JCBM (2017) 1(2). 24-34

JCBM

University of Cape Town

Journal of Construction Business and Management

http://journals.uct.ac.za/index.php/jcbm

Building Quality Condition and Maintenance Cost: The Case of Public Low Income Housing in Abia State, Nigeria

C. P. Ogbu[1]

Department of Quantity Surveying, University of Benin, Nigeria[1].

Received 27 January 2017; received in revised form 3 April 2017 and 11 April 2017; accepted 1 May 2017

Abstract

Maintenance costs of buildings constitute major cost burdens on low-income housing dwellers, which worsens the housing affordability problem. The purpose of this research was to investigate the relationship between physical condition and maintenance cost of low-income housing buildings. The buildings studied were randomly selected from the public low-income housing estates in Ehimiri and Amauba in Umuahia, Abia State. Data were gathered using structured questionnaire and score sheets. The questionnaire elicited responses on the respondents' perception of their buildings' physical conditions. The score sheets were used by trained research assistants to generate information on the physical features of the buildings. Data analyses were carried out using Spearman's correlation. The study found that the element with the highest Relative Condition Index (RCI) is internal walls, while external wall finishes/decoration has the least. Similarly, the element with the highest Quality Index (QI) is electrical services, while internal ceiling finishes/decoration has the least QI. There is no significant relationship between RCI which is based on the respondents' perceptions and QI which is based on the research assistants' scores. The relationship between QI and annual maintenance cost is not significant, whereas the relationship between RCI and annual maintenance cost is significant. The perception of the condition of a building by its occupant, rather than the physical features of the building, is the main driver of maintenance cost. Consequently, low-income housing end users should be allowed to make inputs at the design and planning stages of their buildings.

Keywords: Abia State; Building condition; Low-income housing; Maintenance cost; Quality condition; Quality index.

1. Introduction

Housing is basic to human life. It is a fundamental yardstick for estimating the quality of life of a nation's citizens. Almost every measure of human well-being is connected to housing, be it a measure of health, social, religious or economic factors (Shaw, 2004; Festus and Amos, 2015). The indispensability of housing to humankind makes housing problems a global challenge. These problems are diverse and may take slightly different forms in different climes. Notable problems associated with housing globally include health, affordability, accessibility, quality and maintenance issues (Krieger & Higgins, 2002; El-Haram & Horner, 2002; Quigley & Raphael, 2004). As is often the case, the housing problem of developing countries like Nigeria is more severe, expressing itself in quantitative and qualitative forms (Olayiwola, Adeleye and Ogunshakin, 2005). Quantitatively, the housing problem of Nigeria is that its demand outstrips the supply, and the cost exceeds the customers' willingness to pay (Aribigbola, 2011). Qualitatively, it is agreed that available housing does not meet acceptable quality standards (Coker, Awokola, Olomolaiye, and Booth, 2008). Foreseeably, this status has dire implications for low-income housing users in particular, because the poor quality building could lead to higher maintenance costs.

Aribigbola (2011) explained housing quality as the physical condition of the building and other facilities and services that make living in a particular area conducive. Ilesanmi (2010) also perceived the quality of housing as related to its physical attributes such as the general state of the external finishing including rendering and paints, and the quality of operational elements like doors, windows, ceilings, roofing members and facia boards. Contrariwise, some researchers view quality from the perspective of the

[1] Corresponding Author. Tel: +234-8037346343
Email address: chukwuemeka.ogbu@uniben.edu

perception of the users of the facility (Ibem, 2012; Adeleye, Azeez and Yusuff, 2014; Emankhu & Ubangari, 2015). In this paradigm, the quality of a building will depend, not only on the actual physical condition of the building but on the user's perception of the state of the building. Even with the preponderance of low-income housing research relying on user perceptions, there are still scarce attempts in literature to reconcile these two perspectives.

Irrespective of any researcher's view of building quality, the effect of poor quality building is higher maintenance costs. Maintenance costs can account for a significant portion of a country's construction investments. For instance, maintenance and repair costs amounted to 37 percent of the total construction-related investments made in 2002 in Sweden (Krstić & Marenjak, 2012). At the individual building level, Office for National Statistics (2014) reported that maintenance and repair costs took up 5% of housing expenditure in the UK. This may not be affordable for low-income earners, because the percentage may increase their total housing expenditure beyond 30% of their annual income. Thirty percent is often taken as the upper limit for affordability of housing (Miles, Berens and Weiss, 2003).

Already, a rising trend in the cost of maintenance of buildings in Nigeria has been detected and is blamed on lack of adherence to building standards (Faremi, Adenuga, & Ajayi, 2015). Olusola and Akintayo (2009) maintained that stakeholders accept buildings based on the quality of the workmanship and materials. This is so because the quality of a building is related to its life cycle cost of which maintenance cost is a sizeable portion (Al-Hajj, 1999; Vlachy, 2014).

