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iii. An abstract not exceeding 250 words to provide the purpose, procedure, significant results and conclusions of the research work; as well as state clearly why the research is important, particularly to those who may not necessarily be in that field.
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Study of Factors Influencing Housing Characteristics in Lagos Peripheral Settlements

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Abstract

This research assessed the factors that influence housing character in Lagos peripheral settlements. Case study survey of purposively selected eighteen peripheral-urban settlements in Ikorodu Local Government Area was used for this study. Primary data was collected through survey questionnaires and direct observations. Research instruments were administered randomly selected household in the peripheral urban settlements chosen in the first stage of sampling. Quantitative data was analysed using descriptive statistics to generate frequencies, percentages, cross tabulations and test of correlation. Qualitative data was subjected to descriptive analysis. Findings revealed the differentials in internal and external characteristics of housing which is predominantly influenced by housing providers' branding and distinction. Housing providers adopted different typologies which reflect in the various characteristics of housing developments in the study area. It is concluded that self-help housing initiative in Lagos peripheral-urban settlements needs timely institutional intervention for improved quality in housing development also to give direction on the pattern of housing development. The intervention is to curb high level of housing informality in the study area.

Keywords: Building materials, Housing, Periphery, Residential Typologies, Self- built.

Introduction.

The morphology of housing developments in the metropolitan fringe is influenced by factors, some of which are urban policy, socio-economic demography, the locational attributes, construction materials and housing initiatives (Minghong & Xiubin, 2013). Other determinants in classification of housing are household size, the floor space per person for living and land intensity (Ravetz, Fertner, & Nielsen, 2013). Housing supply could be influenced by affordability and societal need, thus birthing provision on various platforms, predominantly in form of government-led housing, private development and self-help housing (Adedire, Anthony& Adebamowo, 2018).

Different housing providers have distinct characteristics deployed through the mode of construction, tenure and ownership. The city periphery is predominantly characterized by informal self-help housing while the well planned new towns are mainly government-led and private organisation-led housing developments. Government-led housing development usually calls for replacement of the original settlers' culture group by residential diffusion differentiated by ethnicity and Housing type is characterised by different types of neighbourhoods in the peripheral urban. Common housing typologies in the peripheral urban are commodity housing (rooming house), single family house, a single-family bungalow, semidetached bungalow, storied apartment building and middle rise buildings duplex (Olotuah, 2006). The commodity housing has co-renting as its unique attributes. It is called rooming apartment and it is characterized by one apartment sub- divided into culture. It allows structured inequality and results in residential segregation which ultimately lead to disparity in infrastructure development. It is high absorbed peripheral urban housing development.

The self-help housing development is the peripheral urban is influenced by the socio-economic attributes of the residents which impact the dwelling quality, construction materials and arrangement (Bangdome-Dery, Eghan, & Afram, 2014). In most cases, peripheral urban housing is characterised by low density mixed-use residential development. Rigidly segregated housing with limited choices in travel routes is prevalent in the metropolitan fringe (Yue, Liu, & Fan, 2013).The concept of mixed-used development, mixing residential with commercial and service functions emerged to address the multi-dimensional needs of the heterogeneous population in peripheral-urban developments (Tavares, Pato, & Magalhães, 2012; Tan & Li, 2013).The negative impact of mixed-use development usually come in form of environmental pollution which is created by discharge of toxic wastes. This discharged toxic waste affect both dwelling and environmental quality in peripheral urban settlements.

numerous bedrooms. It services the poor migrants in the metropolitan fringe (Mandere, Ness, & Anderberg, 2010). Housing characteristics in Lagos peripheral urban settlements are a cluster of settlements along the axial of the urban corridor of the Lagos-Ibadan expressway. A major land use in Lagos peripheral urban is residential development. Urban morphology in Lagos peripheral urban follows the trend of construction of housing estates on acquired large tracks of land (Tavares, Pato, & Magalhães, 2012).

Housing in Lagos peripheral settlements is characterised mostly by mismatch properties between the users and the spatial planning. The complexity of the heterogeneous population in the peripheral urban calls for participation of the end users in the design framework. These factors known to have strong influence on housing characteristics must be made available for consideration in order to have a user performance and effective housing development in the peripheral urban.

Therefore, this study aims to identify the factors influencing housing characteristics in Lagos peripheral settlements. Findings will be helpful for stakeholders in achieving appropriate housing delivery strategy by housing providers towards the provision of efficient and user responsive housing units.

Literature Review.

Socio economic status of residents has significant influence on the housing typology in the peripheral urban. The types of housing development are a function of the socio- economic composition of the residents. Residents with lower socio-economic status occupy different spatial form of settlements, these are often characterized by squatter settlements (Adedire & Adegbile, 2018). In the peripheral urban, using socio-economic attributes. The most significant differentiating factor that distinguishes migrants from other resident groups is housing tenure.

Differentiating factors between the peripheral urban resident groups could be through either socio-economic factors, personal motivation for housing, housing choices preference or the resulting spatial differentiation. Poverty contributes to the environmental quality in the interface. Non migrant groups are mostly home owners regardless of socio-economic status (Cobbinah & Amoako, 2012). Rural migrants constitute the root of rental housing in the peripheral urban. This class of people eventually settles in low-cost private rental houses in the peripheral urban (Shen & Wu, 2013).

Housing in the peripheral urban interfaces in almost all the developing countries is predominantly informal buildings with no conformity to building regulations (Olotuah, 2006). The types of settlement are a function of the socio-economic composition of the peripheral urban. Residents with lower socio-economic status occupy different spatial form of settlements, these are often characterized by squatter settlements.

Most Nigerian peripheral urban housing is conceptualized as a squatter settlement, illegal areas, and low priority areas in term of municipal planning (Tavares, Pato, & Magalhães, 2012). Causes of inadequate infrastructure in peripheral urban settlements are growing number of informal housing for low income groups, informal housing not served by basic infrastructure, housing density outweighs the pace of infrastructure development. A dynamic of two types of settlements co-exist. One is affluent and integrated into the city with good transportation while some are isolated, poor and over populous, (Simon, 2008).

Most peripheral urban lack efficient land use planning and infrastructure leading to the emergence of informal settlements (Allen, 2003). Poverty contributes to the environmental quality in the interface. The increasing migration composition of Lagos State constitutes a socio-spatial mixture as opposed to the existing structure rooted in kinship, ethnic homogeneity and communal land tenure before the surge in urbanisation (Towry-Coker, 2002). Differentiating factors between the peripheral urban resident groups could be through either socio-economic factors, subjective motivation for housing, housing choices preference or the resulting spatial differentiation

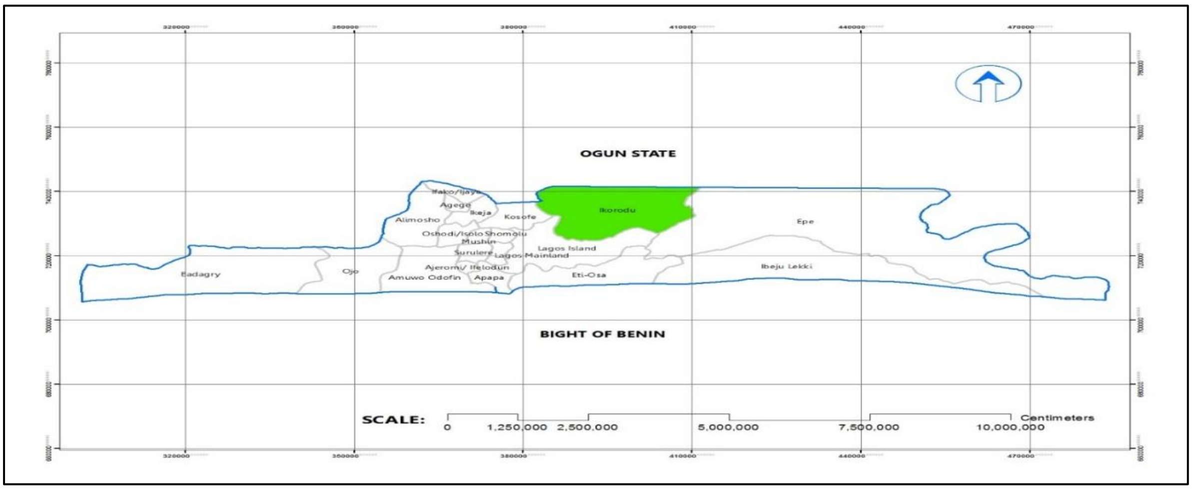

Figure 1: Map of Lagos showing the study area.

Scope of Study

The periphery of Ikorodu Local Government Area in Lagos State is the study area. Ikorodu is located in the North East of Lagos State along the Lagos lagoon and situated at a distance of approximately 36km north of Lagos.

According to the National Population Commission (2006) census, Ikorodu had an enumerated population of 535,619. The study is limited to the peripheral urban settlements in Ikorodu Local Government which covers 345 kilometers square. The sample frame was

drawn from the existing housing units in the peripheral urban

Research Method

Case study approach was applied by conducting field research covering the three tiers of housing that is, self-help housing, private developer-led housing development and government-led housing development. Primary data was sourced from the questionnaire instrument and the observation schedule through a survey of purposively selected 18 settlements in the peripheral urban of Ikorodu. Two-stage sampling was adopted in selecting the sample size made up of randomly selected 384 housing units in the study area. A total of 384 questionnaires were administered to heads of housing units and 379 questionnaires were retrieved. Descriptive analysis was conducted on the data to generate percentages and frequencies of respondents' socio-economic characteristics, housing initiatives, housing typologies, tenure, building materials, factors for informality and segregation in the study area. Secondly, regression analysis using test of correlation was used to identify the relationship between the variables considered to have influence on housing characteristics in the study area. Data processing and analysis for this study were carried out using the Statistical Package for Social Sciences (SPSS) 22 for windows for statistical analysis of the quantitative data.

Data Presentation and Discussion.

5. 1 Socio Demography in the study area.

Self-help housing development constitute 71.5%. The second important player in housing development in the peripheral urban settlements is the private developers, comprising 25.6%. Government participation in housing development was insignificant at 2. 6%. The tenure show longest time most people have lived in Ikorodu peripheral urban settlements fell within a period of five to ten years. Five distinct household sizes were found in Ikorodu peripheral urban settlements (Table 1). The most prevalent household size is composed of 3-5 persons and this constitutes about 48.8% of the sampled households. Household sizes of 1-2 people and 6-9 persons constitute 23.2% and 23% respectively. Also, household size of more than ten persons, 10-12 comprises about 3.7% of the population. The least popular household size is that which is made up of more than 13 persons. The middle-income earners are the most predominant earning between N50, 000.00 to N150, 000.00 monthly. 46.9% of the total population sample was composed of this group while the low income group was 39. 6% of the respondents. High income earners were just 13.4% of the population. This comprised of 1.3%. Informal trading is the most prominent occupation, 31.4% of the respondents were involved. Civil service was 23.7%. Skilled artisans were 17.7% and those engaged in professional practice were 14.8%. Less prominent occupations were studying (4.7%), farming (3.2%), unemployed (0.8%) and retirees (3.2%). There exist low illiteracy level in the study area, 5.5% had below secondary school education constituting the stipulated illiteracy level by UNESCO.

Table 1: Socio Demography of Respondents.

Variable		N=379	%
Housing Initiative	Self-help Housing	271	71.5
	Private developer/Cooperative	98	25.6
	Government allocation	10	2.6
Tenure	Less than 5 years	139	36.7
	5-10years	142	37.5
	More than 10 years	97	25.6
	Others	1	0.3
Household size	1-2 persons	88	23.2
	3-5persons	185	48.8
	6-9persons	87	23
	10-12persons	14	3.7
	More than 13 persons	5	1.3
Monthly Income of household head(Naira)	Low income N25,000-N50,000	150	39.6
	Middle income N50,001-N150,000	178	46.9
Occupation	Civil service	90	23.7
	Trading/business	119	31.4
	Professional practice	56	14.8
	Unemployed	3	0.8
	Retired/pensioner	12	3.2
	Artisan	67	17.7
	Student	18	4.7
	Farming	12	3.2
	Others	2	0.5
Literacy level of the household head	Postgraduate	25	6.6
	First degree/HND	124	32.7
	National diploma	79	20.8
	Secondary	130	34.3
	Primary	18	4.7
	None	3	0.8

Source: Field survey, 2016.

5.2 Attributes of Housing in the study area.

5.2.1 Typologies of Housing.

Characteristics of housing is reviewed using the following parameter; housing typologies, units of household per building and the number of rooms per household. As shown in Table 2, the regular housing typologies in Ikorodu were single family bungalow unit (47.2%), two family semi-detached bungalow (15.3%), single family storey housing (13.2%), tenement bungalow housing(9.2%), storey blocks of flat(4.7%), and multiple unit row bungalow housing(4.2%) in order of occurrences. Other existing but not dominant housing typologies were tenement storey building (2.4%), semi-detached duplex (1.6%), two family semi-detached storey building (1.1%), single unit traditional housing (0.5%), multiple unit traditional housing(0.3%). The most prevalent housing unit in the study area is the single family unit bungalow. It is mainly owner occupied and not part rented. Two families semidetached bungalow housing in the peripheral urban is partly owner occupied and partly rented out. The single storey family housing is wholly owner occupier especially among the polygamous families in the peripheral urban. Two family semi-detached storey housing units also exist and are similar to the two families' semidetached but different in the storey. The owners usually occupy one unit of the whole housing while the other wing is rented out. The semidetached duplex housing unit shares a similar function with the two family semi-detached storey housing unit but different in the internal spatial arrangement. It is widespread in developer-led housing and also among the middle-income earners. Block of flats storey housing and tenement unit bungalow housing are built mostly and purposely for profit and mostly not occupied by the owners. They are rental housing, sharing communal sanitary facilities, built for low income and the poor in the peripheral urban. It is primarily used by students in the higher institutions located in Ikorodu peripheral urban. Multiple unit row housing is similar to additional rental housing but consists of many households units on the same parcel of large lands built for rental purpose. Tenement storey building is a bigger form of commodity housing. It has a ground and first floor but each floor has rows of sanitary facilities communally shared together. Single unit traditional housing and multiple units traditional housing are the regular housing unit among the natives, they have part rented out, built to be lived in by all extended families and usually with poor quality building materials. It is more of an inheritance housing in the peripheral urban.

Table 2: Housing typologies in the study area.

Housing Typology	N=379	%
Single family bungalow unit	179	47.2
Single family storey unit	50	13.2
Two family semidetached bungalow	58	15.3

Two family semidetached storey	4	1.1
Semi-detached duplex	6	1.6
Block of flats storey	18	4.7
Single unit traditional housing	2	0.5
Multiple units traditional housing	1	0.3
Multiple unit bungalow row housing	16	4.2
Tenement unit bungalow	35	9.2
Tenement storey building	9	2.4
Missing	1	0.3

Source: Field survey, 2016.

5.2.2 Spatial Analysis, Occupancy, ownership status and spatial planning.

Table 3: Analysis of housing characteristics in the study area.

Variable		N=379	%
Household units per building	0-2 units	210	55.4
	3-4 units	73	19.3
	5-6 units	38	10
	7-8 units	26	6.9
	8-Above	32	8.4
Rooms per household	0-2	82	21.6
	3-5 room	129	34
	6-9 room	83	21.9
	10-12 room	42	11.1
	13 and above	43	11.6
	Others	0	0
Occupancy	Full family occupation	157	41.4
	Part family occupation/part rented	219	57.8
	Others	3	0.9
Ownership status	Self-built house (owned)	214	56.5
	Family built house (owned)	39	10.3
	Family built house(not owned)	9	2.4
	Employer built house(owned)	1	0.3
	Employer built house (not owned)	2	0.5
	Government built house (owned)	10	2.6
	Tenant (self-paying)	99	26.1
	Tenant (non-paying)	5	1.3

Source: Field survey, 2016.

The commonest household units per building type as shown in Table 3 are 0-2 units, 55.4% and 3-4 units constituting 19.3%. Other existing household units per housing are 5-6 units (10%), 7-8 units (6.9%) and more than 8 household units

(8.4%). There are different rooms per household units, ranging from 0-2 rooms (21.6%), 3-5 rooms (34%), 6-9 rooms (21.9%), 10-12 rooms (11.1%), and more than 13 rooms (11.6%). The dominant housing occupation in Ikorodu peri-urban settlements is a part rented occupation (57.8%). Full family occupation housing units in Ikorodu were 41.4% and other unspecified types were 0.95%. In term of ownership, the commonest types are self-built and owned housing (56.5%), family built and owned housing (10.3%) and tenant self-paying tenant ownership (26.1%). Other ownership status are government built and owned (2.6%), unknown family built (2.4%) and tenant non-paying (1.3%). Further indicated by the analysis of the questionnaire, owner-occupiers (58.3%) were higher than renters (35.1%) in Ikorodu peripheral urban. Few people also were pulled to the peri-urban for commercial purpose (5.8%).

Prevalent Building Materials in the Study Area.

Table 4: Analysis of Building Materials in the study area.

