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An Evaluation of the Problems of Sustainable Public Housing Delivery in Damaturu, Yobe State Capital Nigeria

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ABSTRACT
Housing comprises a whole gamut of shelter, home and the attendant infrastructure such as roads, water, electricity, communication and transportation, Omuojine E.O. (2001). It is the single element that plays a fundamental role in the promotion of good health, work efficiency, productivity, high socio-economic standard, general welfare, and ensure the development of both individuals, society, and nation at large (Jinadu, 2007, and Nubi, 2008).Today we are witnessing the collapse of many buildings in the country. Some modern structures cannot withstand little pressure as a result of change in climatic conditions or soil shrinkage that eventually leads to loss of total investments and lives. Data was collected through administration of questionnaire and interview, soil test and building materials tests. It was analysed using statistical tools, tables, percentile, descriptive, and narrative methods of data analysis. It was concluded that, in order to achieve sustainability in public housing estate within Damaturu metropolis all aspects involve in the development process right from the selection of site, construction of sub-structure and super-structure must be directly undertaken by the certified professionals in the building industry to achieve standard.

I. INTRODUCTION

Housing comprises a whole gamut of shelter, home and the attendant infrastructure such as roads, water electricity, communication and transportation, Omuojine E.O. (2001). It is the single element that plays a fundamental role in the promotion of good health, work efficiency, productivity, high socio-economic standard, general welfare, and ensure the development of both individuals, society, and nation at large (Jinadu, 2007, and Nubi, 2008). Housing was agreed by many scholars to be among the basic human needs, and ranked as first, or second according to their view on it.All built developments, no matter how the scale (small or large), contributed either positively or negatively on their surroundings. The qualities of these developments and of residential in particular, have a long term impact on the communities it shelter, and the surrounding environment. How sound residential accommodations are delivered, depend upon some factors which include; experts used, locational factors, design, materials, project execution and so on.

It has been observed that, the rapid population growth and poor economy have compounded the problem of inadequate housing in NigeriaAdedeji, O.O. et al, (2020). Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs, Robert W. K., Thomas M. P., and Anthony A. L., (2005).Most nations especially, developing world, have no relevant knowledge of what the housing peculiarities of their populace are and how to meet them. They source for housing solutions to problems of which magnitude, context and intricacies they do not know. When they have, what they consider to be a solution, they perused it without a carefully thought-out strategy, leading, in most cases, to sub-optimal results (Tunde, 2001).

According to Ibrahim, (2008), in Olatunde, and Busari (2014), the history of housing problems in Nigeria bears some similarities with that of Britain in the area of population increase and overcrowding in urban areas, as it was estimated that about 40% of the population in Nigeria lives in the urban areas. It was further established that rural-urban migration, poverty and greater increase in birth rate are the major contributors to housing problems in the country

(Ikpe, 2006). 'The issues concerning the provision of shelter have engaged the attention of governments at various levels and has also led professionals in the built environment to offer varied opinions and solutions to the problem of home ownership. (Nwabuna and Okorie, 2014).

The national housing policies of 1980, 1991, and that of 2006, identified 48 strategies all tailored toward attaining housing problem in Nigeria. It was realizedthat, housing problems in Nigeria are not as a result of lacking policies and strategies but the delivery system adopted for the strategies are not effective and sustainable over time due to the absence of post-implementation evaluation (Olusola, 2014). A recent study of housing situation in Nigeria put housing deficit in the country at 15 million housing units (Mabogunje, 2007).While12 trillion naira will be required to finance the deficit;this amount is about the entire 2021 budget estimate of the country which was planned at about 13.6 trillion naira.

More recently, the incidence of Boko Haram insurgency in Nigeria and precisely in north-eastern part has exacerbated the already existing housing problems of the region. Damaturu town; the capital of Yobe State was rated among the cities presently facing greatest housing problems in the entire country. This is because housing delivery by both public and private sectors was very diminutive and slow due to insecurity and higher risks involves. Apart from the natural factors affecting housing delivery which include; flooding, windstorm, soil shrinkage and so on.Theinsurgency in the area leads to the destruction of many existing houses. In addition those under developmentwere abandoned; coupled with higher rate of migration from rural to urban areas for safety and security. These put together, have added a lot to the existing housing problems in the states capital. Although efforts were made by the federal and state governments in the provision of housing accommodations to shelter the increasing number of people leaving in the state capital, yet the desired level is far reach.

