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WOOD: THE SOLUTION TO THE HOUSING PROBLEM IN THE WORLD

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ABSTRACT

In University of Ibadan, building maintenance is conditionally driven and is usually carried out only when there is a release of subvention from Nigerian Universities Commission (NUC), even if the needs are obvious, the building becomes unattractive or even unsuitable for its users and the populace. As such, building maintenance is not regarded as part of the essential duty of the University priority, that is, not as a prime factor of academic process. There is no doubt that the administration is consistently increasing its allocation to the works and maintenance department, but the allocation is grossly inadequate to meet the ever-growing demand for the maintenance backlog.

This paper examines the potential and benefits of wood as an economically efficient material in terms building cost, maintenance and operations as alternative to other building materials. A purposeful survey of building projects in University of Ibadan, Nigeria was conducted to assess wood usage in building projects to determine the efficiency of wood utilization in building construction. The papers also surveyed the wastes of different materials generated during building construction and compared to the projected wastes that were allowed for during the planning stage of building project. Recommendations include government directed policy on the minimum housing standard; possible built and lease programme for the low income earners; a vigorous programme of housing and health education; enhanced collaboration between stakeholders to develop enforceable standards for existing housing stock and future builds. Further studies should be conducted on the modes of joining structural members and more research works could be employed on the connector that are being used for wood structural members. There could also be research into the engineering properties of lesser used timbers.

KEYWORDS: Housing; Economic Efficiency; Wood Versatility; South-Western Nigeria; Building Materials.

1.0 INTRODUCTION

1.1 World Housing Need

Suitable shelter is commonly accepted as a basic human need. The Universal Declaration of Human rights, adopted by the United Nations in 1948, declared that everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including satisfactory housing. In 1996, a number of countries adopted what came to be known as the UN's habitat agenda into full UN program. (Anonymous, 2005). As the world population continues to grow, it places greater pressure on available houses for human use. Most Nigerian cities, with the exception of the newly developed Federal capital city of Abuja, have experienced decay in both housing and physical infrastructural facilities over the past few decades, possibly due to economic downturn in the nation. This accounts for the reason why the river state government in Nigeria embarked on mass demolition of houses in Portharcourt (Guardian Newspaper, 24th August, 2007). Unlike developed nations, the mortgage industry is still in its infancy in Nigeria with the real estate sector contributing less than one percent to the nation's GDP (Punch Newspapers, 5th September 2007). Housing as one of the most important basic necessities of mankind is known to tremendously affect human health and well being. It is wisely acknowledged that adequate housing is essential for good life, is a key requirement for an efficient and satisfied labour force and the foundation of satisfactory community life. The quality of a residential area not only mirrors the city development, planning and allocation mechanisms between socio-economic groups, but also shows the quality of life of the urbanites. The realization of a decent home in a suitable living environment requires the availability of clean air, potable water, adequate shelter and other basic services and facilities. (Coker, 2009)

Furthermore, researchers have shown that housing can affect mental and physical health, both positively and negatively (Fanning, 1967; Macpherson, 1979; Riaz, 1987). The 2006 census estimated the Nigerian population at 140 million and that 30%-40% of the total population live in the urban areas, with an average household of 5 persons. The occupancy ratio of houses in Nigeria is 6 persons per room of 20m2. About 60% of Nigerians are without adequate shelter (under-housed and no housing). Residential home ownership in Nigeria is less than 25% Compared with 75% international benchmarks (Aasin, 2008). Currently, there is an estimated housing deficit of 12- 14 million housing units in the country. The estimated amount required to provide for the deficit is estimated at US$150-200 billion. There is need for the provision of 500,000 units per annum for the next 40 years. An average developer cannot deliver more than 2,000 housing units in 12 months. Housing issues will remain one of the primary social focuses in Nigeria for the next 20 years or more. To come out of this housing problem, the country must look into the area of utilizing wood, the renewable natural resources in all its totality in providing building units.

1.2.1 Wood as Building Materials

There are various materials available that are used in the construction of building structures. These include timber,

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cast iron/ or steel, raffia palm and reinforced concrete. Wood is one of the oldest building materials, yet it remains today a primary and respectable structural material, not only is it used worldwide to construct millions of modern homes every year (in order of two millions in North America alone as at 1986) (Mettem, 1986). It also provides framework for many large important buildings. These include concert halls, sports and leisure centres and Museum in public domain. Wood is remarkable for its beauty versatility, strength, durability, and workability. It possesses a high strength-to-weight ratio at low temperature, and withstands substantial overloads for a short period.

