUENCING THE USE OF SUBSTANDARD MATERIALS IN THE CONSTRUCTION OF RESIDENTIAL BUILDINGS

Olajide Julius Faremi[1*], Oluranti Olupolola Ajayi[1], Olamide Elizabeth Faremi[2]

[1]*Department of Building, Faculty of Environmental Sciences, University of Lagos, Nigeria*
[2]*Department of Zoology, Faculty of Science, University of Lagos, Nigeria*

(Received: December 2019 / Revised: January 2020 / Accepted: February 2020)

ABSTRACT

The use of substandard materials for the construction of residential buildings within Lagos metropolis is experiencing a growing concern for both the government and the residents. The construction of half-lived and substandard buildings contributes to negative consequences ranging from rapid deterioration of building elements, premature failures of key building components, and sometimes building collapse. This study attempts to investigate the factors influencing the use of substandard construction materials for the construction of residential buildings in Lagos State. This research collected primary data through a cross-sectional survey of professionals engaged in the construction of buildings and building owners within the study area. Two sets of structured questionnaires were developed and administered to each of the groups of respondents, respectively. The collected data were analysed using descriptive and inferential statistical tools. The results show that factors influencing the use of substandard construction materials for the construction of residential buildings include corruption, use of quacks, contractor's greed and selfish interests, and client's financial constraints. The results suggested no significant difference in the perception of contractors and building owners on the factors influencing the use of substandard materials for the construction of residential buildings. The study concludes that the use of substandard building materials for the construction of buildings could cause structural failure, high maintenance costs, incessant building defects, and accelerate deterioration of building elements and components. Building clients suggest to engage professionals and refrain from patronizing quacks.

Keywords: Buildings; Defects; Factors; Maintenance; Substandard materials

1. INTRODUCTION

Buildings are structures or shelter purposely built to accommodate humans and to serve as storage for their belongings (Oyenuga, 2010). The materials used for the construction of buildings depends on the type and purpose of the building. Significant factors such as the design, materials, and resources to be employed, and costs amongst others must be taken into considerations when constructing a building (Adewuyi, 2010). Amid these factors, the quality and standard of materials used is of enormous importance.

The quality of buildings in Nigeria remains questioned, given the numerous counts of undesired and unpleasant manifestations that follow shortly after completion and most times during the operational stage.

*Corresponding author's email: juliusfaremi@gmail.com, Tel. +23 4803 785 5322
DOI: https://doi.org/10.32783/csid-jid.v3i1.88

According to Blok and Herwijnen (2001), the service life of a building from a technical perspective is the period in which a structure can perform according to the requirements based on its intended purpose. Langston (2011) marks out variables such as the quality of components of a building (a function of the quality of materials used), design level, work execution level, the environment, users' maintenance level amongst others as factors that contribute to the service life of a building. Vanier (1999) posits that the life span of a building is a complex term with many interpretations, differing from mere "time of existence" to "period of use". However, the author emphasized that the technical lifespan of a building strongly depends on the materials used.

From the metrics set above, it can be inferred that a building's service life is the minimum period during which a building can meet the user's requirements, demands, and perform its designed functions until it becomes obsolete. Therefore, it can be assessed and measured based on the integrity of the individual components, both from structural and non-structural. The standard/quality of materials used in making these components, therefore, stands as a determinant for functionality.

Ugochukwu, Ogbuagu, and Okechukwu (2014) acknowledged building materials as one of the principal factors affecting the effective performance of the Nigerian construction industry. It is a major contributor as the quality of building materials influence the quality of building construction projects. Thus, a decline in the quality of these materials poses a great danger not only to the service lives of buildings but also to human lives, properties and the economy at large. Substandard construction materials are materials that do not meet quality standards and contribute to undesired consequences on the life of a building. The use of substandard materials and poor workmanship account for about 52% of building defects that manifest at the post-occupancy phase of a building, especially in residential buildings (Ayodeji, 2011). Furthermore, Ajufoh et al. (2014) speculate that the use of inferior construction materials has a 10 % causative effect on the collapse of buildings.