In Nigeria, the end users of low-income housing seldom make inputs at the pre-construction and construction stages of the project (Ibem, Opoko, Adeboye & Amole, 2013). They often have to live with whatever quality of housing is provided by the housing designers and contractors. In the attempts to reduce the cost of construction, the quality of low-income housing buildings may be compromised between the design and construction stages of procurement (Adejimi, 2005). The designers of the projects attempt to specify cheaper materials ostensibly to make for affordability, while the contractors carry out shoddy workmanship to increase their profit margin. Similarly, due to the excess demand for housing, these housing providers often give minimal attention to building quality with the notion that whatever is provided for the low-income group will be accepted. This concept has not held true in many cases, partly because residents' satisfaction with their housing is strongly correlated with the buildings' features (Mohit, Ibrahim & Rashid, 2010). Low-income housing buildings are frequently defective as a result (Emuze, Shakantu & Wentzel, 2012; Zunguzane, Smallwood and Emuze, 2012; Dwijendra, 2013). Consequently, unregulated building modifications, and sometimes, significant structural alterations have been carried out to improve the quality of low-income housing buildings in Nigeria (Ibem et al., 2013; Ihuah & Eaton, 2013). This compounds the affordability problem by increasing the cost of maintenance of the buildings. These issues lower the public's perception of low-income housing (Husock, 2003; Varady, 2004). Despite this, the effects of building quality on maintenance cost remain inadequately addressed in literature.

The aim of this paper is to investigate the relationship between quality condition of low-income housing buildings and their maintenance costs towards informing providers of the low-income housing about the consequence of their choices on quality. The specific objectives of the research are to compute Relative Condition and Quality Indices (RCI and QI) for a sample of low-income housing buildings and determine the relationships between the indices and the cost of maintenance of the buildings.

Hypothesis 1

There is no significant relationship between RCI and QI of low-income housing buildings in the study area.

Hypothesis 2a

Ho: There is no significant relationship between QI and annual maintenance cost of low-income housing buildings

Hypothesis 2b

Ho: There is no significant relationship between RCI and annual maintenance cost of low-income housing buildings

2.0 Building Quality Condition

The physical condition of a building refers to the state of its fabric. A building is a composite of different elements and materials. The deterioration or damage of an element of a building will diminish its utility – regarding aesthetics, functionality, and value. Building maintenance, therefore, is an act directed at restoring the utility of a building, its component or element. Every maintenance activity will entail one form of impact or the other on the physical condition of the building. It is assumed that residents judge the adequacy or habitability of their buildings based on predefined standards of physical condition (Ilesanmi, 2010). Some studies evaluated cognitive responses to the physical conditions of buildings focusing on issues such as the perceived quality of the buildings and environmental quality (Kane, Heaney & McGreal 2000; Fornara, Bonaiuto & Bonnes 2006; Cold 1993). Ilesanmi (2010) viewed the experience of 'quality' as originating in the interaction between the individual and the building. Van der Voordt and Van Wagen (2005) described quality as the extent to which a product fulfils the requirements set for it, and 'architectonic quality' as an umbrella term, covering various aspects of quality such as aesthetic, functional (building efficiency), symbolic and cultural value. In the low-income housing sense, a resident's perception of the quality of his/her building will be related to how 'fine' it is. Low-income earners are perceivably used to low standards and will ascribe a higher quality to inferior materials that can serve their purposes in line with the views of van der Voordt and Van Wagen (2005).

User evaluation has been the predominant approach to building assessment (Al-Momani, 2003). Satisfaction, attitudes, and preferences are three types of criteria normally used. Although these responses are not mutually exclusive, satisfaction has been more widely investigated as a criterion (Lawrence, 1987; Varady, 2004). The above studies have, however, not investigated the relationship between user satisfaction and maintenance cost of the buildings. Likewise, the question whether user satisfaction

is related to the materials used in the construction of a building requires further literature inputs.

Fang (2006) noted that housing condition is the main measure of residential satisfaction. Thus, there is conceptually a relationship between the physical condition of a building and its user's satisfaction, which requires further literature exploration. Physical conditions of buildings, as stated by Danguah and Afaram (2014), include wall quality, construction quality, roofing, ceiling and windows. According to US Housing and Urban Development (2009), the acceptability of houses depends on the physical condition of all the elements of the building. The present study attempts to depart from the solely constructivist approach, by measuring the quality indices of the buildings, based on the buildings' construction materials and physical condition.

2.1 Maintenance Cost

Maintenance cost refers to the cost of ensuring that a building remains in a habitable condition. It is the total cost required to keep, restore or improve a building in a given period (Faremi, Adenuga, Dada and John, 2016). The incidence of maintenance cost can be as a result of a planned maintenance activity or a cost incurred as a consequence of a breakdown (Al-Najjar, 1999). Al-Najjar (1999) identified three types of maintenance policies, namely, breakdown maintenance, age-based maintenance and condition-based maintenance. Irrespective of the primary cause of the need for maintenance, it will involve altering the elements or fabrics of the building to restore or preserve the owner's or the occupier's requirements. Uzarski and Grussing (2008) explained that as buildings age and endure usage, some defects in building components that negatively affect its performance occur. Ultimately, if these defects were not repaired, it would result in decreased utility from the building. Shah Ali (2009) identified existing building condition, building age, complaint received about building performance, client's request, availability of funding, and safety and health requirements as factors to be considered when making a decision on maintenance cost. In Ali, Kamaruzzaman, Sulaiman and Peng (2010), maintenance cost was depicted as being influenced by the tenant, political, maintenance, building characteristics and other factors. Salleh, Yakin, Ismail and Talib (2016) identified tenant, building characteristics, maintenance, regulation and other factors as affecting the maintenance cost of buildings. Faremi, Adenuga, Dada and John (2016) focused on institutional buildings and found that building age and size are important factors affecting maintenance cost. El-Haram and Horner (2017) grouped the determinants of maintenance cost into building characteristics, tenants, maintenance, political and other factors. Although physical, economic and socio-psychological dimensions of the neighbourhood are also considered parts of housing quality (Galster, 1981), the consistent mention of building condition points to the importance of this factor in relation to maintenance cost.