It has low electrical and thermal conductance. It resists the deteriorating action of many chemicals that are extremely corrosive to other building materials. There are few materials that cost less than wood. Wood is a renewable resource and in this respect it is unique amongst structural materials. The course of this attractive building material is assured as long as the biosphere of our planet remains basically unaltered, and this is an essential that cannot be ignored. This feature is sufficient to ensure that wood will continue to be in use as a structural material virtually forever and it is also likely to ensure that wood remains the cheapest of all structural materials.

1.2.2 Adverse factors of the use of wood

Wood with its multipurpose utilities has some adverse effects when used as a material of construction. These adverse effects as identified by Brough (1964), Panshin and de Zeeuw (1980), and Mettem (1986) include:

- Its relatively low fire resistance being a combustible material. The rate at which it looses strength is strictly proportional to the rate at which it is consumed by fire.
- The wood hygroscopicity which if unchecked has a considerable effect on its dimensional stability.
- Wood is susceptible to degradation by fungi, insects and weather elements.
- Wood's high variability in strength within and among species.

1.2.3 Protective measures

Wood with its great versatility in building and other structures has not enjoyed the widespread support and approval of the majority of people as construction material because of its adverse effects. However, these seeming disadvantages of wood could be curtailed with the adoption of certain protective measures. There are a number of protective measures applicable to wood members in service. Like all other materials, both the mechanical and other properties of wood can be satisfactorily improved to meet the required functional purpose. Some of the protective measures in common use include the following:

A) Measures against Biological Agencies.

(i) Painting

Paints are generally used to provide a durable and colourful protective coating for their vulnerable surface. Conditions of painting are often far from ideal, particularly outside, but it is essential that the surface to be painted is dry, clean and free from grease. A variety of colours are available but it is essential to ensure that the paint selected is suitable for the work it has to do whether internal or external.

(ii) Applying preservative

Preservation is the term given to those solutions designed to protect timbers from insect or fungal attack. Timber preservation within the timber trade and allied industries is now accepted as an integral part of wood processing. For many years it has been possible to have structural timber treated with preservative under pressure to ensure deep penetration. Any untreated surfaces that are exposed during work are then brush-coated.

(iii) Adequate Drainage

Provision of adequate soil drainage beneath and around the building is a protective measure.

(v) Adequate ventilation under the building and keeping all wood in the building at least 200 mm from the ground will keep the integrity of the wooden structure

B) Measures against fire Hazard

(i) Treatment with chemicals

All wood is to be treated with fire retardants by the addition of chlorinated rubber to gloss paints and borax and magnesium phosphate to emulsion paints

(ii) Construction Method

Fire hazard could be curtailed by pegging using mineral wool, plasterboard and guilt (25 mm mineral wool). This type of construction will give ½ hour fire resistance; probably 1 hour with chicken wire beneath the mineral wool.

(iii) Method of compartmentalization

Building fires have been found to spread through doors, windows and other openings, what could be curtailed by compartmentalizing the building.

(iv) Projection over windows

Another method that could curtail fire hazard is the provision of projection of 1.5m above the windows to prevent emerging flames from curling back and igniting the windows above.

2.1 THE STUDY AREA

Ibadan is situated in southwestern Nigeria (3° 45" to 4° 00" E; 7° 15" to 7° 30" N). It has two distinct seasons; dry (October - March) and wet (April - September). Initially, the city began as a war camp (1829) and since the 1960s has grown to become the nation's largest urban centre. The University of Ibadan is the first University in the sub-Saharan region of West Africa. It is located in Ibadan, the capital of Oyo state.

Fig. 1 Location of University of Ibadan

3.0 STUDY METHODOLOGY

3.1 Instrument For Data Collection

The study adopted was the experimental action research which involved the use of structured questionnaire.

The instrument was a 30-item structured questionnaire aimed at evaluating the potentials of wooden houses.

The instrument was developed based on five domains. The first section dealt with capital cost , while the other sections dealt with environmental factors, structural details of wooden houses, maintenance cost, fire protection , and sociological dimension of wooden houses. After generating the items, they were given unedited to practicing Architects, Engineers, Geographers, Sociologists Town planers, Quantity Surveyors who have bias for roof failures and five doctoral students who have their research focus on engineering failures. The feedback obtained from these sources helped in sorting the items into relevant domains and led to the elimination of ambiguous items.

3.1.1 Reliability of the Instrument

To test for the reliability, the test-retest method was used. 40 contractors/suppliers from the University were randomly selected and the questionnaire was administered on them. After one month, another administration of questionnaire was carried out. When the two sets results were correlated, the co-efficient of correlation indicated a high relationship between the two sets of results. A correlation co-efficient 0.84 significant at 0.05 confidence level was obtained. The Spearman Brown correlation co-efficient was used.