Many buildings in Nigeria, especially in Lagos, are built with substandard building materials. Akinyemi, Dare, Anthony, and Dabara (2016) opine that many contractors are greedy as they patronize vendors and suppliers of substandard building materials with the motive to profit from such practice. This is evident in the rate of defects in many of the newly completed buildings as well as the high rate in the occurrence of building collapse within the state. Akinyemi, Dare, Anthony, and Dabara (2016) assert that 60% of building collapses in Nigeria occur in Lagos, ascribing the use of substandard materials and poor workmanship by quacks as being responsible for the majority of the building collapse. In addition, Omenihu, Onundi, and Alkali (2016) posit that the use of substandard materials for the construction of buildings accounts for 13.2% contribution to the collapse of buildings being second to structural failure with 24.9% contribution. Akande, Akinjobi, Alao, and Akinrogunde (2016) explain that substandard materials, especially reinforcement rods, steel sections and cement contribute immensely to the failure of buildings with up to 18.4% contribution.

The non-structural effects showed that the use of inappropriate and substandard construction materials often lead to defects in building without attaining the building's service life. AlSadey, Omran, and Kadir Pakir (2010) identified some common problems arising from construction defects in homes are associated with substandard construction strategies, bad building materials, and faulty workmanship, amongst others. In the case study of defects in selected buildings by Kumar (2017), it was reported that defects attributable to the use of substandard building materials include spalling, column cracks, the disintegration of concrete from columns and corrosion of reinforcement bars.

There are government agencies such as the Standard Organization of Nigeria (SON) that is responsible to regulate the quality of materials used for construction works. But, the reality shows that these agencies are not as effective in discharging their function of monitoring and enforcing standards (Kabir, 2015). This condition exists due to the proliferation of substandard materials in the construction market and contributes largely to the construction of half-lived and substandard buildings. Ameh, Odusami, and Achi (2007) acknowledged that corruption and other unethical practices are endemic in the construction industry. A valid argument would be that unscrupulous manufacturers and suppliers inserting themselves into the supply chain and introducing substandard construction materials propagate the sources of these materials.

Despite the proliferation of substandard materials in the construction market of Lagos State and Nigeria at large, previous studies mostly focused on the consequences of using substandard materials (Danso, 2010; Waziri & Vanduhe, 2013; Kumar, 2017). Whereas, studies investigating the factors influencing the use of substandard materials for building construction works remain limited. Furthermore, many of the existing studies on substandard materials discussed the influence of substandard materials on building collapse and not on the factors that influence construction stakeholders to buy and use substandard materials for building construction projects. Therefore, this study aims to investigate the factors influencing the use of substandard materials for the construction of buildings within Lagos metropolis.

1.1. Research Objective

The objective of the study is to investigate the factors influencing the use of substandard construction materials for the construction of residential buildings in Lagos State.

1.2. Research Hypothesis

Ho: There is no statistical difference in the perception of building owners and contractors on the factors influencing the use of substandard construction materials for the construction of residential buildings

2. LITERATURE STUDY

Kanniyapan et al. (2015) suggested that the selection and usage of the right construction materials could lengthen the life span of building elements, reducing repair and replacement works. Waziri et al. (2013) posit that the use of substandard materials and components affects the maintenance of a building as such materials have lower life and durability than standard materials and components. As the result, frequent maintenance is required in situations where substandard materials are used to preserve the building over its lifespan. Substandard construction materials have negative structural effects on the service life of buildings and affect untimely defects, which leads to maintenance cost and consequently, resulting in the poor physical and economic life of buildings.