2.2 Previous Similar Studies

Kain and Quigley (1970) evaluated the physical and environmental qualities of dwelling units in St. Louis, USA. Market prices of the buildings were regressed against the qualitative measures of the physical and environmental qualities of the dwelling units. Part of the findings of the study was that the quality of a house has as much effect on its price as the quantitative aspects such as the number of rooms. This study adopts Kain and Quigley's (1970) approach regarding asking the dwellers to rate the physical conditions of their buildings. Dwellers interact with their buildings. Such interactions produce dispositions and perceptions about the elements of the buildings. The measure of a dwellers' perception of their building, be it good or bad, is an indication of the quality of the building. Kain and Quigley's (1970) study differs from the present study in context – not being low income-specific, and not being based in a developing country. Also, in the present study, rather than relate the quality of the buildings to their rental values, the quality of the buildings is related to their annual maintenance costs. Harris (1976) compared housing quality to housing satisfaction and, similar to the present study, viewed housing quality as being dependent on buildings' characteristics. The study concluded that a significant relationship exists between the two variables, but neither of the variables was related to the maintenance cost of the buildings. Ilesanmi (2010) undertook a post occupancy evaluation of the medium and low-income housing estates in Lagos State, in which measures of the estates' quality of environment were related to the residents' satisfaction with their estates. The study differs from the present study in two ways: in not being peculiar to the buildings, and in not relating the physical state of the buildings to their maintenance costs. Maintenance cost is a major component of the life-cycle cost of the buildings. Even where the cost of acquisition is low (which is the focus of most low-income housing providers), the life-cycle cost can still make the building unaffordable for dwellers. Although Ilesanmi's (2010) study and the present study are focused on Nigeria, the former was based in Lagos State, South-West Nigeria, while the current study is located in Abia State, South-East Nigeria. It is still important to get research feedbacks from the different completed low-income housing buildings in Nigeria, especially regarding quality performance. This study fills this gap by relating the physical characteristics of the buildings (measured by QI), as well as the residents' perception of the features (measured by RCI) to the buildings' maintenance costs.

Olanrewaju and Anifowose (2015) analysed the state of building conditions in Ekiti State, Nigeria, and identified seven major defects in buildings of which peeling and spalling of wall surfaces was said to be significant. The study did not explain whether the state of the buildings was consequential to their cost of maintenance. A similar approach was adopted in this study in that quality indices were computed for the elements of low-income housing buildings. Also, in this study, the relative condition indices of the buildings were calculated to observe whether the perception of building quality by low income housing users is related to the physical conditions of the buildings. Oseghale and Ikpo (2014) evaluated defects in industrial facilities in selected estates in Lagos State and disclosed that industrial buildings' defects result from construction faults, design deficiencies, corrosion, physical aggression, moisture and rodent

attacks. The study noted that over 50% of the maintenance managers in the industrial buildings rated them highly regarding electrical services, external walls, and condition of windows. Although the study did not attempt to relate the ratings to the buildings' maintenance costs, it espoused the perspective that the views of users are relevant to the determination of building quality, which this study corroborates.

3 Methodology

In this research, the physical condition of a building was conceptualized as the physical state of parts of the building that can be seen and touched. These include the walls, roofs, doors and windows, finishes, electrical and plumbing installations, and soakaway/septic tanks. This study was carried out in three low-income housing estates in Umuahia, Abia State, South-East Nigeria namely, Ehimiri, Amauba Phase 1 and Amauba Phase 2. The housing estates were procured through public, private partnership arrangements between the government of Abia State and the private sector (Ibem, 2010; ASO Investment and Development Company, 2011). The number of houses in each estate as obtained from the Abia State Housing and Property Development Corporation is shown in Table 3. A questionnaire and a score sheet were used in the collection of primary data for the study. The questionnaire was administered on a house-to-house basis on occupants/beneficiaries of the low-income housing estates studied, while at the same time, research assistants used the inventory (score) sheets to capture information required for computing quality indices. The administration of questionnaire was done purposively. The reason for using this method was to ensure that copies of the questionnaire were given to knowledgeable adults that are capable of providing accurate data for analysis. Microsoft Excel was used to generate random numbers based on which house numbers were selected for the administration of questionnaires. In all, 305 copies of the questionnaires were distributed as shown in Table 3.