In Damaturu metropolis, the total number of houses supplied by the public authorities at all levels is about3,500; with 1,500 currently under construction. Although this figure is considered as supplement to the one supplied by the individual developers and the development companies, it is far below the rising demand. The provision of adequate housing in Nigeria remains one of the intractable challenges facing human and national development, Akinyemi, S.O. et al (2020).

Yobe State Government has been giving appreciable consideration to low-cost housing scheme in its annual budgets. However, the amount usually allocated has been inadequate to meet the existing demand over the years. The Federal Government of Nigeria has intervened in order to tackle this problem by establishing North-east development commission. One of the prime aims of this commission is redeveloping the areas affected by book haram insurgency; construction of housing and resettlement of the displaced persons were included in the term of reference.

It is therefore important if some of these problems affecting public housing production and delivery are investigated and clearly presented with the aim of providing sustainable and affordable housing accommodations for Nigerians residing in Damaturu in particular and the entire North-East region in general.

Statement of the Research Problem

Shelter is one of the basic human needs, second beside food. Human being needs shelter in whatever condition they found themselves for many reasons. Man experienced how to develop shelter in accordance with area he lives, its terrain, climatic conditions, culture and professions. He has undergone several trials before establishing what is today referred to as house. More dynamic and new architectural designs are still emerging to satisfy human dwelling, convenience, satisfaction and activities.

If properly built and adequately maintained a house or any real property can stand for thousands of years functioning. It is however, disturbing why properties developed for many years even though with local materials and technology remains durable than those which are developed in recent years. Today we are witnessing the collapse of many buildings in the country. Some modern structures cannot withstand little pressure as a result of change in climatic conditions or soil shrinkage that eventually leads to loss of total investments and lives.

Housing collapse and maintenance is seemingly worse in public housing schemes where the maintenance culture is weak. A lot of mistakes are there in the entire process of the housing delivery right from the initial stage of conceptualization of the project through design, construction to the final level of allocation for occupation. It has been an experienced in many schemes a pretty number of some houses do collapse during construction before completion. Cracks on walls and floors appeared, which eventually are predisposed to expand. Termite weaken Quite a number of the building fabrics

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especially the roofing members and other wooding elements.

Beside, some of the housing units fail before completion, which make them less desirable by the targeted people, and the cost of producing each unit of the accommodation is usually very expensive when compared with the structure produced on the ground. As a result people's interest turned to alternative accommodations leaving the public housing supplied for many years unoccupied this make them to deteriorates faster.

The process of housing allocation is usually negatively affected by politics and the influence of wealthy individuals that defeated the purpose of such housing schemes. Although government applied discounting measures to reduce the purchasing price and enhance occupancy ratio of these houses; in Yobe State the discounted rate is up to 60%. However, the question not yet answered is to what extent will this policy be sustained? It is obvious that, many contracting firms and some states drive profit from the same scheme which ensures the continuity of the programmes in those places.

The study is concern with finding ways in which public housing delivery in Damaturu metropolis, Yobe state and Nigeria at large, will achieve it aim of providing standard, durable, aesthetic, hygiene and safety accommodations to its citizens at an affordable rate. It also intends to ensure cost-effectiveness in public housing delivery, so that government can drive returns from it; which may not be in cash, rather for the achievement of a specific objective.

II. SOME LITERATURE REVIEW

Housing Supply

This is the quantity of housing units that actually come into the housing market for sale or lease at a given unit price and specific time Nurudeen, A. B. (2006). Housing production does not equate to housing supply. It is possible to have 1,000 housing units constructed at a given time and price, but not all these units constructed are termed housing supply, the actual fraction that is offered willingly to the market by the owner for lease or sale is the housing supplied. Out of the housing developed multiple holdings may exist by a single owner; where the owner occupied or put in to use certain number of the houses constructed.

The supply of new housing is inelastic in the short run. This is due to the fact that housing suppliers whether public or private cannot suddenly plan, decide, and deliver the required housing units merely because of an increase in housing demand.Some factors like land, finance, and other housing inputs together with inevitable time delays in construction projects makes the supply of newly built housing supply.

Housing Delivery System in Nigeria

Housing delivery system is a collection of production mechanisms, regulatory and administrative devices by which housing services are provided to the consumers Nurudeen, A. B. (2006).It is the system that allocates houses to household in a given country irrespective of class and location (Bello N.A. 2008). The two major actors in housing delivery are public and private sectors. Public housing is those housing units provided by the government, its parastatals, and bodies for public use. The supply of housing by public sector was dated back to the colonial era when government reservation area's (GRA) were constructed for the colonial masters and other top government officials. Since then, the governments, through public sector organization and agencies such as federal housing authority and various state housing corporations has been active in housing production.