Building materials	Type	N=379	%
Wall	Block wall	358	94.5
	Mud wall	11	2.9
	Thatch/others	9	2.4
	Missing System	1	0.3
Roof	Aluminium	223	58.8
	Thatch	62	16.4
	Concrete slab	47	12.4
	Other	46	12.1
	Missing system	1	0.3
Window	Aluminium	243	64.1
	Louvre	74	19.5
	Wooden	56	14.8
	Casement	5	1.3
	Missing system	1	0.3
Door	Steels/iron	170	44.9
	Flush/panel/wooden	176	46.4
	Glass	24	6.3
	Others	8	2.1
	Missing System	1	0.3

Source: Field survey, 2016.

Through observation schedule and the analysis of field survey, there were diverse building materials in the study area. As indicated in Table 4, the prevailing wall material was block wall (94.5%), mud and thatch wall are sparingly used in the order of 2.9% and 2.4% respectively. The roofing material used mostly in Ikorodu was Aluminum (58.8%). Thatch, concrete slab and other unidentified roofing materials are also used in order of 16.4%, 12.4% and 12.1% respectively. The commonest window material in the study area was aluminum, representing 64. 1% of the analyzed data. Louvre, wooden and casement windows were also represented in order of 19.5%, 14.8% and1.3 % respectively. Steel and wooden doors were more pronounced in use than glass doors in the peripheral urban.

Environmental quality in the study area.

The variables considered for measuring environmental quality in this study are appropriate waste disposal system, a good drainage system and the state of roads. Analysis of the field survey (Table 6) shows good waste disposal system is also lacking in most places in Ikorodu peripheral urban as indicated by 72.8% of the respondents' population. Only 26.4% shows satisfaction with access to good waste disposal system. Drainage system is a great issue in the study area, 80.2% of the respondents were affected by poor drainage systems while 18.8% live in places with good drainage. Observation shows that most secondary roads in Ikorodu are not good. Graded and ungraded earth road is the prevailing road types in Ikorodu peripheral urban settlements. These findings corroborate the findings through the investigation by Lawanson, Yadua and Salako (2012) and Chirisa (2013) on the state of poor environmental quality in peripheral urban settlements.

Table 6: Respondents' assessment of environmental quality

		Ikorodu	
		N=379	%
State of waste disposal system	Good	100	26.4
	Bad	276	72.8
	Missing system	2	0.5
Good drainage system	Yes	70	18.5
	No	304	80.2
	Neutral	2	0.6
	Missing	2	0.5
Good road	Yes	74	19.5
	No	303	79.9
	System	1	0.3

Source: Field survey (2016).

Conclusion and Recommendation.

Identified housing typologies in Ikorodu peripheral urban settlements are single family bungalow unit, single family storey housing, two family semidetached bungalow, two family semi-detached storey building, semidetached duplex, blocks of flats, single unit traditional housing, and tenement housing. Among these, commonest housing type in the study area was the single family bungalow housing and single family storey building constituting 47.2% and 13.2% respectively. The least occurring building types in both locations were the tenement and single traditional housing. The commonest type of housing units per building was 0-2 units per dwelling and the commonest type of rooms per household was 3-5 rooms. In terms of housing occupancy, Self-built and owned housing was lower in Ikorodu. Most of housing development, 57.8% were part rented housing occupation. Prevailing building materials in the study area were conventional building materials like cement sand Crete blocks, aluminium, aluminium roofing, burglar-proofed windows, wooden panel internal doors and steel external doors. Few buildings among self-help housing were built with traditional building materials like mud block, thatch roofing sparingly in the peripheral urban. Both government-led housing and developer-led housing rely much on the use of conventional building materials. Findings show no trace of alternative building materials for the mentioned housing initiatives in the peripheral urban. It is recommended that post occupancy study should be carried out all housing initiatives to determine their efficiency and suitability for the peripheral urban settlements. The influence of various initiatives on housing characteristics should be evaluated to help in improvement of housing and environmental quality. The state government should intervene in the housing process of self-help housing development by putting in place an efficient regularisation scheme to curb informality.

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Investigation of the Role of Incentives on Site Agents' Turnover in Selected Projects in Lagos State, Nigeria.

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Abstract.

This study investigated the functional relationship between voluntary labour turnover of site agents in construction firms in Lagos State, and incentive schemes in operatiom within the firm. The sampling frame was from construction companies registered with Federation of Construction Industry (FOCI) and were selected by a simple random sampling technique. The sub-problems were investigated by conducting a study on site agents, their peers and superior officers. Through the data obtained from the study, the hypotheses were tested and their validity established by employing inferential statistical techniques, using computer-based statistical package for the social sciences (SPSS) at 5% level of significance. The study revealed that site agent's tenure with present construction firms is dependent on the cumulative incentives given to site agents but independent of individual incentives. Based on the above findings, it is recommended that employers should pay more emphasis on the total incentive package to site agents and regularly review this in line with developments in the country, as this will motivate, retain site agents and increase productivity. The study concluded that there is a high turnover of site agent's in the Nigerian construction industry which is detrimental to the growth and survival of firms.

Keywords: Site agent, Incentives, Mobility, Turnover, Job satisfaction.

INTRODUCTION.

In the construction industry the production technique is relatively labour intensive in Nigeria (Wahab, 1980 & Andawei, 2002). The most important corporate resource over the next 20 years will be talent and skill. Creativity and innovations needed to survive beyond turbulent periods can only come from employees. Employee retention is one of the primary measures of the health and success of an organization. The greatest challenge faced by construction firms in Nigeria today is not one of growth or profitability. Rather it is about retaining their best employees.

As one of the most important sustainability project management practices, prefabrication has been drawing increasing attention to project construction practitioners. However, due to the needs of high technology and large capital investment, there is a great challenge for suppliers to adopt prefabrication in mega project construction. Therefore, designing an adequate incentive mechanism has become a daunting task for the project owner, which aims to ensure a socially and environmentally friendly project delivery Shi, Zhu and Li (2018).

Job mobility is a disruptive and costly exercise which has brought the question of the quality of staff left behind to successfully execute projects as a result of the depletion of the pool of experienced and well trained workers accumulated over the years (Ward, 1979). Job mobility may be attributed to various factors such as dissatisfaction due to lack of advancement, poor salary and incentives, very poor safety records, site and organizational politics, conditions of work and perception and evaluation of alternative jobs.

Incentives have had a two-fold effect on labour turnover in the construction industry. One, they have enabled construction firms to sustain the commitment of its labour force within the firm to achieve its aims and objectives. Two, they have afforded construction firms the opportunity to attract and employ experienced workers from their previous employers in order to improve its labour force.

As posited by Ward (1979) the present increase in the movement of skilled and unskilled workers in the construction industry has serious implications for the industry considering the fact that the construction industry is deemed to be labour intensive. The frequent replacement of workers means recruiting, selecting, placing and training new employees with its attendant effect on cost, time and quality of building projects. It is therefore imperative to identify the factors that are responsible for this high turnover in order to stimulate the necessary incentives that will encourage long stay in construction firms. The author suggests that employees long stay in the employment of a firm will ultimately enhance productivity of the firm and growth of the Nigerian construction industry.

Prefabrication has been viewed as an important means that improves the sustainable construction of mega projects by alleviating environmental risks compared to traditional construction. Jaillon and Poon (2010). Several researchers have studied the technology and methods to increase the performance of prefabrication, such as simulation modeling and optimization techniques Jaillon and Poon (2010) Jeong, Hastak, Syal and Hong (2010), Chen, Okudan and Riley (2010) compared prefabrication and on-site construction method comprehensively and identified a list of holistic criteria for assessment and assisting construction practitioners in selecting the appropriate construction methods. Shi, Zhu, Hertogh and Sheng (2018) and Feng, Tai, Sun and Man (2017) explored the cooperation tendency of prefabricated producers by considering incentive mechanism in mega projects. Wu, Zuo, and Zhao developed an incentive model to analyze the cooperative relationship between owners and contractors in sustainable construction projects.

The research proposed to investigate the role of incentives on voluntary labour turnover of site agents as against involuntary turnover. This study is expected to show the effects of incentives on site agent's turnover sensitize owners and managers of construction firms to the consequences of incentives and turnover on the survival and growth of the construction industry and suggest ways and means of controlling the exodus of experienced and well trained employees.

Lagos State was chosen for this study because it accommodates the head offices and branch offices of a significant proportion of contractors and provides a lot of work for contractors and is representative of Nigeria.

LITERATURE REVIEW

Incentive schemes were first introduced into the building industry on a formal basis with the use of the "payment-by- results" scheme which began as a war-time measure. The scheme was designed to achieve increased performance and productivity on government projects and its operation conformed to standards set by the British Ministry of works. The scheme was generally considered to be a success and its war-time use led to the development of incentive schemes during peace.

On October, 1947 official approval was given by representatives through the National joint council for the building industry to the development of incentives based on the principle that an operative's increased performance above a previously agreed level should be proportionally reflected by increased earnings. It is on this principle that most incentive schemes in the building industry were based.

In the construction industry individuals have certain skills, potentialities or experiences that they seek to sell to construction firms or clients. In turn, the intent of clients and construction firms is to offer pay, incentives, fringe benefits, status and promotions that will attract personnel who can efficiently perform the jobs that are available and increase productivity. Thus the preferred wages are intended to serve as an incentive to accept employment. Pay is typically thought of as performing a number of functions that contribute to organizational effectiveness; in particular it serves as a reward to make employees satisfied with their jobs, motivate them, gain their commitment to the organization, and keep them in the organization.

To meet these ends, pay must serve as an incentive that is perceived fulfilling certain needs of individuals. In this regard money does provide the wherewithal to keep body and soul together to fulfill what Maslow describes as the individual's physiological needs.

Northcott (1960) defines incentives as stimulus directed to awaken, maintain and strengthen the desire to attain a given goal or end. According to Petitpas (1970) incentives are rewards over the basic salary which can be awarded or withheld to encourage improved performance. Thus incentives are tools at the disposal of employers to stimulate workers to achieve productivity. Examples of financial incentives include: bonus scheme, profit sharing, piecework rates, hourly rates or day work, group incentive scheme, plus rate or spot bonus, job and finish and standard time or hour system (overtime) hour-saved system.

Non-financial incentives involved are fairly intangible, and are the ones related to Maslow's higher needs and involve in particular the fulfillment of those needs defined by Herzberg as the motivating needs. Thus the incentives offered acknowledge the importance of the individual and recognize his need for group participation to provide social satisfaction. Such incentives include employee participation, competition, praise and reproof, employee training and management development, job and security and good working conditions (Fagbenle 2009).

Landy (1989) opines that theories of motivation have both process and content components. Five broad classes of work motivation theories were considered: need theory, instrumentality theory, goal setting theory, and reinforcement theory. Bassey (1994) defines motivation as the process which influences or encourages a person to take actions towards achieving the desire goal. A number of researchers are of the opinion that motivation is strongly related to opportunities for promotion (Peterson et al. 2003). Kreitner and Kinicki (2001) however state that the positive relationship between promotion and motivation is dependent on perceived equity by employees. A number of authors maintain that having friendly and supportive colleagues contribute to increased motivation (Johns, 1996, Kreitner & Kinicki, 2001).

According to Robbins, Odedaal and Roodt (2003) tenure and motivation are positively related. Oshagbemi (2003) found tenure to have a relationship with motivation. Clarke, Oswald and Warr (1996) contend that employees with longer service may experience higher motivation levels because the job matches their personal needs.

The following factors were identified as contributing to increase in motivational level of employees: fairness of pay, good relationship with workmates, overtime payment, bonus and good safety programme, making receipt of important job outcomes contingent on the performance or completion of the assigned task, better accommodation, good welfare conditions, a challenging job, good safety provision, challenges, achievement, autonomy, job security (Ng, Skitmore, Lam & Poon, 2004, Ogunlana & Chang, 1998).

Halepota (2005) opines that for construction workers, the physiological needs include: wage, salary and working conditions. The safety needs include job security, sick pay and safe working conditions. The social needs include team work and other activities to develop relationships between coworkers. The esteem needs include positive feedback and opportunities for advancement. Self-actualization needs include creating challenging tasks that are stimulating

The standard form of building contract in Nigeria describes the site agent as the person-in charge of the work who represents the contractor and is constantly on site. Within the context of this study, turnover is the resignation rate of site agents per year in construction firms.

Viscussi (1979) defines labour turnover as the flow of manpower into and out of an organization. The inflow side is referred to as accession and the outflow side is referred to as separation. Types of labour turnover include accessions and separations. Individuals leaving the organization without notice for a specific number of days, as stipulated in the employment contract as well as those leaving the organization by giving the necessary notice can be listed in the category of voluntary quits. Discharges or disciplinary layoffs are prejudicial to an employee's record. It is initiated by management because of dissatisfaction with an employee performance or conduct. Natural separation is due to permanent or partial disability, retirement or death. Layoffs for lack of work is called redundancy. It is initiated by management presumably without prejudice to the employee, because a job is being eliminated, or due to reducing of employment owing to insufficient demand for goods or services of the organization.

Ahiazu (1985) found out in his study that employee ranked good salary (i.e. financial compensation) as foremost in importance to their motivation on the job. However, Beach (1965) said money can be used as a motivator if geared towards achievement. Pigors and Myers (1981) stated that employees may voluntarily leave the organization because of one or more of the following reasons: to seek a better job elsewhere, working conditions, lack of advancement, personal reasons,

Flowers and Hughes (1979) classifies employees into four motivation profiles these are turn – overs, turn-offs, turn-ons and turn-ons plus. Employees falling into the category of turn-overs are those dissatisfied at work, and are likely to seize the first opportunity to quit. Those in the category of turn-offs stay on in an organization physically. They are being kept there by maintenance factors (salary etc). Those in the category turn-ons are highly motivated individuals whose felt needs are being met at work. They are unlikely to leave unless there is acute external pressure, or if their satisfaction is reduced. These individuals categorized as turn-ons experience a high degree of satisfaction, both at work and in the local environment. They are most likely to stay and to remain highly productive.

More satisfied employees are likely to stay longer with their employer, those who have lower satisfaction usually have higher rates of turnover. They are more likely to leave their employers and seek greener pasture elsewhere while their more satisfied associates remain. Scientific and professional employees (i.e. accountants, engineers, etc) because they have a high investment in educations and professional preparation expect to be rewarded accordingly, and if they are not rewarded to their satisfaction, they often seek other jobs. Compared with other workers, they tend to be highly mobile, being willing to move elsewhere for new opportunities and challenges.

Flowers and Hughes (1979) stated that employees may stay with the organization for any of these three reasons: largely because of inertia, that is lacking the power move, financial needs, if their financial needs are being met, they are unlikely to move, personal reasons, i.e. closeness to home, children's school, spouses' workplace etc. Remedies to labour turnover include pay levels, evaluation, contingency, incentives and fringe benefits, cost of living adjustments and good faith.

THE RESEARCH METHODOLOGY

The sampling frame comprises the contractors listed in the Federation of construction industry (FOCI) directory. The sample for this study was selected through simple random sampling technique.

FOCI population revealed a composite list of homogenous sub groups based on listing on the Nigerian stock exchange, affiliation with foreign companies and geographical location/regional base (which increases representativeness in social class, ethnic groups, and broad range of attitudes that exist in FOCI population)

Data was collected from 48 respondents from Chairmen or Personnel Managers, site agents and their peers (engineers or general foremen) in on-going projects were selected on a simple random sampling technique. An analytical survey method was adopted, data were analyzed and hypotheses were tested using chi-squire test, likelihood ratio, linear-by-linear association, and Pearson's correlation using computer-based SPSS (statistical package for social sciences) software.

In order to achieve the purpose of this study, some relevant data were obtained from twenty-one construction firms in Lagos State with on-going projects. The study focused on construction companies that are members of Federation of Construction Industry (FOCI) in Nigeria. The reason for limiting construction companies to those registered with (FOCI) is because the sampling frame was derived from the current directory of FOCI. Moreover, most construction companies that are members of Federation of Construction Industry (FOCI) are well structured construction companies (large and medium).

In Lagos state there are 31indigenous firms and 22 firms expatriate construction firms registered with FOCI. A selection of Federation of Construction Industry (FOCI) registered construction companies using a simple random sampling technique, with selection based on minimum of one out of every three registered construction companies with FOCI with on-going projects in Lagos State resulted in 13 indigenous firms and 8 firms expatriate construction firms. Consequently, a sample size of 63 comprising of 3 people from each firm was taken for questionnaire distribution. The names of these firms as well as the names of the chairmen or Managing directors or personnel managers, site agents and their peers were not disclosed for the purpose of confidentiality, and prejudice or fear of intimidation.

RESEARCH FINDINGS

To find solutions to the problems the following hypotheses were set up:

Site agent's tenure with the present construction firms and individual incentive in operation in the construction firms are independent while the alternative hypothesis maintains that the two variables are dependent. Site agent's tenure with the present construction firms and all the incentives given to site agents in the present construction firm are independent of each other, while the alternative hypothesis maintains that the two variables are dependent.

Out of the 63 questionnaires distributed 48 were returned and found useable making a return rate of 76%. This is high enough. Out of the 48 respondents 24 were site agents, 9 were the peers of the site agents (i.e. site engineers, site architects, project engineers) and 15 were the superior officers of the site agent (i.e. chairmen, managing, directors' personnel managers, executive directors and chief executive officers.