The sample size was obtained using the Yamane (1964) formula for a finite population.

$$n = \frac{N}{1+(N\times e^2)} \qquad (1)$$

Where: n = sample size, N = population size (501), e = coefficient of confidence or margin of error or allowable error or level of significance (0.05). A sample size of 305 was obtained using this process.

This paper adopts the Queensland Department of Housing and Public Works' (2012) classification and definitions of building conditions into 'excellent', 'good', 'fair', 'poor', and 'very poor' (see Table 1). In the questionnaire, the residents of the low-income buildings were asked to rate the elements of their buildings on a scale of 1-5 as shown in Table 1.

Table 1. Definition of Rating/Condition of Buildings

Rating	Status	Definition of Building Condition
5	Excellent	• no defects • as new condition and appearance
4	Good	• minor defects • superficial wear and tear • some deterioration to finishes • major maintenance not required
3	Fair	• average condition • significant defects are evident • worn finishes require maintenance • services are functional but need attention • deferred maintenance work exists
2	Poor	• badly deteriorated • potential structural problems • inferior appearance • major defects • components fail frequently
1	Very Poor	• building has failed • not operational • not viable • unfit for occupancy or normal use • environmental/contamination/pollution issues exist

Department of Housing and Public Works (2012

This approach was adopted based on the belief that the decision to spend on maintenance often depends on the occupier's perception of the state of the building. The Relative Condition Index (RCI) of each of the sub-elements (for all the buildings covered by the study) was computed using Equation 1.

$$RCI = \frac{\sum w}{A\times N} \qquad (2)$$

where w is the rating given to each sub-element by the respondents, ranging from one to five, A is the highest rating (i.e. 5 in this study), and N is the total number of samples.

To obtain the quality indices of the different elements of the buildings, the trained research assistants were given score sheets containing the possible materials used in the

construction of the visible elements of the low-income housing buildings. The materials employed in the visible elements were ranked as shown in Table 2 in the order of their expected life spans.

Table 2. Measurement of Quality Index for Buildings

Building Element	Score	Building Element	Score
Roof		**Internal Floor Finishing**	
Long Span aluminium	5	Vitrified floor tiles	6
Clay dominant	4	Non-vitrified floor tiles	5
'Cameroon' zinc	3	Terrazzo	4
Galvanised Steel Corrugated iron roofing sheets	2	PVC floor tiles	3
Asbestos	1	Broken tiles	2
External Walls		Floor screed	1
225mm thick without cracks	4	**External Wall Finishes & Decor**	
150mm thick without cracks	3	Wall tiles	6
225mm thick with cracks	2	Rendered and painted	5
150mm thick with cracks	1	Rendered but not painted	4
Internal Walls		Partly rendered but not painted	3
225mm thick without cracks	4	Partly rendered and partly painted	2
150mm thick without cracks	3	Not rendered	1
225mm thick with cracks	2	**Internal Wall Finishes & Decor**	
150mm thick with cracks	1	Wall tiles /Rendered and painted	6
External Doors		Rendered and painted only	5
All metal doors	6	Rendered but not painted	4
Metal doors and panel doors	5	Partly rendered but not painted	3
Metal doors and flush doors	4	Partly rendered and partly painted	2
All panel doors	3	Not rendered	1
Panel doors and flush doors	2	**Services: Electrical**	
All flush doors	1	Conduit Wiring	2
Internal Doors		Surface Wiring	1
Metal doors and panel doors	5	**Services: Mechanical/Plumbing**	
Metal doors and flush doors	4	WC toilets operational with water supply	5
All panel doors	3	WC toilets operational with water fetched with buckets	4
Panel doors and flush doors	2	WC toilets available without water supply	3
All flush doors	1	Wash hand basin and sink available	2
Windows		Wash hand basin and sink not available	1
Aluminium sliding/projecting casement windows	4	**External Works: Septic tank and soakaway**	
Metal casement windows	3	Septic tank/soakaway available & neatly finished	3
Louvre windows	2	Septic tank/soakaway available but broken or not plastered	2
Wooden casement windows	1	Soakaway/Septic tank unavailable	1
Internal Ceiling finishing		**External Works: Neighbourhood**	
Pop (Plaster of Paris) ceiling	3	Serene, clean & beautiful neighbourhood	3
PVC ceiling	2	Dirty neighbourhood with bad roads	2
Asbestos ceiling	1	Unsightly neighbourhood (slum)	1
External Ceiling finishing		**External Works: Landscaping**	
Long Span aluminum	3	Clean environment with plants	*3*
PVC ceiling	2	Clean environment but no plants	*2*
Asbestos ceiling	1	Unclean environ & no plants	*1*
External Floor finishing			
Vitrified floor tiles	6		

Non-vitrified floor tiles	5
Terrazzo	4
PVC floor tiles	3
Broken tiles	2
Floor screed	1

Using the scores, the Quality Index (QI) of each of the sub-elements of the buildings was obtained using Equation 2.

$$QI = \frac{\sum a}{N \times q} \qquad (2)$$

where a is the score given to each sub-element by the research assistant based on Table 2, q is the highest score for the element and N is the sample size

Additionally, the questionnaire elicited data on the average annual maintenance costs of the buildings covered by the study. The respondents were asked to state their average annual building maintenance expenditure. Although some of the respondents were tenants, they bear maintenance costs that approximate to those borne by the building owners. In the estates covered by the study, tenants usually rent or lease entire buildings, rather than apartments in the buildings. This makes them be in charge of the buildings, with an agreement to vacate the buildings in good tenantable condition at the end of their stay.