Despite various metrics on the prospects of attaining standard and sustainable buildings using high-quality materials, several studies have shown that the prevalence of this process caused by several factors. Greed, incompetence, and corruption have been associated with the recurring collapse of buildings during construction. These practices are common among some construction stakeholders including contractors and builders who may use un-specified or sub-standard material in order to cut cost of production (Ezeagu, Udebunu & Obiorah, 2015). The authors also revealed that “Owner Construction Syndrome” might also be a great factor influencing this act. The owner or clients in a bid to save cost would want to build by

themselves using a direct labour workforce. They in-turn purchase materials, found cheap and inferior building materials without any considerations on the later effects and implications.

Ezeagu, Udebunu, Obiorah (2015) on issues surrounding building collapses established that financial constraints could be a causal factor as it encourages the involvement of incompetent professionals and the use of poor construction materials during the construction of foundations. The authors further stressed that inexperienced contractors constantly use substandard materials leading to bad quality building, which is dangerous to the owners and occupants. Based on these findings, it is argued that corruption has become one of the major factors for substandard construction materials in Nigeria. Several works of literature have been found to support this ground. Zou (2006) suggests corruption as "the behaviour which deviates from the norms, rules and duties governing the exercise of a privileged role or office for private gain". Hawkins, Walters, Harvey, Walshe, Matthews, Saggers, Nembhard (2013) also adopted a definition of corruption as "the abuse of entrusted power for private gain". It encompasses not only the government (where private gain includes institutional and political gain) but also the contractors, consultants and those who are engaged to deliver infrastructure services.

Hawkins et al. (2013) further stressed that unethical behaviour including bribing to win contracts, manipulating designs, false invoicing for substandard materials or concealing defects flourished during the procurement and construction stages of the project cycle. This supported by 2008 survey, which stated that the use of substandard materials was the biggest source of unethical conduct in the construction industry. Other researchers identified financial issues, material prices, availability of resources, and project managers' ignorance, negligence and lack of knowledge as factors contributing to the problem (Joy, 2014).

Kanniyapan et al. (2015) opine that the use of defective, poor quality materials creates major building defects during the post-construction service, which compounds the problems associated with maintainability. In addition, the study asserts that the enormous maintenance workloads experienced by users are because of faulty material selection and that repair caused by defective materials account for the second-largest cost of maintenance.

Hawkins et al. (2013) also argue that the effect of corruption on material quality at this stage has an influence on the day-to-day lives of people. A major risk is the potentially poor quality of the finished asset, leading to its rapid deterioration and consequently, higher repair and maintenance costs. Zaidi and Davies (2010) establish that in cases where a decline in quality and issues of repeated building defects surface, a problem of customer dissatisfaction and housing performance arises.

Many of the concerns and perceptions of users arising from the post-construction effects of substandard construction materials hover around maintenance and maintainability of these inferior materials. In this regard, previous researchers have found that attaining maintainability has been a major problem, as the use of substandard materials in several components of a building defeats its very purpose. Kanniyapan et al. (2015) proposed a working definition of maintainability as the means of achieving an optimum performance throughout the building's life span with a minimum life cycle cost. According to the authors, the maintainability of building material is essential to sustain the building functions in order to prolong the life span of the building. It is understood that substandard materials do not satisfy this criterion.

The use of substandard materials in the construction of buildings could lead to untimely defects occurring in both old and newly constructed buildings. Nurul and Azree (2014) identified and attributed substandard construction materials as a major contributor to some notable defects. They include but are not limited to cracks on the wall, peeling paint, faulty electrical wiring or lighting, defective or faulty plumbing, dampness, sagging or deformation, defective plaster rendering, roof defects. Kanniyapan et al. (2015) asserted that materials used for construction

purposes should be maintainable, and of the right quality to accommodate aesthetic and functional performance requirements at minimal intervals for cleaning and inspections for defects. The study adopts all factors enumerated in this section as a guide to assessing the factors influencing the use of substandard construction materials for the construction of residential buildings.