Classification of Respondents	Number of Respondents	%
Site agents	24	50%
Peers	9	19%
Superiors	15	31%

Table 1: Classification of respondents

The entire respondents were male. The age band distribution shows that 22 of the site agents were between the ages of 25 to 35 years, I was between 36 to 45 years, I was above 45 years while none was found to be below 25 years. Thus majority of the site agents are between the ages of 25 to 35 years.

Site agent's tenure with the present construction firms and all the incentives given to site agents in the present construction firm are independent of each other, while the alternative hypothesis maintains that the two variables are dependent.

Ho: A = 0

H1: A # 0

Where A stands for independence

Summary Statistics	Calc. value	Tab value	D. F.	Significance	Remark
Chi-square	24.0	15.51	8	.002	Reject Ho.
Likelihood Ratio	32.6		8	.000	Reject Ho.
Linear by Linear association.	2.4		1	.124	Low

Calculated value of $\chi 2$ which = 24.0 is greater than the tabulated value at 5% level of significance which = 15.51 and significance P which = .2% is less than 5%. Hence the null hypothesis is rejected in favour of the alternative hypothesis which states that "site agents' tenure with the present construction firms depends on the cumulative incentives given to site agents in the present construction firms".

Site agent's tenure with the present construction firms and individual incentive in operation in the construction firms are independent, while the alternative hypothesis maintains that the two variables are dependent.

Ho: B = 0

H1: B # 0

Where B stands for independence

Null hypothesis Ho: Tenure of site agents with present construction firms & incentives are independent	Pearson's R	Sig.	Fisher's Exact Test		Remark
			One Tail Significance	Two Tail Significance	
Profit sharing by present firms	-0.43	N.S	0.68	0.96	Accept Ho
Piecework rates paid by present firms	0.48	S.S	0.38	0.76	Accept Ho
Hourly rates / day work paid in present firms is independent.	-0.32	N.S	0.201	0.321	Accept Ho
Group incentives in present firms.	-0.43	N.S	0.63	1.00	Accept Ho
Plus rate/spot bonus in present firms.	-0.16	N.S	0.44	0.64	Accept Ho
Job and finish incentive.	0.48	N.S	0.069	0.092	Accept Ho
Overtime paid by present firms.	0.35	N.S	0.157	0.188	Accept Ho
Management development of site agent in present firms.	0.31	N.S	0.156	0.204	Accept Ho
End of year bonus in present firms.	0.29	N.S	0.29	0.48	Accept Ho
Job security and good working conditions in present firms.	0.48	N.S	0.069	0.091	Accept Ho
Insurance scheme in operation In present firms.	-0.1	N.S	0.48	0.69	Accept Ho
Hours saved incentive in present firms.	-0.35	N.S	0.31	0.47	Accept Ho
Site agents' pparticipation in decision making in present firms.	-0.21	N.S	0.291	0.386	Accept Ho
Self-competition by site agents in present firms.	0.47	N.S	0.003	0.006	Accept Ho
Praise and reproof of site agents' in present firms.	0.43	N.S	0.068	0.096	Accept Ho

NOTE: S.S: Statistically Significant. N.S: Not Statistically Significant.

Table 3: Pearson Product-Moment Correlation Coefficient, R & Fishers Exact Test of site agent's tenure with the present construction firms & incentive Schemes in operation within present construction firm.

The major findings that emerged are summarized below: the tests carried out on the hypothesis revealed the relationship between site agents tenure with present construction firms and incentives. Based on the responses obtained from the administered questionnaires and presented in table 3 and the tests carried out, it was found that site agents' tenure with present construction firm is independent of each individual financial incentives, site agents' tenure with present construction firms is independent of each individual non-financial incentive expect self-competition. However, it was found that site agent's tenure with present construction firms is not independent of all the incentives put together, i.e. site agents' tenure with present construction firms is associated with all the incentives given to site agents in the present construction firms.

Other important findings here are that: incentives discourage job mobility and turnover of site agents, the incentives increase the earnings of site agents, the incentives give job satisfaction to site agents,

Financial and non-financial incentives are important to site agents in taking up jobs in the construction industry. This is in agreement with Beach (1965) and Flowers and Hughes (1979) who found that their various studies that the total package is of utmost ra importance in workers motivation and retention of their jobs. This negates Hertzberg, Mausner and Sydnerman (1959) who state that money does not motivate.

The incentives increase the earnings of site agents and gives job satisfaction to site agents. Incentives discourage job mobility and turnover of site agents, this finding agrees with that of Flowers and Hughes (1979), who concluded that employee may stay with an organization if their financial needs are being met.

CONCLUSION

Site agent's tenure with construction firms is associated with the cumulative incentives he receives for his performance. Thus financial compensation is important in motivating and

There is no evidence that site agents have a positive attitude to the firm, their superiors and the work because of the incentives. This finding indicates that incentives satisfies only the lower order needs of the site agents and higher-order needs are yet to be satisfied by site agents in construction firms as highlighted by the need theories.

Based on the findings of this study and their implications the following recommendations are suggested as antidotes to the problems highlighted from the study: There should be a general review of the wages, salaries and incentives of site agents in the construction industry. Adequate compensation is an important factor in retaining employees. More emphasis should be paid to the total package so that the higher order needs of site agents are satisfied and more regular reviews of the total package and other conditions of service so as to keep abreast with the goings on in the country.

Smaller construction firms would benefit more by merging with one another to form single large and formidable firms capable of paying site agents adequately and providing the working conditions conducive for labour stability and productivity. Even though hazards are not pronounced in site agents' turnover, whenever they occur they make a lot of negative impact on site agents. Therefore, management should make effort towards minimizing and cushioning off the effects of professional hazards by subscribing to special life insurance scheme for site agents.

Turnover rate of site S agents in construction firms should be reduced and discouraged to ensure high labour stability and productivity. Retention methods should be evolved to keep top talents and have a significant and positive impact on an organization's turnover rate.

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Sustainable Environment: Review of Indoor Air Quality in Buildings

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Abstract.

The work examined the indoor air quality of buildings and implication on the wellbeing and health of the occupants. It observed that good indoor air quality should be a major consideration for design of buildings. Poor indoor air quality can impact individual productivity, personal comfort, building maintenance, costs and safety of occupants. The relationship among buildings owners, architects and occupants of the building could be utilized maximally to encourage the maintainable good indoor air quality.

Keywords: Sustainability, Environment, Indoor air quality and Building

INTRODUCTION

Indoor air quality is the air quality (IAQ), within and around buildings and structures (Wikipedia) IAQ is known to affect the health, comfort and well-being of building occupants. Poor indoor air quality has been linked to sick building syndrome, reduced productivity and impaired learning in schools.

Good indoor air quality in buildings will be a base for considering new design, construction or renovation of any building, especially if the parallel objective is to achieve a sustainable built environment. Efforts to create optimal indoor environmental conditions enable owners and managers to anticipate and avoid negative health effects. architects, contractors, owners, and managers have long been challenged with providing quality indoor environments at a reasonable energy cost. Current efforts to improve building energy efficiency, including goals of sustainability and net-zero energy use, are bringing more focus on how to successfully achieve energy efficiency and good indoor air quality (IAQ). Efforts to improve IAQ involve planning, designing, building, operating, maintaining, and renovating buildings in ways that reduce pollution sources and remove indoor pollutants.

Sustainable practices are significant to IAQ in different ways, including buying and using cleaning and maintenance products; selecting building materials and furnishings that are manufactured with less toxic materials; and designing for more and better light. Sustainable practices are intended to conserve resources that benefit human life and health and discourage the use of substances and materials that waste resources, cannot renew themselves (as "natural" resources such as wood can), contaminate air and water, and generally impair quality of life over the long term

Sustainability and IAQ intersect in construction practices, The EPA however defines green or sustainable construction as "the practice of creating and using healthier and more resource-efficient models of construction, renovation, operation, maintenance, and demolition." Research shows that when buildings are designed and operated with lifecycle impacts in mind, they contribute to all three aspects of sustainability: social, environmental, and economic. A conclusive link between the quality of the indoor environment and occupant productivity has the potential to dramatically change the way buildings operate in the future.

Based on this review, this chapter highlighted primary source of indoor air pollution, causes and effects on buildings/occupants. The chapter further discussed preventive measures of poor IAQ and ways of improving good indoor air quality on building. The chapter concluded based on research, that architects should consider sustainable design solutions at the initial stage of design in collaboration with owners/occupants perception on issues about indoor air quality.

ENVIRONMENT

The word Environment is derived from the French word "Environ" which means "surrounding". Our surrounding includes biotic factors like human beings, Plants, animals, microbes, etc. and abiotic factors such as light, air, water, soil, etc. Environment is a complex of many variables, which surrounds man as well as the living organisms. Environment includes water, air and land and the interrelation ships which exist among and between water, air and land and human beings and other living creatures such as plants, animals and microorganisms (Kalavathy, 2004). She suggested that environment consists of an inseparable whole system constituted by physical, chemical, biological, social and cultural elements, which are interlinked individually and collectively in myriad ways. The natural environment consists of four interlinking systems namely, the atmosphere, the hydrosphere, the lithosphere and the biosphere. These four systems are in constant change and such changes are affected by human activities and vice versa (Kumarasamy et al., 2004).

Components of Environment

Our environment has been classified into four major components:

1. Hydrosphere
2.Lithosphere
3.Atmosphere
4.Biosphere.

Hydrosphere includes all water bodies such as lakes, ponds, rivers, streams and ocean etc. Hydrosphere functions in a cyclic nature, which is termed as hydrological cycle or water cycle.

Lithosphere means the mantle of rocks constituting the earth's crust. The earth is a cold spherical solid planet of the solar system, which spins in its axis and revolves around the sun at a certain constant distance. Lithosphere mainly, contains soil, earth rocks, mountain etc. Lithosphere is divided into three layers- crusts, mantle and core (outer and inner).

Atmosphere is cover of the air, that envelopes the earth is known as the atmosphere. Atmosphere is a thin layer which contains gases like oxygen, carbon dioxide etc. and which protects the solid earth and human beings from the harmful radiations of the sun. There are five concentric layers within the atmosphere, which can be differentiated on the basis of temperature and each layer has its own characteristics. These include the troposphere, the stratosphere, the

mesosphere, the thermosphere and the exosphere
(Kalavathy, 2004).

Biosphere is otherwise known as the life layer; it refers to all organisms on the earth's surface and their interaction with water and air. It consists of plants, animals and micro-organisms, ranging from the tiniest microscopic organism to the largest whales in the sea. Biology is concerned with how millions of species of animals, plants and other organisms grow, feed, move, reproduce and evolve over long periods of time in different environments. Its subject matter is useful to other sciences and professions that deal with life, such as agriculture, forestry and medicine. The richness of biosphere depends upon a number of factors like rainfall, temperature, geographical reference etc. Apart from the physical environmental factors, the man-made environment includes human groups, the material infrastructures built by man, the production relationships and institutional systems that he has devised. The social environment shows the way in which human societies have organized themselves and how they function in order to satisfy their needs (Kumarasamy et al., 2004).

Structure and Composition of Atmosphere(air)

An *atmosphere* is a layer or a set of layers of gases surrounding a planet or other material body, that is held in place by the gravity of that body (Wikipedia). It contains lifegiving gases like oxygen for humans and animals and carbon dioxide for plants. The air is an integral part of the earth's mass and 99 per cent of the total mass of the atmosphere is confined to the height of 32 km from the earth's surface. The air is colourless and odourless and can be felt only when it blows as wind.

ENVIRONMENTAL SUSTAINABILITY

Sustainability is the ability of a system to exist constantly at a cost, in a universe that evolves towards thermodynamic equilibrium, the state with maximum entropy. In the 21st century, it refers generally to the capacity for the biosphere and human civilization to coexist. (Wikipedia)

Environmental sustainability is defined as responsible interaction with the environment to avoid depletion or degradation of natural resources and allow for long-term environmental quality. The practice of environmental sustainability helps to ensure that the needs of today's population are met without jeopardizing the ability of future generations to meet their needs.

When we look at the natural environment, we see that it has a rather remarkable ability to rejuvenate itself and sustain its viability. For example, when a tree falls, it decomposes, adding nutrients to the soil. These nutrients help sustain suitable conditions so future saplings can grow.

When nature is left alone, it has a tremendous ability to care for itself. However, when man enters the picture and uses many of the natural resources provided by the environment, things change. Human actions can deplete natural resources, and without the application of environmental sustainability methods, long-term viability can be compromised.

Issues of environmental sustainability

Environmental sustainability is concerned with issues such as:

- Long-term health of ecosystems: Protecting the long-term productivity and health of resources to meet future economic and social needs, e.g. protecting food supplies, farmland and fishing stocks.

- Intergenerational decision making: When making economic decisions, we should focus on implications for future generations, and not just the present moment. For example, burning coal gives a short-term benefit of cheaper energy, but the extra pollution imposes costs on future generations.
- Renewable resources: Diversifying into energy sources that do not rely on non-renewable resources. For example, solar and wind power.
- Prevent the consequences of man-made global warming: Policies to ensure the environment of the planet does not deteriorate to a point where future generations face water shortages, extreme weather events, excess temperature.
- Protection of species diversity and ecological structure: Sometimes medicines require elements within specific plant species. If some species go extinct, it limits future technological innovation.
- Treating environmental resources as if they have intrinsic rights and value: In other words, we shouldn't just rely on a monetary value, i.e. we should protect rainforests because they deserve to be protected rather than using a cost-benefit analysis of whether we gain financially from protecting rainforests.

INDOOR AIR QUALITY (IAQ)

Indoor air quality is the air quality within and around buildings and structures. IAQ is known to affect the health, comfort and well-being of building occupants. Poor indoor air quality has been linked to sick building syndrome, reduced productivity and impaired learning in schools.

IAQ can be affected by gases (including carbon monoxide, radon, volatile organic compounds), particulates, microbial contaminants (mold, bacteria), or any mass or energy stressor that can induce adverse health conditions. Source control, filtration and the use of ventilation to dilute contaminants are the primary methods for improving indoor air quality in most buildings. Residential units can further improve indoor air quality by routine cleaning of carpets and area rugs.

Primary source of Indoor Air pollution

Indoor pollution sources that release gases or particles into the air are the primary cause of indoor air quality problems. Inadequate ventilation can increase indoor pollutant levels by not bringing in enough outdoor air to dilute emissions from indoor sources and by not carrying indoor air pollutants out of the area. High temperature and humidity levels can also increase concentrations of some pollutants.

There are many sources of indoor air pollution. These can include:

- Fuel-burning combustion appliances
- Tobacco products
- Building materials and furnishings as diverse as:
- Deteriorated asbestos-containing insulation
- Newly installed flooring, upholstery or carpet

- Cabinetry or furniture made of certain pressed wood products
- Products for household cleaning and maintenance, personal care, or hobbies
- Central heating and cooling systems and humidification devices
- Excess moisture

CAUSES OF INDOOR AIR POLLUTION IN BUILDING.

Many indoor air problems are the result of giving no attention to IAQ as a key issue at the very beginning of the design process. Basic design decisions related to site selection, building orientation, and location of outdoor air intakes and decisions on how the building will be heated, cooled, and ventilated are of critical importance to providing good IAQ (Ashrae, 2009). Efforts to achieve high levels of building performance without diligent considerations of IAQ at the beginning of the design process often lead to IAQ problems and represent missed opportunities to ensure good IAQ.

