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# Component Analysis of Design and Construction as Housing Acceptability factor of Public Housing Estates in Anambra State, Nigeria

By Architect Dr. Chikadibia Michael Eni  
*Federal Polytechnic, Nigeria*

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COMPONENTANALYSISOFDESIGNANDCONSTRUCTIONASHOUSINGACCEPTABILITYFACTOROFFUBLICHOUSINGESTATESINANAMBRASTATENIGERIA

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# Component Analysis of Design and Construction as Housing Acceptability Factor of Public Housing Estates in Anambra State, Nigeria

Architect Dr. Chikadibia Michael Eni

**Abstract-** The thrust of this study was to evaluate the design and construction as a housing acceptability factor of nine public housing estates in Awka and five others in Onitsha towns in Anambra State using Principal Component Analysis (PCA) method. The universe of the study consisted of 2,805 housing units in Awka and Onitsha by house type and 2,955 occupants including 50 persons each from Anambra State Housing Development Corporation/Anambra Homeownership Company Limited (ASHDC/ AHOCOL), Non Estate Occupiers (NEOs) and Private Estate Developers (PEDs) involved. The sample size for the study was 899 which represented 30% of the total population which were drawn using proportionate cluster sampling technique, while 887 were complete responses. One research question and one hypothesis were formulated for the study. An 18-item structured questionnaire (QAHPH) was developed; face and content validated and reliability test was done using Cronbach Alpha Technique index value of 0.90 and pre-tested on a sample of 30 respondents/residents of another housing estate. T-test, Correlation Matrix and Principal Component analysis were used in answering research questions, while t-test were used to test hypotheses at 0.05 level of significance. The major findings of the study was (1), there is a significant difference between the mean perception of the occupants and the staff of ASHDC/AHOCOL on the design and construction of public housing. It was concluded that (1). That the design and construction of public housing in Awka and Onitsha met the expectations and preferences of the end-users. The adoption of flexibility in design which increased densities encouraged mix uses and changed urban land use form based on different interpretations given to blueprints for developments and targeting of different income groups made for improvement of public housing estate delivery.

**Key Terms:** housing acceptability, public housing and Principal component.

## I. BACKGROUND TO THE STUDY

Housing is a major concern to governments across the world. Since man transitioned from primitiveness to modernity, the problem of providing adequate housing has been of critical consequence. The significance of housing in human well-being needs not be overemphasized. Housing has

*Author: Department of Architectural-Technology, Federal Polytechnic, Oke., Aguata, Anambra State, Nigeria. e-mails: chikaeni@yahoo.com, chikaeni@gmail.com*

been universally acknowledged as the second most indispensable item in human need after food (Sultan Sidi, 2012). Housing has a profound impact on the health, welfare and productivity of individuals and human beings (Federal Republic of Nigeria 1997 and Gilbertson et al, 2008). Housing fulfils physiological needs through the provision of security to life and property and also protects individuals from adverse weather and climatic conditions. It fulfils psychological needs through the provision of a sense of personal space and privacy (Buddenhagen, 2003) and fulfils sociological needs by providing a gathering area and communal space for the family, which is the basic unit of any given society (So and Leung, 2004 and Sultan Sidi, 2012). In many societies, it also fulfils economic needs by functioning as a centre for commercial production (Kothari, 2001 and Kothari, 2009). According to Apparicio and Seguin (2006), it is of immense psychological importance, because it is part and parcel of the description of a people's quality of life and social standing.

Non-provision of adequate housing is a problem that affects different strata of the society differentially, the rich, the vulnerable poor and the middle class (Akeju, 2007 and Eni, 2014). However, millions of people never experience these positive benefits.

The best conservative United Nations estimate of 2013 is that of 2005 estimates which puts the number of homeless at 100million which translates to over 100million homeless people who are forced to live with no shelter at all and another 100million hidden homeless people bringing the conservative UN estimate of total population of homeless to 200 million and over 1 billion people worldwide who are inadequately housed (Cronley, 2010). A UN-Habitat (2009) estimate had indicated that more than one billion of the world's city residents live in low quality housing, mostly in the sprawling slums and squatter settlements in developing nations. In Lagos, many hidden homeless people live "as homes" under public bridges and flyovers on the high ways (Ehingbeti 2008). With a Nigerian population of over 174,507,539 persons (Nation Bureau of

Statistics, July 2013), United Nations (2013) and Nigerian Demographic Profile (2013) studies put the overall Nigerian housing deficit at 17 million units while Nigeria National Bureau of Statistics estimates were between 12 and 14 million housing units (National Bureau of Statistics, 2013). As of 2009, there was a deficit of 16 million housing units in Nigerian urban centres (Kolawale, 2009).

The above statistics were evidence of the difficulty governments have in guaranteeing access to housing for their citizens. However, as part of government's effort to provide suitable and adequate shelter for the citizenry, she went into public housing provision initiative (Akeju, 2007 and Obeng-Odoom, 2009). Public housing is usually owned and operated by the government although some public housing projects are managed by subcontracted private agencies. Public Housing is housing financed, constructed and allocated by the state, usually for persons in low income category (Sengupta and Sharma, 2008) or Public housing is a form of housing tenure in which the property is owned by a government authority, which may be central or local. Social housing is an umbrella referring to rental housing which may be owned and managed by the state, by arm-length non-profit organizations, or by a combination of the two, usually with the aim of providing affordable housing. Social housing can also be seen as a potential remedy to housing inequality. Although the common goal of public housing is to provide affordable housing, the details, terminology, definitions of poverty and other criteria for allocation vary within different contexts (Wikipedia, the free encyclopedia).

