TOWARDS SUSTAINABLE TIMBER HOUSING DEVELOPMENT IN NIGERIA

OLUFEMI DANIEL DURODOLA
Department of Estate Management, Covenant University, Canaanland, Ota, Ogun State, Nigeria
dan_ass.2007@yahoo.com

Abstract
Currently, there is about 16 million housing shortfall in Nigeria going by the United Nation Standard for housing provision and the level of local housing delivery. One of the viable solutions as prescribed by United Nation Industrial Development Organization (UNIDO) is the exploitation of locally available building materials. Timber housing is thus an option but its percentage within the housing stock is negligible. The prime objective of this research therefore is to investigate the low response to timber buildings as a veritable alternative to other types of buildings in Nigeria. The purpose is to be able to identify the ways and means of popularizing timber buildings to increase its percentage within the housing stock and thus provide more houses for the needy within their available resources. In order to achieve the objective, a pilot survey was conducted with some timber industry stakeholders (Foresters, timber merchants, Architects, Quantity Surveyors, Local Government Authorities etc.) after, which a total of 142 questionnaires were administered among the stakeholders. Moreover, prototype low-cost houses designed by Oyo State Development and Property Corporation (which typically are made of block walling) were costed and compared with the cost of the alternative being proposed (timber housing). The results showed that timber buildings could be viable alternatives to other types of buildings currently in use in Nigeria because of the availability of the material and the stress bearing capacity of timber. However, high cost, depleting stock of hardwood, absence of bylaws supporting timber housing construction and serviceability problems associated with current timber buildings were identified as impediments to acceptability. The study concluded that despite the great potential timber buildings possess, its mass introduction into the housing stock faces several hindrances, which must be addressed. Recommendations such as public education, development of building codes regulating timber buildings and the compulsory adoption of timber buildings in public housing were also put forward.
Key Words: -Sustainability, framework, timber housing, materials and byelaws

Introduction

There is no nation without its own share of the housing problems, but the most important issue is that each exploits her resources to tackle the problem headlong. Housing problems expand as the paces of development and population increase. For example, Nigeria's population was 55,670,000 as per 1963 census. The 1991 census established a figure of 88,514,501 that is 60% increase over that of 1963 census. The estimated figure for the forthcoming National population census scheduled for year 2006 is 144 million based on an annual growth rate of 3.3% per annum. That is 63% increase over that of 1991.

The rise in population growth needs a corresponding increase in the provision of basic facilities, housing inclusive. However, Nigeria's housing provision is put at a 2-3 dwellings per thousand of her population per annum compared to a United Nations declaration of a requirement rate of 8-10 dwellings per a thousand population per annum. This indicates a shortfall of 72% approximately in housing delivery in Nigeria today. (Abiodun, 1985; Mimiko, 2005). Little wonder the much vaunted slogan "Housing for all by the year 2000" a United Nations (U.N) declaration ushered in the millennium with anticipated respite in meeting this need, which later turned out elusive (Adedeji, 2000: 6-12).

UNIDO's(1980) suggested solution for the housing problem in the developing countries is the development of local building materials, which rely on local knowledge and technology. This assertion was buttressed by Arayela (2005: 2-3) when he wrote thus: -

From an historical perspective, one can see that the use of reinforced laterite material has played a prominent role in solving the problems of cheap and affordable construction material in times past. The need for re-awakening this important technology is more acute today,

especially in the developing countries where population explosion is high, poverty level continues to rise and fall, and where provision of shelter is very low. This is the resultant effect of high costs of imported construction materials that keep on rising every day. The need for the development of local building materials is a must, if housing for the majority will be achieved in Nigeria and other developing countries of the world.

Among the many materials usually mentioned is timber, which has been found to be a very versatile building material and has been used by man since his most primitive days.

Kio, Ademiluyi and Badejo (1988:4) defined wood as a renewable natural resource accruing from the growth in diameter and height of a tree in the forest.