Construction materials and indoor equipment

The wide range of occupancies and activities in commercial and institutional buildings involve many different types of equipment and activities. IAQ problems have resulted from improper equipment operation, inadequate exhaust ventilation, and poor choices of materials used in some of these activities. The materials known for absorbing moisture from some building materials are known for source of Indoor air problems. For instance, When Asbestos containing materials are damaged or disturbed, they release asbestos fibers into the air. Airborne asbestos fibers pose an increased health risk for mesothelioma, lung cancer, and asbestosis (IAQMP, 2012). Lead can be found in paint and varnishes, and possibly other materials and items. When lead is released as dust or chips, individuals may inhale or ingest the lead. This can affect the nervous system, and young children are particularly susceptible (IAQMP, 2012). The type of mirrors used for the construction of doors and/or windows play a great role in moisture content inside the room due to condensation, and also it results in increment of room temperature due to lack /absence of attention given to the transparency of mirrors used for windows and doors. In other words, there are some mirrors which are known for high reflection of sun radiation resting on them. According to EBC1 (2016) News, most of the large buildings with doors and/or windows made of mirrors are highly reflecting to sun radiation, which was one of the causes of car accidents in the capital city of Ethiopia (Addis Ababa), as a result of eye irritation of drivers. Not only this, but also the higher reflection resulted in the increment of surface temperature in the city where report was made, which in other words, affect the temperature of indoor since there is air exchange between indoor and outdoor. Moreover, some mirrors are known for their “Green House Effect”. The type of color mirrors are painted with affects the transparency and absorption to sunlight energy. This is to mean that some mirror are transparent to short wave radiation coming from the sun and less transparent (translucent) for long wave irradiations reflected back from walls of building, floor, ceiling or from any materials inside the room. There is positive net energy inside the room, which will result in temperature increment that in other words results in indoor air pollution. Recent developments in construction materials have resulted in the use of more synthetics and composites, which can affect air quality. Radical changes in technology have led to innovations such as computers and photocopiers that provide greater efficiencies and time savings, but they can also affect the quality of indoor air (TSI, 2013). A healthy indoor environment is one in which the surroundings contribute to productivity, comfort, and a sense of health and well-being. The indoor air is free from significant levels of odors, dust and contaminants and circulates to prevent stuffiness without creating drafts. Temperature and humidity are appropriate to the season and to the clothing and activity of the building occupants

Microbial organisms

Excessive levels of moisture in building assemblies, particularly in the building envelope lead to IAQ problems. Such situations can lead to mold growth that can be very difficult to fix without major renovation efforts and costs (USEPA, 1991; Ashrae 2009). Microbial organisms, such as fungi (for example, mold) and bacteria can cause illness (such as allergies, asthma), costly damage, and discomfort. Microbes need moisture, a food source (such as drywall) and other particular conditions to grow (IAQMP, 2012). Moisture problems arise for a variety of reasons, including roof leaks, rain penetration through leaky windows, envelope design and construction defects such as low-permeability wall coverings in hot and humid climates, and poor building pressure control buildings (USEPA, 1991; Ashrae, 2009). These problems are largely avoidable but require an understanding of building moisture movement and attention to detail in envelope design and construction and in mechanical system selection, installation, and operation

(IAQMP 2012).

Lack of commitment

Despite the building design problems, there are opportunities to improve the indoor air quality of building either by regular removal of wastes (residues of fruit or food, paper, volatile organic compounds), or planting plant species with dense crown on the side of pollution source. Making a commitment to good IAQ at the beginning of a project and maintaining that focus through design, and construction will result in a building that is more successful in meeting its design goals and achieving the desired level of performance throughout its life. However, all of the activities to improve indoor air quality need the commitment of individuals, occupants, organizations, different sectors, and owners. This is because of the reason that the community participation plays a great role in solid waste reduction by showing their willingness to use materials with no/or little waste, which results in a significant reduction in total waste generated (Alefu 2015). As a result of this, the total amount and composition of gases released (outdoor air, which is one of the major sources of indoor air pollution) from biodegradation of solid wastes is or can be reduced.

Poor outdoor air quality

The traditional means of dealing with IAQ is through outdoor air ventilation. While ventilation can be an effective means to dilute indoor contaminants, it assumes that the outdoor air is cleaner than the indoor air. In many locations and for many contaminants, this is not the case, and insufficiently treated ventilation air can actually make IAQ worse (Ashrae, 2009). Poor outdoor air quality includes regionally elevated outdoor contaminant levels as well as local sources, such as pollen, dust, fungal spores, industrial pollutants, motor vehicle exhaust from nearby roadways and contaminants generated by activities in adjacent buildings (USEPA, 1991; Ashrae, 2009). Some programs encouraging higher levels of building performance recommend increasing outdoor air ventilation rates, but such recommendations should be based on the consideration of the potential impacts of poor outdoor air quality. In urban areas of developing countries, most of the buildings are constructed without considering methods of filtering and/or reducing the total outdoor air mixture by plants or trees before they enter into indoor. Plants absorb different toxic chemicals on their leaves and barks, and also they use carbon dioxide (carbon sink) for photosynthesis.

Inadequate ventilation rates

There are a variety of reasons for inadequate ventilation rates, including lack of compliance with applicable codes and standards, installation or maintenance problems that lead to the design ventilation rate not being achieved in practice, or space use changes without an assessment of the need for updated ventilation rates (Ashrae 2009; Osha, 2011). Also, system-level outdoor air intake rates may be adequate, but air distribution problems can lead to certain areas in the building being poorly ventilated.

Ineffective filtration and air cleaning

Filtration and air cleaning are effective means of controlling many indoor air pollutants, particularly those associated with poor outdoor air quality. Air filtration or air cleaning, therefore, can provide an important adjunct, and in some cases substitute, for outdoor air ventilation (Ashrae, 2009; Osha, 2011). This study focuses on treatment of filtration and air cleaning alternatives that, when properly administered and maintained, can improve both IAQ and energy performance.

EFFECTS OF POOR INDOOR AIR QUALITY ON BUILDINGS/ OCCUPANTS.

The design, physical layout, mechanical systems, equipment and space usage are all essential elements that can affect air quality in buildings. The quality of indoor air can impact productivity, personal comfort, building maintenance costs and even health and safety, either positively or negatively depending on how air quality is managed (Ashrae. 2009; TSI, 2013). Failure to respond promptly and effectively to IAQ problems has the following consequences (USEPA, 1991). These are:

1. Increasing health problems such as cough, eye irritation, headache, and allergic reactions, and, in some rare cases, resulting in life-threatening conditions (for example, legionnaire’s disease, carbon monoxide poisoning).

2. Reducing productivity due to discomfort or increased absenteeism.

3. Accelerating deterioration of furnishings and equipment.

4. Straining relations between landlords and tenants, employers and employees.

5. Creating negative publicity that could put rental properties at a competitive disadvantage

6. Opening potential liability problems.

PREVENTING IAQ PROBLEMS IN BUILDING

Building owners, designers, and contractors can all benefit from an increased focus on providing good IAQ in their buildings (Ashrae, 2009). The relationships among building owners, management, staff, and occupants are an important factor in decisions that affect indoor air quality. The objectives of the major players in these relationships may be very different. Occupants want the building to be pleasant, safe, and attractive; if they are paying tenants, they also want to get the maximum use out of the space they rent for the least cost. Building owners and management want to maintain a reputation for providing quality property at reasonable cost, but also need to derive a profit. Facility staffs are often caught in the middle, trying to control operating and maintenance costs while still keeping occupants satisfied. Any IAQ management system will be successful only if it is organized to fit your specific building. It would not be appropriate for this document to prescribe any single approach. However, the skills associated with IAQ management activities will be identified to help building management decide who will be best able to carry them out. Education and training programs for staff and building occupants should be provided to ensure that new procedures are understood and adopted. Preventive maintenance plays a major role in maintaining the quality of air, by assuring that the building systems are operating effectively and efficiently. Moreover, it helps to maintain a comfortable temperature and humidity in occupied spaces. According to IAQMP 2012, preventive maintenance means the routine inspection, adjustment, and repair of building structures and systems, including the heating, ventilating, and air conditioning system (HVAC), local exhaust, and flooring. According to US EPA (2014), 13.1% of Country's total budget was assigned for the achievement of its goal of addressing Climate change and improving air quality in 2015.

IMPROVING INDOOR AIR QUALITY IN BUILDINGS.

basic strategies to improve indoor air quality in buildings:

1. Source Control
2. Increasing ventilation
3. Installing air cleaning devices

Source Control

Usually the most effective way to improve indoor air quality is to eliminate individual sources of pollution or to reduce their emissions. Some sources, like those that contain asbestos, can be sealed or enclosed; others, like gas stoves, can be adjusted to decrease the amount of emissions. In many cases, source control is also a more cost-efficient approach to protecting indoor air quality than increasing ventilation because increasing ventilation can increase energy costs.

Increasing Ventilation

Another approach to reduce the concentrations of indoor air pollutants in buildings is to increase the amount of outdoor air coming indoors. sustainable design of buildings features mechanical systems that bring outdoor air into the home. Some of these designs include energy-efficient heat recovery ventilators (also known as air-to-air heat exchangers). Ventilation and shading can help control indoor temperatures. Ventilation also helps remove or dilute indoor airborne pollutants coming from indoor sources. This reduces the level of contaminants and improves indoor air quality (IAQ). However, proper ventilation could be considered during the design stage of the building by the architect.

Installing air cleaning devices

Building occupants can take the appropriate action to improve the indoor air quality by unblocking an air supply vent, or opening a window to temporarily increase the ventilation.

CONCLUSION

Solutions to poor indoor air quality in buildings will involve eliminating or controlling the sources of pollution, increasing ventilation and installing air cleaning devices. Wrong considerations that lead to poor IAQ in buildings are made during design stages and could be resolved by sustainable building and design solutions.

RECOMMENDATIONS

In order to reduce the negative effects/enhancing the indoor air quality in buildings, architects should consider sustainable design solutions at the initial stage of design in collaboration with owners/occupants perception on issues about indoor air quality. furthermore, the relationship between energy consumption and IAQ, occupants sensitization on health effects of indoor pollutants and their sources may need more attention in achieving good IAQ in buildings.

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Analysis of Dry Season Soil Samples from Umuokiri-Umuoduru, Osisioma Local Government Area, Abia State, Nigeria for Increased Cassava Production

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Abstracts

Soil samples collected at 0-15cm and 15-30cm soil depths were collected purposively from the study area and subsequently analyzed at a soil laboratory for physical and chemical properties. Results of particulate size distribution showed that sand, silt and clay were moderately available to support cassava production. Textural classification ranged from; loam, sandy-loam to sandy-clay-loam. Primary nutrients results showed reasonable deficiencies for Total Nitrogen, Available phosphorous, Exchangeable potassium, Organic carbon and Organic matter. Both organic matter and organic carbon results were less than critical soil value of 2% which is needed to cultivate cassava. Base saturation was moderate but not sufficient to support cassava production. Given that it is a dry season soil, it was suggested that irrigation activities will improve the soil water activity and improve crop water availability. At the same time, application of inorganic and organic fertilizers will help to improve the primary nutrient content of the soil.

Keywords: Particulate size distribution, Cassava production, Primary chemical nutrient.

INTRODUCTION

Currently, Nigeria is the largest global producer of cassava. Annual output was over 40 million tons in 2005, (CBN & FAOSTAT, 2005), and 60 million tons by 2019 (FAOSTAT, 2019). Within this period, world cassava production stood at 278 million tons; Africa's total production was about 170 million tones (about 56%) of world production, (FAOSTAT, 2019 & Alozie Oti and Wogu, 2018). Cassava was first cultivated in South America but introduced into Nigeria in the 16th century. Cassava is very much grown on marginal croplands, hence, it is cultivated everywhere, especially in the wet, fairly wet and fairly dry areas in Nigeria. Even in compound farms of most Nigerians, cassava is prominent among other food crops. However, Abass, Mokaka, Okechukwu and Ranivoson, Tarawal, and Kanju (2015) observed that cassava production technology is still very low, rudimentary and ineffective. Nevertheless, cassava production has uplifted the livelihood of most households in rural Nigeria. Cassava is best known for its starchy roots and products worldwide (Obasi, Onyekwere, and Ebeniro, 2015).

Cassava production is dependent on the availability of essential nutrients in the soil. Mortvdt, (1985) observed that absence of essential micro nutrients in cassava nutrition causes about 30% reduction in cassava yield. Hence, characterization of soils in the study area becomes necessary to ascertain it's producible/fertility contents of which will either increase or decrease cassava production. In this sense, assessment of dry soils of Umuokiri, Umuduru, and Osisioma Local government area will help to determine the suitability of the soils in the production of cassava even in dry season. Increased generation of water, as observed by Alozie and Alozie, (2015), through rain water harvesting and private boreholes, has increased the possibility of dry season farming.

STUDY AREA

The study area, Umuokiri-Umuoduru is increased in Osisioma Local government area, Abia state and within Abia Central Senatorial Zone. Population size for Osisioma Local Government Area by 2006 was about 2,845,380 (NPC, 2006) but projected to 4,303,888 by 2020 at 3.026% growth rate.

The study area is firmly located in the coastal plain sand zone (Benin Formation), with annual average rainfall well above 2200mm. Rainfall season stretches from March to October each year, while average temperature is about 27^0c. Soil in the area is characteristic of ferrallitic soils usually, zone associated with coastal sands. Dry season occurs usually from the month of November to early March. Given the five months period of dry season, sometimes stretching to six months; thus raising the need for increased food production, it becomes pertinent to investigate the veracity of dry soil samples from this zone in supporting the production of cassava, at least in minimal commercial quantity.

METHODOLOGY

Soil samples were collected in three representative location in Umuokiri, Umuduru, Osisoma Local Government Area. The soil samples were collected using soil arguer ranged at 0-15cm and 15-30cm soil depths. Collected samples were placed in soil bags, labeled appropriately for physicochemical analysis. Determination of particulate size distribution was by application of Bouyoucous Hydrometer method, organic matter was by walkley-black wet oxidation method. Total nitrogen was by Kjadal method, while available phosphorus and exchangeable cat-ions was determined by Bray No 1 method and Ammonium acetate extraction method respectively (Obasi, *et al*, 2015). Soil P^H was also determined in suspension using a glass electrode P^H meter (Ohuri and Ano, 1988).

RESULTS AND DISCUSSIONS

Table 1: Particulate size distribution of soil samples from Umuokiri at 0-15cm soil depth.

Location	Sand %	Silt %	Clay %	Textural classification
A	81.80	5.10	13.10	Sandy loam
B	61.50	21.10	17.10	Sandy loam

C	29.80	45.10	25.10	loam

In table 1, sand recorded the highest result at location A, (81.89%), while the least result was recorded at location C, (29.50%). Silt recorded highest result at location C, (29.80%) and least result was recorded at location A, (13.15%). Textural classification ranged from sandy loam to loam.

Table 2: Particulate size distribution of soil samples from Umuokiri at 15-30cm soil depth.

Location	Sand %	Silt %	Clay %	Textural classification
A	71.80	5.10	23.10	Sand Clay Loam
B	59.80	7.10	33.10	Sandy Clay Loam
C	61.50	19.10	19.10	Sandy Clay loam

In table 3, sand recorded the highest result at location A, (71.80%) while the least result was recorded at location B, (59.80%). Similarly, silt recorded the highest result at location C, (19.10%). Clay recorded the highest result at location B, (33.10%). While the least result was recorded at location C, (19.15%). Textural classification ranged from sandy loam to sandy clay loam. The increasing clay content of the soil especially at 0-15cm soil depth is due to the wetland nature of the study area.

Table 3: Chemical Properties of soil samples collected at Umuokiri at 0-15 soil depth.

Location	P^H (H_2O)	P Mg/Kg	N %	K Cmol kg-1	Oc %	Om %	BS %
A	4.93	10.40	0.042	0.184	0.37	0.63	86.35
B	5.43	27.10	0.126	0.174	1.39	2.410	84.87
C	4.52	35.70	0.156	0.133	3.58	6.17	86.83

In table 3, P^H recorded the highest result at location B, (5.43), while the lowest result was recorded at location C, (4.52). Phosphorus (P) recorded the highest result at location C, (35.70 mgkg), while the lowest result was recorded at location A, (20.40 mgkg). Nitrogen (N) recorded the highest result at location C, (0.156%), whereas location A recorded the lowest result (0.042%). Potassium (K) recorded the highest result at location A, (0.184 cmolkg-1), while the lowest result was recorded at location C, (0.133 cmolkg-1). Organic carbon (OC) recorded the highest result at location C, (3.58%), while the lowest result recorded, was at location A, (0.37%). Organic matter (OM) also recorded highest result at location C, (6.17%), but lowest result was at location A, (0.63%).

Table 4: Chemical properties of soil samples collected in Umuokiri, at 15-3cm soil depth.

Location	**P^H (H20)**	**P MgKg**	**N %**	**K (molkg-1**	**Oc %**	**Bs %**	**Om %**
A	4.83	8.50	0.056	0.164	0.38	62.49	0.65
B	4.80	20.60	0.056	0.109	0.30	78.67	0.51
C	5.20	28.00	0.140	0.184	1.27	78.38	2.18

In table 4, pH recorded the highest result at location C, (5.20). In addition, phosphorous (P), Nitrogen (N), Potassium (K), Organic carbon (OC), and Organic matter (OM) recorded highest results at location C. Similarly, at location A, virtually all the chemical properties analyzed recorded their lowest results, (from P^H to OM).

In comparison, the physical properties of sand, silt and clay slightly agree with the requirements for cultivating cassava as well as the textural clarification. Alozie, Chima and Igolo, (2010) observed that the soils of Akpukpa wet land possess physical soil properties necessary for cassava production. Similarly, the particulate size distribution values as recorded in the study area is also possible to support cassava production. However, the higher concentration of sand, though synanimous with Coastal plain sands, (Korieocha, 2009 and Alozie, Chima, Eze and Alozie 2015) still showed signs of dryness, hence the need to apply measures to improve the soil water content. At 0-15cm soil depth, the soils were strongly to moderately acidic with a pH range of 452-5.43. the same situation is almost applicable to the pH values recorded at 15—30cm soil depths. Here, soil P^H ranged from 4.80 to 5.20, although soil acidity is slightly higher at 0-15cm as compared with 15-30cm soil depth. Available phosphorus was low at both soil depths, the same thing is applicable to Exchangeable potassium suggesting a possible unrestricted amount of leaching in the area (Obasi, et, al, 2015). The low content of these primary nutrients necessary for cassava production is suggestive of the need to add Inorganic and Organic fertilizer to improve the soil fertility. Organic carbon for both depths were also very low, whereas organic carbon requirement for cassava cultivation is 2%, regarded as the critical organic carbon content in the soils (Korieocha, *et al* 2009). Onyekwere, Chukwu, Ano and Nwosu (2008) quickly observed that organic matter is necessary to be sufficient in the soil, since it is essential for the production of most of the nitrogen and half of the phosphorus taken up by unfertilized crops.