It is indeed regrettable that in Nigeria despite the fact that the 1999 Constitution Section 16(3) (d) under "*Fundamental Objectives of State Policy*" compelled the Nigerian State "to provide suitable and adequate shelter for all citizens" (Federal Republic of Government, 1999). The attainment of such a goal is still unrealizable.

In many states of the Nigerian Federation different public housing schemes abound ranging from low-cost, middle-class and upper-class housing projects (Eni, 2014). These are meant to cushion the effect of dearth of housing (Obeng-Odoom, 2009) However, Muoghalu (1986, 1989 and Eni, 2014) stressed that government is attracted to public housing because of its visibility and the money accruing from contracts and politicians can point with pride at the highly visible, public-aided housing projects as a measure of their concern for people and their social accomplishment. Unfortunately, private investment and involvement in housing provision still dominates the effort to provide housing which is a good development. The benefits of public housing, despite efforts and activities of governments are lost to millions of Nigerians because Private Estate Developers (PEDs) or Real Estate Developers' Association of Nigeria (REDAN)

appear to be dominating the so called affordable housing scene with the government efforts trailing far behind them, which ordinarily is a healthy development (Raji, 2008) nevertheless in an economy where many are exceptionally poor and earn less than \$2.5 a day (Olotua, 2000a) this would be counterproductive. In the United States of America the share of total expenditure of the poorest 10% is about 1.9%, that of the richest 10% is about 33.2% whereas about 70.8% earn less than \$1.00 (US dollar) a day between 1990 and 2005 (United Nations Development Programme, 2008). In Nigeria over 70% of Nigerians live on less than \$2.5 a day (Olotua, 2000b).

There seem to be a severe dearth of public housing generally in Nigeria and Anambra State in particular; the available estates also suffer a number of limitations including keen competition from Private Estate Developers (PEDs) and corporate organizations. It may be recalled that some of the available estates have survived for years and have become nerve-centres of some towns and cities where they are located (Ndubeze, 2009). There is no doubt, that in the absence of these estates, the accommodation problem of the citizenry would have worsened. This situation called for appraisal of Federal and State governments' effort in providing affordable and habitable public housing with a view to identifying the perceived problems, proffering suggestions on how to overcome the problems and improving affordable adequate housing (Ademiluyi and Raji, 2008). To this end, the issue of evaluating the design and construction as a housing acceptability factor of public housing became crucial. It was the above scenario that led to the articulation of the problem of this research.

## II. IDENTIFICATION OF THE PROBLEM

Public housing delivery in Awka and Onitsha cities seemed to have a multiplicity of housing design styles and construction methods. Different interpretations were given to blueprints for development unlike the usual monolithic housing use which follows master plan zoning, where there was usually uniformity of design and construction criteria (Nuefert, 2012 and Eni, 2014). Some public housing catered exclusively for the low income group, while in some public housing estates, a variety of income groups were lumped together with varying design and construction options. This was in contrast to what obtained in most public housing estates and there was need to investigate if this flexibility in design which increased densities encouraged mix uses and changed urban land use form made for improvement of public housing estate delivery (Eni, 2014).

As the philosophical basis of this study is on equity and social justice in housing environment or built environment, this study surveyed the ratio of

contributions (inputs) and rewards/benefits/ costs (output) of occupants at the various locations in Awka and Onitsha cities. It is acknowledged that there are subtle and variable major factors of public housing provisioning such as design and construction of public housing that affect an occupant's assessment and perception of their relationship with their public housing estates and their housing providers. The idea was to have the rewards (outcomes) directly related with the quality and quantity of the occupants' contributions (inputs) in the spirit of egalitarianism in the distribution of housing resources (Eni, 2014). If occupants of Awka and Onitsha public housing estates were possibly rewarded alike, it would help the occupants realize that the organizations were just, attentive, and appreciative.

This study assessed how public housing in the study area had achieved its intended goals in terms of the design and construction as a housing acceptability factor of public housing estates in Anambra State of Nigeria. The public housing estates studied were either owned by the Federal government or Anambra State governm.

In Awka Urban, these seven public housing estates were studied; Iyagu Housing Estate, Real Housing Estate, Udoka Housing Estate, Ngozika Housing Estate, Oganiru Housing Estate Phases 1&2, AHOCOL (Inner City Layout) Housing Estate, AHOCOL (Think Home) Housing Estate Phase 1 (or Ahocol 1 and AHOCOL (Think Home) Housing Estate Phase 2 (or Ahocol 3) while in Onitsha urban, these two housing estates were studied; Niger Bridge-head Housing Estate and Federal (Site and Services) Housing Estate, Trans-Nkissi (or 33), Onitsha making a total of nine housing estates in all.

### III. AIM AND OBJECTIVE

The aim of this study was to specifically determine design and construction as housing acceptability factor of public housing estates in Anambra State. The specific objective was to:

- a) determine the perception of adult occupants and the staff of ASHDC/AHOCOL on the construction and design of public housing, while the study sought answer to the following research question: What was the perception of adult Occupants and the Staff of ASHDC/AHOCOL on the design and construction of public housing as a housing satisfactoriness factor?

The null hypothesis  $H_0$ : There is no significant difference between the perception of Occupants and the staff of ASHDC/AHOCOL on the construction and design of public housing was tested.

The study looked at residence in public housing and not private housing and the occupants may have different design and construction problems quite different from what obtains in private housing. At best, it

described post occupancy housing tolerability challenges in public housing estates in Anambra State than a generalized housing acceptability challenges in other genre of housing.