Challenges of public housing in Nigeria are derived from a historical lack of focus on housing development. Over the years, the country has not been able to develop and sustained housing finance system due to either lack of expertise, sound policies, poor system of implementations and corruption Oladoja, I.O. (2020).A cumulative of 48 strategies were established in solving housing problems in the country, 8 in 1980, 18 in 1991, and 22 in 2006, but the housing deficit yet continued (Jinadu, 2007; and Jonathan S. 2020). It has therefore emerged that housing problems in Nigeria are not as a result of absence of housing policies and strategies but that the delivery strategies being employed were not effective and sustainable over time due to the absence of post-implementation evaluation (Olusola, 2014). At no point it has been adequately supplied either quantitatively or qualitatively (Omoniyi and Jiboye, 2011).

Institutional framework forms the basis of the entire housing delivery system and as such greatly influences the success of housing delivery. Institutional roles began at the initial stages of policy development and continue through the implementation and review stages. A major factor on which the fundamental relationship between the various factors in the housing delivery can be achieved is the flexibility to adjust to dynamic socio-economic and political changes without unnecessary disruption to the system Udechukwu C. E. (2008).

National Housing Policy

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The National Housing Policy recognised the right that every Nigerian have to access decent, safe and affordable housing accommodation with secure tenure (Bello N.A. 2008). For this goal to be realizable; the federal government planned to construct 40,000 housing estate per annum throughout the country in 1991, with the exception of Lagos, that will have 200 units, Kano and River 1500 units each, and 300 units in Abuja every other state of the federation will have 1,000 housing units each (Aluka, 2004). Most of the developing nations cannot afford the responsibility of a full range of housing delivery and services to their citizens; they therefore make it to become social declaration to avoid citizen's demand for enforcement and implementation which may be beyond their reach (Bello N.A. 2008).

It was also projected by the federal ministry of works and housing that by the year 2000, eight million units of houses would be needed before housing could be provided for all; it was further divided in five million houses for urban settlers and three million for rural dwellers. The estimated cost of sixteen trillions was made at two hundred thousand naira per house. When compared with the country's annual budget it could be concluded that the dream of providing houses for all by the government is impossible (Aluka, 2004).

Not much was achieved through housing provision for Nigerians after 1985 by both the federal and state governments up to 1991 when a comprehensive housing policy was formulated.The new policy makes the private sector the major vehicle for the organization and delivery of housing product and services with the government as a very active promoter and enabler (Aluka, 2004).

Housing Need in Nigeria

This is referred to the extent to which the supply of adequate housing fall shortage of the demand of household in term of psychological and physiological needs. It is the levelsto which the quantity and quality of existing accommodation fall short of that required to provide each household with accommodation of a specified minimum standard and above (Bello N.A. 2008).

Although there are no accurate data on Nigerian housing stock; estimates were made by different studies as per back as 1988 by Umorento be at 1,000,000 units and 3,300,000 by 1990. Agboola (1998) estimated it to be 13,000,000 on yearly basis in order to meet the target of housing for all within the period of 3 years (1997-2000). However, in Jinadu (2007), annual housing needs of Nigerians were estimated to be 392,000 and 345,000 units in urban and rural areas respectively. A more recent study of housing situation in Nigeria put existing housing stock at 23 per low inhabitant housing deficit is put at 15,000,000 housing units (Magunbe, 2007) and 12 trillion naira was estimated to finance the deficit (Oladoja, 2020).

Section 28 of the Land Use Decree number 6 of 1978 which empowered government to revoke the right of occupancy of any Nigerian on any housing for overriding public interest upon which compensation is paid. These compensations are usually not sufficient to enable the affected persons obtained replacement and eventually turn to squatters elsewhere (Bello N.A. 2008).

Types of Public Housing

This is characterised by housing provided by government, its parastatals and bodies for public use. Public housing supply can be trace back to colonial era when government reservation areas (G.R.A.) where constructed for government officials. Now government and its agencies such as Federal Housing Authority, Federal Mortgage Bank and the various state housing corporations as well continue to serve for that purpose.