CONCLUSION

The soil from Umuokiri-Umuduru in Osisioma Local Government Area of Abia is slightly textured and soil reaction is considerably tolerant. This means that the soil may be good for cassava production. This is similar to the investigation of soil in Ikwuano Umuahia by Obasi *et al*, (2015) to ascertain its suitability to cassava production. Nonetheless, phosphorus, potassium, nitrogen, organic carbon and organic matter are low in content, hence requiring the need to apply inorganic and organic fertilizers.

Irrigation of farmlands is very necessary since results of base saturation (BS) are slightly low. It is also a good development because the base saturation (BS) results show an evidence of soil water retention, even in dry season, although, base saturations results were low especially with 15-30cm soil depth. Possible explanation is due to soil water drawn down by gravity.

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Investigation of International Best Practices and Government Regulation of Building Construction Process

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Abstract

The study deals on International Best Practices and Government Regulation of Building Construction Process, with the aim of providing policy makers, and regulators with a tool for enforcing International Best Practices for successful reforms in the area of construction regulation. Primary and Secondary data were used to collect data. For the primary data, oral interview and questionnaire were employed. The stakeholders in the construction industry served as the target population while simple sampling technique was used to select respondents in Abia State. Eighty copies questionnaire were distributed and 60 were retrieved. The data collected were presented and analyzed using simple percentile method. The Chi-square was employed to prove statistically whether the hypothesis is valid or not. From the analyzed data, the findings showed that International Best Practices is partially applied or observed in Nigeria especially through the enactment of the National Building Code and application of ISO 9001-2008 for Quality Management in building. It was also observed that the Regulatory bodies of the various professionals (CORBON, COREN, etc) in the construction industry help to maintain International Best Practices through the application of various codes of practices. The need for an act of parliament for the enforcement of these best practices especially, the National Building Code is recommended in States and Local Government.

Keywords: International Best Practices, Government Regulation Building construction process and National Building Code

INTRODUCTION

The Construction Industry Institute (CII, 1995) defines best practices as a process or method that when executed effectively leads to enhanced project performance. To qualify, a practice must be sufficiently proven through extensive industry use and/or validation. Elegbe (2015), opined that International best practices often refer to a widely accepted, informally standardized technique methods or processes that are regarded as effective to achieve certain goals in a sector or sphere of business. They are the techniques that have shown through experience to consistently lead to the desired result. According to Bogan (1994),

International Best practices is a widely accepted method or technique that has consistently shown result superior to those achieved through other means/method and it is used as benchmark. Best practice is used to maintain quality construction in built environment legislated for universal application within the industry as minimum standard requirement or benchmark for desired standard. Through the National Building Code and physical planning laws, the government strive to ensure the application of international best practices in regulating the physical development within the built environment in Nigeria.

Encarta (2008), further stated that building codes are enforced by Municipal and State to regulate the construction of buildings and prescribe minimum requirements for time, protection, sanitation and safety. Building codes are primarily intended to set standards for new construction but also prevent the continued use of buildings deficient in this respect. The Building Code in Nigeria was developed in 2006 during the civilian government of Chief Olusegun Obasanjo after a series of building collapse in Nigeria especially in Lagos. The government felt that a regulatory instrument is necessary to mitigate against the incessant collapse of buildings.

Under the new dispensation, the Abia State Ministry of Physical Planning and Urban Renewal, need to begin the implementation of the well thought out plans in line with statutory functions and provisions of the State Urban and Regional Planning Board, empowered by the Planning Laws Cap 38 Vol 2 of Abia State 1999-2000. The federal government beginning with the Federal Capital Territory Administration (FCTA) have taking steps to implement sustainable construction in Nigeria with the view of achieving International Best Practice.

BUILDING INDUSTRY IN NIGERIA

Organized building practice in Nigeria dates back to 1930, when the very few significant construction activities in the country were handled by the Public Works Department (PWD), and the Royal Army Engineers, which later transformed into the Nigerian Army Engineers (Mbamali *et al.*, 2012).

Nigeria independence in 1960 brought an upward trend in building activities, and until the late sixties, most of the available construction companies were over stressed with contracts. The oil boom of the 1970's brought an overwhelming upsurge in construction contracting in Nigeria, up to the end of the second republic in 1983.

Unfortunately, the period also witnessed unprecedented level of degeneration of international best practice in the project delivery process projects were poorly conceived, carelessly planned and shabbily executed. The result was unreasonably high time, and cost overruns, low quality and widespread abandonment and collapse (Dawaki 1987).

Until 2006, Nigeria was without uniform regulations, guidelines and standards for the design, construction and operation/maintenance of buildings. This manifested in a range of deplorable state of affairs in the building industry, characterized by patronizing none professionals, utilizing untested and uncertified materials/components (Mosaku *et al.*, 2006). These resulted to incessant collapse of buildings, fire infernos and other disasters.

In view of these, the National council on Housing and Urban Development instituted the process of evolving a National Building Code, which sought to proffer solution to hazardous trends in the Building Industry among other regulations.

INTERNATIONAL BEST PRACTICE

International best practice, is a widely accepted method or technique that has consistently shown result superior to those achieved with other methods/means, and that is used as a benchmark.

According to Bogan (1994), Best practice is considered by some as a business word used to describe the process of developing and following a standard way of doing things that multiple organization can use. International best practices are used to maintain quality as an alternative to mandatory legislated standards and can be based on self-assessment or benchmarking.

Construction Industry Institute (CII) (1995), defines international best practice, as a widely accepted process or methods, that when executed effectively leads to enhanced project performance. To qualify, a practice must be sufficiently proven through extensive industry use and/or validation.

In the construction industry, organization have begun to adopt international best practices, which include dispute resolution with good results. Industry data indicates that those who use international best practice reduce the potential for conflict, improve safety and business practices and develop better project relationship (Oluwakiyesi, 2011).

Furthermore, best practices can evolve to become better as improvements, it is a form of program evaluation in public policy (George *et al.,* 2010).

International best practice in the building industry could be said not to be uniform as independent countries have their rules and regulations in the form of building codes.

However, the aim and objectives of these regulations/building codes are same globally. They aim to achieve building projects that assure quality, safety, durability, cost effective, dispute resolution and environmental friendly (Mayer, 2003).

International organizations have drawn up regulations in which most countries, and smaller or local organizations derive their regulations or building codes.

The Construction Industry Institute (CII). Texas, has developed many best practices including the following;

1. Advanced Work Packaging (AWP): These entails overall process flow of all the detailed work packages, construction, engineering and installation work packages. AWP is a planned, executable process that encompasses the work on an EPC (Engineering, Procurement and Construction). Project, beginning with initial planning and continuing through detailed design and construction execution. AWP provides the frame work for productive and progressive construction, and presumes the existence of a construction execution plan.

2. Alignment: The condition where appropriate project participants are working within acceptable tolerance to develop and meet a uniformly defined and understood set of project objectives.

3. Constructability: The effective and timely integration of construction knowledge into the conceptual planning, design, construction and field operations of a project to achieve the overall project objectives in the best possible time and accuracy at the most cost-effective levels.

4. Planning for Start-up: Start-up, defined as transitional phase between plant construction completion and commercial operations that encompasses all activities that bridge these two phases, including systems turnover, check-out of systems, commissioning of systems, introduction of feed stocks and performance testing.

5. Material Management: This is an integrated process for planning and controlling all necessary effort to make certain that the quality of materials and equipment are appropriately at a reasonable cost, and are available when needed.

6. Team Building: A project-focused process builds and develops shared goals, interdependence, trust and commitment and accountability among team members and that seeks to improve team member's problem-solving skills.

7. Project Risk: Assessment The process to identify, asses and manage risk. The project team evaluates risk exposure for potential project impact to provide focus for mitigation strategies.

8. Partnering: A long-term commitment between two or more organizations as in an alliance or it may be applied to a shorter period of time such as the duration of a project. The purpose of partnering is to achieve specific business objective by maximizing the effectiveness of each participant's resources.

9. Quality Management: Quality management incorporates all activities conducted to improve the effectiveness of design, engineering, procurement, QA/QC, construction and start-up elements of construction projects.

10. Change Management: The process of incorporating a balanced change culture of recognition, planning, and evaluation of project changes in an organization to effectively manage project changes.

11.Di spute Resolution and Prevention: Techniques that include the use of disputes review board as an alternate dispute resolution process for addressing dispute in their early stages before affecting the progress of the work, creating adversarial positions, and leading to litigation.

12. Zero Accident Technique: This includes the site specific safety programmes and implementation, auditing, and incentive efforts to create a project environment, and a level of training that embraces the mindset, that all accident are preventable and that zero accident is an obtainable goal.

13. Front End Planning: This deals with the essential process of developing sufficient strategic information with which owners can address risk and make decisions to commit resources in order to maximize the potential for a successful project.

14. Benchmarking and Metrics: It is the systematic process of measuring an organizations performance against recognized leaders for the purpose of determining best practices that lead to superior performance when adopted and utilized.

15. Planning for Modularization: The evolution and determination of off-site construction in the front end planning phase to achieve specific strategic objectives and improved project outcomes, includes developing a business case and execution strategy for large scale transfer of stick-built construction effort from the job site to fabrication shops or yards (CII, 1995).

ISO: Standard for Best Practices

The International Organization for Standardization (ISO) is the world largest developer of voluntary international standards, comprising national standards of 164 countries. ISO have developed standards for the building/construction industry, which include:

a. ISO 14001 (2002): Deals on Environmental Management System Standard

b. ISO 9001-2008: prepared by technical committee ISO/Tc 176, deals on quality management and quality assurance.

c. ISO/TC 59 (1949): deals with building and civil engineering

d. ISO/TC 92: Standards for fire safety

e. ISO/TC 138: Standard for plastics, pipes, fittings and valves for the transport of fluids.

f. ISO/TC 178: Standards for lifts, escalators and moving walks etc.

ISO standards are efforts to ensure international best practices in the industry. They are engineered to guarantee life span of buildings without running up extraordinary economic and environment cost. ISO (2002).

• ISO 14001 is the principal management system standard which specifies the requirements for the formulation and maintenance of an EMS. This helps to control your environmental aspects, reduce impacts and ensure legal compliance.

• ISO 9001: 2008 certification of quality management systems: It enables continuous improvement of your organization's quality management system (QMS) and processes. In turn, this improves the ability of your operations to meet customer requirements and expectations.

BUILDING CODE A NECESSARY TOOL FOR ACHIEVING BEST PRACTICES

Building Code addresses many of a society's most important concerns, including public health, safety and environment protection.

Building Codes are set of rules, regulations, and standards, outlined democratically by building stake holders backed by laws to guide the entire process of building construction.

Over the years, building Codes have evolved from regulation stemming from tragic experience to standards designed to prevent them (the insurance institute for Business and Home Safety (IBHS).

The Code of Hammurabi (1800 B.C) is generally recognized as the world first building Code. The beginning of modern Building Code can be traced to the 1897 publication of the National Fire Protection Association (NFPAS), National Electrical Code (NEC). Natural disasters also lead to Code improvement: Seismic Code provisions appeared first in Italy and Japan in the early 20th century, and in the United States as an appendix to the uniform building Codes in 1927 (EPA, 2003). In the United States, Building Codes are usually referred as model code.

According to U.S. Environmental Protection Agency (EPA), we (humans) spend nearly 90% of our lives inside buildings, which is why the EPA is concerned about the impact of indoor air quality on public health (EPA, 2003).

Building Codes are a set of minimum acceptable standard and requirement set for construction, maintenance and occupancy of buildings in the interest of health and safety and warfare of the public (those that will use the building). Building Codes underpin the work force of Architects, surveyors, Engineers and Builders.

Building Codes are meant to be enforced down to the grass root for standardization and to be result oriented. They should be transformed to local law, when they are enacted by the federal and state legislatures. Building Codes are to be updated to meet the international best practices.

In 2016, the Nigerian Government came up with the National Building Code to regulate the conduct and operations of professionals and stakeholders in the construction industry, with a provision for a review every three years, as practice in other countries, like the U.S.A.

The need to update the National Building Code, is to correct the lapses and omissions identified; align them with the current policy direction of government, and adequately carb the alarming rate of building collapse, necessitated stakeholders in the building industry to gather in Abuja, in 2013, to revalidate and press for the adoption of the revised Building Code. (Odewale, 2013).

Worried by the low level of adherence to the National Building Code since 2006, MS Amma Pepple (former minister for lands Housing and Urban Development) emphasized the need for state and local government to enforce the revised Building Code.

Construction experts believed that the updated version is necessary so as to confirm with the International Building Code which emphasizes the seriousness of fire hazards in building, among others.

BUILDING PERMIT; ABIA STATE EXPERIENCE.

Building permit is a permit required in most jurisdiction for new construction, or adding onto pre-existing structures, are in some cases for major renovations. Building permit serve as a common legal script for building professionals in a particular jurisdiction or locality (state or local government). State and Local government that adopt and enforce updated Codes as enshrined in their permit, help stimulate the market for product innovation and improved building performance. Conversely, when state and local government do not adopt and enforce current Codes, they are allowing construction of building that do not meet the current consensus on minimum public health and safety (Umezuruike, 2015). However, there are some hiccups that tends to militate against the speed required to attain the optimum progress in building construction in Abia State. They include but not limited to:

1. Lack of professional staff: The lack of professional staff in the ministry is due to nepotism. The staff are not encouraged to go for training and retraining.

2. Non implementation of master plans, structure plans and elimination of Land use and Allocation Committee (LUAC) and Land Advisory and Allocation Committee (LAAC) from land use decisions.

3. Poor remuneration of staff: the poor remuneration given to staff that work at the ministry, does not encourage them to be dedicated and loyal to their duties. The tend to look outside the ministry for contracts, and are being bribed to give permit to poorly executed or sub-standard building construction.

SUSTAINABLE CONSTRUCTION IN NIGERIA, TO ADDRESS CLIMATE CHANGE

The modern history of regulation of the built environment is filed with well-intentioned Codes, standards and policies followed by discovery of unintended consequences and unrecognized hazards and the eventual response to those newly identified problems.

The imperative to address the impacts of climate change is a public safety issue for both mitigation and adaptation. What appears certain is that climate change is already happening and it is accelerating (Eisenberg, 2016).

There is no doubt that populations, infrastructure and ecology of cities are at risk from the impact of climate change. However, tools are becoming available for addressing some of the worst effects. For example, appropriate building design and climate sensitive planning, avoidance of high risk areas through more stringent development control, in corporation of climate change allowance in engineering standards, and shoreline protection works are already adopted as new strategies. (Hunt, 2004).

GOVERNMENT REGULATIONS, IN THE CONSTRUCTION INDUSTRY

The Nigerian government in a bid to assure international best practices in the construction industry, has over the years promulgated and enacted various decrees and act to assist in regulating various professionals in the industry. Some of the decrees and acts in existence in the Nigeria Construction Industry are:

1. Cap 55 of 1970, amended by decree 27 of 1992 establishing the Council for the Regulation of Engineers (COREN)

2. Act Cap 13 LFN 2004 (formerly Decree 45 of 1989) which established the Council of Registered Builders of Nigeria (CORBON)

3. Decree 3 of 1988, established Town Planning Registration Council of Nigeria (TOPREC)

4. Decree 22 of 1986, established the Quantity Surveyors Registration Board of Nigeria (QSRBN)

5. Decree 44 of 1978 established the Estate Surveyors and Registration Council of Nigeria (SURCON)

6. Cap III of the Federal Republic of Nigeria (formerly decree 24 of 1975) established the Estate Surveyors and Valuers Regulation Board of Nigeria (ESVRBN)

7. The National Building Code, 2006,

The essence of these legislation is to ensure adequate quality control that will attest international best practices in building projects for the various professionals.

The National Building Code, is the most widely accepted regulation among professionals, and a key element of government industry-development strategy. This code outlines specific principles and standard of behaviors that underpins best practices, whilst promoting positive changes in the industry. The building code, divided the entire building process into four convenient stages and developed under two sub-headings:

Requirements and Enforcement: The four stages are:

a. Pre-design stage

b. Design stage

c. Construction stage

d. Post construction stage

This approach does not only make the enforcement functional, but its adaptability to the Nigerian situation makes it efficient (the National building code, 2006).

It is this hope that this National building code will open a new vista in the building industry and eliminate or reduce to the bare minimum the incidents of collapsed building syndrome in Nigeria, promote safety and qualitative housing for every Nigerian. To achieve these laudable objectives, every tier of government (federation, state and local) must imbibe the spirit and intent of this code. To this end, State governments are implored to integrate the provision of this code into their local laws, particularly those relating to design, construction and maintenance (post construction), and efficiently monitor the implementation of the code.

The building standards throughout the country have however, not met standards of the international community. Generally, accountability in Nigeria is weak, because of the lack of political will to enforce same.