### IV. LITERATURE EXAMINATION

Relevant literature related to the present study was extensively reviewed. The objective was to critically examine the existing body of knowledge on issues bordering on design and construction as a housing acceptability factor of public housing in Awka and Onitsha urban areas in order to eliminate duplication of efforts and to call attention to gaps in literature that prompted this study. According to Wikipedia, architects plan, design and review the construction of buildings and structures for the use of people. It is the professional duties of the architects to produce building design. According to Ruskin (1986) the need for housing design is to ensure not only a good production of the drawing, but also to guarantee its functional and structural integrity and provide a guide for carrying out the actual construction/development, so as to achieve optimum comfort for human habitation and functional requirements of other usages. The need and importance of housing design before eventual construction cannot be over emphasized. The truth, however, is that the design stage provides opportunity for cost reduction in housing, It is relatively cheaper to correct, redesign and change design criteria on a piece of paper than during construction. Fourteen studies relating to the design and construction of public housing were reviewed. In a heuristic study previously done by Oladapo, in 1993, Jiboye (2008) used co-relational research method and found out the need for technocrats to identify appropriate design criteria and to use them as inputs to housing design and development. He advised that the tasks confronting architects, planners, policy makers and all those concerned with providing housing, is to identify the factors which determine adequate and satisfactory housing. Similarly, Jiboye, (2010) employed a conceptual model and found the need to consider relevant factors of the environment, dwelling and management in housing design and development.

He systematically surveyed 1,232 (10%) households out of a total of 12,323 households in six randomly selected public housing states in Lagos. This followed the study by Onibokun, (1973) and Muogahlu, (1984a). Globally, some research findings and recommendations seem to support these findings. Kellekc et al (2005) found that housing design and construction were important determinants of users' satisfaction and environmental quality in Turkey in his study "Determinants of Users' Satisfaction and Environmental Quality: Sample of Istanbul Metropolis".

So and Leung (2004) found that the Chinese consider design and construction (appearance) of their

housing a very important issue in housing satisfaction. They employed survey research technique in surveying the attitudes of Chinese towards buildings in three Chinese cities: Hong Kong, Shanghai and Taipei. They found that attractiveness of design contributed to housing satisfaction. In the same vein Amerigo et al (1990) established that appearance of council housing contributes towards housing satisfaction in the UK, while using survey research to assess residential satisfaction in council housing there. However Prew (1961) used historical research method and found out that the poverty of the masses and shortage of adequate technical know-how were the bane of building design/construction and recommended subsidizing the poor to own or rent adequate housing. Djebarni et al (2000) found that public housing is better assessed through users' assessments as against designers' opinions. They employed survey research technique to assess satisfaction level within neighbourhoods in low-income public housing in Yemen. Anantharajan (1983) used survey research method and found out, in a research conducted in randomly sampled public housing in Miami Florida that those end users point of view is important in the evaluation of their housing perception and recommends the evaluation of residential development through users' ratings and rankings of both design and environmental attributes and in Nigeria. Onibokun (1973) who studied Ontario, Canada used survey research method and found that a dwelling that is adequate from the physical or design point of view may not necessarily be adequate or satisfactory from the users' point of view and recommended the use of subjective criteria of resident satisfaction with public housing. Diogun (1989) studied "Housing Problems in Nigeria: Low-Income Housing survey" and found that government's direct involvement in housing development and delivery has been on the increase and advised against it and suggested that government should be seen as a regulator and setter of standards, while Muoghalu (1984) used survey research method in an empirical study of two public housing estates in Enugu. It was found that a critical mass of occupants felt dissatisfied with the design and construction of their housing units and suggested the need to combine objective criteria with subjective indicators of resident satisfaction with public housing. Oladapo (2006) employed co-relational research approach, which showed that tenants satisfaction could be measured by housing attributes such as the function and physical adequacy of the dwelling, quality and adequacy of social and community facilities, the nature and effectiveness of official policies and personnel attitudes, convenience for living, the condition and maintenance of the home environment, maintenance of the dwelling facilities, privacy, territoriality and neighbourhood security among other variables and recommended that tenants satisfaction should be

measured by housing attributes such as the functional and physical adequacy of the dwelling, quality and adequacy of social and community facilities. His findings tallied with those of Muoghalu, (1984a). Technically speaking, Fletcher (1961 and Neufert, 2012) contend that architects plan, design and review the construction of buildings and structures for the use of people. A good building should satisfy the three principles of *firmitatis*, *utilitatis*, *venustatis*, which translate roughly to - Durability - it should stand up robustly and remain in good condition. Utility - it should be useful and function well for the people using it. Beauty - it should delight people and raise their spirits. Similarly, Vaughan (1967) used a case study research approach to look at the revolution in housing both in the world and in Nigeria and concluded that Nigeria has been subjected to three major influences such as, the Indigenous mud architecture, P. W.D Colonial brick block wood and pan and the Machine age.

However, the Nigerian architect has come under intense criticisms. Nigerian architects have been accused of over-designing. According to Muoghalu (1984a) what appeals to technocrats will not necessarily appeal to consumers. It is obvious that he was advocating inclusion of, and enlistment of residents' co-operation in design, as well as in environmental management. According to Michelson (1968) most people do not want what architects want. Most researchers such as Jiboye (2008 and 2010); Kellekc, et al (2005); So and Leung, (2004) and Anantharajan (1983) recommend the appraisal of residential development through users' ratings and rankings of the design and construction attributes, while Onibokun, (1973) states that though a dwelling unit may be adequate from the physical or design point of view, it may not necessarily be adequate or satisfactory from the users' point of view.

According to Wikipedia (2014), part of the architectural profession and also some non-architects feel that architecture has not been a personal philosophical or aesthetic pursuit by individuals; rather it had to consider everyday needs of people and use technology to give a liveable environment.

## V. STUDY AREA

The study area, Awka and Onitsha cities are located in Anambra State of Nigeria. Anambra State was created on 27<sup>th</sup> August, 1991. Its name is derived from 'Oma Mbala' now known as Anambra River, a tributary of the famous River Niger.