3.2 Field Work

Structured questionnaire survey was undertaken to assess the areas of wood usage in building projects and also to assess the economic efficiency of wood in building industry. There were also interview schedule and focused group discussions conducted with allied professionals in the building industry to discuss the potentials of wood as building materials. The study was carried out in the University of Ibadan.

Preliminary activities involved literature search to find out where in the country wood has been used as purely (without the use of other building materials) construction material in the past. The pilot study was undertaken using the Works and Maintenance Department of the University of Ibadan as the focal point. Then the University was divided into three major groups (Students' Hostel, Offices and Classrooms and Staff residential areas). The study approach involved the use of survey instruments (questionnaires) to gather primary data relating to wood usage and efficiency in the University. The questionnaires were in two Parts with the first part addressing general information while the second part was an interview guide used for collecting data from selected stakeholders.

4.0 RESULTS AND DISCUSSIONS

4.1 Wood Versatility in building projects in the university on Ibadan

The result of various areas of the building projects where wood is in use is shown in Table 1. From this table, it can be shown that there are a great number of areas in which wood is being used in building projects from conception to the finish. This shows the wood versatility in building projects. No other building materials enjoy so much wide rang of usage in building as wood.

Table 1: Current Building projects in the University of Ibadan in which wood products are utilized

S/N	Project	Nature of job	Area of wood use
1	Department of agronomy	Roof construction	Trusses, wall plates, fascia boards.
2	Department of anatomy	Roof construction	Trusses, fascia board, wall plate.
3	Post graduate school extension	Complete Rehabilitation	Trusses, noggins, wall-plate fascia board, door and window frames, profiling.
4	Department of physics	Roof construction	Trusses, fascia board, wall plate, noggins.
5	Classroom extension ISI	Complete	Scaffolding, doorframes, fascia board, wall-plate, trusses.
6	Baptist services centre	Rehabilitation	Platform construction, rabbit, door frames, window frames, trusses.
7	Dean's office Fac. Of science	Roof construction	Trusses, noggin, wall-plate fascia board.
8	Faculty of art	Roofing/rehabilitation	Trusses, noggins, wall-plate, fascia board.
9	Department of forestry	Roof construction	Trusses, fascia board, wall plate.
10	Chapel of resurrection	Roof construction	Staircase, props/scaffolding, formwork, doorframe, noggins fascia boards.

Source: Field Survey (2011)

4.2 Wood optimization

The research evaluated the actual levels of wastes experienced on building sites by the analysis of sets of questionnaires administered on contractors, materials merchants and manufacturers. The results show that the overall wastes experienced in construction amount to about 8% of material usage or 5% of the total contract sum.

When one speaks about wastes in construction, the first, and usually the only notion that comes to mind is material waste. However, it is well known that construction is an integrated systematic process involving an optimal application of scarce resources such as labour, plant, finance and of course, materials. This, in essence, does not mean a 'waste free' operation but it is one in which waste, in all their ramifications, are reduced to the barest minimum. Of all the common building materials, wood is the material that has the largest chance of being controlled to minimize waste. Tables 2 and 3 show that wood is the better building material in terms of waste control. Four basic sources of waste have been identified and their appropriate contributions to wastages in building industry. Table 2 and Figure 2 shows that wood do not in anyway generate controversy in building project as the value of wastes estimated at the planning stage is often greater than that of the actual waste generated during construction. Wood is the only material with downward slope from estimated to actual waste. Table 3 reveals also that wood products are the materials with the least percentage of waste 5.4 %, 5.7% and 5.8 % for plywood, wrot(wood that are smoothened) and sawn wood respectively. It has been revealed by the research that great numbers of abandoned projects are as a result of greater cost due to rise in anticipated wastes of material at the execution stage than was forecasted at the planning stage.

Table 2: Comparison of planning estimates and actual wastes of some Building Materials

Materials	Estimated Waste	Actual Waste	B as % of A
Block work	7·0	12.4	178
Cement	6·0	12.5	208
Concrete	5·0	7.1	142
Timber	8·0	6.5	81.3
Roofing sheet	6·0	7.5	125
Paints	5·0	6.9	138
Reinforcement	5·0	6.5	130
Glass work	7·8	13·0	167
Tiles	6·5	10.7	165
Nails	7·0	9.3	133