The Public Procurement Act PPA) 2007, which evolve from the "Due Process Policy" of 2001, is also one of the attempts of government to achieve international best practice in the award of contracts in the construction industry, and other sectors of the economy. This will be discussed in a sub-heading for proper comprehension.

THE IMPORTANCE OF GOVERNMENT REGULATION OF BUILDING CONSTRUCTION PROCESSES.

The enforcement of construction permits continues to be complex the world over creating opportunities for widespread discretion and ultimately leading to high numbers of informal buildings in many cities in the country. Many buildings do not go through any form of control at the design, construction, or post construction stages which can amount up to 60-80% buildings that do not go through such controls are often assumed to have poor or not titling deeds and are referred to as "informal buildings" in such cases, both the land plot and the building can be said to be informally owned. What Hernado De Soto (2000) called" dead capital) Unregulated Building construction processes creates planlessness in our cities, poor safety standards and high cost for the community.

While the cost in human lives can be even more evident, local building authorities also lose the chance to generate revenues and deliver better services to the community.

METHODOLOGY

A survey of expert opinion on international best practices in government regulation of building construction process was conducted. A well-structured questionnaire was designed and administered to senior ranking construction industry professionals on selected projects in Umuahia, Abia State. A total of eighty (80) copies of questionnaire were distributed out of which sixty (60) representing 75% were properly completed and returned. The major issues addressed in the survey include: importance of building regulation in Nigeria built environment, identify the gap between building regulation practices in developed countries and what is obtainable in Nigeria and determine the international best practices that can be applied in Nigeria building permit system and construction regulation improvement.

DATA ANALYSIS PROCEDURE

The data collected from the respondents were analyzed using simple percentile, and frequency tables.

To prove statistically whether the hypothesis is valid or not, the chi-square was employed. The 0.05 level of significance was used.

$$x^2 = \sum \frac{(\text{fo}-\text{fe})^2}{\text{fe}}$$

Where

X^2= chi- square

Fo= observed

Fe= expected frequencies

∑= summation

The expected value is derived by calculating the r×c contingency table given as

$$\text{e}= \frac{\text{Rt} \times \text{Ct}}{\text{Gt}}$$

Where

e= expected frequency for a given cell

RT= row total for each roll

Ct= column total for each column

Gt= Grand total for all observed frequencies.

DATA PRESENTATION AND ANALYSIS

The prime aim of this data presentation and analysis is to show the importance of International Best Practices in the Nigerian Construction sector. In the presentation and analysis of the data, the primary data was obtained from respondent reactions and responses to copies of questionnaire administered to them. However, emphasis on the analysis will be placed on the results from the field (Questionnaire), which have direct bearing or relevance on the formulated Hypothesis of this study.

DECISION RULE:

If the value of the computed x^2 is greater than the critical value (Confidence limit of 5% of response), reject null hypothesis otherwise accept it.

Hypothesis 1:

Ho: International Best practices is not applied in the Nigerian Construction Industry.

Hi: International Best Practices is applied in the Nigerian Construction Industry.

In testing this hypothesis, relevant questions were directed to professionals and non- professionals.

Table1: OBSERVED AND EXPECTED FEQUENCIES

Response	Builders	Quantity Surveyors	Architects	Engineers	Total
Yes	15(13)	10(11.33)	5(5.33)	10(10)	40
No	5(6.66)	7(5.66)	3(2.66)	5(5)	20
Total	**20**	**17**	**8**	**15**	**60**

The figure in the bracket are the expected values
The expected values are derived from the formula
$e= \frac{Rt \times Ct}{Gt}$

Chi-square Table (x^2):

Fo	fe	Fo-fe	$(fo-fe)^2$	$(Fo-fe)^2/fe$
15	13	2	4	0.308
10	11.33	-1.33	1.769	0.156
5	5.33	-0.33	0.109	0.0204
10	10	0	0	0
5	6.66	-1.66	2.756	0.413
7	5.66	1.34	1.796	0.317
3	2.66	0.34	0.116	0.0436
5	5	0	0	0
Total				**1.258**

Conducting the test at 0.05 confidence limit
Where x^2= 1.258<0.05 response
We therefore accept the null Hypothesis.

DECISION RULE:

There is clear prove that International Best Practices is not broadly applied in the Nigeria Construction Industry.

Hypothesis 2

Ho: International Best Practices will not help achieve quality Construction work.

Hi: International Best practices will help achieve quality Construction work.

TABLE: 2 OBSERVED AND EXPECTED FREQUENCIES

Response	Builder	Quantity Surveyor	Architect	Engineers	Total
Yes	10(9.9)	13(12.65)	7(7.7)	3(2.75)	33
No	8(8.1)	10(10.35)	7(6.3)	2(2.25)	27
Total	**18**	**23**	**14**	**5**	**60**

The expected values in the bracket in the above table is gotten from:

$e = \frac{Rt \times Ct}{Gt}$

Chi-square Table(x^2)

fo	fe	fo-fe	$(fo-fe)^2$	$(fo-fe)^2/fe$
10	9.9	0.1	0.01	1.0
13	12.65	0.35	0.123	9.75
7	7.7	-0.7	-0.49	-0.064
3	2.75	0.25	0.0625	0.0227
8	8.1	-0.1	0.01	1.234
10	10.35	-0.35	-0.1225	-0.0118
7	6.3	0.7	0.49	0.078
2	2.25	-0.25	-0.0625	-0.0278
				11.951

Conducting the test at 0.05 confidence limit

Where x^2= 11.95

We therefore reject the null Hypothesis and accept the alternate Hypothesis

DECISION RULE:

There is clear evidence that International Best Practices will help to achieve quality Construction work.

DISCUSSION OF FINDINGS

From the data collected and analyzed, it was observed that the international best practices is partially applied or observed in Nigeria as only small proportion of Nigeria construction companies and or individual contractors adhere to best standards.

Construction experts believes that the updated version of the National Building Code is necessary, so as to conform to the International Building Code/ Standards.

Green building is not practiced in Nigeria; there is no any enabling environment in the form of legislation or policy on green building practice. The overall perception from respondents, revealed that most professional are aware of the new trend (Green building) and its enormous benefits derived.

The main drawback of international best practices is the ignorance of the stakeholders in the efficacy of Building Code and Permit.

Therefore, the state and local councils need to adopt and enforce the revised Building Code.

CONCLUSION

The most important justification of best practice is to ensure the highest standards/ Quality of Building Safety for the community. In order to achieve this, stakeholders in the building sectors needs to adopt and enforce; ISO 9001-2008, the National Building Code, Building Permit, and the Green Building Initiative (GBI).

It is one thing to have best practice regulation, but if the enforcement culture and personnel lack the appropriate disposition or ethos, then the best application of the legislation can be constrained.

RECOMMENDATIONS

1. Builders and other professionals need to organize seminar and conference on international best practice and in addition, there should be a mandatory continuing professional development (CPD) courses as prerequisite to the renewal of one’s license to practice. The more skillful the practitioner, the less possibility of compromise.
2. Political influence and nepotism should be avoided in recruiting personnel in the regulatory agencies.
3. Institution should be established where craft men will improve their trade for high quality work
4. Construction industry workers need to receive high wage in order to give quality work.
5. To ensure best practices is adhered to by the state and local councils, building regulation should contain comprehensive and mandatory inspection regimes.
6. Educating people on the importance of going green on building construction, will boost the gains derivable from such initiative
7. The federal and states regulatory authorities should study the American, and British Environmental Policy rating methods (LEED and BEEAM), the GREENSTAR of Australia, GREENMARK, of Singapore and GBI of Malaysia.
8. Updated codes, also mean updated standards. Building Codes needs to keep up with continuing advancement in building science and technology.
9. Construction workers need to be well motivated for work well done.

Training and re-training of manpower in the industry should be encourage.

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Effect of Geometry of Shading Devices on Quantity of Indoor Heat gain in Residential Buildings in Southeast Nigeria in Owerri Urban

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Abstract

The challenge of excessive heat gain in buildings has become a major source of concern, especially in residential buildings. This is because the build-up of heat within indoor spaces of residential buildings causes thermal discomfort for the occupants. The objective of the study was to examine different geometries of shading devices and their effect on quantity of indoor heat gain in residential buildings with a view to developing design strategies to reduce heat gain in residential buildings. The research was designed as a field survey. Out of the 13 housing layouts within Owerri, five (5) homogenous layouts were chosen using random sampling. Out of a total population size of 1570 shaded housing units, a 5% rule of thumb was applied to select a sample of 79 for the survey. Data was collected using observation schedule and data loggers. The variables in focus were interval variables; hence, Pearson's Product Moment Correlation Analysis tool was used to examine the significance of the relationship at 95% compliance. It was found that there was no significant relationship between the length of projection of the horizontal overhang (with integrated vertical fins) and average heat gain in residential buildings in Owerri, Nigeria. It is therefore recommended that the use of shading devices should be encouraged; education and awareness of appropriate principles for effective implementation of this shading instrument should be robustly conducted in the study area.

Keywords: Geometry, Shading devices, Indoor heat gain, Residential buildings, Southeast Nigeria

INTRODUCTION

The challenge of excessive heat gain in buildings has become a major source of concern, especially when designing residential buildings. It has been stated that higher efficiency in the use of energy, largely contributes to the reduction of greenhouse gas emissions (Blazer, 2008). In other words, the problem of elevated levels of indoor heat gain in residential buildings is linked to increased temperature on a global scale. Measures commonly used to mitigate the discomfort due to indoor heat gain include air conditioning. The resulting by-products of air conditioners only exacerbate global warming, gradually increasing the need for even more air conditioning systems in residential buildings (James, 2002). There is therefore the need for new and sustainable ways of reducing indoor heat gain in residential buildings.

Architects and other designers in the building industry to match their designs with the ambient environment of their designs. Window openings are responsible for much of the heat gain within the building and, therefore, shading them properly offers an effective protection against heat gain (Dubois, 1997). Hawkes, McDonald and Steemers (2013) observed that window openings should be well shaded from solar radiation to reduce the ingress of radiation in warm-humid and hot seasons. Build-up of heat within indoor spaces of residential buildings generate thermal discomfort for the occupants. Incorporation of natural ventilation in the design, or the use of electric fans and air-conditioning are ways of mitigating the negative effects of indoor heat gain. The energy to operate these fans and air-conditioning equipment generally comes from fossil fuels. Their consumption partly militates against the attainment of sustainable architecture with the following adverse environmental effects: reduction of the ozone layer; increased atmospheric temperature and associated indoor heat gain in residential buildings (Union of Concerned Scientists, 2016).

Whereas literature abounds on the effect of shading devices on indoor heat gain in residential buildings within warm-humid climatic regions (Toledo, 2007; Odim, 2008; Odim & Nwanguma, 2012), little has been done to understand this phenomenon in residential buildings in Imo State. A cursory observation of parts of Owerri reveals that there is a lingering problem of poor passive design strategies for controlling heat gain in residential buildings in the area.

Owerri, the capital of Imo State, Nigeria, (see Figure 1), occupies a land mass of about 11,420 square kilometres. It is situated in the southern part of Imo River Basin, an area that lies in the central part of the former Eastern Region of Nigeria. Imo State shares boundaries with Anambra State to the north, Rivers State to the South and Abia State to the east. Imo State has a high population density, with a population of over 11 million people (National Population Commission, 2006; onlinenigeria.com, 2003). The rivers, which crisscross the State are mainly the

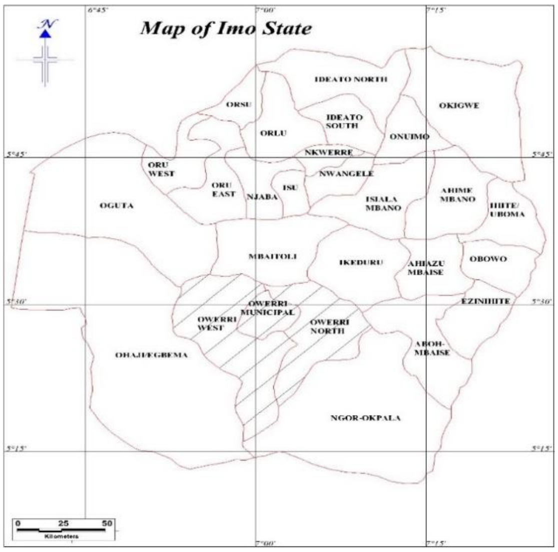
tributaries of Imo River; Imo River discharges into River Niger, which joins the Atlantic Ocean. The area has an abundance of clay minerals, gravel, sand, shale and lignite (Nwachukwu, Feng, & Alinnor, 2011).

Figure 1: Map of Nigeria Showing Imo State (hatched)

Source: Department of Surveying and Geo-informatics, Nnamdi Azikiwe University, Awka, Anambra State, 2016

Owerri lies within latitudes 5°16′N and 5°33′N, and longitudes 6°50′E and 7°10′E, and is 159 meters above sea level (maps-streetview.com, 2011). It is situated in the warm-humid zone of the tropical rain forest belt of Nigeria. Derived savannah grassland interspersed with oil palm trees have replaced the greater part of the area's natural vegetation. It is characterised by two climatic seasons: the rainy season which occurs from April to October; and the dry season, which occurs from November to March. During the dry season, northeast wind blowing from the

Mediterranean Sea crosses the Sahara Desert, bringing with it, harsh winds to the southern part of Nigeria. (Amadi, et al., 2012). During the dry season, humidity is usually low and clouds are absent. The monthly temperatures are generally high throughout the year. A mean annual temperature of 31℃ is typical of the area (Ezeigbo, 1990). In addition, according to Ezeigbo (1990), the area experiences double maximum rainfall peaks in July and in September; a mean annual rainfall of 2152 mm characterizes the wet season. There is an 'August break' during this wet season, generally observed as a dry period in the last two weeks of August. This sometimes occurs in early September due to



the vagaries of the weather. Whereas Imo State is made up of 21 local government (administrative) areas, Owerri, the area under study, comprises three (3) of these namely Owerri-Municipal; Owerri-North and Owerri-West (see Figure 2).

Figure 2: Administrative Map of Imo State, Showing Local Government Areas within Owerri

Source: Department of Surveying and Geo-informatics, Nnamdi Azikiwe University, Awka, Anambra State, 2016

LITERATURE REVIEW

Research on 'Architectural Strategies in Reducing Heat Gain in Sub-Tropical Urban Heat Island (UHI)' was reported by Blazer (2008). It observed that heat gain is more pronounced in urban areas due to a phenomenon known as the UHI effect. This is considered as one of the major problems in the 21st century posed to human beings as a result of urbanization and industrialization of human civilization. The large amount of heat generated from urban structures, as they consume and re-radiate solar radiations, and from the anthropogenic heat sources are the main causes of UHI. The two heat sources increase the temperatures of an urban area as compared with its surroundings, which is known as Urban Heat Island Intensity (UHII). The problem is even worse in cities or metropolises with large population and extensive economic activities. The estimated three billion people living in the urban areas in the world are directly exposed to the problem, which would be increased significantly in the near future. It is noteworthy that Owerri is a growing urban centre.

This UHI phenomenon is a seemingly inevitable result of urban development with far-reaching consequences. With energy costs skyrocketing and the destruction of the environment at risk, urban planners and managers must do more to make the urban settings more environmentally friendly. Two well-known ways to combat the urban heat island effects were reported. First, the effect can be slightly negated by adding well-watered vegetation (i.e. urban afforestation) to the site; second, building materials and systems that reflect sunlight can be used, thus increasing the overall albedo (the ratio of the reflected light energy to the absorbed energy) of the urban area (Blazer, 2008).

As stated in Madhumathi, Radhakrishnan, and Priya (2014), the interface between the interior of the building and the outdoor environment, including the walls, roof and foundation serves as a thermal barrier and plays an important role in determining the amount of energy necessary to maintain a comfortable indoor environment relative to the outside environment. Minimizing heat transfer through the building envelope is crucial for reducing the need for cooling the indoor space. The primary function of building envelope is to control the solar heat loads. It is necessary to shield any windows from direct sun penetration and to reduce the heat transmitted through the sunlit walls and the roof. The east and west walls receive a good deal of radiation, but when the angle of incidence is small (early morning and late afternoon), the intensity of radiation is not at its maximum. The north and south walls receive comparatively little radiation and are much easier to shade with over-hanging eaves, verandas or trees and plantings (Tzempelikos, Athienitis, & Karava, 2007).

Al-Tamimi and Fadzil (2011) stated that building surfaces (such as windows, walls and roofs) exposed to the sun can admit heat from solar radiation, leading to an increase in the amount of energy needed for cooling purposes. To avoid the inflow of heat, whether direct or indirect, the surfaces on which the sun's rays fall must be protected. Emphasis must be given to shading devices because glazed windows are the main components which allow the penetration of incoming heat. A major conclusion, therefore, was that there was the need to implement, as appropriate, the optimum external shading devices required to reduce incoming heat and in turn reduce the risk of overheating, which substantially contributes to increased energy consumption.