Source: Wikipedia, the Free Encyclopedia, 2014.

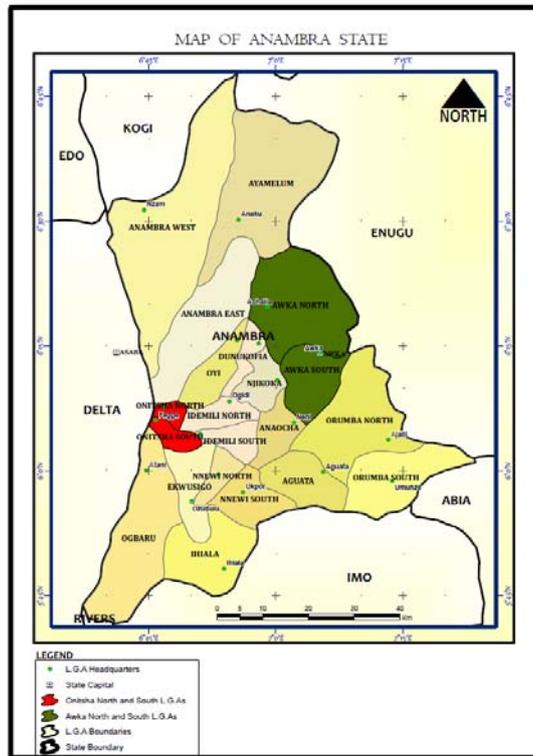
Fig. 1 : Relative position of Nigeria in the world map



Source: Adapted from Wikipedia, the Free Encyclopaedia, 2014.

Fig. 2 : Location of Anambra State in Nigeria



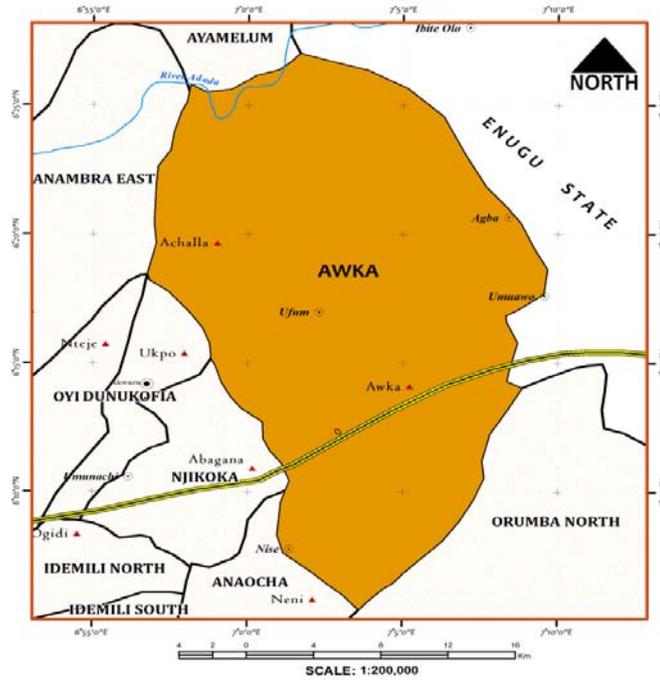


Source: Adapted from Nwabu, (2010) Google Maps.

Fig. 3 : Map of Anambra State Showing the Study Area

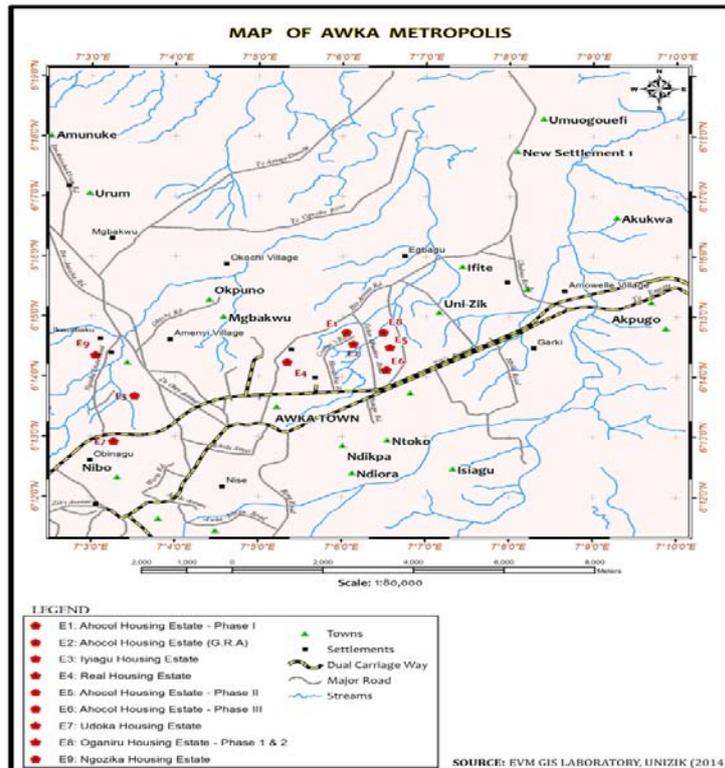
## VI. AWKA CITY

Awka became the capital of Anambra state after it was carved out of the old Anambra State in 1991. Awka South had a population of 189,045 persons and Awka North 112 had 6,080 persons (National Population Commission, 2006). This figure is considered doubtful because Awka town had grown from a population of 11,243 in 1953, 40,725 in 1963, and 70,568 in 1978 to 141,262 in 1983. The surprise is that the population of Awka town as at the National Census conducted in 1991 stood at 58, 225. This is made up of 28,335 males and 29,890 females (National Population Commission, 1991). However, the extrapolation of census figures of 1953, 1963, 1978, 1983 and 2006 put the population of Awka town at approximately 90,573 for the year ended 2007 and 375, 000 persons in 2010.