According to Oladoja, I.O. (2020),a basic division in houses is between free-standing or single- family houses and various types of attached or multi-user dwellings; both can vary in scale and amount of accommodation provided. Some of the classes of public housing are:

a. **Addison House:**A tape of low cost house with metal floors and cavity walls made of concrete blocks, mostly built in United Kingdom and in Ireland during 1920 to 1921 to provide housing for soldiers, sailors and airmen who had returned from home from the First World War.
b. **Airey House:**This is a low cost house that was developed in the United Kingdom during the 1940s by Sir Edwin Airey, and then widely constructed between 1945 to 1960 to provide housing for the soldiers, sailors and airmenthat returned from World War II.
c. **Tenement:**A multi-unit dwelling of frame construction, quite often brick veneered, made up several tenants usually more than four and it can be up to five stories.
d. **Terraced House:**This is where identical individual houses are conjoined into rows a line of houses which about directly on to each other built with shared party walls between dwellings whose uniform fronts anduniform height created an ensemble that was more stylish than a "row house".
e. **A-frame:**This is called as a result of the appearance of the structure.

Other categories of the public housing include:

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f. **Bungalow Housing:**This type of accommodation is design and constructed in one level or floor, it is characterized by low laying structure on the ground without upper floor, (Arugbola, 2005).

g. **Low-rise Housing:**This comprises single floor rooms or 2 to 3 storey building (in Nigeria) which may be detached or rooming apartment, (Orukobu, 2000).

h. **High-rise Housing:**This is a building where the floor of an occupiable storey is greater than 75 feet (23 metres) above the lowest level of the fire department vehicle access (National fire Protection Association, 2011). Most high-rise are built using a standard up to 15 feet (or more) per floor measurement. Therefore, it is safe to assume that a five to eight-storey building could be regarded as a high-rise (McGrill, 2007).

III. RESEARCH METHODOLOGY

3.1 Instruments for Data Collection

Questionnaire and formal interview was simultaneously administered to some residence of the ten units of the housing estates used as sample areas; that were selected at random through stratified random sampling technique and each housing estate is considered to be a stratum. Only 5%of the population in each stratum was selected to represent the total population, therefore, 115 respondents were targeted (table 3.1).Data related to housing demand, delivery, maintenance, usage, occupancy rate, and other factors affecting sustainable development in their respective locations were targeted here.

Table 3.1 Units of Housing Accommodations

S/N	HOUSING ESTATE	TOTAL UNITS	5%
1	Ali Marami	250	12.5
2	Ben Kalio	100	5
3	Bra- Bra B	300	15
4	Buhari Estate	110	5.5
5	Don Etebet	100	5
6	Nyanya	440	22
7	Obasanjo	100	5
8	Red Bricks	250	12.5
9	Waziri Ibrahim	250	12.5
10	ZannaZakariya	395	19.75
	TOTAL	**2,295**	**115**

Source: field survey, 2021.

Soil samples at one metre depth were collected and tested from theten housing estates.In addition; samples of building fabrics such as cements, blocks, gravels, and reinforcement tensilewere tested, as shown in table 3.2

Table 3.2: Laboratory tests conducted

S/N	Material	Nature of Test	Purpose
1	**Soil test** Soil sample at 1 metre depth	Sieve Analysis, Bearing Capacities, liquid limit, and plastic limit.	Soil classification, soil grading, safebearing capacity
2	**Cement test** Sample A: Ashaka cement Sample B: Bua Cement Sample C: Dangote Cement	Setting time of Cement and soundness.	Initial and final setting time
3	**Fine Aggregate test** Sample A: Shira stone Sample B: Kiyawa Stone	Water absorption test Aggregate crushing value Silt content Sieve analysis	Preliminaries
4	**Concrete test**	Cube test (compressive strength)	Compressive strength at

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		For 3 days, 7 days, 14 days, 21 days, and For 28 days	the age 28 days
5	**Block test** 9 inch, 8 inch, and 6 inch	Compressive strength test for 3 days each	Compressive strength
6	**Reinforcement tensile test** Sample A: 10 inches tensile Sample B: 12 inches tensile Sample C: 16 inches tensile	Compressive test, Tensile test, and Flexural test	Tensile and flexural strength

3.2 Concrete mix Design: As a result of both the soundness and the setting time of the three samples of cements are within the same range. One of the samples (Ashaka Cement) was used for concrete mix design. It was designed for grade 25 N/mm^{2}and grade 30 N/mm^{2}for 28 days.

3.3Method of Data Analysis
The data collected was analysed using charts, percentile, tables, narrative and descriptive methods of data analysis.