The potential of wood in the housing provision is unlimited in that timber is a very versatile building material. It is used currently for roofing, door and window frames, internal decoration, door and window construction, floor construction, staircase, balustrade, piling, framing, sheet piling, bridge construction, railway slippers and furniture fabrication to mention just a few.

Today, many countries endowed with timber rely on its potentials by using wood to construct timber houses to meet their housing needs. Derrick and Marsh (1974:3-4) identified British Columbia, Canada and United States of America as countries that have adopted timber buildings as parts of their housing stock. Griffith (1989:5-8) commenting on housing situation in Great Britain wrote thus: -

House building completions in Great Britain with the private sector exceeded 182,000 in 1987, a 3% increase on 1986 figures and the highest total of new completions recorded for 14years. While a substantial proportion of these new homes continue to follow traditional masonry designs, 6% of dwellings currently built in England, Wales and Northern Ireland and 31% of houses presently constructed in Scotland are timber-framed.

As developed countries have seen and adopted timber as a building material for their housing provision, Nigeria needs to also look inward by relying on her timber resources and use them for her housing needs.

Chong (1977:105) had discussed extensively the basic structure and properties of wood. Wood is composed mostly of organic matter apart from water, which may be up to 150% of dry weight when oven-dried at 100-105°c. Other components include cellulose 45-60% of dry weight of wood; hemi cellulose 15-25% of dry weight of wood; Lignin 25-35% of dry weight of wood; inorganic materials 1-5% of dry weight of wood and other minor components, which include natural resins, oils, tannins, colouring matter and alkaloids. These form the bark, the cambium layer, etc.

Compared with other materials, wood is the only material that has maintained its usefulness as a construction material from the ancient times to date because it is a renewable natural resource accruing from the growth in the diameter and height of trees in the forest. Trees are replanted through afforestation programmes and many do grow naturally on their own in the forest. Due to this regenerative ability, wood seems to be almost inexhaustible although it takes decades to mature and if not replanted and properly managed may not be able to meet the demand as presently foreseen.

The extensive and varied use of timber is due to the amazing progress made in developed countries in transforming wood from a material of craftsmanship to one of engineering. Its use in housing development has gone beyond doors and windows frames, rafters and purlins to complete prefabricated buildings of various sizes and uses to meet the increasing demand for housing. Canada, the United States of America, Columbia, and Britain are some of the countries that have adopted timber-framed buildings to supplement their housing requirements. Reasons adduced by Griffith (1989:5-8), Prisky (1981) and Richardson (1976) for these developments are as follows: -

a. Reduction in site labour, and less plant intensive.
b. Speed and ease of erection.
c. Insulation and other building regulations are easily met.
d. Easy choice of internal house design and cladding
e. Little or no interruption to completion programme due to adverse climatic conditions
f. Ease of working by hand or machine
g. Low cost per unit volume
h. Good strength/weight ratio

i. Good fire resistance
j. Low tooling costs
k. High aesthetic properties and
l. Only structural material available as a crop.

Despite these numerous advantages and the increasing adoption in various countries of the world, many developing countries with liberal supplies of timber have not exploited the potentials of timber in meeting their housing needs.

At present in Nigeria, the use of timber is limited to the construction of building elements such as windows, doors, frames, roofs, furniture and other general utilities. Available information based on studies of houses in Nigeria carried out by the Federal Office of Statistics, Lagos (1986: 21-33) has shown that timber houses account for less than 1% of Nigeria's housing stock.

The cornerstone of the report of the special committee on National Housing Policy (1985) was the promotion and adoption of locally available building materials. This accords with the UNIDO's (1980) strategy, which states that the best strategy is the promotion of locally available materials in all its ramifications including wood. Besides, no job is ever completed; no life is ever lived meaningfully and in comfort until we appreciate the dominant role of wood and wood products in our lives. The perceived extent of local availability of hardwood timber makes it imperative that potentials of timber must be exploited to satisfy the yearnings for more houses.