The RCI and QI of the elements of each building were averaged. These averages were related using Spearman's rank correlation since the two datasets were on the ordinal scale. Essentially, this test was to ascertain whether the low-income housing dwellers' perception of the condition of their buildings was related to the quality of the materials used in the construction. The relationships between each of the two indices and the annual maintenance cost of the buildings were likewise investigated using Spearman's rank correlation.

Table 3. Abia State¬ Low Income Housing Estates¬

Housing Estates	No. of houses	No. of Questionnaire shared	No. of Returned Questionnaire
Ehimiri Housing Estate	439	267	187
Amauba Housing Estate Phase 1	26	16	9
Amauba Housing Estate Phase 2	36	22	18
Total	501	305	214

4 Results

4.1 Relative Condition Indices of Elements of the Buildings

Based on the physical condition ratings of the respondents' buildings, the element with the highest RCI was 'internal walls' (RCI=0.78), while 'external wall finishes/decoration' had the lowest (RCI=0.45) (see Table 4). This result is related to the use of predominantly sandcrete blocks in the construction of walls. The low RCI for external wall finishes/decoration shows that the residents have a low opinion of their building's external wall finishes.

Table 4. Relative Condition Indices of Building Elements

BUILDING ELEMENTS	Very Poor	Poor	Fair	Good	Excellent	RCI
Roof						
Roof	4	4	112	84	10	0.69
Walls						
Internal walls	10	25	33	54	92	0.78
External walls	33	52	70	34	25	0.57
Doors/Windows						
Internal doors	55	71	44	21	23	0.49
External doors	23	44	22	36	89	0.72
Windows	12	16	55	72	59	0.74
Finishes and Decoration						
Internal ceiling finishes/decoration	86	32	38	55	3	0.47
External ceiling finishes/decoration	65	41	45	63	0	0.50
Internal wall finishes/decoration	77	23	43	66	5	0.51
External wall finishes/decoration	72	45	65	32	0	0.45
Internal floor finishes/decoration	15	31	72	67	29	0.66
External floor finishes/decoration	66	56	59	33	0	0.46

Services						
Electrical	66	36	56	30	26	0.52
Mechanical/plumbing	21	44	62	56	31	0.63
External Works/Environment						
Septic tank/Soakaway	74	15	21	98	6	0.55
Neighbourhood	22	54	32	54	52	0.66
Lawns/landscaping	67	44	25	55	23	0.53

RCI=Relative Condition Index

4.2 Quality Indices of Elements of the Buildings

The trained research assistants captured the types of construction materials used in the visible elements of the buildings. Quality indices of the buildings' elements computed on the basis of this data are shown in Table 5. The results indicate that the electrical services element of the buildings were in good condition (QI=0.93). The conduit wiring system was used in most of the buildings, which must have contributed to this result. On the contrary, the internal ceiling finishes/decoration sub-element was found to have a low QI (0.49).

Table 5. Quality Indices of Building Elements

BUILDING ELEMENTS	1	2	3	4	5	6	N	QI
Roof								
Roof	0	86	10	0	118	na	214	0.74
Walls								
Internal walls	45	6	152	11	na	na	214	0.65
External walls	33	52	95	34	na	na	214	0.65
Doors/Windows								
Internal doors	27	0	112	21	42	12	214	0.57
External doors	0	0	22	33	54	105	214	0.86
Windows	0	79	0	135	na	na	214	0.54
Finishes and Decoration								
Internal ceiling finishes/decoration internally	112	102	0	na	na	na	214	0.49
External ceiling finishes/decoration	109	24	81	na	na	na	214	0.62
Internal wall finishes/decoration	0	0	15	28	72	99	214	0.87
External wall finishes/decoration	0	0	34	52	128	0	214	0.74
Internal floor finishes/decoration	0	37	5	0	94	78	214	0.80
External floor finishes/decoration	66	60	0	0	76	12	214	0.50
Services								
Electrical	31	183	na	na	na	na	214	0.93
Mechanical/plumbing	0	44	50	45	75	na	214	0.74
External Works/Environment								
Septic tank/Soakaway	0	76	138	na	na	na	214	0.88
Neighbourhood	4	123	87	na	na	na	214	0.80
Lawns/landscaping	61	80	73	na	na	na	214	0.69

QI=Quality Index, na=not applicable

Test of Hypothesis 1

Given the outcomes in Tables 4 and 5, it was hypothesised that there is no significant relationship between the RCI and the QI of low-income housing buildings in the study area. A Spearman's correlation between the residents-rated RCI and the research assistants-scored QI (Table 6) revealed no significant relationship between RCI and QI (p=0.372). Indicatively, residents' perception of the physical condition of their buildings is not related to the quality of materials used in their construction.