3. METHODS

A cross-sectional survey research design was used for the study. The population of the study comprises building owners and contractors who were involved in the construction of residential buildings within Lagos metropolis. The choice of Lagos as the study area was because the state is considered as the economic centre of Nigeria with the largest concentration of industries, financial institutions and major seaports. In addition, Lagos is considered to be among the fastest-growing states in the world and as a result, the state has a significant level of construction activities including a high level of residential building developments. The human population of the state is in excess of 9 million people (National Population Commission, 2009).

The study uses a pilot survey of of seventy residential buildings that were recently built, occupied and accessible within the study area. The participants are building owners that expressed willingness to participate in the survey and provide the contact information of the contractors who built the buildings. The addresses of the identified buildings were compiled on paper to generate a sample frame from which the sampled buildings were drawn.

The simplified formula for proportions (Yamane, 1967) was used to determine the sample size for each category of the targeted respondents. At a 95% confidence level and a 0.05 precision level, the proportionate sample size from the seventy identified residential building population was calculated as:

Sample size (S) = $\frac{N}{1+N(e)^2}$ ---------equation 1

Where S is the minimum sample size, N is the population size and e is the level of precision.

S=70/1+70(0.05^2) =59.57, the sample size is approximately 60.

This research used a structured questionnaire to collect primary data for the study. The questionnaire contained closed-ended questions for eliciting information relating to the research objective from the respondents. In sampling the respondents, the purposive sampling method was adopted to ensure that only targeted respondents were engaged. The factors used in the questionnaires were collated from pilot interviews and literature review. Among the collected factors, 15 factors that align with the research objective were selected. Each of the factors was provided with scales to collect responses from 1 to 5 in order to obtain the perceived ratings for each of the factors from the respondents. The description of the scale is as follows: 1 implies highly insignificant, 2 implies insignificant, 3 implies moderately significant, 4 implies significant and 5 implies highly significant.

A total of 120 questionnaires consist of 60 building owner's questionnaires and 60 building contractor's questionnaires were self-administered. There are 41 building owner's questionnaires and 49 building contractor's questionnaires were duly completed and retrieved. A total of 90 questionnaires were then analysed for the study representing a 75% response rate. The responses were coded and analysed using the Statistical Package for Social Sciences (SPSS) (Version 23). Frequency tables, charts, and t-test were used as statistical tools for the descriptive and inferential statistical analyses respectively.

The response data collected from the 90 respondents were coded in SPSS in correspondence with the value of each factor according to the rating given by the respondents. The level of significance of each of the factors was then calculated by using the relative significance index (RSI). The factors were then ranked according to the RSI value. Usually, the relative significance is used in ranking factors influencing an outcome so, it was adopted to rank the factors influencing the use of substandard building materials. The formula for the relative significance index is as follows:

RSI = ∑W/ (A ∗W) ---------equation 2

Where RSI - Relative Significance Index
∑W- Weight that was given to each factor by the respondents
A - Highest weight
N - Total number of respondents

The RSI value ranges from 0 to 1. The resultant value of each factor suggests the level of significance for that particular factor.

4. RESULTS AND DISCUSSION

4.1. Results

The respondents are distributed among building owners (46%) and building contractors (54%) shown in Figure 1. The result illustrated that the respondents equally possess an adequate level of education with various level of academic qualification. The result shows that 2% of the respondents had Ordinary National Diploma (OND), 16% had Higher National Diploma (HND), 40% had Bachelor's Degrees and Master's Degrees respectively, and 2% had other types of academic qualifications. The result implies that the respondents have acquired a significant level of formal education and were able to comprehend the questions and provide appropriate responses to the various questions in the questionnaire.