The Focus of Empirical Work In This Paper

The review above had shown that housing shortages are endemic in Nigeria and are still continuing unabated. At the same time, Nigeria being a tropical country is blessed with abundant natural resources, which need to be exploited to solve the housing problem. It is also an established fact that timber, one of the locally available materials is exploitable in housing provision and has indeed being exploited by other nations equally blessed with timber. This work therefore, is intended to bridge the gap between timber availability and its utilization for housing in Nigeria by examining the factors encouraging or militating against the use of timber houses in Nigeria.

The objectives are as follows: -

- To examine the available timber resources for housing development in Nigeria
- To assess the level of application and the potentials for further development of timber resources for housing provision
- To examine the problems and the prospects of timber housing development
- To formulate strategies for improved and more economical use of timber in housing provision in Nigeria

Literature review (Griffith, 1989; Prisky, 1981) had indicated that several problems are prevalent with timber framed building schemes as an alternative solution to housing problems. The problems revealed include: -

- Repugnancy among the populace despite its wide acceptability in the riverine areas of the country and tested trials among the developed nations
- Research work on timber housing prototypes including cost comparison with other established conventional housing is not in wide circulation
- Lack of linkage between housing problems solution proposals and users' likely reaction in practice to determine possible acceptability.
- Lack of assessment of performance characteristics of existing timber framed buildings in terms of quality of fabrication and quality of workmanship as basic aid in determining the qualities of acceptable timber framed buildings.

In order to achieve the objectives of this study, as earlier identified, the use of preliminary discussions with professionals in the construction industry, questionnaire survey, personal interview, field survey of existing timber houses, laboratory testing of some selected wood species, prototypes designs and costing of some timber framed buildings and comparison with conventional concrete block wall buildings were employed.

Questionnaire Survey

Due to the large number of people involved, a different sampling technique appropriate to each questionnaire was used. In administering the general questionnaire, a minimum of 10 questionnaires was set-aside for each of the five states covered by the survey. A randomization

technique whereby every third timber house owner or occupier was included in the sample.
For forest resources questionnaire, 10 copies each were reserved for each of the states covered (Lagos, Ogun, Oyo, Osun, Delta and Edo States). In each state, copies were distributed among top echelons of the departments of forestry, project engineers of ministry of works, chairmen of selected timber selling units identified to be experienced by foresters of the localities involved and general managers of wood processing plants around.
In all, 142 questionnaires were administered to the stakeholders. (Wood Users, Insurance Companies, Mortgage Institutions and Town Planning Authorities). Recipients were carefully chosen for all questionnaires to reflect knowledge of wood usage, training, experience and exposure. Out of the 142 questionnaires distributed for all categories, 100 copies were fully completed and returned.

Survey of Existing Timber Buildings

Four hundred (400) timber houses including residential, commercial, educational and recreational facilities were examined. Important and large settlements that are known for their timber buildings were visited including Igbokoda and Ayetoro in Ondo state and Epe in Lagos State. Other cities, towns and villages visited included Benin City, Warri, Sapele, Ughelli, Koko, Akure, Ibadan, Okiti-pupa, Ore, Ondo, Lagos, Abeokuta and Badagry. These places were selected because of their known flair for timber buildings and because literature had revealed that most of the information obtained from them could be universally applicable.

In order to assess the performance of existing timber framed buildings surveyed, care was taken to examine the quality of the initial design, including the materials specification, the quality of the fabrication of the component parts, the quality of workmanship on site and on the occupiers not making adverse structural, or other modifications. The major faults noted in various buildings were grouped into 39 types for analysis.

Comparative Cost appraisal

Low cost houses designed and built by Oyo State Property Development Corporation were used as a basis for analysis. (Appendix 1). The buildings were assumed to be built of 'sandcrete' block wall with timber framed roof and corrugated iron covering. A firm of Quantity Surveyors was given the drawings for pricing. Prices were also received for proprietary timber prefabricated system from African Timber and plywood industry, Sapele. The data as received were compared and conclusions drawn.

Problems Experienced

It was generally difficult to track people down to fill the questionnaires. Sometimes, timber merchants had to be convinced that the questionnaires had no statutory implications but for academic purposes. In some cases, five or more visits were made before a questionnaire could be retrieved. Because of so many cities involved, transportation was a serious problem. In some cases vehicles were hired which made the cost of the research high. In the riverside areas where motorboats had to be entered over a long distance, it was a memorable experience.

