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Sustainability of Residential Buildings in Nigeria: An Appraisal of the Factors that Influence Maintenance of Residential Buildings' Standards

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Abstract

Sustainability issues in residential buildings in many cities of the world and the search for factors that influence the level of maintenance of residential buildings, with appropriate measures to assist in the solutions to the problems of building maintenance has been an issue of concern, most especially to the house designers and developers in Niger State, Nigeria. This paper therefore planned to determine factors that influence the level of maintenance of residential buildings' standards. The research method employed was descriptive and inferential survey. The data collected were subjected to uni-variate analysis and multi-variate analysis, using Statistical Package for Social Sciences (SPSS). The study found among others that factors that influence the level of maintenance of residential buildings standards includes, (i) building's state of repair, (ii) building type and (iii) Owners/Occupiers highest level of education. The paper concludes that for any meaningful approach to maintainability of residential buildings in view of adequate provision of descent accommodation for the populace, Government and other stakeholders needs to embark on public enlightenment campaign for the residential buildings' owners/occupants on the need for residential buildings and building premises maintenance and the implication for failure to maintain buildings and buildings' premises regularly.

Keywords: Appraisal, building standards, maintenance, residential building, sustainability.

1. Introduction

Sustainability issues of building include ways of constructing, maintaining and cleaning a facility that maximizes its health, efficiency, cost-effectiveness and durability. Today, housing production, access and affordability and maintenance of existing stock in habitable condition still remain some of the most difficult problems facing many cities of the world. United Nations Commission on Human Settlement – UNCHS (1995 and 1996) stated that in spite of national and international efforts aimed at developing appropriate policies and strategies, no effective remedy has been found to cure housing ills. Maintenance of buildings therefore needs cure so as to enhance durability, improve quality of life, protection of human health and the environment. To achieve all these benefits and other necessary required acceptable physical, functional and economic life span of the building and the associated infrastructural facilities depend on the level of maintenance.

Maintenance of residential buildings is one major factor of housing ills in many cities of the world which needs urgent attention and cure. This problem seems pronounced most especially in developing countries (Nigeria inclusive) where very little emphasis is laid on building maintenance functions and management. Consequently, maintenance of the existing housing stock in habitable condition still remain a great problem to be solved in Nigeria among other countries and Niger state among other states in Nigeria (Olagunju, 2011).

This problem forms the basis of this study which is a report of part of a research conducted by the author between 2006 and 2010. The study assessed the level of maintenance of the private residential buildings (excluding all agencies provided housing), located in one most populous Local Government Authorities (LGA) headquarters of each of the three senatorial districts as existed in Niger state.

1.1 Objectives

The main objectives of the study are, to identify factors that influence maintenance of residential buildings' standards in Niger state, Nigeria and to proffer adequate measures to the lingering problems of building maintenance.

2. Research Justification

Niger State, the study area is located in the North Central Geopolitical Zone (Middle Belt) of Nigeria. The choice of the study area was as a result of its location in the Middle-belt of Nigeria which by influence, houses developments and settlement of migrants from the Northern and Southern parts of Nigeria. Maintenance culture of the residents at the study area reflects varieties from various part of the country. Thus, the research findings may be applied in any part of Nigeria, considering variety of people (residents) with their different maintenance characters.

The standard of maintenance has an important influence on the quality of the built environment. Therefore, it deserves attention, in addition, alterations and modifications of many residential buildings in neighbourhood centres which are not in conformity with the basic planning rules, poor maintenance culture of the residents and low aesthetic quality of neighbourhood centres, all these constitute problems that need to be solved to enhance residential buildings sustainability. For instance, improving the standard of maintenance of the existing housing stock could help to maintain the quality and quantity of the existing housing in Nigeria (Bajere, 1996:8; Lee, 1998). In other words, for any meaningful approach to sustain maintainability of the existing housing stock in Nigeria like any other country there is the need to identify and appraise the factors that influence maintenance of residential buildings.

3. Methodology

The study covers three selected LGA headquarters, which include Bida LGA (senatorial district A, dominated by the Nupes), Minna LGA (senatorial district B, dominated by the Gwaris) and Kontagora LGA (Senatorial District C, dominated by the Hausas). Thus, the three LGA headquarters were selected based on the 2006 Nigerian population and housing census enumeration demarcation lists for the three senatorial district zones (A, B, and C). One Local Government Councils' headquarter was selected from each of the three Senatorial districts, based on the hierarchy of settlements in the state (100 km radius influence) and population density (highest). The three selected Local Government Councils' headquarters include, Bida (Zone A) Minna (Zone B) and Kontagora (Zone C), see Table 1. This was also employed in the selection of neighbourhood centres on the basis of population density. Systematic sampling method was further used for neighbourhood centres available in a particular urban centre. In addition, systematic sampling method was adopted for the selection of the private residential building units in each town (sample).