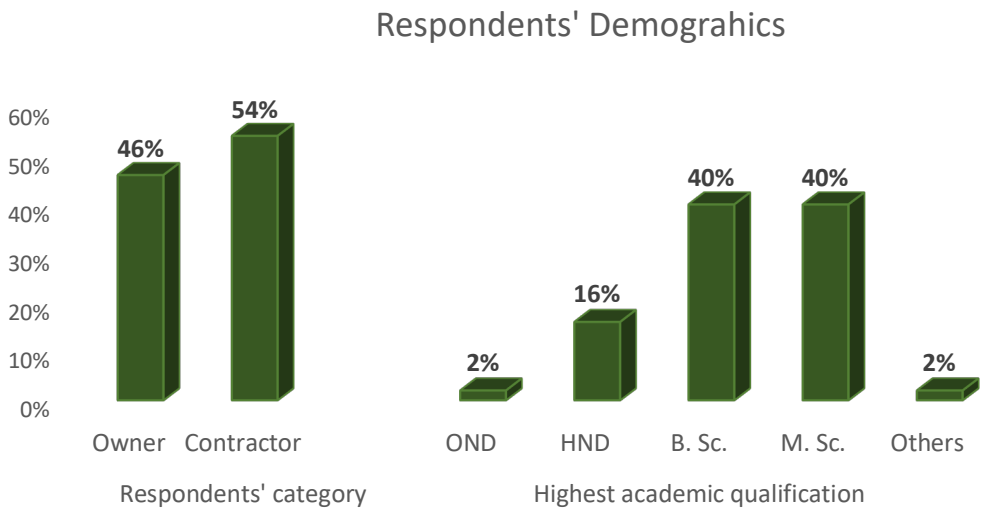

Figure 1 Respondents' demographic data

The objective of the study was to assess the factors influencing the use of substandard materials in the construction of residential buildings within Lagos metropolis. In order to achieve the

objectives, fifteen factors were presented to each of the survey participants through the structured questionnaire. The respondents were asked to rate the level of significance of each of the fifteen hypothesised factors that were extracted from the literature. A 5-point rating scale ranging from 1 representing not significant to 5 representing very significant were used by the respondents to rate each of the factors. The result of the analysis is presented in Table 1.

The result shows that building owners ranked corruption and the high prices of construction materials that meet standard requirements in a tie (RSI= 0.87) respectively, as the most significant factor influencing the use of substandard materials in the construction of residential buildings. On the other hand, contractors perceived corruption (RSI= 0.90) as the most significant factor similar with the ranking from building owners., Subsequently, contractor ranked greed and selfish interest (RSI= 0.89) as the second most significant factor. Furthermore, both the building owners and contractors perceived that the third most significant factor influencing the use of substandard materials is the use of quacks (RSI= 0.85; 0.86) for the construction of residential buildings.

Table 1 Factors influencing the use of substandard materials

S/N	Factors	N		RSI		Rank	
		Owners	Contractors	Owners	Contractors	Owners	Contractors
1	Corruption	41	49	0.87	0.90	1	1
2	High prices of construction materials that meet standard requirements	41	49	0.87	0.82	1	5
3	Use of quacks	41	49	0.85	0.86	3	3
4	Contractor's greed and selfish interests	41	49	0.84	0.89	4	2
5	Financial constraints	41	49	0.83	0.80	5	8
6	Nonconformity and compliance to standards	41	49	0.80	0.81	6	6
7	Supplier/Vendor's deceit	41	49	0.80	0.73	6	S
8	Contractor's incompetence and deficient material quality knowledge	41	49	0.80	0.81	6	7
9	Inadequate construction material testing	41	49	0.79	0.77	9	10
10	Negligence and poor supervision	41	49	0.78	0.84	10	4
11	Ignorance/Awareness of professionals and clients	41	49	0.78	0.79	10	9
12	Owners' contractor syndrome	41	49	0.78	0.76	10	11
13	Fear of high investment costs	41	49	0.74	0.70	13	15
14	Falsification of material test results	41	49	0.70	0.75	14	12
15	Availability of materials	41	49	0.69	0.72	15	14

Source: Field Survey

Note: RSI of 0.76 and above implies most significant; 0.67 – 0.75 implies significant; 0.45 – 0.67 implies less significant and below 0.45 implies not significant (Waziri & Vanduhe, 2013).