Data Analysis and Results Interpretation

Responses to validated factors under different questionnaires were analyzed to determine which factor was considered the most important. Since the opinions of experts in the wood and construction industry might differ from those of general users, comparative analyses of data were made.

Ranking, bar charts and pie charts were used in data analyzes. Ranking of factors was considered necessary because of numerous suggestions and the facts that the range of factors differed greatly. It was considered that in majority of cases, the higher the frequency of a factor, the more the importance attached to it by the respondents. Where percentages were not critical to analysis, bar charts were used and where percentages were critical, pie charts were used.

Available Wood Resources for Timber Housing

Out of the well over 600 species, between 34 and 63 species were mentioned as species being currently exploited for timber. Nevertheless, not all are still available in large quantities all year round. Table 1 below reflects wood species available all year round.

Level of Application

Two major categories of users came out of the findings; the riverside area users and the hinterland users. The former anchored their adoption of timber buildings on exigencies and cost. Exigencies in the sense that they live inside waterlogged areas with running soil. It is

therefore impossible with little resources to build block wall houses. The hinterland users cited exigencies, cost and elegance. In the hinterland, timber cladding, plywood prefab and African Timber and Plywood (ATP) system were the most common with timber cladding topping the list. This is reflected in Table 2 below: -

Procurement Methodology

The type of building dictates design and construction methodology. Houses on stilt, timber cladding and composite structure are self-built relying on the carpenters' experience and competence. This type of construction dominated the timber housing stock available in Nigeria today as reflected in Figure 1 below.

ATP system and plywood prefab are based on design and construct system but it is possible for ATP system to be prefabricated leaving erection in the hands of trainees who can be brought in by the purchaser for coaching.

Quality of Existing Timber Houses

The percentages of houses over the total number surveyed having different types of defects were computed and for each defect, the houses were ranked. The number of times each building was coming 1st, 2nd, 3rd, 4th and 5th respectively were computed and the means computed .The means were tested using Analysis of Variance (ANOVA) as shown in Table 3 to see whether there was any difference in the degree of defects occurring in the buildings.

The deduction here is that using the means as shown in Table 3, ATP system and plywood prefab faired well in terms of defects compared with others but in general there is nothing to write home in terms of quality of existing timber houses as confirmed by analysis of variance in that there were no significant differences between the degree of defects found in all the buildings. The reasons can be highlighted as follows: -

- Mis-use of wood
- Poor quality of workmanship
- Lack of knowledge of timber technology
- Lack of maintenance
- Design defects

This perhaps explains the poor response to the adoption of timber buildings.

Limiting Factors

This identified all those factors limiting the use of timber buildings by bringing together the opinions of the public, the professionals, the insurance companies, the fire brigade and all the segments sampled as compiled from the responses received. Such factors are shown in Table 4 below: -

Propagation problems and prospects

This identified major problems and likely prospects that might arise from efforts to propagate timber buildings. The frequency of occurrence and degree of importance are as shown in Table 5 below: -

From the above, it is apparent that lack of knowledge of the technology of wood, high expectation of quick profit and little or no interest in timber buildings influence the poor response of people towards timber housing development. Likely media for propagating timber houses were adduced. Such media using ranking are as follows: -

a. Publicity and aggressive education programme
b. Compulsory adoption of timber framed buildings for housing development by governments and housing corporations
c. Group sponsorship by woods industries and other stakeholders.

Comparative Cost Analysis

Appendix 1 shows low cost houses designed and experimented by Oyo State Property Development Corporation to meet the housing needs of the low and medium income people. The buildings were to be assumed constructed with sandcrete blockwalling being the commonest construction materials for buildings now and the cost compared with those constructed with timber of various types – white wood, hardwood, plywood cladding, wood cladding and ATP system.