Table 6. Spearman's Correlation

			RCI	QI
Spearman's rho	RCI	Correlation Coefficient	1.000	.231
		Sig. (2-tailed)	.	.372
		N	17	17
	QI	Correlation Coefficient	.231	1.000
		Sig. (2-tailed)	.372	.
		N	17	17

Test of Hypothesis 2

Spearman's correlation was used to investigate hypotheses 2a and 2b. The results are shown in Tables 7 and 8. Table 7 indicates that there is an insignificant negative relationship between QI and annual maintenance cost (rs= -0.05, N=214 and p>0.05). On the contrary, Table 8 shows that there is a significant positive relationship between RCI and annual maintenance cost of the buildings (rs= 0.225, N=214 and p<0.05). The sum of ranks for the RCI (370) and QI (221) shows that the annual maintenance cost of low-income housing buildings depends more on the perception of the physical condition of the building by the residents, than on the quality of the building materials.

Table 7. Spearman's Correlation between QI and Annual maintenance cost

			Cost	QI
Spearman's rho	Cost	Correlation Coefficient	1.00	0.05
		Sig. (2-tailed)	.	0.43
		N	214.00	214.00
	QI	Correlation Coefficient	0.05	1.00
		Sig. (2-tailed)	0.43	.
		N	214.00	214.00

Table 8. Spearman's Correlation between RCI and Annual maintenance cost

			RCI	Cost
Spearman's rho	RCI	Correlation Coefficient	1	.225**
		Sig. (2-tailed)	.	0.001
		N	214	214
	Cost	Correlation Coefficient	.225**	1
		Sig. (2-tailed)	0.001	.
		N	214	214

**. Correlation is significant at the 0.01 level (2-tailed).

5.0 Discussion of Results

The findings of this study are to the effect that while the internal walls of low-income housing buildings in Ehimiri and Amauba were perceived to have the highest RCI (0.78), it is electrical services that have the highest QI (0.93). The residents are apparently satisfied with the state of the internal walls of the buildings, while the scoring based on the quality of materials used in the elements of the buildings show that relatively, electrical services have the highest QI (0.93). This type of difference between the opinion expressed by the residents and the actual state of their buildings captured by the QIs led to an insignificant relationship between the two categories of indices used in this study. The external wall finishes and decoration having the least RCI of 0.45 seems to tally with the observation of Olanrewaju and Anifowose (2015) that peeling and spalling of the low-income surface is the predominant defect of buildings in residential buildings in Ekiti State. However, while Olanrewaju and Anifowose (2015) blamed the problem on the use of kerosene cooking stoves in the kitchen areas, the external walls of the buildings covered by this study appear to have been affected by weather and frequent touching of their surfaces. Despite this, it is possible that the low QI obtained for internal ceiling finishes/decoration (QI=0.49) was as a result of the use of kerosene stoves in the kitchens of the buildings.

In a study of the maintenance of industrial buildings, 78% of the respondents were satisfied with the condition of the external walls of the buildings (Oseghale & Ikpo, 2014). This tallies with the present study in which the

external wall element has an RCI=0.57 and QI=0.65. This confirms the expectation that the state of the external walls of a building is independent of the building's type of use. Further, this study points to the possibility of neglect of external wall finishes and decoration in low-income housing (residential) buildings in the research area, even though the external walls themselves are in good condition.

The results indicate that the residents rate the conditions of their buildings higher than the conditions are in reality, as measured by the QI. Thus, although Dwijendra (2013), Emuze, Shakantu and Wentzel (2012) as well as Zunguzane, Smallwood and Emuze (2012) concluded that the quality of low-income houses is often low or defective, the residents of such houses may be having a different view. This suggests that a distinction can be made between actual and perceived building qualities in the context of low-income housing buildings. However, this is at variance with the findings of Harris (1976) and Ilesanmi (2010), whom both found different degrees of significance in the relationship between the physical condition of the buildings they studied and residential satisfaction. It is to be noted that while Harris (1976) included general measures of satisfaction such as 'house comfort' and 'house image', Ilesanmi (2010) measured residential satisfaction using general statements on the user's perception of the entire estate.

Additionally, the QI is not significantly related to the annual maintenance cost of the low-income housing buildings, whereas the RCI is significantly related to it. Suggestively, the amount spent on building maintenance by the residents tends to be directly related to their perception of the condition of the buildings, rather than to the quality of the buildings measured by QI.

6.0 Conclusion

This study investigated the quality condition and maintenance cost of low income housing buildings in Ehimiri and Amauba housing estates, Abia State Nigeria. The study set out to determine whether the quality condition of the fabric of the buildings is related to their maintenance costs. RCI and QI were computed for the elements of the buildings. It was found that internal walls has the highest RCI of 0.78, while external wall finishes/decoration has the lowest RCI of 0.45. The respondents consider the internal walls of their homes to be good but consider the exterior wall finishes/decoration of the buildings to be poor. Contrariwise, it is the electrical services that were found to be of the highest quality (QI=0.93) using the QI metric, while internal ceiling finishes/decoration was found to have the lowest (QI=0.49).

Based on Spearman's correlation, a significant relationship does not exist between the RCI and the QI, indicating that the relative condition of the buildings as perceived by the end users is not related to the quality of materials used in constructing the buildings.