Factors that were highly ranked by building owners that significantly influencing the use of substandard materials for the construction of residential buildings include contractor's greed and selfish interests (RSI=0.84), financial constraints (RSI=0.83), nonconformity and compliance to

standards (RSI=0.80), supplier/vendor's deceit (RSI=0.80). Other significant factors comprises of contractor's incompetence and deficient material quality knowledge (RSI=0.80), inadequate construction material testing (RSI=0.79), negligence and poor supervision (RSI=0.78), ignorance/level of awareness of professionals and clients (RSI=0.78) and owners' contractor syndrome (RSI=0.78).

In addition, the result in Table 1 shows that other factors of significant influence as perceived by building contractors include negligence and poor supervision (RSI=0.84), supplier/vendor's deceit (RSI=0.81), nonconformity and compliance to standards (RSI=0.81), contractor's incompetence and deficient material quality knowledge (RSI=0.81). Som other factors such as financial constraints (RSI=0.80), ignorance/level of awareness of professionals and clients (RSI=0.79) and inadequate construction material testing (RSI=0.77) also deemed significant.

4.2. Test of hypothesis

This research postulated a hypothesis to analyse the factors influencing the use of substandard materials for the construction of residential buildings, which illustrated as follows.

Ho: There is no statistical difference in the perception of building owners and contractors on the factors influencing the use of substandard construction materials for the construction of residential buildings.

The hypothesis was tested using the independent samples t-test. The t-test results are presented in Table 2.

Table 2: Independent samples t-test on the perception of building owners and contractors

Factors influencing the use of substandard materials	F	df1	df2	MD	*p*-value	Remark
High prices of construction materials that meet standard requirements	2.77	85	84	.34	.15	NS
Fear of high investment costs	1.82	85	85	.15	.54	NS
Availability of materials	6.73	85	71	-.15	.52	NS
Financial constraints	0.83	85	85	.13	.60	NS
Use of quacks	1.07	85	71	-.30	.14	NS
Supplier/Vendor's deceit	3.24	85	85	.26	.28	NS
Nonconformity and compliance to standards	0.23	85	85	-.06	.77	NS
Contractor's incompetence and deficient material quality knowledge	1.96	85	73	-.38	.07	NS
Contractor's greed and selfish interests	1.73	85	84	-.04	.81	NS
Inadequate construction material testing	0.16	85	78	.10	.63	NS
Falsification of material test results	6.07	85	71	-.22	.29	NS
Corruption	0.37	85	77	-.16	.35	NS
Negligence and poor supervision	0.25	85	79	-.09	.69	NS
Ignorance/Awareness of professionals and clients	0.03	85	82	-.08	.70	NS
Owners' construction syndrome	0.65	85	83	.09	.69	NS

Note: *p* is significant at $p \leq 0.05$. df1 and df2 =degree of freedom, MD=Mean difference, NS=not significant.

The results in Table 2 shows that each of the factors influencing the use of substandard construction materials for the construction of residential buildings has *p*-values greater than

0.05 (p>0.05), therefore the null hypothesis is accepted for each of the factors. This implies that there is no statistical difference in the perception of building owners and contractors on the factors influencing the use of substandard construction materials for the construction of residential buildings.

4.3. Discussion of findings

From the results, the study shows that the factors with most significant influence on the use of substandard materials for the construction of residential buildings include corruption, the use of quacks, contractor's greed and selfish interests, and prices of construction materials. Both groups of respondents, building owners and contractors agreed that corruption significantly influences the use of substandard materials during the construction of residential buildings. As building construction sector is highly porous, there are sharp practices across the construction value chain which often results in the purchase and use of substandard materials and the delivery of poor works. The results of the study align with the findings of Ezeagu, Udebunu and Obiorah (2015) that corruption, greed, incompetence and financial constraints influence the quality of work during the production of buildings.