IV. DATA PRESENTATION AND ANALYSIS

4.1 Soil Analysis

Table 4.1: Soil Classifications

S/N	Location	D10 (mm)	D30 (mm)	D60 (mm)	Cc	Cu	Fines (%)	Classification	
								USCS	AASHTO
1	Don Etebet	0.07	0.084	0.35	0.29	5.00	2.20	SP	A3
2	Buhari Estate	0.072	0.088	0.25	0.43	3.47	2.10	SP	A3
3	Waziri Ibrahim	0.069	0.08	0.12	0.77	1.74	3.20	SP	A3
4	Bra Bra	0.067	0.085	0.32	0.34	4.78	3.20	SP	A3
5	Obasanjo	0.068	0.085	0.3	0.35	4.41	2.50	SP	A3
6	Nyanya	0.077	0.18	0.55	0.77	7.14	1.40	SW	A-1-b
7	Ben Kalio	0.062	0.075	0.095	0.96	1.53	3.70	SP	A3
8	Red Bricks	0.065	0.08	0.15	0.66	2.31	3.10	SP	A3
9	ZannaZakariya	0.074	0.085	0.24	0.41	3.24	3.10	SP	A3
10	Ali Marami	0.072	0.085	0.18	0.56	2.50	1.70	SP	A3

Source: laboratory analysis, 2021.

Table 4.1 shows the soil classification (USCS & AASHTO) of the 10 sample areas;where $1 \leq Cc \leq 3$ and $1 \leq Cu \leq 6$.

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Table 4.2: Summary of Soil Bearing Capacities

Locations	Parametres					Ultimate Bearing Capacity qu (kN/m2)	Safe Bearing Capacity (kN/m2)	Ultimate Bearing Capacity qu (kN/m2)	Safe Bearing Capacity (kN/m2)
	ϕ (˚)	Nc	Nq	Ny	C (kN/m2)	690 mm Strip		1x1 m Squarefooting	
BUHARI	30	37.2	22.5	19.7	2	543.14	135.79	582.80	145.70
ALI MARAMI	29	34.78	20.4	17.7	1	458.88	91.78	484.89	121.22
NYANYA	22	20.7	9.52	6.9	4	273.21	68.30	304.12	76.03
ZANNA ZAKARIA	30	37.2	22.5	19.7	4	617.54	154.39	679.52	169.88
BRA BRA B	30	37.2	22.5	19.7	4	617.54	154.39	679.52	169.88
OBASONJO	30	37.2	22.5	19.7	5	654.74	163.69	727.88	181.97
BEN KALIO	30	37.2	22.5	19.7	1	505.94	126.49	534.44	133.61
RED BRICKS	30	37.2	22.5	19.7	1	505.94	126.49	534.44	133.61
DONE ETIBET	30	37.2	22.5	19.7	1	505.94	126.49	534.44	133.61
WAZIRI IBRAHIM	30	37.2	22.5	19.7	4	617.54	154.39	679.52	169.88

Source: Laboratory analysis, 2021.

Table 4.2 shows the bearing capacities both ultimate and safe at 690 millimeters strip and 1 square metre and at a safety of 4.