The RCI and QI for each building were each related to the annual cost of maintenance of the buildings. It was found that the RCI, rather than the QI, is significantly related to the cost of maintenance of the buildings. Deductively, the residents' building maintenance cost depends on their perception of the condition of the buildings, and not on the real quality of the building.

The designers of low-income housing buildings should improve on their choice of materials for external wall finishes/decoration and internal ceiling finishes/decorations. Materials with lower life cycle cost and higher maintainability should be preferred.

7.0 Limitation of the Study

During data collection, the users of the low income housing buildings covered by this study were not separated into owner and tenant groups. In view of this, care should be taken in generalizing the findings of the affected sections of this study for either of the two groups.

References

Adejimi, A., 2005, June. Poor building maintenance in Nigeria: Are Architects free from blames. In Being paper presented at the ENHIR international conference on "Housing: New challenges and innovations in tomorrow's cities" in Iceland.

Adeleye, A.O., Azeez, O.T. and Yusuff, O.I., 2014. Perception of Housing Quality by Residents and Non Residents of Ibara Housing Estate, Abeokuta, Ogun State, Nigeria. American Journal of Human Ecology, 3(3), pp.35-42.

Ali, A.S., Kamaruzzaman, S.N., Sulaiman, R. and Cheong Peng, Y., 2010. Factors affecting housing maintenance cost in Malaysia. Journal of Facilities Management, 8(4), pp.285-298.

Al-Hajj, A., 1999. Modeling running and maintenance costs for life cycle costing applications in buildings. Durability of Building Materials & Components, 8, pp.1699-1706.

Al-Momani, A.H., 2003. Housing quality: Implications for design and management. Journal of urban planning and development, 129(4), pp.177-194.

Al-Najjar, B., 1999. Economic criteria to select a cost-effective maintenance policy. Journal of Quality in Maintenance Engineering, 5(3), pp.236-248.

Aribigbola, A., 2011. Housing affordability as a factor in the creation of a sustainable environment in developing world: the example of Akure, Nigeria. Journal of Human Ecology, 35(2), pp.121-131.

ASO Investment and Development Company, 2011. Ochendo Liberation Housing Estate, Amauba Umuahia, Abia State. (online) http://www.aidc.com.ng/ochendoabia.html (March 29, 2017)

Coker, A.O., Awokola, O.S., Olomolaiye, P. and Booth, C., 2008. Challenges of urban housing quality and its associations with neighbourhood environments: Insights and experiences of Ibadan City, Nigeria. Journal of Environmental Health Research, 7(1), pp.21-30.

Cold, B. 1993. Quality in architecture. In B. Farmer, H.J. Louw, H. Louw and A. Napper (eds) Companion to Contemporary Architectural Thought. Taylor & Francis.

Dwijendra, N.K.A., 2013. Quality of affordable housing projects by public and private developers in Indonesia: The case of Sarbagita Metropolitan Bali. Journal of Geography and Regional Planning, 6(3), p.69.

Danquah, J.A. and Afram, S.O., 2014. Residential User Satisfaction of Real Estate Housing in Ghana. International Journal of Civil Engineering, Construction and Management, 1(3), pp.1-21.

Department of Housing and Public Works, 2012. Building Condition Assessment. Brisbane: The State of Queensland (Department of Housing and Public Works). (online) www.hpw.qld.gov.au/SiteCollectionDocuments/MMFBca.pdf (January 10, 2017)

El-Haram, M.A. and Horner, M.W., 2002. Factors affecting housing maintenance cost. Journal of Quality in Maintenance Engineering, 8(2), pp.115-123.

Emankhu, S. E. and Ubangari, A. Y. 2015. Analysis of housing quality in the peripheral area of Lafia town. International Journal of Geography and Regional Planning Research, 1(3), 9-17

Emuze, F.A., Shakantu, W.M. and Wentzel, L., 2012. Factors: Affecting quality of low income houses in a South African Province, Conference 24-26 July 2012 Abuja, Nigeria (Vol. 2, p. 1393).

Fang, Y., 2006. Residential satisfaction, moving intention and moving behaviours: A study of redeveloped neighbourhoods in inner-city Beijing. Housing Studies, 21(5), pp.671-694.

Faremi, O.J., Adenuga, O.A., and Ajayi, O. M. 2015. A study of the cost trend of maintaining high rise buildings in Lagos State, Nigeria. (Online) www.unilag.edu.ng (June 5, 2015)

Faremi, O, Adenuga, O, Dada, M. and John, B. 2016. Factors Affecting Maintenance Cost of Institutional Buildings. (online) unilag.edu.ng/opendoc.php?...Factors%20Affecting%20Maintenance%20Cost%20of…(November 20, 2016)

Festus, I.A. and Amos, I.O., 2015. Housing Policy in Nigeria: An Overview. American International Journal of Contemporary Research, 5(2), p.23.

Fornara, F., Bonaiuto, M. and Bonnes, M., 2006. Perceived hospital environment quality indicators: A study of orthopaedic units. Journal of Environmental Psychology, 26(4), pp.321-334.

Harris, C.M., 1976. MEASUREMENT OF QUALITY IN HOUSING AND ITS RELATIONSHIP TO HOUSING SATISFACTION. Housing Educators Journal, 3(2), pp.7-13.