Furthermore, the results confirmed Hawkins et al. (2013) who assert that corruption stands as a major driver for the use of substandard materials on construction projects. The study explains that corruption is endemic in the construction industry as professionals engaged in all sorts of unethical behaviour including bribing to win contracts, manipulating designs, false invoicing for inferior and substandard materials or concealing defects flourished during the procurement and construction stages of the building project. Zou (2006) affirms that corrupt practices are have been reported among construction stakeholders at different stages of building projects most especially during material purchasing and procurements.

The findings further show that the use of quacks instead of professionals for the construction of buildings also significantly influence the rate at which substandard materials are used for the construction of buildings. Quacks, because of their services are cheaper than professionals, is often patronized by building owners. The result agrees with the result of Dahiru, Salau and Usman (2014) that the increasing patronage of quacks by building owners for construction works has promoted the use of poor quality materials as they lack the expertise to recognise and appreciate quality materials.

5. CONCLUSION

This research summarized the key factors influencing the use of substandard materials for the construction of residential buildings. It consists of corruption, the use of quacks for construction work, greed of contractors, relatively high prices of construction materials, financial constraints of both building owners and contractors, non-compliance with standards and specifications, negligence and poor supervision, contractor's incompetence and poor knowledge of material quality, ignorance and poor awareness of professionals and clients about construction material market, inadequate construction material testing facilities, supplier and vendor's deceit, and owners' contractor syndrome.

Furthermore, the study concludes that the use of substandard building materials for the construction of buildings resulting in structural failure, high maintenance costs, incessant building defects and accelerated deterioration of building elements and components. Subsequently, there is no statistical difference in the perception of building owners and contractors on the factors influencing the use of substandard construction materials for the construction of residential buildings.

In order to promote the use of quality materials for the construction of residential buildings, the study recommends construction stakeholders to engage professionals and refrain from patronising quacks and workers without professional competence in the science and technology of building and construction materials. Proper supervision should be carried out on work processes over the life cycle of building construction projects to ensure proper materials are used, and in line with project specifications. There should be advocacy on the benefits of using standard and quality materials. Professionals in the built environment should develop an honest and good ethical culture, maintain their integrity, work in accordance with standard practise and refrain from corrupt practices in order to prevent the proliferation of the menace. Regulatory agencies such as the Standard Organisation of Nigeria [SON] should be vigilant, prevent importation or local production of substandard materials and suggest with fail-proof and effective means of enforcing compliance to the use of quality materials.

REFERENCES

Adewuyi, A. (2010). *Structural Factors That Cause Building Failures*. University of Nigeria, Nssuka.

Ajufoh, M. O., Gumau, W. A., & Inusa, Y. J. (2014). Curbing the Menace of Building Collapse in Nigeria. *International Letters of Natural Sciences*. https://doi.org/10.18052/www.scipress.com/ilns.20.168

Akande, B. F., Akinjobi, S. D., Alao, T. O., & Akinrogunde, O. O. (2016). Causes , Effects and Remedies to the incessant Building Collapse in Lagos State , Nigeria. *International Journal of Basic & Applied Sciences*, *16*(August), 15–30.

AlSadey, S., Omran, A., & Kadir Pakir, A. H. (2010). Deffects in the Libyan Construction Industry: A case study of Bani Walid City. *ACTA Technica Corviniensis - Bulletin of Engineering*.

Ameh O.J, Odusami K.T, Achi F.O, A. (2007). An Assessment of Professional Ethics Content in the Academic Curriculum of Construction Disciplines in Nigerian Universities . *Built Environment Education Conference*, 1–10.

Ayodeji, O. (2011). *An Examination of The Causes and Effects of Building Collapse in Nigeria*. *9*(December), 37–47.