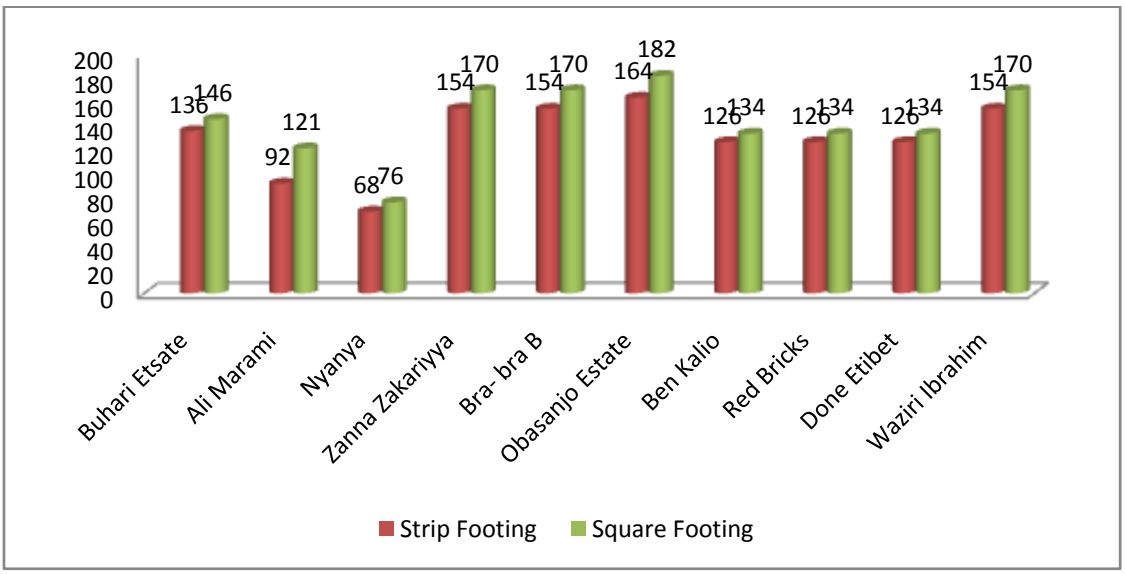

Figure 4.1 shows the strip footing at (690 mm) and 1 metre square footing of the 10 Housing Estates

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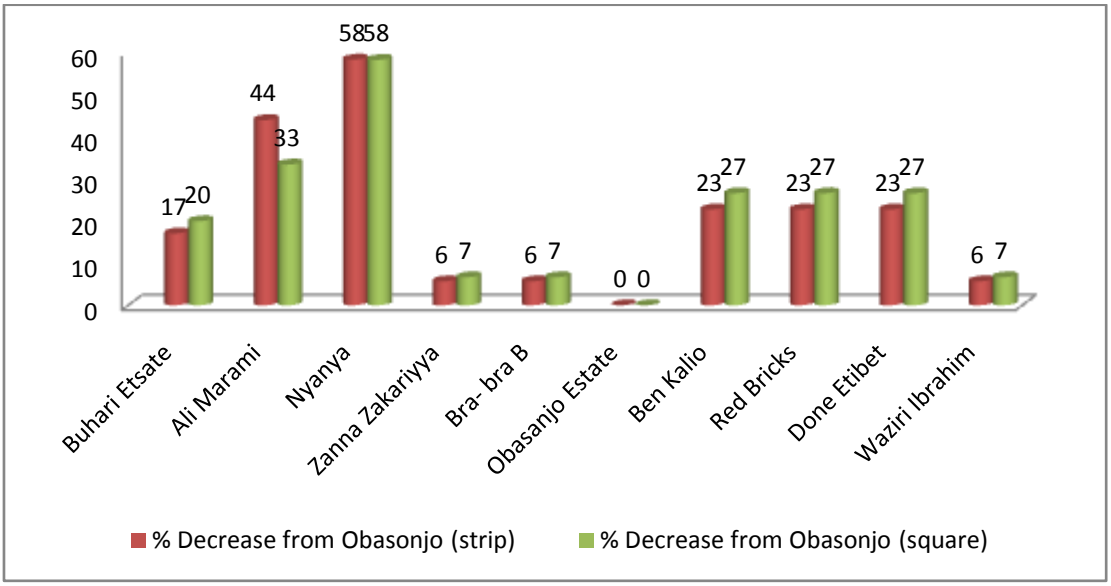

Figure 4.2 reveal the percentage decrease of safe bearing capacity from highest bearing capacity area (Obasonjo Housing Estate) at 690mm strip and 1 metre square footings.

4.2 Concrete Mix Design: Using the course aggregate of Shira and Shuwarin, Ashaka cement, and mile 12 fine aggregate the concrete mix ratio for grade 25 are: 1:2:3 (cement, fine aggregate, and course aggregate) and water cement ratio of 0.48. The ratio for grade 30 using same materials is: 1:2:2 and water cement ratio of 0.43.