Husock, H. 2003. How public housing harms cities. City Journal, 3(1) winter. (online) http:www.city-journal.org/html/issue 3-1 (March 6, 2016)

Ibem, E.O., 2012. Residents' perception of the quality of public housing in urban areas in Ogun State, Nigeria. International Journal of Quality & Reliability Management, 29(9), pp.1000-1018.

Ibem, E.O., 2010. An assessment of the role of government agencies in public-private partnerships in housing delivery in Nigeria. Journal of Construction in Developing Countries, 15(2), pp.23-48.

Ibem, E.O., Opoko, A.P., Adeboye, A.B. and Amole, D., 2013. Performance evaluation of residential buildings in public housing estates in Ogun State, Nigeria: Users' satisfaction perspective. Frontiers of Architectural Research, 2(2), pp.178-190.

Ihuah, P.W. and Eaton, D., 2013. A framework for the sustainable management of social (public) housing estates in Nigeria: A pilot study. RICS COBRA.

Ilesanmi, A.O., 2010. Post-occupancy evaluation and residents' satisfaction with public housing in Lagos, Nigeria. Journal of Building Appraisal, 6(2), pp.153-169.

Kain, J.F. and Quigley, J.M., 1970. Measuring the value of housing quality. Journal of the American Statistical Association, 65(330), pp.532-548.

Krieger, J. and Higgins, D.L., 2002. Housing and health: time again for public health action. American journal of public health, 92(5), pp.758-768.

Krstić, H. and Marenjak, S., 2012. Analysis of buildings operation and maintenance costs. Građevinar, 64(04.), pp.293-303.

Mohit, M.A., Ibrahim, M. and Rashid, Y.R., 2010. Assessment of residential satisfaction in newly designed public low-cost housing in Kuala Lumpur, Malaysia. Habitat International, 34(1), pp.18-27.

Kane, G., Heaney, G. and McGreal, S., 2000. Resident participation in the evaluation of external accessibility requirements in housing estates. Facilities, 18(1/2), pp.45-55.

Lawrence, R.J., 1987. Housing, dwellings and homes: Design theory, research and practice (p. 319). (Chichester: Wiley).

Miles M.E., Berens, G. and Weiss, M.A. 2003. Real estate development and process (3rd edition), (Washington DC: Urban Land Institute).

Office for National Statistics 2014. Chapter 2: Housing expenditure. (online) http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/dcp171766_386375.pdf (March 27, 2017).

Olanrewaju, S.B.O. and Anifowose, O.S., 2015. The challenges of building maintenance in Nigeria:(a case study of Ekiti State). European Journal of Educational and Development Psychology, 3(2), pp.30-39.

Olayiwola, L. M., Adeleye, O. and Ogunshakin, L. 2005. Public Housing Delivery in Nigeria: Problems and Challenges. (World Congress on Housing, Transforming Housing Environments through the Design, Pretoria South Africa).

Olusola, B.S. and Akintayo, O., 2009. An assessment of failure of building components in Nigeria. Journal of Building Appraisal, 4(4), pp.279-286.

Oseghale, G.E. and Ikpo, I.J., 2014. An Evaluation of Industrial Facilities Defects in Selected Industrial Estates in Lagos State, Nigeria. Civil Engineering Dimension, 16(2), pp.104-111.

Quigley, J.M. and Raphael, S., 2004. Is housing unaffordable? Why isn't it more affordable? The Journal of Economic Perspectives, 18(1), pp.191-214.Salleh, N.A., Yakin, M.K.A.M., Ismail, K. and Talib, Y., 2016. Preliminary Investigation on The Factors That Influencing the Maintenance Cost of Apartment. In MATEC Web of Conferences (Vol. 66, p. 00046). EDP Sciences.

Shah Ali, A., 2009. Cost decision making in building maintenance practice in Malaysia. Journal of Facilities Management, 7(4), pp.298-306.

Shaw, M., 2004. Housing and public health. Annual. Review of Public Health, 25, pp.397-418.

US Housing and Urban Development, 2009. Housing quality standards. (online) http://www.hud.gov/offices/adm/hudclips/guidebooks/7420.10G/7420g10GUID.pdf (June 23, 2015)

Uzarski, D. and Grussing, M. 2008. Building condition assessment metrics: Best Practices. Infrastructure Reporting and Asset Management: pp. 147-152. doi: 10.1061/9780784409589.ch20

Varady, D.P 2004. Predicting satisfaction in public housing. Journal of Architecture and Planning Research, 21(13): pp.181-192

van der Voordt, D.J.M. and Wegen, H.B., 2005. Architecture in use: an introduction to the programming, design and evaluation of buildings. Routledge.

Vlachy, J., 2014. Using life cycle costing for product management. Management: Journal of Contemporary Management Issues, 19(2), pp.205-218.

Yamane, T. 1964. Statistics: An introductory analysis. (New York, Harper Row Publishers).

Zunguzane, N., Smallwood, J. and Emuze, F., 2012. Perceptions of the quality of low-income houses in South Africa: defects and their cause. Acta Structilia: Journal for the Physical and Development Sciences, 19(1), pp.19-38.