Table 1: Niger State Senatorial District, Local Government Councils, Hierarchy Of Settlements And Selected Towns

S/No	Senatorial District	COMPOSITION BY LGA	LGA HQ	Population Density	HIERARCHY OF SETTLEMENTS (Km Radius influence)	Remarks
1.	A	Bida	Bida	3762.87	Rank 1 (100km)	Selected
2.		Lavun	Kutigi	497.61	Rank 2 (50km)	
3.		Edati	Enagi	211.02		
4.		Katcha	Katcha	72.46		
5.		Gbako	Lemu	66.64	Rank 3 (30km)	
6.		Mokwa	Mokwa	54.69	Rank 2 (50km)	
7.		Agaie	Agaie	67.37	Rank 2 (50km)	
8.		Lapai	Lapai	33.72	Rank 2 (50km)	
9.	B	Chanchaga	Minna	2745.76	Rank 1 (100km)	Selected
10.		Bosso	Maikukele	91.75		
11.		Paikoro	Paiko	69.97	Rank 3 (30km)	
12.		Munya	Sarkin Pawa	44.87		
13.		Shiroro	Kuta	42.35	Rank 2 (50km)	
14.		Suleja	Suleja	1411.48	Rank 1 (100km)	
15.		Tafa	New Wuse	368.88		
16.		Gurara	Gawu-Babangida	80.77		
17.		Rafi	Kagara	51.12	Rank 2 (50km)	
18.	C	Kotangora	Kontagora	69.72	Rank 1 (100km)	Selected
19.		Rijau	Rijau	51.30	Rank 2 (50km)	
20		Wushishi	Wushishi	45.96	Rank 3 (30km)	
21.		Magama	Nasko	45.58		
22.		Mariga	Bangi	33.29		
23		Mashegu	Mashegu	21.48	Rank 3 (30km)	
24		Agwara	Agwara	27.26		
25		Borgu	New-Bussa	14.59	Rank 3 (30km)	
Total		**25 Nos**	**25 Nos**	**51.65**		**3 Nos**

Source: Adapted from Niger State of Nigeria Gazette, Notice No 14, 2001, Niger State Regional Plan, 1979 – 2000, and National Population Commission, Abuja, 2006

The research method employed was descriptive and inferential. The estimated number of the private residential buildings in Niger state stood at 121,956, while the estimated number of the private residential buildings in Bida (18,489), Minna (29,044) and Kontagora (13,266) towns stood at 60,800 (PHCN, 2009). However, the estimated population used has shortcomings. Apparently, not all the private residential buildings in the three selected towns, Bida (Senatorial District "A"), Minna (Senatorial District "B") and Kontagora (Senatorial District "C") are

connected with Power Holding Company of Nigeria (PHCN). The choice of the PHCN private residential customers' record was informed by the availability and reliability of the private residential buildings residents' database compared to the Niger state Water Corporation and Nigerian Telecommunications Plc (NITEL) private residential buildings customers' records/database. In addition, there is no readily available data on private residential buildings in the state, even from the National Population Commission released result of the last 2006 National Population and Housing Census conducted in Nigeria (Olagunju, 2011).

Probability sampling method was used for the research. Ibanga (2006:14), described probability sampling as a procedure which permits the elements in the population to have known probabilities of selection, and allows the units to be selected independently. Probability sampling method was adopted so as to allow equal opportunity of being selected to every data collected, and also to allow selection of every data independently without influencing each other.

Based on the population size, sampling frame of 1216, which is (2%) of the research population (60,800) was used. The sampling frame of 1216 buildings was further distributed on pro-data basis among Bida (370), Minna (681) and Kontagora (265) for the data to be fully representative (see table 2)

Table 2: Power Holding Company Of Nigeria (PHCN) Private Residential Customers In Bida, Minna And Kontagora

S/No	Town	No of Private Residential Customers (Population)	No for Inspection (2% of the Population)
1.	BIDA	(14740 x *1.25439) = 18489	370
2.	MINNA	(23154 x *1.25439) = 29044	581
3.	KONTAGORA	(10576 x *1.25439) = 13266	265
Total		(48470 x *1.25439) = 60800	1216

Source: Author, 2009

Note: *Denotes multiplier derived from Kpakungu area, Kpakungu actual and available PHCN record.

Source: Adapted from Power Holding Company of Nigeria (PHCN), Minna, Nigeria, 2009

The questionnaire was designed to reflect on the research problem. It was also designed to allow the researcher and the research assistants to ask questions from the landlords/house agents/household heads (respondents). This was done purposely to ensure accurate data collection. A questionnaire was administrated in each of the 1216 buildings selected at random. The questionnaires were retrieved from a respondent in each of the buildings immediately after completion and collated for analysis.