Blok, R., & Herwijnen, F. V. (2001). *Service life and life cycle of Building structures*. Eindhoven.

Dabara, D. I., Akinyemi, A. P., Dare, G. M., & Anthony, A. I. (2016). Building Collapse in Nigeria : Issues and Challenges. *Conference of the International Journal of Arts & Sciences*.

Dahiru, D., Salau, S., & Usman, J. (2014). A Study of Underpinning Methods Used in the Construction Industry in Nigeria. *The International Journal Of Engineering And Science*, *3*(2), 5–13.

Danso, F. O. (2010). *Occupational health and safety issues involving casual workers on building construction sites in Ghana, a Kumasi study*. Kwame Nkrumah University Of Science And Technology.

Ezeagu, C. ., Udebunu, J. ., & Obiorah, S. M. (2015). Destructive and Non-Destructive Assessment of Collapsed Structures in Onitsha , Anambra State , Nigeria. *American Scientific Research Journal for Engineering, Technology, and Sciences*, *12*(8), 170–186.

Hawkins, J., Walters, A., Harvey, M., Walshe, M., Matthews, R., Saggers, G., & Nembhard, A. (2013). How to Note : Reducing corruption in infrastructure sectors. In *Climate and Environment Infrastructure*.

Joy, T. (2015). A Study on Factors Influencing Quality of Construction Projects. *International Journal of Innovative Research & Development*.

Kabir, B. (2015). Quest for Standardisation of Processes and Products in Housing

Development. *Real Estate Developers Association of Nigeria/World Bank Workshop*, 1–12.

Kanniyapan, G., Mohammad, I. S., Jawahar Nesan, L., Mohammed, A. H., Abdullah, M. N., Asmoni, M., & Ganisen, S. (2015). Implementing maintainability in building material selection: A preliminary survey. *Jurnal Teknologi*. https://doi.org/10.11113/jt.v77.6882

Kishore Kumar, S., & Sriram, P. (2017). Pivotal factors causing defects in buildings: A case study in Chennai, Tamil Nadu. *International Journal of Civil Engineering and Technology*.

Langston, C. (2011). Estimating the useful life of buildings. *36th Australasian University Building Educators Association (AUBEA) Conference*.

National Population Commission. (2009). 2006 population and housing census of the Federal Republic of Nigeria. *Official Gazette of the Federal Republic of Nigeria*, *96*(2), 1.

Nurul, N., & Azree, M. (2014). General Building Defects: Causes, Symptoms and Remedial Work. *European Journal OfTechnology and Design*, *3*(1), 3–17. https://doi.org/10.13187/ejtd.2014.3.4

Omenihu, F. ., Onundi, L. ., & Alkali, M. . (2016). An Analysis of Building Collapse in Nigeria (1971-2016): Challenges for Stakeholders. *Annals of Borno*, *XXVI*(June).

Oyenuga, V. (2010). *Building Collapse – The Structural Engineer Point of View*.

Ugochukwu, Ogbuagu, and Okechukwu, C. (2014). An Appraisal of the Sources, Quantities and Prices of Imported Building Materials in Nigeria. *International Journal of Advanced Research*, *2*(9), 871–889.

Vanier, D. J. (1999). *Durability of Building Materials and Components*. Canada.

Waziri, B. S., & Vanduhe, B. A. (2013). Evaluation of Factors Affecting Residential Building Maintenance in Nigeria : Users ' Perspective. *Civil and Environmental Research*.

Yamane, T. (1967). *Statistics: An Introductory Analysis* (2nd ed.). New York: Harper and Row.

Zaidi, M. A., & Davies, H. (2010). *A Prospective Study on Building Quality: Enforcement of Control in the Australian Housing Industry*.

Zou, P. X. W. (2006). Strategies for minimizing corruption in the construction industry in China. *Journal of Construction in Developing Countries*.