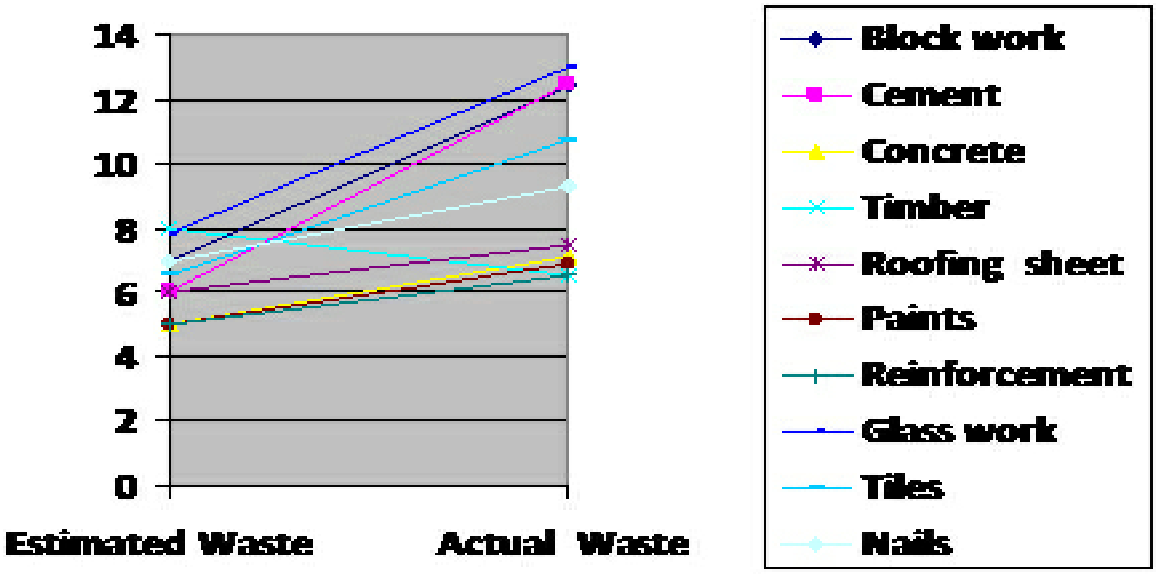

Figure 2: Comparison of Estimated and Actual Wastes of some Building Materials

4.3 Wastes Economy of Wood

Tables 3 revealed various sources of waste which refers to the complete loss of materials such as when they are either irreparably damaged in transit to site, during stacking, retrieval or installation, or are just lost from site. Direct waste can occur from any of three distinct sources, with the level of wastes experienced in any firm being dependent on the site conditions, skill, efficiency, workmanship, handling techniques, construction method, etc. the three sources are transportation, storage and construction.

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Table 3: Sources of wastes in building Materials

s/n	Materials types	Transport	Storage	Pilfering	Execution	Total waste
1	150mm solid sandcrete blocks	2.3	2.4	1.6	3.5	9.8
2	225mm solid sandcrete blocks	1.7	2.2	1.2	3.2	8.3
3	150mm sandcrete blocks	4·0	4·0	1.9	4.6	15.5
4	225mm sandcrete blocks	3.5	3.6	2.2	4.3	13.6
5	Ordinary Portland cement	2.1	3.6	2.3	4.1	12.1
6	Coarse aggregate	1.6	3.7	1.6	3.5	10.4
7	Sand	1.7	3.5	1.9	4.2	11.3
8	Sawn wood	1.1	1.8	0·5	2.4	5.8
9	Wrot wood	0·9	1.5	0·5	2.8	5.7
10	Plywood	1·0	1.4	0·5	2.5	5.4
11	Corrugated iron sheets	1.8	3·0	0	2.4	7.2
12	Aluminum roofing sheets	1.7	2.3	0	3.2	7.4
13	Asbestors sheets	2.4	2.7	0	4.3	9.4
14	Emulsion paints	1.1	2.6	0·9	3·0	7.6
15	Gloss paints	1.2	2.8	0·3	3.2	7.5
16	Preservatives	1.2	1.9	0·9	3.1	7.1
17	Vernishes	1·0	2.1	1.3	2.5	6.9
18	Mild steel bars	1.1	1.5	1.1	2.7	6.4
19	High strength bars	1.1	1.5	1.1	2.8	6.5
20	Aluminium monger	0·8	1.7	1.7	2.2	6·0
21	Glass work	2.5	3·0	2.5	5·0	13·0
22	Sanitary fittings	1.3	1.7	0·8	2.8	6.6
23	Tiles	1.8	2.8	1.4	4.7	10.7
24	Cellotex	1.4	2.1	0·8	3.8	8.1
25	Louvre carriers (Aluminium)	0·8	1.8	0·9	2.5	6·0
26	Louvre carriers (steel)	0·5	2.2	0·8	3·0	6.5
27	Electrical fittings	0·8	1.6	0·8	2.6	5.8
28	Nails and screws	1.6	2.5	1.6	2.8	8.5
29	P.V.C. Pipes	1.3	1·0	1.1	2.6	6·0

4.3 Economic efficiency analysis

Economic efficiency is the efficiency with which scarce resources are used and organized to achieve stipulated economic ends.