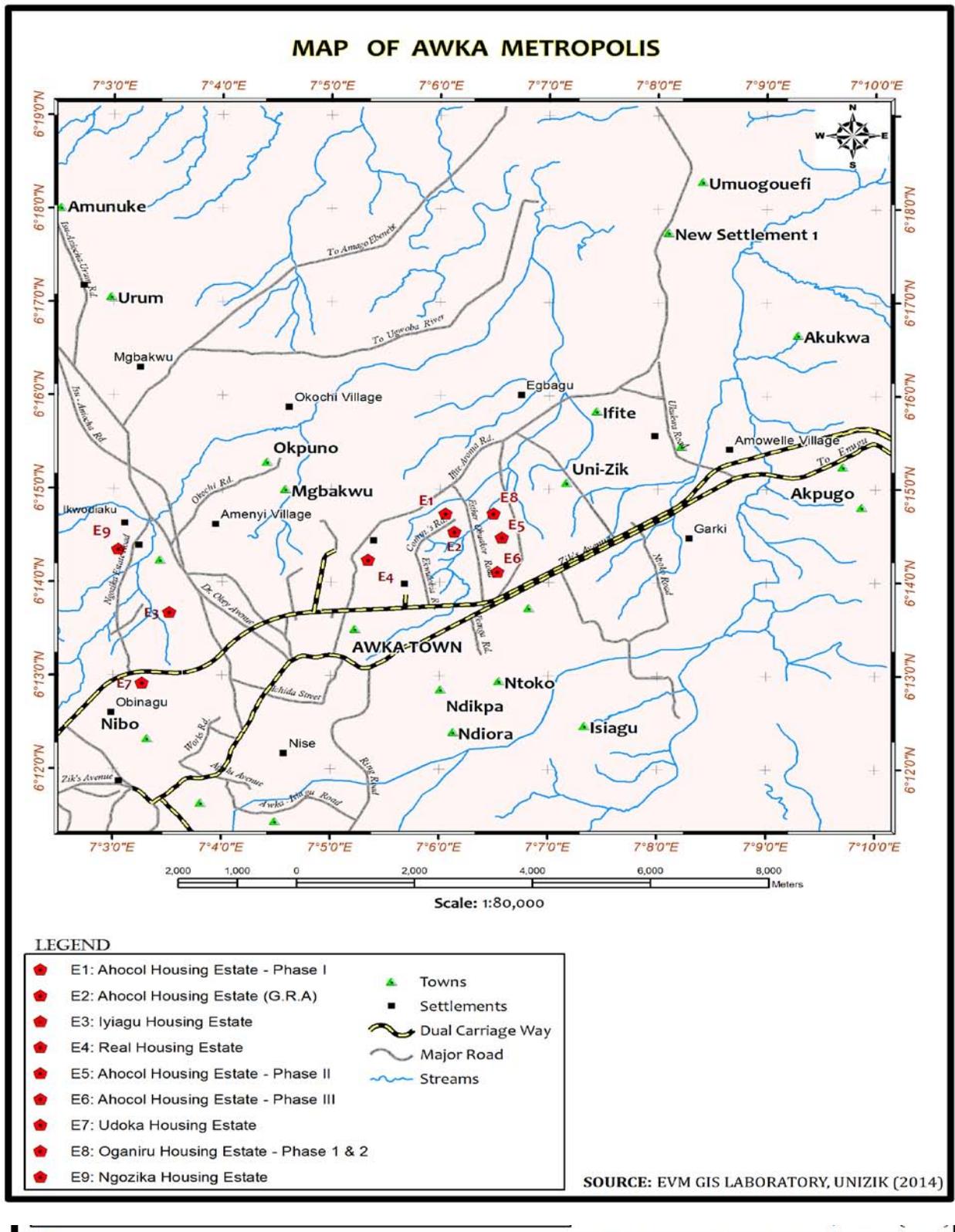


Source: EVM GIS Laboratory, NAU, 2014.

Fig. 4 : Map of Awka Metropolis showing the neighbouring towns



SOURCE: EVM GIS LABORATORY, UNIZIK (2014)



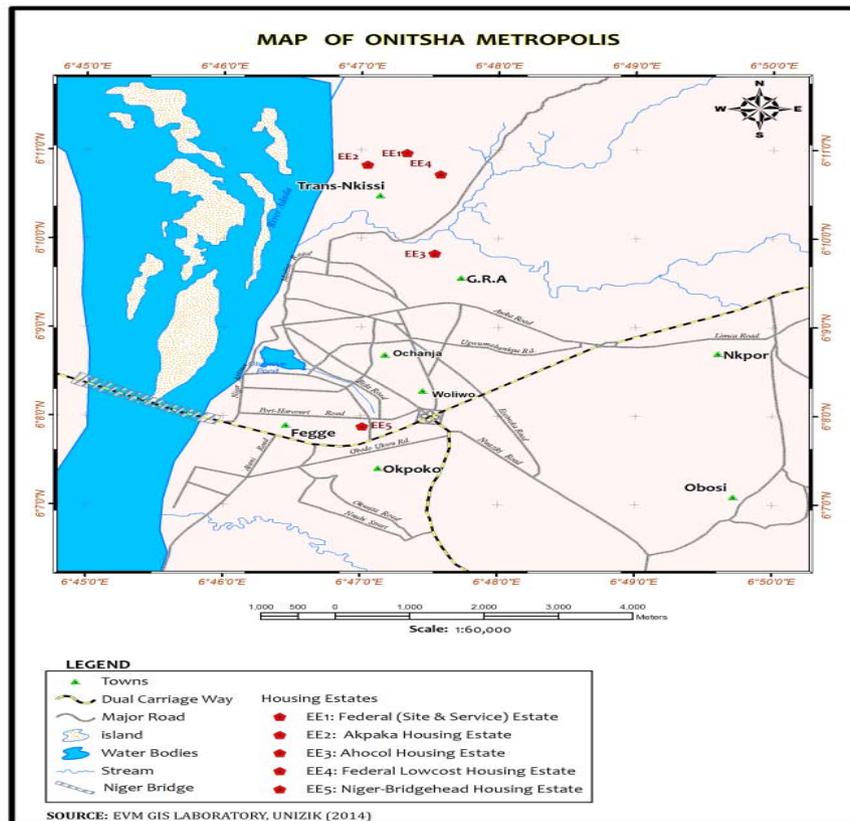
Source: Environmental Mgt GIS Lab NAU, 2014.