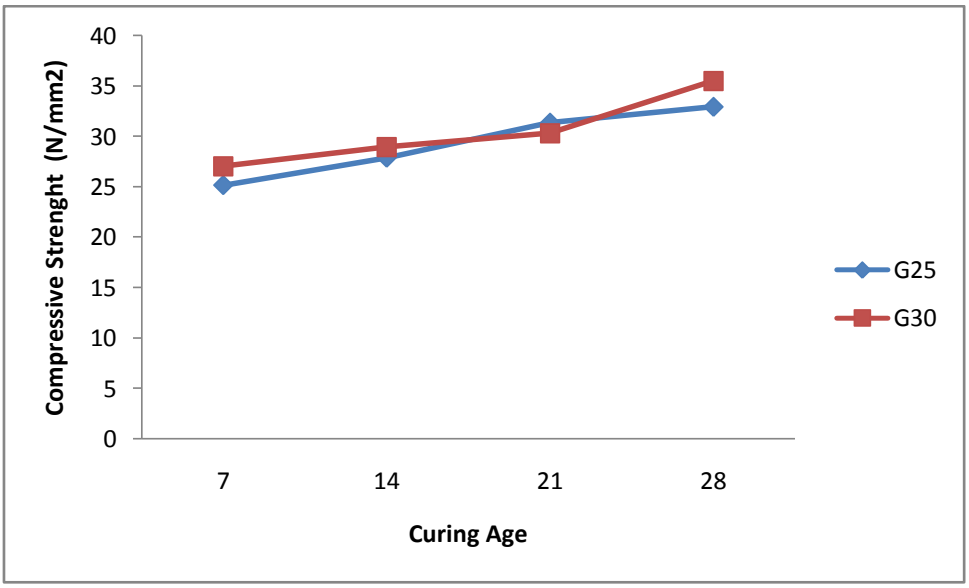

Figure 4.3 concrete design mix for G25 and G30 at an age of 28 days each

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Table 4.3: Tensile test of Material (Steel Test)

Steel Type	Nominal Diameter	Actual length (mm)	Gauge Length (mm)	Weight (g)	Area (mm2)	Upper Yield		Lower Yield		Maximum		Modulus of Elasticity (E)	% Reduction in Area at	Elongation at max. stress
						Load kN	Stress (N/mm2)	Load kN	Stress (N/mm2)	Load kN	Stress (N/mm2)			
Y10	10	409	80	241	78.5	52.26	665.73	51.61	657.45	62.45	795.54	21000	34.35	7.50
Y10	10	505.5	80	265	78.5	59.09	752.74	56.09	714.52	62.47	795.80	21000	40.67	5.00
Y10	10	503.4	80	257	78.5	56.56	720.51	55.3	704.46	63.37	807.26	21000	32.72	7.50
Y12	12	404	80	317	113	70.45	623.45	69.3	613.27	82.1	726.55	21000	41.16	6.25
Y12	12	405.8	80	300	113	64.3	569.03	63.3	560.18	78.7	696.46	21000	14.35	5.00
Y12	12	406.5	80	306	113	62.98	557.35	62.4	552.21	72.7	643.36	21000	29.09	6.25
Y16	16	606	80	1001	201	106.9	531.74	105.1	522.74	128.5	639.05	21000	31.91	3.75
Y16	16	608	80	1003	201	108.9	541.79	104	517.41	124	616.92	21000	31.34	3.75
Y16	16	609	80	1010	202	107.8	536.32	105	522.39	368.1	1831.34	21000	31.68	3.75

Source: Laboratory analysis, 2021.

The above specimens were tested in accordance with BS 18- method of tensile test of materials BS 4449 – Hot rolled steel bars for reinforcement of concrete and BS 4461 – cold worked steel for reinforcement of concrete have complied with the standard requirements.

Table 4.4: Block Test

S/N	Company	Size of Block Tested			Date Tested
		225x225x450mm	200x225x450mm	150x225x450mm	
1	MaduguriBlocks Industry	0.43	0.53	0.54	09/02/2021
2	BulamariBlocks Industry	0.43	0.42	0.63	09/02/2021
3	YahasBlocks Industry	0.46	0.52	0.67	09/02/2021
	Average Compressive Strength (N/mm^2)	0.44	0.49	0.61	

Source: Laboratory analysis, 2021.

V. SUMMARY OF FINDINGS

- According to USCS and AASHTO soil classification tables out of the ten housing units Nyanya housing estate have the best soil capable of supporting public housing scheme. The soil was found to be clean sand well graded (SW) in USCS, while the other nine sample are clean sand poorly graded (SP). Furthermore, it was considered to be excellent material (A-1-B) in AASTHO, this make it the best soil above all (table 4.1).
- Obasonjo Housing Estate has the highest safe bearing capacity of 164 KN/m^2 and 182 KN/m^2 at 690 mm and 1 m^2 respectively, while Nyanya Estate have the lowest safe bearing capacity of 68 KN/m^2 at 690 mm and 76 KN/m^2 at 1 m^2 footing. In other words,Nyanya Housing Estate has the greater percentage decrease of safe bearing capacity of 58% at both 690 mm and 1 m^2 footing when compared with Obasonjo Housing Estate, while ZannaZakariyya, Bra-bra B and Waziri Ibrahim Housing Estates obtained the smaller percentage decrease of 6% at 690mm and 7% at 1 m^2footing.(Figure 4.1)
- The safe bearing capacity of 100 KN/m^2wasused for all the housing estates. These cannot be suitable for Ali Marami and Nyanyawhich have safe bearing capacity of 91.78KN/m^2 and 68.30 KN/m^2respectively.Careful observations on sites revealed that in most of the housing estates built, structural engineers are not

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involved in the process and in few cases where they are employed they mostly uses presumed value of 100 KN/m^2 for their designs as investigations on site's soils are barely conducted.