Statistical Package for Social Sciences (SPSS) version 17 computer program was used for the analysis. The data collected were subjected to uni-variate analysis (Descriptive summary measure; frequencies) and multi-variate analysis {multiple regressions (linear), using stepwise method)}.

4. Research Findings

The data revealed that there are five types of buildings in the three selected urban centres, Bida, Minna and Kontagora; these types of buildings include, three hundred and thirty four (364) numbers of traditional compounds, three hundred and seventeen (317) numbers of rooming houses, one hundred and ten (110) numbers of semi-detached bungalows, three hundred and eighty five (385) numbers of single family bungalows and thirty one (31) numbers of storey buildings. This shows that the dominant building types in Niger state are single-family bungalows (31.9%), traditional compound (30.2%) and rooming house (26.3%), see table 3.

Table 3: Types of Buildings In Niger State, Nigeria

S/No	Building Type	Frequency	Percent (%)	Cumulative Percent (%)
1.	Traditional Compound	364	30.2	30.2
2.	Rooming House	317	26.3	56.4
3.	Semi-detached Bungalow (Flats)	110	9.1	65.5
4.	Single-family Bungalow (1 Flat)	385	31.9	97.4
5.	Storey Building	31	2.6	100.0
Total		1207	100.0	

Source: Author's Data Analysis, Using SPSS program, 2010

In addition, the regression coefficient table result when forced entry method was used for the dependable variable (physical condition of building) and seventeen predictor variables (see table 4). The regression coefficient table shows that:

(a) Only six predictor variables are significant (see table 5).
(b) The multiple correlation coefficient 'r' is 0.752. This means that there is strong and positive relationship between physical condition of buildings (dependent variable) and (predictor variables).
(c) The coefficient of determination 'r^2' is 0.565. This means that the prediction variables can give about 56.5% explanation for residual variation in physical condition of buildings.

Table 4: Specification of Variables

S/No	Variable Number	Code	Name
1	V01	AGEBLD	Age of Building/Date built
2	V02	NOFLRS	Number of Floors
3	V03	FLAREA	Floor Area
4	V04	TNOOCC	Total Number of Occupants
5	V05	TNOMOC	Total Number of Male Occupants
6	V06	TNOFOC	Total Number of Female Occupants
7	V07	NOBDRM	Number of Bedrooms
8	V08	PLOTDEV	Plot Development Ratio (Percentage)
9	V09	NOFNTL	Number of Functional Toilets
10	V10	NOFNBA	Number of Functional Bathrooms
11	V11	BLDTPE	Building Type
12	V12	TPETEN	Type of Tenure
13	V13	RESEDU	Respondent's Highest Education Level
14	V14	RESOCC	Respondents Occupation
15	V15	WALMAT	Wall Material
16	V16	BLDREP	Building State of Repair
17	V17	BLDFAC	Building Facilities

Source: Author's Research Design, 2010

Table 5: The Six Predictor Variables

S/No	Variable Number	Code	Name
1	V16	BLDREP	Building State of Repair
2	V11	BLDTPE	Building Type
3	V13	RESEDU	Respondent's Highest Education Level
4	V17	BLDFAC	Building Facilities
5	V15	WALMAT	Wall Material
6	V12	TPETEN	Type of Tenure

Source: Author's Data Analysis, Using SPSS program, 2010

Multiple regression was again used to establish relationship between dependent variable (physical condition of buildings) and the six predictor variables, using stepwise method. The analysis shows the following result (see table 6).

Table 6: Model Summary of the Physical Condition and Other 17 Variables – (Bida, Minna and Kontagora)

Mode	R	R Square	R Square Change	Sig. F Change
1	0.697	0.486	0.486	0.000
2	0.721	0.519	0.033	0.000
3	0.733	0.537	0.017	0.000
4	0.739	0.546	0.009	0.000
5	0.744	0.553	0.007	0.000
6	0.747	0.558	0.005	0.000

Source: Author's Data Analysis, Using SPSS program, 2010

Table 6, further shows that:

(i) Only the first three predictor variables (building state of repair, building type and respondent highest education level) are significant, with R Square Change not less than 0.01

(ii) The multiple correlation coefficient 'r^2' is 0.733. This means that there is strong and positive relationship between physical condition of buildings (dependent variable) and predictor variables.

(iii) The coefficient of the determination (r^2) is 0.537. This means that the predictor variables can give about 53.7% explanation for residual variation in physical condition of buildings (dependent variable). Others may be as a result of chance effect which may not be measurable.