Fig. 5 : Street Map of Awka Metropolis viewing Public Housing Estates

## VII. ONITSHA CITY

Onitsha is located on the western part of the State and on the eastern bank of the River Niger and situated between Latitudes 6°09' N and 7.03N and Longitudes 6°.45' E and 6°.50'E with an estimated land area of 104sq.km (Onitsha Town Planning Authority, 1998). It has nine (9) residential wards or quarters such, Otu, Fegge, Okpoko, GRA, Woliwo, Odakpu, Awada, Inland Town, Omagba and its peri-urban communities. Onitsha had an estimated population of 511,000 with a metropolitan population of 1,003,000 (Minahan, 2002). The population of Onitsha is not well reflected in the Nigerian census figures because the traders migrated to their bases, neighbouring villages and states during census events reducing the official figures. Even the population of the town 623,274 in 2006 is contested (National Population Commission, 2006). This includes the population of the legal city of Onitsha and its peri-urban communities. However, the United Nations' Habitat has rated Onitsha among the world's fastest

growing cities (*Daily Sun*, 2010, p 5). In terms of geology, relief and drainage, Onitsha lies on the Niger Anambra flood plain underlain by Nanka sands. The relief shows a general westward trend towards the River Niger; although local variations of relief exist in some parts of the town (Orajiaka, 1975 and Ofomata, 1975). According to Azikiwe, (1930), Igbos call it N'Idu Ado N'Idu. The city was founded in 1550. The indigenous people of Onitsha are primarily of Igbo ethnicity. Anioma people (an Igbo subgroup), and settlers from the Kingdom of Benin are believed to have settled in Onitsha in the 16th century, which was originally called Ado N'Idu (Azikiwe, 1930). It soon became capital of an Igbo Kingdom (Nipost Postcode Map, 2009). Eze Aroli was the first Obi of Onitsha, the monarch of the city (Azikiwe, 1930). In 1884, Onitsha became part of a British protectorate. The British colonial government and Christian missionaries penetrated most of Igboland to set up their administration, schools and churches through the river port at Onitsha.



Source: EVM GIS Laboratory, NAU, 2014.

Fig. 6 : Map of Onitsha Metropolis showing Public Housing Estates

The British colonial government and Christian missionaries penetrated most of Igboland to set up their administration, schools and churches through the river port at Onitsha. In the mid 1850s, Onitsha became an important trading port for the Royal Niger Company following the abolition of slavery and with the

development of the steam engine when Europeans were able to move into the hinterland. Trade in palm kernels and palm oil which was going on along the coast of the Bight of Biafra since the 12th century was now moved upwards and other cash crops also boomed around this river port in the 1800s. Migrants

from the hinterland of Igboland were drawn to the emerging town as did the British traders who settled there in Onitsha, and coordinated the palm oil and cash crops trade. In 1965, the River Niger Bridge was built across the Niger River to replace the ferry crossing. Onitsha is a commercial centre and a river port on the eastern bank of the Niger River in Anambra State, southeastern Nigeria (Muoghalu, 1983).

### VIII. METHOD OF DATA COLLECTION

An 18-item structured questionnaire on design and construction of public housing (QPH) was developed. Section A had open-ended questions or unstructured responses on demographics which elicited from respondents why they chose a particular scale, it tapped preliminary / personal information on respondents' and was analyzed using percentages such as gender, age, occupation, marital status, educational qualifications of respondents and section B which focused on design/ construction of public housing estates and had multiple-choice structured 5-point Likert Scale questions of possible responses from which respondents chose as appropriate. This represented a 5-point Likert rating scale in which

respondents indicated the extent to which they considered the listed variables in the design and construction for occupants. The mid-point was 3 and this implied that any result significantly different from this mean value was assumed to be either positive or negative. The universe of study consisted of 2,805 respondents comprising mainly households, and secondly, 2,805 house units, comprising 1,032 in Awka town and 1,773 in Onitsha town. The sample size of 30% consisted of 842 housewives. Women were used as primary respondents in each household because they interact with the housing environment more than men. A stratified random sampling of these fourteen disparate public housing estates was studied. This instrument was face and content validated. Cronbach Alpha Technique index was used for reliability test which gave a value of 0.90. This technique was pre-tested on a sample of 30 respondents/residents of another housing estate. Out of a total of 842 respondents, 797 responded representing 94.7% complete responses. A stratified random sampling of these public housing estates, were studied as shown in Tables 1 and 2 below: A simple random sampling was then drawn from housing units in each stratum.