In comparing several potential building materials on an economical basis, the cost of executing a given project is analyzed. These costs may, in turn, vary with the number of housing units especially when we are dealing with massive housing estates. If the expected housing unit is substantially large, as it often is in developers built and lease programme, the economic comparison can be made by identifying the fixed and variable costs and graphing them for each material. This method is sometimes referred to as Material break-even analysis. The graphic approach has an advantage over a simple tabular approach in that one can easily identify ranges over which over which one material is preferable to another.

The methodology for Material break-even analysis may be summarized as follows:

1. Determine all relevant costs that vary with the material under consideration.
2. Categorize the costs for each material in terms of fixed costs (FC) and variable costs (VC).
3. Select the material with the lowest total annual cost (TC) at the expected production volume (v).

Because of the rising cost of building project, the economical material among wood, brick and sandcrete block has been determined.

Table 4: Break even analysis of material (Capital Cost)

Material	FIXED COST (Construction)	VARIABLE COST(finishes)
Block	N 1,100,000	N 200
Brick	N 900,000	N 250
Wood	N 600,000	N 150

Assuming a building of total wall area of $500m^2$, the economic break even analysis is as follows

TC= F + VC(V)

Block TC= N1,1000,000 + N200(1,000)=N1,300,000
Brick TC= N900,000 + N250(1,000)=N1,150,000
Wood TC= N600,000 + N150(1,000)=N750,000

From table 4, the most economical material is wood since it costs N 1,500 to erect a building on area of 1 m^2 as opposed to N 2,300 and N 2,600 for brick walling and block walling respectively.

4.4 Maintenance Cost

An outstanding advantage of wooden houses is the distinctive architectural effects provided by the exposed plank and beam ceiling. Often no further ceiling treatment is desired beyond the application of stains, sealer or paint, which provides a fine appearance at low cost. In post and beam wooden construction, ceiling height is measured to the under side of the plank, whereas in conventional construction, it is measured to the underside of the joists. The difference between the thickness of the plank and the depth of the joist provides a reduction in the total volume of the building. This makes possible a saving in sheathing, siding and length of exterior studs, as well as reducing painting, down spouting, stairs and other services.

4.5 Structural Analysis

During interview with consultants in building industry, it was revealed that advantage can be taken of the strength and stiffness of wood by making planks or beams continuous over more than one span or by cantilevering them. For example, a plank or beam which is continuous over two span is nearly two and half times as stiff as one which extends over single span, as illustrated in figure 3. I deflection is the governing actor, as it is in most decking designs, maximum spans may be increased as much as 34 %, depending on the degree of continuity. This factors ensures structural integrity of buildings

4.6 Load Analysis

Wood will carry short term loads substantially higher than those permitted for long periods. This factor makes wooden houses to be more resistance to sudden loads. Also wood has been found out to be capable of transferring static and dynamic loads without harmful deformations to the foundation. These factors provide assurance against the incessant building collapse in the country.

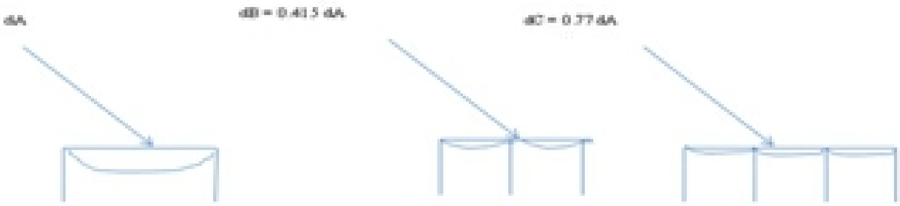

Figure 3: Comparison of Stiffness

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based on the study carried out, the following conclusions are made

1. Wood species are widely used for both structural, functional and decorative purposes in building;

2. There are still some numerous designated building components parts that wood could be used other than roof and frame construction;

3. Wood is economically efficient in use, reliable in service and good for all state economy;

4. Housing problems in Nigeria would be overcome with the proper and adequate use of wood in building industry.

5.2 Recommendation

It is suggested that further studies should be conducted into the ways in which the bio-degradation of wood could be improved to enhance it's usage without fears in housing construction. There could also be research into the engineering properties of lesser used timbers in order to ensure that wood use in housing construction are optimzed.

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