The primary functions of exterior shadings are to reduce the thermal heat gain in a building as well as to control the levels of direct light. Bakhlah, Ismail, and Rahman (2008) concluded that exterior devices are generally more effective in decreasing heat build-up because they block, absorb or reflect solar heat before it gets into interior spaces. To keep unwanted solar heat out, it is either a device is attached to the building skin or is an extension of the skin itself. Exterior shading devices include Awnings, louvres, shutters, rolling shutters and shades as well as solar screens. Adjustable shading is particularly useful for east- and west-facing windows. Horizontal shading devices (i.e. overhangs) are usually placed horizontally in front of the window, in various ways. Their shape, type, depth, and height all differ, depending on the sun conditions. A window overhang is usually a horizontal surface that juts out over a window opening to shade it from the sun. This is desirable to reduce glare or solar heat gain during warm and hot seasons. Exterior vertical, as well as egg-crate solar shading devices, are primarily useful for east and west exposures. The egg-crate solar shading device is a combination of vertical and horizontal shading elements; they are more commonly used in warm and hot climatic regions because of their high shading efficiencies. The horizontal elements control ground glare from reflected solar rays. The device works well on walls especially those with extensively glazed windows (usc.edu, 2016).

SHADING DEVICES AND THEIR GEOMETRIES

FUTA (2016) has identified three types of sun-shading devices - vertical, horizontal and egg-crate devices (there could be variants of these basic three). It further notes that vertical shading devices consist of pilasters, louvre blades or projecting fins in a vertical position, while horizontal shading devices are usually in the form of canopies, long verandas, movable louvre blades or roof overhangs. Combinations of vertical and horizontal devices form egg-crate devices. The effectiveness of vertical fins is determined by the horizontal shading angle (δ in Figure 3). Their performance as shading devices is better when the projection of the fins is longer. In addition, they have been found to be most effective when placed on eastern and western elevations. On the other hand, horizontal fins are most appropriate for northern and southern elevations. The effectiveness of the egg-crate type is determined by both the horizontal and vertical shadow angles that result (δ and ε in Figure 3 and Figure 5, respectively). They are usually in the form of grill blocks or decorative screens (FUTA, 2016). See Figure 3, Figure 4 and Figure 5.

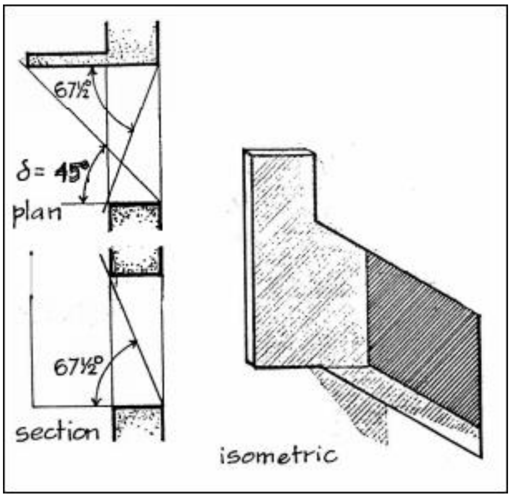
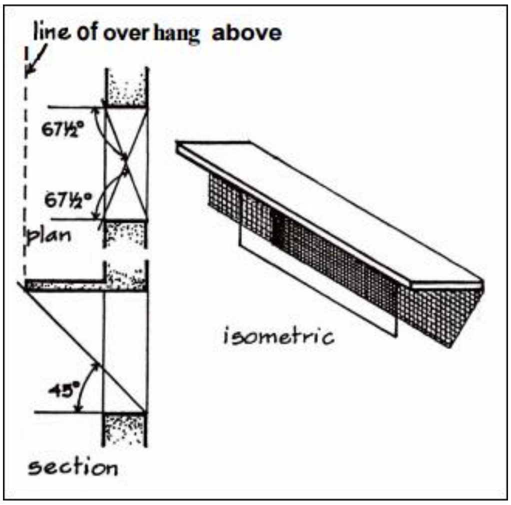


Figure 3: Section and Isometric of Vertical Shading Device



Source: FUTA, 2016

Figure 4: Section and Isometric of Horizontal Shading Device

Source: FUTA, 2016

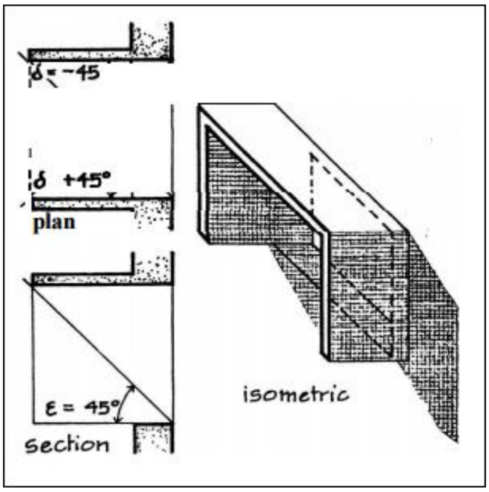


Figure 5: Section and Isometric of Egg-crate Shading Device
Source: FUTA, 2016

CALCULATION OF SIZES FOR OVERHANGS AND FINS

One of the methods to ensure minimal build-up of heat gain within residential buildings is to use shading devices whose parameters have been correctly sized (Designguide, 2016). It summarized the steps for sizing the overhangs and fins as follows:

i. Select critical months and times of shading for each façade. Suggested: for south windows, September - noon; for east windows, September - 10 am; and for west windows, September - 3 pm is recommended. Alshamrani and Mujeebu (2016) averred that the north façade does not present much problem, with regards to shading.

ii. Find the solar altitude and azimuth for the target month and hour. See Figure 6.

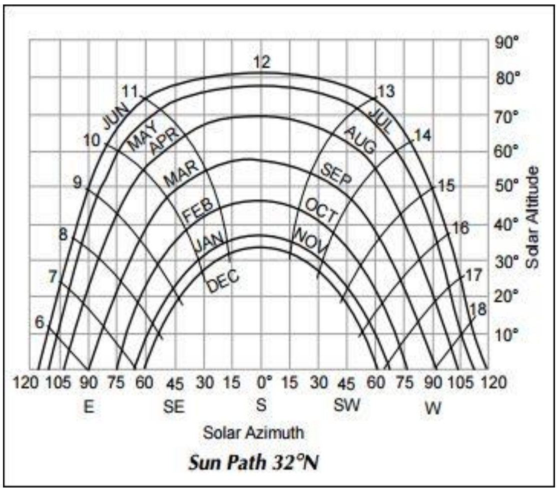


Figure 6: Example of Solar Azimuth Chart

Source: Design guide, 2016

iii. Apply the relevant formulae (equations 1 and 2) to obtain the size of the overhang and fin respectively. The results are a minimum starting point.

For an overhang:

$$h = \frac{D \times \tan(solar\ altitude)}{\cos(solar\ azimuth - window\ azimuth)} \quad (1)$$

For a fin:

$$w = D \times \tan(solar\ azimuth - window\ azimuth) \quad (2)$$

The relevant parameters are described in Figure 7.

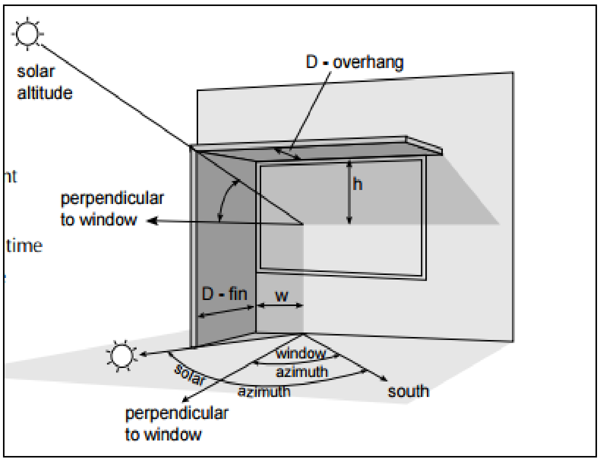


Figure 7: Showing proper sizing of overhangs and fins in residential buildings

Source**:** (Designguide, 2016)

For total shade at the target month and hour, h is set to height of window from sill to head; the value of D, the required overhang depth, is computed. For the partial shade, h is set to acceptable height of shadow (perhaps 2/3 of window height); Value for D, the required overhang depth is then computed; For a fin, the value of w is computed using equation 2.

COMPUTATION OF HEAT GAIN

To calculate heat gain in the buildings, the Stefan-Boltzmann Equation (Bright Hub PM., 2009) was applied. This follows Bozman's law which stated that the total radiant heat energy emitted from a surface is proportional to the fourth power of its absolute temperature (Encyclopædia Britannica, 2009). This heat energy is given by the following Stefan-Boltzmann Equation:

$P = e\sigma AT^4$, where: P = Power radiated (Watts); e = emissivity (no units); σ = Stefan Boltzmann constant ($5.67x10^{-8}Wm^{-2}K^{-4}$); A = Surface area ($m^2$); T = Temperature (Kelvin)

This formula gives the relationship between heat gain and the independent variables: emissivity, surface area, and temperature. Emissivity is a measure of how well a surface emits thermal energy. It has no units. It is also described as the fraction of energy being emitted relative to that emitted by a thermally black surface (a black body). A black body with an emissivity value of 1 is regarded as a perfect emitter of heat energy. A material would be considered a perfect thermal mirror if it has an emissivity value of 0; it does not absorb any heat energy and so cannot emit any (ThermoWorks, 2016). The surface area, A in square metres ($m^{2)}$, represents the total area of the surface materials enclosing the indoor space being investigated. The temperature, T in Kelvin (K), represents the air temperature of the indoor space of the residential building being studied. Examples of some common surface materials with their emissivity values are given in Table 1.

Table 1: Common Substances Emissivity Table

S/No.	Surface Material	Emissivity Coefficient (ε)
1.	Aluminium, Painted	0.27-0.67
2.	Asbestos, Board	0.96
3.	Asbestos, Paper	0.93-0.945
4.	Asphalt	0.93
5.	Iron	0.95
6.	Black Enamel Paint	0.80
7.	Brass, Rolled Plate	0.06
8.	Brick, Red Rough	0.93
9.	Brick, Fireclay	0.75
10.	Concrete, Tiles	0.63
11.	Cotton, Cloth	0.77
12.	Copper, Electroplated	0.03
13.	Copper, Polished	0.023-0.052
14.	Copper Nickel Alloy, Polished	0.059
15.	Glass, Smooth	0.92-0.94
16.	Granite	0.45
17.	Limestone	0.90-0.93
18.	Sand	0.76
19.	Sandstone	0.59
20.	Tile	0.97
21.	Wood Oak, Planed	0.885
22.	Wrought Iron	0.94

Source: Thermo Works (2016).

METHODOLOGY

The research design was survey design. A multi-stage random sampling method was applied in the selection of the sample. The universe for the study consisted of the 13 housing layouts within the study area (See Table 2). The buildings to be sampled were shaded buildings i.e. buildings with some form of shading device designed or installed.

Table 2: List of Housing Layouts in Owerri

1. Akwakuma Layout
2. Aladinma Housing Estate Layout
3. Aladinma Northern Extension Layout
4. Amakohia Layout
5. Emmanuel College Layout
6. Government Station Layout
7. Ikenegbu Layout
8. Ikenegbu Extension Layout
9. Irete Layout
10. New Market Layout
11. Orji Layout
12. Orlu Road Secretariat Layout
13. Works Layout

At the first stage of the sampling, five layouts were chosen by balloting. These were Akwakuma layout, Aladinma Housing layout, Amakohia layout, Ikenegbu layout and Works layout. The study population consisted of all shaded residential buildings within these randomly selected housing layouts in Owerri. The total number of housing units within these five layouts was 1570 (See Table 3).

Table 3: Distribution of buildings among the Layouts

S/N	LAYOUT	NUMBER OF BUILDINGS IN LAYOUTS	PERCENTAGE OF TOTAL
1	Akwakuma	211	13%
2.	Aladinma	344	22%
3.	Amakohia	230	15%
4.	Ikenegbu	435	28%
5.	Works	350	22%
	TOTAL	**1570**	**100%**

Using the rule-of-thumb method suggested by Gay (1987), as cited in Yount (2006), 5% of 1570 = 78.5 (approximately 79) was obtained as sample size. Random sampling was again applied in the selection of which housing units that would be surveyed. In each street, after the first house, every fourth house would be surveyed. In addition, these study buildings were chosen from the layouts bearing in mind the factors of willingness by the occupants to be surveyed and cost. The distribution across the layouts, based on their percentage contribution to the total population is shown in Table 4.

Table 4: Population Distribution of Sample Size among the Layouts

NAME OF SAMPLED LAYOUT	NUMBER OF HOUSING UNITS IN EACH SAMPLED LAYOUTS	PERCENTAGE OF TOTAL
Akwakuma	11	13%
Aladinma	17	22%
Amakohia	12	15%

Ikenegbu	22	28%
Works	17	22%
Total	**79**	**100%**

The main research instruments were observation schedule, which was used to collate data on the variables being studied, and data loggers used to gather temperature and other data during the survey. The temperature data obtained was then used to compute heat gain values, the vital dependent variable in the study.

RESULTS AND DISCUSSIONS

The material of the shading devices under discussion was reinforced concrete. Data was gathered on the occurrence of shading devices whose geometry consisted of horizontal overhang projections with integrated vertical fins. Analysis of the data showed the following:

Analysis of length of projection of horizontal overhang of reinforced concrete shading devices with integrated vertical fins (half height of window opening)

Analysis of data gathered showed that majority of the shaded residential buildings in the sample had no shading devices whose geometry consisted of horizontal overhang projections with integrated vertical fins (half height of window opening). Less than one tenth of the sample had horizontal projections of 0.15m – 0.45m length, in this category. This is shown in Table 5.

Table 5: Occurrence of projection lengths of horizontal overhang with integrated vertical fins (half height of window opening)

Value label	Valid Percent (Frequency)	Cumulative Percent
None	92.9	92.9
0 - 0.15m	0.0	0.0
0.15-0.45m	7.1	100.0
Above 0.45m	0.0	100.0
Total	**100.0**	

Analysis of length of projection of horizontal overhang of reinforced concrete shading devices with integrated vertical fins (full height of window opening)

Analysis of data showed that under this variable, about half of the buildings studied had no projection of horizontal overhang. About one fifth had horizontal projections of 0.15m – 0.45m length; a smaller proportion had projections of less than 0.15m length. In addition, less than one tenth (7%) of the buildings had horizontal projections of above 0.45m length. This is shown in Table 6.

Table 6: Occurrence of projection lengths of horizontal overhang with integrated vertical fins (full height of window opening)

Value label	Valid Percent	Cumulative Percent
None	57.1	57.1
Projection below 0.15m	14.3	71.4
0.15-0.45m	21.4	92.9

Above 0.45m	7.1	100.0
Total	**100.0**	

HEAT GAIN IN SAMPLED BUILDINGS

Daily temperature readings were obtained in the sampled residential buildings using data loggers. Heat gain values (for the study period: one year) were calculated. The results showed similarities in results for the buildings. This is shown in Table 7.

Table 7: Heat Gain values in ascending order of magnitude for the sampled buildings

S/No	No. of Units with similar results	Heat Gain (watts)
1	6	0.000018732
2	6	0.000026129
3	6	0.000068445
4	6	0.000150254
5	6	0.000176659
6	6	0.000239636
7	6	0.000246741
8	6	0.000425754
9	6	0.000515072
10	5	0.000523343
11	5	0.000686456
12	5	0.000897548
13	5	0.001000245
14	5	0.001673204

Test of Hypothesis

Ho1- The relationship between the length of projection of horizontal overhang (with integrated vertical fins) and average heat gain in residential buildings in the study area

The specific objective was to investigate the geometry of the shading devices and their effect on the quantity of heat gain in the shaded residential buildings in the study area. The variables in focus were interval variables, hence, Pearson's Product Moment Correlation techniques was used to examine the significance of the relationship. The result of the analysis showed a Pearson's Product Moment correlation coefficient value of 0.145 and a significance value point of 0.620, which was greater than ρ = 0.05. At 95% compliance, it means, therefore, that the relationship is strong, but it is not significant. The null hypothesis was therefore accepted which is that '*there was no significant relationship between the length of projection of the horizontal overhang (with integrated vertical fins, half height of window opening) and Average heat gain in residential buildings in Owerri, Nigeria'*. The result is shown in Table 8

Table 8: Correlation analysis result of relationship between the projection of horizontal overhang with integrated vertical fins and average heat gain in the sampled buildings

		Average heat gain
Length of projection of the horizontal overhang with integrated vertical fins (half height of window opening)	Pearson's Correlation	-0.145
	Sig. (2-tailed)	0.620
	N	14

Another associated correlational analysis was conducted to further examine the phenomenon. This involved horizontal overhang with integrated vertical fins (full-height of window opening). Similarly, the the result of the analysis showed a Pearson's correlation coefficient value of 0.191 with a significance value point of 0.513. This, again, implied a high, positive relationship existed between the two variables. However, the significance value of 0.513 showed that it was not significant at 95% compliance. It means, therefore, that the relationship was strong, but not significant. The null hypothesis was therefore accepted, i.e. '*there is no significant relationship between the length of projection of the horizontal overhang with integrated vertical fins (full height of window opening) and Average heat gain in residential buildings in Owerri, Nigeria'*. The results are shown in Table 9.