The system adopted was to take-off quantities for the first two-bedroom in block wall and timber and bills of quantities prepared for them. The bills of quantities were then sent to a firm of Chartered Quantity Surveyors at Ibadan for pricing. Estimated cost was obtained from the operations Department of the African Timber and Plywood Industry Sapele. Since a room addition to each building distinguishes one from the other, estimates for the three-bedroom and four-bedroom buildings were derived from the estimate for the two-bedroom building using superficial area as basis for analysis. This is a method common in approximate estimating in engineering and building. The summary of cost obtained is shown in Table 6

In order to make the comparison more meaningful, it was assumed that materials were available on site ready to be installed removing all the constraints likely to arise from waiting for delivery. Price increases were also assumed to be a usual occurrence as at the time of analysis so that for future use of the data inflation should be allowed for using retail price index or any acceptable price index. Quality and quantity should be adjusted if high standard is expected than the level assumed by the designer. Block wall building was taken as a yardstick for comparing cost for those buildings being the most common and popular. The percentage difference between block wall and other building types were computed as reflected in Table 6. The result is shown in Table 7 below while graphical representation is shown in Figure 2

Using Tables 6 and 7 as well as Figure 2, the cost of block wall building of medium standard lies between the cost of standard timber building of ATP type and low quality timber building of self-built timber cladding. Thus, as the quality of timber building increases, its cost increases until it eventually surpasses the cost of block wall building.

Findings and Conclusions

From the discussions so far, the following can be summarized: -

(1) That despite the fact that timber housing possesses the potentials in solving the problem of massive housing scheme, the potentials are not exploited,

(2) That though the country has over 600 species of wood only few are useful for massive timber housing and such few are being massively exploited without corresponding regeneration programme

(3) That the low responses to timber housing are due to increasing scarcity of hardwood which leads to high cost, conservatism of house developers and users alike, lack of recognition for timber housing by Town Planning Authorities and financial institutions and lack of knowledge of technology of wood by users. Currently, there is no code of practice for timber housing construction.

Based on these findings, the conclusions drawn can be listed as follows: -

(1) That for now massive timber housing cannot easily be embarked upon due to inadequate attention to wood regeneration activities and extreme conservatism of the people arising out of the poor knowledge of the technology of timber.

(2) That for timber housing to be employable as part of the strategies for meeting housing needs, radical changes in the building regulation is necessary so as to allow timber building as permanent structure.

(3) Massive sensitization and education of the public as regards the usefulness, versatility and durability of timber buildings.

Recommendations

Based on the findings of this work, the following recommendations are made:

(1) That the potentials of timber buildings be exploited in practice through institutional supports by housing corporations and local governments coming together to form co-operatives. By so doing high standard can be attained and through mass production, cost reduction can be achieved.

(2) That emphasis should be laid on re-use of wood wastes to form particle boards for use for general utilities to reduce the demand on hardwood and thus bring down the current high cost.

(3) That energy should be diverted to research on the peculiar diseases of our local wood species to aid their regeneration and formulation of structured programme towards increasing the level of afforestation programme.

(4) That procurement methodology useful for timber housing is prefabrication based on open system and this should be encouraged.

(5) Investment in massive plantation establishment and sustainable management of the natural forest reserves.

(6) Encouragement of the use of appropriate machinery for wood conservation and woodwork for production efficiency including putting in place holistic and mainstreamed land use plan for the use of all stakeholders in natural resources of Nigeria.

(7) Tenural uncertainty, which contributes to widespread disregard for the need for conservation and provides little incentives for the private sector to establish forest plantation and manage the forest effectively must be removed.

(8) That the potential of timber in housing provision can only be fruitful by: -

(a) Improving on the efforts in research on wood regeneration, afforestation and re-cycling of wood wastes.

(b) Compulsory adoption of timber housing by government agencies such as Federal and State Ministries of Works and Housing corporations.

(c) Emphasizing on prefabrication based on open system to ensure the use of treated wood and thus improve standard.

(d) Re-writing building byelaws to allow for construction of timber buildings as permanent structures having fulfilled laid down quality standard.