- The average differencebetween the two points L1 (distance before heating) and L2 (distance after heating) of the three samples of cements (Ashaka, Dangote, and Sokoto) after 5 trials is 1mm. It is therefore, found to be within the limit of less than 10mm; hence, the three samples are suitable to be used for the construction of housing estates.
- The average crushing value of Shira stone after three trials is 1.70%, while Shuwarin stone is 13.10%,hence, they are suitable for construction according to British Standard (less than 45%). Furthermore, the average water absorption value of Shira stone within 24 hours is1.7%, while that of Shuwarin stone is 1.5%. This makes them suitableand reliable (less than 3%).
- The design mix for G25 and G30 concrete has a compressive strength of 32.95 N/$mm^2$and 35.51 N/mm^2respectively. Therefore the mix ratio for G25 (1:2:3 and water cement ratio of 0.48),can be used to achieve G30 concrete (1:2:2: and water cement ratio of 0.43) and it is found to be more economical.
- The three steels tested Y10, Y12, and Y16 after three trials have all passed the test as they obtained the average upper yield value (stress) of 712.99 N/mm^2,583.28 N/mm^2, and 536.62 N/mm^2 respectively.As the characteristic stress of steel used in Nigeria should not be less than 410 N/mm^2(table 4.3).
- According to Standard Organization of Nigeria (SON) the average compressive strength of a block before meeting standard of production and be used for any construction in the country is 2.5 N/mm^2 to 3.45 N/mm^2.The average compressive strength of the three samples of blocks selected from the three block industries operating in the area (150x225x450mm, 200x225x450mm and 225x225x450mm) are 0.61 N/mm^2, 0.49 N/mm^2, and 0.44 N/mm^2. None of them achieved the above minimum requirement (table 4.4). Therefore, the blocks are substandard and not suitable for any construction projects.

5.1 CONCLUSIONS

It was concluded that, in order to achieve sustainability in public housing estate within Damaturu metropolis all aspects involve in the development processright from the selection of site, construction of sub-structure and super-structure must be directly undertaken by the certified professionals in the building industry to achieve standard. The usage and maintenance should bekept to standard.Laboratory investigations are required to ascertain the nature and condition of soil, quality of building materials to be used and so on.

The scale for the acceptance or otherwise of public projects in the country should onlybe a worldwide recognised building standards. The use of substandard building materials at any time is not accepted and where combinations of standard and substandard materials are identified the project should be restructured to avoid waste of resources, loss of lives and investments.

Public projects should be elastic at all time so as to accommodate changes or corrections on the identified errors in order to keep the project target on course and ensure safety, convenience, hygiene, demand, profit and satisfaction of the end user's needs.

5.2 RECOMMENDATIONS

- Ali Marami and Nyanyahousing estates that have safe bearing capacity of 91.78KN/m^2 and 68.30KN/m^2respectively should have been redesigned to prevent or reduce the impact of future events such as gradual deterioration of the buildings, low quality production, change in demand, higher maintenance costs whichmight not occur immediately as a result of faulty design.
- Only laboratory results of building materials obtained from the recognised institutions and organizations should be accepted by the government's representatives and consultants in public projects. No public project should be done without meeting the minimum required standard.
- Where a proposed site is declared unfitting for future projects by the laboratory results or expert opinions, alternative sites should be provided to relocate the project in order to achieve sustainability and safety of the end users and avoid waste of public funds.
- Politics should not play a role in the selection of contractors responsible for public housing development. Every developer should meet the minimum requirements of a project and be selected best on remit and capacity to deliver.
- Yobe State Housing and Property Development Corporation, and other organization representing the state government in public housing developments should be frequently trained on the issues and challenges

of public housing projects, techniques of urban development, urban renewal and so on. The problems of substandard structures in government projects will be reduce to the minimum.

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