Table 9: Pearson's product moment correlation analysis result of relationship between the projection of horizontal overhang with integrated vertical fins (full height of window opening) and average heat gain in the sampled buildings

		Average heat gain
Horizontal overhang with integrated vertical fins full height of window opening.	Pearson Correlation	.191
	Sig. (2-tailed)	.513
	N	14

From the foregoing, it can be observed that the majority of the housing units did not have shading devices whose geometry comprised of horizontal overhang projections with integrated vertical fins. It can also be seen from the results of the analyses that where this existed, it did not significantly affect average heat gain in the buildings. It is intuitive that, where these have been installed, all the advantages expected of shading devices (including reduction in heat gain) would be expected (Dubois, 1997; Hawkes, McDonald, & Steemers, 2013). It is therefore likely that other attenuating factors intervened to give this result. It is entirely possible that this passive design strategy has not been applied appropriately. This view then makes it imperative that the guidance described earlier by FUTA (2016), with regard to rules of choice and placement as well as that by Designguide (2016), with regard to calculation of sizes and angles of placement of shading devices, be carefully observed.

CONCLUSION AND RECOMMENDATION

In architectural design, achievement of indoor thermal comfort within residential buildings in warm-humid climatic regions such as Owerri has largely been associated with the quantity of heat admitted into the indoor spaces. The intensity of solar radiation across the external envelope of residential buildings affects indoor heat gain. To ameliorate the resulting discomfort, occupants tend to use unsustainable means such as air conditioning to mollify the effect of the influx of heat. Following from this, different geometries of shading devices and their effect on quantity of indoor heat gain in residential buildings were examined. Specifically, the relationship between 'length of projection of horizontal overhang with integrated vertical fins (half height of window opening) and quantity of indoor heat gain in residential buildings in Owerri was tested using statistical tools. It can be concluded from the results that there was no significant relationship between the two variables. This appeared counter-intuitive. However, examination of literature revealed that this could be as a result of inappropriate application of this passive design strategy. It is therefore recommended that, following established science, to increase its adoption, the use of shading devices should be encouraged; education and awareness of appropriate principles for effective implementation of this shading instrument should be robustly conducted in the study area. Corroborated studies indicate that if these are done, there would likely be a reduction in heat gain in residential buildings in the area. The result would be a reduction in energy usage, reduction in the cost of house maintenance and ultimately a reduction in the contribution of housing to climate change.

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Manufacturing of Local Building Materials; An Panapanacia to Rising Cost of Building Construction

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Abstract

The over dependent on imported building materials will continue to do harm to the socio-economic development of the nation. Access to decent and affordable housing, to majority of Nigerians, will continue to be elusive until the scarcity and the prohibitive cost of imported building materials and their components are brought under check by encouraging our manufactures, distributors, architects and the end users (clients) to look inward and to embrace our local building materials and less of the imported ones. Our existing national standard for building products still reflects our inherited colonial standard. The principal task facing the development of building materials in Nigeria is how to attain the goal of development of local capacity for the production of building materials in adequate quantity and quality to lower construction costs. Thus, we must at this point take a tangential deviation from our past and formulate a standard local building materials policy for our country as a way forward. There is need to evolve policies that will encourage Research and Development of local building materials components and building process and systems. This paper x-rays the housing situation in the country, and examines how to remove the impediments to the manufacturing of adequate local building materials for affordable housing delivery.

Keywords: Local Building material, Affordable Housing and Construction Cost.

INTRODUCTION

The high cost of building construction has always been an issue of discussion at different seminars and workshops. Apart from other socio-economic factors, the cost of labour and building materials account for the very high cost of building construction world-wide, particularly in Nigeria. The cost instead of abating has been on the rise. This view was shared by Ajayi (1991), when he posited that the cost of building construction in the country for the past decades has been on the rise from 100% to 200% to 300%.

It is an established fact that the cost of building materials alone account for about 60% or more of the total cost of building construction. The labour to material ratio according to Oduntun (1991) is about 40:60. Munonye (2008) agrees when he opined that building materials and components constitute between 50-70 % of the total cost of construction input. Unfortunately, most of these building materials are not produced in this country, rather they are imported. It is estimated that 60 to 70% of the materials cost in urban housing construction may be in imported items (Ola, 2004). Balogun (1984), also agrees, that the elements of architecture at present relies heavily on imported building elements.

In order to bring down cost of building houses, there is a need to focus on appropriate technology by looking inwards, (Isimi,2005). This view was generously shared by Odili (2004) when he averred that our national standard for building products still reflect our inherited colonial standards and that this does not in any way encourage the inward-looking strategies of the use of alternative local building material.

Natural building materials like granite, marble, limestone, timber, clay, stone, mud, etc. are plentiful in Nigeria. Most of these natural materials are also beautiful, durable, heat resistant and easy to maintain. When properly harnessed, they will help a great deal to reduce the over dependence on imported building materials, thereby reducing drastically, the very high cost of building construction. Faworaja (1998) agrees when he averred that for a successful implementation of the housing policy, there would be the need for concerted and sustainable efforts at developing local building materials, and to promote their utilization as a means of reducing housing costs. It is imperative to recall that as far back as 1971, the then National Council on Housing Corporation of Nigeria set up a committee to review the housing situation in the country. It had as one of its aims and objectives; to examine facilities for research and development of local building materials and to make suitable recommendations with a view to the production and use on a massive scale (Olaopa, 1984).

This paper critically looks into the housing situation in the country, the availability of natural materials, the general impediments to their manufacturing and the way forward.

HOUSING SITUATION IN NIGERIA.

Housing is a major and basic human need as every human being needs a roof. However, providing housing to every family has become a major problem as a result of rapid urbanization and increase in population. With a population of 140 million plus (2006 preliminary census) and a population growth of 2.025% (2008 Estimate world fact book home), Nigeria is the most urbanized country in population in black sub-Sahara Africa. The United States Census Bureau projects that population of Nigeria will reach 264 million by 2050 and that Nigeria will be the 8th most populous country in the world.

With this population, the number of those who do not have roof over their heads is put at about 84 million Representing 60%. Majority of these fall under low- and middle-income people. According to Mas’ud Abdulkarim (2005), a larger proportion of Nigerians, particularly in the low-income group are inadequately housed. Opoko (1998) was in total agreement when he said that a significant feature of the housing situation is the poor, estimated at well over 90% of the national population many of whom have no visible means of livelihood. The National Housing Policy was more explicit on what low-income category means when it averred that a conservative estimate of Nigerians who fall into this low-income category could be put at about 90% of the population; made up of all employees and self-employed persons whose annual income as at 2003 stood at N100 ,000 or below.

Nigeria has been in stagnation and relative decline since 1981, from a per capital GDP of $1200 as in 1981 to about $300 in 2000 (Daily Independent Newspaper,2008) in addition, the United Nations Development Index (2007) posits that 95% of Nigerians live below poverty line with a per capital income of less than 3 dollars a day (ie about N12,000 per month). This situation is not helped by the rapid surge in the prices of building materials which has further reduced housing affordability to most Nigerians who according to Diogu (2004) spend over 51% of their annual earnings on housing alone.

According to National Rolling Plan (NRP), the national housing requirement is between 500,000 and 600,000 units per annum considering the prevailing occupancy ratio of three to four persons per room.(Ojenuwah, 2006). Isimi (2005) agrees in his research when he said that the United Nations Habitat survey between 1991 and 2001 indicates the requirement of 392,000 units for the urban areas and 345,000 for the rural areas. If these estimated annual requirements were to be provided at an average of N800,000 per unit for a modest two-bedroom bungalow, the costs would be enormous and indeed unrealizable. The cost of providing housing alone would be between N400 trillion and N480 trillion (excluding the cost of infrastructural development). If the cost of building materials alone constitutes between 60% to 70% of the building cost, then building materials alone would cost as much as N240 trillion to N336 trillion. Consequently, government and even mortgage institutions would not be capable of tackling the housing situation on the macro-level. If we have to continue importing building materials, it will seriously deplet our foreign reserves. On the micro-level, owing a house is high on the scale of preference of most families. For now, owing a decent and affordable house by majority of Nigerians remains a mere dream in view of the situations already analysed. If we have to shift from this hopeless situation, we have to agree with Opoko (1998) who posited that efficient provision to Nigerian's access to descent housing at prices they can afford could be achieved through judicious use of local building materials:

AVAILABILITY OF BUILDING MATERIALS; CASE STUDY ON CEMENT

The availability of materials and their costs are important factors to overall cost of building construction. Presently, houses built rely so much on cement. This reliance on cement, at the expense of local building materials like clay bricks, for housing construction results to the high demand for cement as the rate of building construction increases. With about eight cement factories producing a total of less than five million tons of cement annually, and with the annual consumption rate of eight million tons, there will always be the need to import as much as 3 million tons of cement annually to meet demand (Okeke et al, 2005). The consumption rate of cement is further amplified by the fact that the nation needs about 18.0 million metric tons of cement yearly; but, our local cement companies are only able to produce between 6-6.5 metric tons, leaving a deficit of about 11.5 million tones. This shortfall has always accounted for the galloping cost of cement every year.

SOME INDIGENOUS MATERIALS AND THEIR BYE PRODUCTS

The table below shows some of the indigenous building materials; their processing techniques, intermediate products and the end products.

S/NO	Raw Materials	Process Involved	Intermediate Products	Building Materials
1.	Laterite/River sand	Mixing with cement and water (stabilization and compaction)	Cement Stabilised laterite bricks / sandcrete blocks	Bricks, blocks
2.	Limestone	Crushing screening, calcinations, Cooling grinding, classification and packaging.	Calcium oxide (quick lime), calcium hydroxide	Cement manufacture and fluxing stone for iron smelting.
3.	Gypsum	Crushing, fire milling, calcinations, screening classification, cooling, pulverizing, sieving and packaging.	Calcium sulphate, hydrate gypsum or calcinated gypsum.	Used as filter in light weight concrete, rubber goods, pvc pipes, roofing sheets etc
4.	Diatomite	Crushing, drying, calcinations, screening, grinding classification, milling and packaging.	Uncalcinated diatomine.	Used as filter in light weight concrete, rubber goods, pvc pipes, roofing sheets etc.
5.	Glass sand	Washing, drying, crushing or sieving, melting, mixing with glass additives like soda ash, cutting, shaping molding, cooling and packaging.	Classified sand aggregate for gravel pack additives in cement industry.	Glassware, sheet used as additives in the cement industry.
6.	Kyanite	Crushing grinding, screening, weighing and packaging.	Powdered Kyanite.	For the production of cement, ceramics, refractory and in iron and steel alloy products.
7.	Tale	Evaporation, crushing, pulverizing, screening, liquefaction, purification, separation and packaging.	Fine powder tale.	Used in the production Of paints, cement, etc.

8.	Marble	Crushing, grinding, screening, weighing, packaging, smoothening and classification.	Calcium carbonate, calcium hydroxide and calcium oxide.	Used in cement Production, building and road construction.
9.	Feldspar	Crushing, milling, sieving, mixing, shaping and compaction drying, firing, finishing and cooling.	Aluminum, silicates of potassium, sodium calcium etc.	Used in filters in glass, Ceramics, plate, paints, tiles, terrazzo and tiles manufacture, building construction etc.
10.	Dolomite	Crushing, screening, fire grinding, magnetic separation and packaging.	Fired stabilized dolomite.	Used for refractory brick, Cement manufacture etc.
11.	Magnesite	Crushing, Screening, fire grinding, magnetic separation and packaging.	Magnesium, magnesium compounds.	Employed in the manufacture of special cement.
12.	Clay	Crushing, fine grinding, sizing, mixing with water, molding, shaping and drying.	Fine ground powdered clay.	Used in ceramic manufacture as refractory agents and fillers.
13.	Mica	Crushing, screening, classification, drying and packaging.	Silicate of aluminum and potassium biotite.	Used for electrical insulation.
14.	Trona (Soda ash)	Crushing, calcinations, dissolution, filtration on activation with carbon, evaporation, cooling and packaging.	Sodium carbonate	Manufacture of glass etc.

Source: Adebola (2004)

IMPEDIMENTS TO THE PRODUCTION OF LOCAL BUILDING MATERIALS

Many factors are against the production of adequate quality and quantity of local building materials. Ola (2004) averred that the principal task facing the development of building materials in Nigeria is how to attain the goal of developing local capacity for the production of building materials in adequate quantity and quality to lower construction costs and produce safe buildings. However, the attainment of this goal is currently constrained by the following challenges -

i. **Uncoordinated Research:**

There is uncoordinated approach to research and development efforts, non-utilization of research results due to poor publicity and poor quality. According to Zubairu (2006), many research and educational institutions have carried out various researches on many local building materials and construction techniques and there is clear evidence that only a very tiny percentage of these findings have been developed and commercialized.

ii. **Poor Infrastructure:**

In the absence of the basic infrastructure, such as regular electric power, water and good roads, the cost of locally produced materials are often high (Mbanefo ,1991). The Sun Newspaper (2009) was more emphatic on electric generation capacity in Nigeria when it observed that South Africa generates 40,000 megawatts of electricity and India generates 950,000 megawatts while Nigeria could boast of is mere 3,000 megawatts of electricity.

iii. **High Cost of Imported Machinery and use of Foreign Supervisors:**

Most of the machinery used in the production of the local building materials are imported. The high cost of importing and servicing machineries and the plants cause the products to be costly, because of unsteady and unfavourable exchange rate of the naira against the dollar and other major currencies.

The foreign experts and supervisors engaged to produce such products like roofing sheets, glass, gloss paints add considerably to the overall high cost of these materials, because of their high pay.

iv. **Difficulty in Accessing Loans:**

Manufacturers do not have easy access to loans. Where such loans are granted, they are given with very high interest rates and are usually expected to be repaid over a very short period of time.

v. **Poor Funding of Research Institutes**

Research Institutes in the country are poorly funded. Without adequate funding not much could be done in research. The world's big economies devote a large part of their Gross Domestic Product (GDP) to research. For example, in 2006, the United States spent $343 billion, about 2.6 % GDP; Japan spent $130 billion, about 3.2 % of GDP on research and development. On the other hand, Africa (including Nigeria) spending on research and development as at 2003 was far much lower than 1% GDP (Qurix, 2008).

RECOMMENDATIONS:

- Architects must be the bridge between the research institutions, manufacturers of such local building materials and the end users. In this case our researchers will require feedbacks from architects on such issues as durability of the products and their acceptability. This way, the quality and even the cost of the products can be reviewed periodically. According to Mbanefo (1991) a medium of communication should be established by which the client, the architect and the manufacturers can educate one another on their needs for building materials and ways of improving their products.

- The local governments should employ architects in their works department. This way useful data of local building materials and technology can be collected at grassroot level (Zubaim, 1998).

- Government should create enabling environment for manufacturers by providing good roads, constant electric and water supply.

- The Construction Development Banks should be strengthened so that manufacturers can have easier access to loans. In addition, government should mandate Central Bank of Nigeria to direct commercial banks to lower their interest rate on loans.

- Research Institutes in the country should be restructured, strengthened and properly funded.

- The products from the Research Institutes must be monitored and evaluated by the quality regulatory bodies such as Standard Organization of Nigeria (SON) to ensure the production of quality products. In Nigeria, the Standard Organization of Nigeria is charged with the establishment of National Code of Practice (NCP) for product standard including building materials.

- Building material manufacturing companies should have comprehensive and up to date quality evaluation of materials manufactured in catalogue form, as is done abroad. Archi Built Journal has as one of its objectives; to compile data and publish an annual compendium that will contain detailed specification of building / construction materials and the technology / method of application (Faworaja, 1998). This, will help architects to know different local building materials, their applications and the manufacturers.

- There should be regular organization of seminars and exhibition of natural building materials by the manufacturers and retailers so that architects and manufacturers can cross-pollinate their ideas.

CONCLUSION:

The Research Institutes and manufacturers of building materials are making inroads into providing alternative use of building materials. According to Chendo (1990), soil products can now be treated with preservatives and stabilized with asphalt emulsion, molasses and other binding, but non-corroding materials. Chemical treatment can protect grass or bamboo against fire and termites. extending life from 2 to 12 years. The introduction of a hydration machine. which is a technology that uses more of laterite with very little cement for the construction of low-cost housing, has become imperative since cost of cement which has contributed to the high cost of housing in Nigeria has remained uncontrollable (Adedeji, 2009). "Cement-stabilized soil matrix latcem" is a ready solution to the heavy reliance on cement for the production of sancrete blocks in Nigeria (Okereke, 1985).

'Mador-tiles' are produced from a mixture of appropriate fiber in this case palm kennel fibre-sand and cement, and used to roof houses (Okpoko,1998). Forestry Research Institute of Nigeria. Ibadan produces decorative ceiling boards from saw-dust and wood shavings all locally available. Floor tiles could be made from such local materials (Badejo 2009).

The way forward is bright for affordable housing delivery if; we architect, manufacturers, government and clients work collaboratively to encourage the use of local building materials by playing our respective parts.

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