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Table 1: - Wood Species Available All Year Round

S/No	Wood Species	Botanical Name	% Occurrence	Hardwood	Softwood
1	Iroko	Chlorophora excelsa	74	X	
2	Ijebo	Gedu Nohor	53	X	
3	Apa	Afzelia spp	64	X	
4	Afara		98	X	
5	Ayan/Apa	Distemonanthus benth	55	X	
6	Oporoporo	Pterygota macrocarpa	95		#
7	Oriro		98		#
8	Ofun		76	X	#
9	Odan/Oganwo		74	X	#
10	Abura	Mitragyna Ciliata	95		#
11	Ahun		95		#
12	Apado		67		#
13	Ponna-Ponna		90		#
14	Araba		86		#
15	Erinmado		55		#
16	Aye-E		64		#
17	Akoko-Igbo	Lovoa trichilioides	100	X	
18	Ayunre		98		#
19	Arere		98		#
20	Opepe	Nauclea diderrichii	90	X	
21	Olofun		69	X	
22	Agba		69		#
23	Idigbo	Terminalia ivorensis	98	X	
24	Omo	Cordia platythyrsa	69	X	
25	Obeche		55		#
26	Teak	Tectona Ivandis	67	X	
27	Danta		83	X	
28	Gmelina		90		#

Source: Field Survey

Key to Table 1

X = Hardwood

\# = Softwood

Table 2: - Motivating Factors for Adopting Timber Houses

S/No	Motivating Factors	No of Respondents	Frequency of Occurrence
1	Exigency	37	14
2	Cost	37	9
3	Elegance	37	8
4	Custom	37	2
5	Unsure	37	2
6	Promotional	37	1
7	Maintenance	37	1

Source: Field Survey

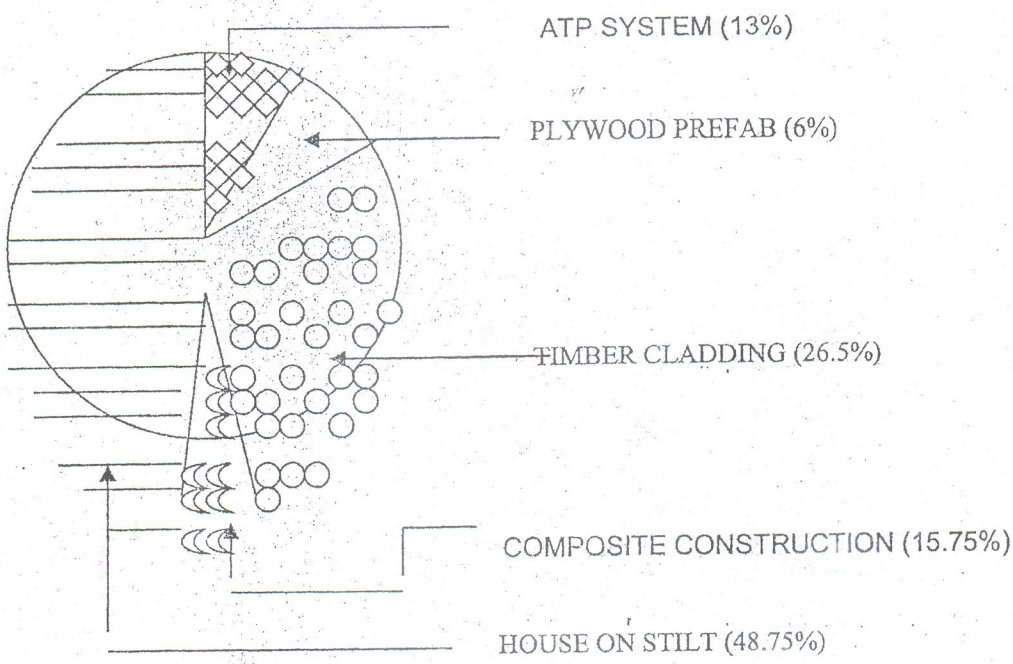

Figure 1: Pie chart showing Construction Techniques for Timber Housing.