Therefore, Model (1) equation is, $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_{3+} + \ell$ (1.1)

Where:

Y = Physical condition of buildings (dependable variable)

X_1 = Building's state of repair (BLDREP)

X_2 = Building type (BLDTPE)

X_3 = Respondents' highest education level (RESEDU)

Table 7: Regression Model (1) Coefficient and The Corresponding Beta Values

S/No	Regression Model Coefficient Particulars	Value	Beta Value
1	Constant β_0	19.391	
2	β_1	8.749	0.585
3	β_2	1.590	0.153
4	β_3	1.675	0.148

Source: Author's Data Analysis, Using SPSS program, 2010

Therefore, Model (1) equation is,

$\hat{Y} = 19.391 + 8.749X_1 + 1.59X_2 + 1.675X_3$ (1.2)

Table 8: Mean Values of Model (1) Variables

S/N	CODE	PARTICULARS	MEAN SCORE
1	X_1	Building's state of repair	2.9503
2	X_2	Building type	2.50
3	X_3	Respondents' highest education level	3.49
4	Y	Physical condition of buildings (dependable variable)	55.02

Source: Author's Data Analysis, Using SPSS program, 2010

From the data, the mean values of the above variables are as shown in table 8 indicates that the model estimate is,

(iv) $\hat{Y} = 19.391 + 8.749(2.9503) + 1.59(2.5) + 1.675(3.49)$

(v) $\hat{Y} = 55.0239247$

(vi) Model (1) estimate, $\hat{Y} = 55.0239247$, while actual observation, Y = 55.02).

(vii) Where error term is given as:

$$\ell^2 = (Y - \hat{Y})^2$$

$$\ell^2 = (55.02 - 55.0239247)^2$$

$$\ell^2 = 0.00001540327009$$

(viii) This means that

(a) the error term is 0.00001540327009, which explains the deviation of (Y) from the fitted regression line/model ($\hat{Y}$)

(b) the explanatory variables in the model are

- BLDREP (Buildings' state of repair)
- BLDTPE (Building type)
- RESEDU (Respondent's Education Level)

(c) The quantitative regression equation is

- $\hat{Y} = 19.391 + 8.749$BLDREP $+ 1.59$BLDTPE $+ 1.675$RESEDU

(d) Hence, the buildings' state of repair, building type and respondent's education level are maintenance factors with 53.7% influence on the maintenance of residential buildings in Niger state.

5. Recommendations and Implementation

5.1. Recommendations

Based on the study findings, the researcher found it worthy to recommend the following to the Niger State Government for the full utilization of the accrued benefits derivable from the study:

(i) Development of the Niger state maintenance policy and strategy from the research findings in view of the Millennium Development Goals (MDGs) requirements.

(ii) Niger state Government should embark on public enlightenment campaign for the residential buildings occupants and owners on the need for residential buildings and buildings' premises maintenance and the implications for failure to maintain buildings and building's premises regularly.

(iii) The physical condition assessment model developed, $\hat{Y}$ = 19.391 + 8.749BLDREP + 1.59BLDTPE + 1.675RESEDU should be adopted and used by the Niger state for quick assessment of residential buildings in the state.

5.2. Implementation

For effective implementation of the above recommendations, the following have to be strictly adhered to:

(i) Niger state government needs to formulate policy and strategy for planning and development permit and control in order to set minimum maintenance standards for residential buildings in the state. This may be through renovation permit such as;

– Minor repair works,

a. Major repair works and
b. Total redevelopment, decoration and improvement notice.

In addition, planning standards for types of residential development must also be well spelt out, such as;

a. Planning standards
b. Architectural Standards
c. Structural Engineering standards
d. Electrical Engineering standards and
e. Mechanical Engineering standards (Development Control Department, 2007) so as to enhance permanent and effective improvement to the buildings and environment.

(ii) Niger state government needs to educate the residents on the need for residential buildings and buildings' premises maintenance and the implications for failure to maintain buildings and building's premises through radio and television announcement and discussions. In addition, strategic placement of posters and effective distribution of hand bills can also be employed for the enlightenment campaign.

(iii) The developed model for the prediction of residential buildings' physical condition could be used for quick assessment of residential buildings' physical condition by the Buildings and Building Premise Inspection Programme (BBPIP) agents in the state.

6. Conclusion

The research set out to identify factors that influence maintenance of residential buildings' standards in Niger state, Nigeria and to proffer solutions to the lingering problems of building maintenance. Thus, the research finidings shows that: (1) the dormant building types in Niger state are single – family bungalow (31.9%), traditional compound (30.2%) and rooming house (26.3%). (2) Physical condition of building can be assessed with the developed model, $\hat{Y}$ = 19.391 + 8.749BLDREP + 1.59BLDTPE + 1.675RESEDU. (3) Building state of repair, building type and respondent education level are maintenance factors with 53.7% influence on the maintenance of residential buildings in Niger state. Based on its level of prediction, the model can be used for quick assessments of physical condition of residential buildings. Thus, aid sustainability of residential buildings in Nigeria, since the findings are applicable in either northern or southern part of Nigeria and possibly in other developing countries with similar conditions.

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