Table 1 : Distribution of Public Housing Population and Sample Size in Awka

Parameters	Name of Estate									Housing Units
	Iyagu	Real	Udoka	Ngozika	Ahocol (GRA)	Ahocol (1)	Ahocol (2)	Ahocol (3)	Oganiru	Total
Population	94	90	500	25	8	27	34	174	80	1032
Sample size	28	27	150	8	2	8	10	52	24	310
Awka town percentage	9.03%	8.70%	48.40%	2.60%	0.65%	2.60%	3.22%	16.80%	7.75%	100%
Overall percentage	3.32%	3.20%	17.81%	0.95%	0.24%	0.95%	1.88%	6.18%	2.85%	36.82%

Table 2 : Distribution of Public Housing Population and Sample Size in Onitsha

Parameters	Name of Estate					Housing Units
	Fed. Trans Nkissi	Niger Bridge	Fed. Low Cost	Akpaka	Ahocol (GRA)	Total
Population	1177	554	15	17	10	1773
Sample size	353	166	5	5	3	532
Onitsha town percentage	66.35%	31.20%	0.94%	0.94%	0.56%	100%
Overall Percentage	41.92%	19.71%	0.60%	0.60%	0.36%	100%

## IX. EVALUATION OF PERCEPTIONS OF THE RESPONDENTS ON DESIGN AND CONSTRUCTION AS A HOUSING ACCEPTABILITY FACTOR OF PUBLIC HOUSING

Research questions on mean perception of respondents of public housing estates at Awka and Onitsha, professionals from housing institutions ASDHC/AHOCOL and private estate developers and non estate occupants, on design and construction as a housing acceptability factor of public housing were answered.

### a) Variables of Housing Acceptability in the Study Area

The following variables were deemed necessary in the investigation of design and construction as a housing acceptability factor;

### i. Design and Construction of Public Housing Component (DC)

Perception on Design and Construction with Building Design (PDCBD)

Perception on Design and Construction with Nature of Materials (PDCNM)

Perception on Design and Construction with Block Work (PDCBW)

Perception on Design and Construction with Roofing Pattern (PDCRP)

Perception on Design and Construction with Burglary Protections (PDCBP)

*Research Question:* What is the perception of adult occupants and the Staff of ASHDC/AHOCOL on the design and construction of public housing?

**Table 3 :** t-Test for Perception of Adult Occupants and the Staff of ASHDC/AHOCOL on the Design and Construction of Public Housing

Group		N	Mean	Std. Deviation	Std. Error Mean
Perception on Design and Construction	Occupants	839	3.3714	1.26407	.01702
	Staff of ASHDC/AHOCOL	15	3.9500	0.66118	.10509

*Significant at 0.05 level of confidence*

Table 3 shows that the mean ratings of the occupants on design and construction of public housing were all greater than the cut-off point of 3.00. However, the occupants complained about lack of functional community facilities like electricity and water supply. These have environmental implication as the respondents in their free comments decried the excessive use of private generating sets that spew pollutants in to the atmosphere with the concomitant respiratory tract diseases. They also complained about the very high intensity of noise generated by this generating sets and suggested the engagement of Independent Power Providers (IPP) as is the practice in some other states especially Lagos State. The lack of portable water supply is worrisome because of the importance of water in personal hygiene, respondents' health and environmental sanitation. In the respondents' free comments, they wanted the reactivation of the water works instead of the rampant resort to use of water vendors, tanker service, hand dug wells and bore holes. There is no doubt that the extensive use of bore holes is environmentally defective because of the possibility of contaminating the aquifer. Although, there may be provisions for these facilities in the estates, but their functionality is in doubt. On the other hand, there were some disparities in the mean responses of the staff of ASHDC/AHOCOL when viewed against those of the occupants. The mean ratings of the staff were greater than the cut-off point (3.00). They were of the view that

PDCNM-the building materials used in the estates were of superior quality, and also that PDCRP-the roofing patterns/materials can withstand the taste of time. The standard deviation for the respondents ranged from 0.35 to 1.44, giving the extent of spread about the mean value as 1.09 deviation units. From the cluster mean perception of the occupants (3.37) and that of the staff of ASHDC/AHOCOL (3.95), it could be concluded that the respondents perceived the design and construction of public housing in the area of study as acceptable, since these values are all greater than the cut-off point (3.00). *The result indicated no variability (significant difference) in the perception of respondents on design and construction of public housing.*

The relationship between the perception of respondents on design and construction factors associated with public housing was further established using Pearson's Product Correlation technique and 2-tailed test and the result is presented on table 4.

The result reveals serial autocorrelation as factors showed strong and significant positive correlation with each other. For example PDCRP (.094) is very highly correlated with PDCBP (.094), while PDCBW and P DCBD (.018) were lowly correlated (Turner, 1971:100). With these serious auto correlations that characterized the data, the next option is to subject the result to Principal Component Analysis (PCA) in

order to transform them into defined orthogonal components. PCA was invented in 1901 by Karl Pearson (Pearson 1901). Now it is mostly used as a tool in exploratory data analysis for making predictive models. PCA can be done by eigenvalue decomposition of a data covariance or correlation matrix or singular value decomposition of a data matrix usually after mean centering (and normalizing or using Z-scores) the data matrix for each attribute (Abdi and Williams, 2010). *Principal component analysis (PCA)* is a mathematical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called *principal components* (Jolliffe, 2002). The number of principal components is less than or equal to the number of original variables. This transformation is defined in such a way that the first principal component has the largest possible variance

(that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it be orthogonal to (i.e., uncorrelated with) the preceding components. Principal components are guaranteed to be independent only if the data set is jointly normally distributed. PCA is sensitive to the relative scaling of the original variables (Miranda et al June, 2008). Depending on the field of application, it is also named the discrete *Karhunen-Loève transform (KLT)*, the *Hotelling transform* or *proper orthogonal decomposition (POD)*.

The results of a PCA are usually discussed in terms of component scores, sometimes called factor scores (the transformed variable values corresponding to a particular data point), and loadings (the weight by which each standardized original variable should be multiplied to get the component score) (Shaw 2003).