Table 3: - Analysis of Variance for Defects in Houses Surveyed

	SOURCE	SS	MS	DF	F	p
1	Between Samples	5.84	1.46	4	12.41	5%
2	Within samples	362.40	18.12	20	12.41	5%
3	Total		19.58	24		

Source: Field Survey

Key to Table 3

SS = Sum of Squares
MS = Mean Square
DF = Degree of freedom
F = F – Ratio
P = Significance

Table 4: - Factors Limiting the Adoption of Timber Buildings

S/NO	Identified factors
1	Inadequacy of good hardwood timber coupled with increasing cost
2	Limitedness of seasoned and treated timber in the construction of existing timber houses
3	The belief that timber houses are fire prone.
4	Conservatism coupled with ignorance of the technology of timber by house builders.
5	Lack of recognition by Town Planning Authorities who regard timber buildings as temporary structure.
6	Non-acceptability of timber framed buildings as collateral security for mortgage purposes.
7	Inadequate support by government for research activities in areas of timber development
8	Poor quality of existing timber houses which discourages developers from taking to timber buildings

Source: Field Survey

Table 5: Ranked reasons for lack of interest in Timber Housing propagation

S/N	Reasons	% Response	Frequency	Rank
1	Is not my business	27.0	10	1
2	Is not profitable	13.51	5	3
3	Lack of knowledge	8.11	3	4
4	Not interested at all	24.32	9	2

Source: Field Survey

Table 6: - Summary of Cost for Buildings Using Various Materials

S/N	BUILDING TYPE / CONSTRUCTION	2 BEDROOM N	3 BEDROOM N	4 BEDROOM N
1	Block wall	1,051,364	1,249,112	1,531,454
2	Timber- white-Wood	836,205	993,485	1,218,046
3	Timber – hard-Wood	1,017,914	1,209,371	1,482,730
4	Timber - ATP	1,356,742	1,611,929	1,976,279

Source: Field Survey

Table 7: - Percentage Differences in cost between Buildings

Building Types	2 Bedroom	3 Bedroom	4 Bedroom
	%	%	%
Block wall	0	0	0
Timber – Low Quality	-20	-20	-20
Timber-Medium Quality	-3	-3	-3
Timber-High Quality	+29	+29	+29

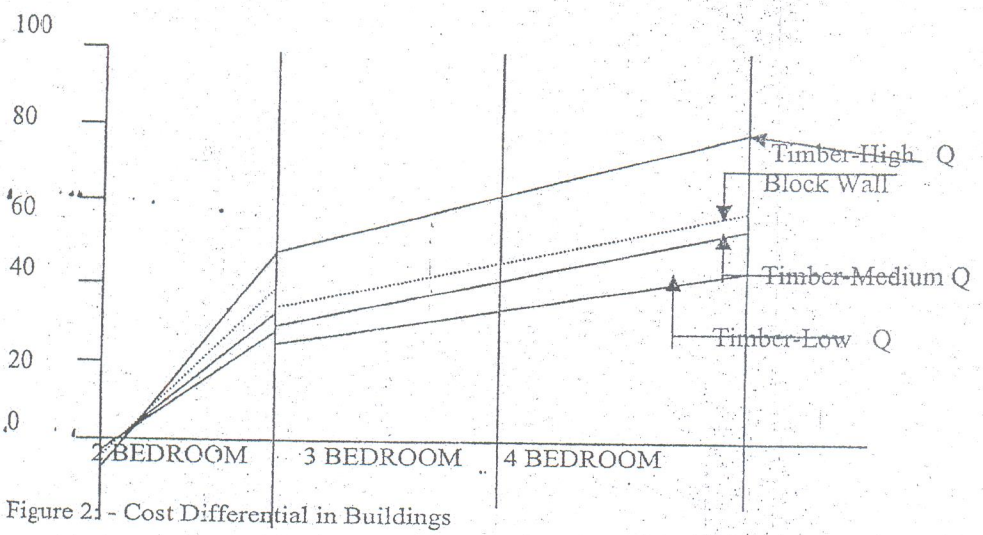

Figure 2: - Cost Differential in Buildings