**Table 4 :** Correlation Matrix on Variables of Respondents on DC as a housing acceptability factor of Public Housing

Variables	PCDBD	PCDNM	PCDBW	PCDRP	PCDBP
PCDBD Pearson correlation	1	-019	-018	-486**	-464**
Sig. (2-tailed)		.889	.890	.000	.000
N	59	59	59	59	59
PCDNM Pearson Correlation	-019	1	-468**	-304*	356**
Sig-(2-tailed)	.889		.000	.019	.006
N	59	59	59	59	59
PCDBW Pearson Correlation	.018	-468**	1	-056	-261*
Sig-(2-tailed)	.890	.000		.674	.046
N	59	59	59	59	59
PCDRP Pearson Correlation	-486**	-304*	-056	1	.094
Sig-(2-tailed)	.000	.019	.674		.481
N	59	59	59	59	59
PCDBP Pearson Correlation	-464**	-356**	-261*	.094	1
Sig-(2-tailed)	.000	.006	.046	.481	
N	59	59	59	59	59

\*Correlation is significant at the 0.05 level (2-tailed).

The result of the principal component analysis is presented on Table 5. Two principal components were extracted and explained 85.62 % of the respondents' perception on design and construction of public housing.

Component I has very high loading on "roofing patterns" (PCDRP) (0.912), high loading on "burglary protection" (PCDBP) (0.6374) and moderate positive loading on "quality of block work" (PCDBW) (0.5288), and but low negative loading on the "nature of materials" (PCDNM) (-0.9201) in the construction and building design. It has Eigen value of 3.041 and explained 60.83% of respondents' perception in the data set. This component reflected on the quality of construction, building materials and block work as perceived by respondents. Respondents argue that construction of public housing was shoddy in that quack contractors and amateurs were employed in their construction that used substandard building materials to

build. They also asserted that that compliance monitoring supervisors were either negligent or casual in the supervision of such projects.

**Table 5 :** Variables on Design and Construction of Public Housing

Components		
Variables	I	II
Building Design(PCDBD)	<u>-0.8229</u>	0.07279
Nature of Materials(PCDNM)	<u>-0.9201</u>	0.1093
Block Work (PCDBW)	<u>0.5288</u>	<u>0.7932</u>
Roofing Pattern (PCDRP)	<u>0.912</u>	0.2299
Burglary Protections (PCDBP)	<u>0.6374</u>	<u>-0.7351</u>
Eigen Value	3.04138	1.23963
% Variance	60.83	24.79
Cum. %	60.83	85.62

Significant loadings are underlined

Component II had high positive loading on block work (PDCBW) (0.7932) and low negative loading on burglary protection (PDCBP) (-0.7351). It has an Eigen value of 1.23963 and explained additional 24.79% of respondents' perception on design and construction of public housing. Component I and II explained 85.62% of the responses. They are reflective of the respondents' perception on the aesthetic appeal of both the design and construction of public housing. They were of the view that the building materials used in the estates were of superior quality, and also that the roofing patterns/materials can withstand the taste of time. This result is in conformity with the f-test result in above. The initial units of public housing estates were built by contractors, who maximized profit by cutting corners and by the using inferior materials. This problem was later solved by use of site and services, which allowed the homeowner to build according to his taste and regulated standard

b) Discussion pertaining to research question

The result tallied with Abloh (1980), who noted that housing acceptability should take into account, type of construction, materials used, and amount of space, services and facilities, condition of facilities within and outside dwelling, function and aesthetics among many others and Ebong (1983), who identified aesthetics, ornamentation, sanitation, drainage, age of building,

access to basic housing facilities, burglary, spatial adequacy, noise level within neighbourhood, sewage and waste disposal, air pollution and ease of movement among others, as relevant quality determinants in housing.

This perception of the occupants (consumers) of public housing can only be a reaction that they do not want what the Staff of ASHDC/AHOCOL want or is providing for them. It was Davidoff, (1965) and Webber (1969), who argued that after technical (objective) indicators have been met, the residual and often decisive evidence is formed by the preferences, values and needs of the consumers. The officials charged with the responsibility of public housing planning, designing, constructing and administration need this kind of information system which monitors the community as a dynamic system which sustains improvement.

*Hypothesis:* There is no significant difference between the perception of the occupants and the staff of ASHDC/AHOCOL on the design and construction of public housing was tested.

Items 13 to 18 in the research instrument QAHPH bordering on perception of respondents on the design and construction of public housing, were statistically transformed into the following variables; DPHPW, DPHFR, DPHFH, DPHGL and DPHEC and the result is show on table 5.

Table 6 : t-Test Analysis of the Perception of the Respondents on the Design and Construction of Public Housing

Variables	Groups	N	Mean	SD	d.f	t-cal	t-crit	P-value	Decision
Perception of Design/Construction	Occupants	839	2.98	1.39	852	7.604	1.64	<0.05	Significant, Reject
	Staff of ASHDC/AHOCOL	15	3.95	1.15					

From Table 6, the calculated value of t is 7.604. The critical value of t at 0.05 level of significance and 852 degree of freedom is 1.64. Since the t-cal (7.604) is greater than the t-critical (1.64), we reject the null hypothesis and accept the alternative. Therefore, there is a significant difference between the perception of occupants and the staff of ASHDC/AHOCOL on the construction and design of public housing. From respondents' free comments the occupants complained about lack of functional community facilities like electricity and water supply. This result supports the findings in research question that there is variability (significant difference) in the perception of respondents on design and construction of public housing

From the research findings of this study, in relation to research question one on design and construction of public housing, it could be concluded that the respondents perceived the design and construction of public housing in the area of study as acceptable. Therefore also based on the findings of the study, the following conclusion was made: The design

and construction of the public housing met the housing needs of the respondents; therefore the problem of public housing in Anambra State is not from design and construction viewpoint.

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