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B. J. Olawuyi
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BOOK OF PROCEEDINGS

MAIN THEME:
Sustainable Housing And Land Management

3RD -5TH MAY, 2021

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School of Environmental Technology International Conference (SETIC 2020)

3RD – 5TH MAY, 2021

Federal University of Technology Minna, Niger State, Nigeria

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PREFACE

The School of Environmental Technology International Conference (SETIC 2020) is organised by School of Environmental Technology, Federal University of Technology Minna, Nigeria. In collaboration with Massey University New Zealand, Department of Civil Engineering Faculty of Civil Engineering and Built Environment Universiti Tun Hussein Onn Malaysia, Malaysia Centre For Professional Development and Industrial Project Development School of Professional and Continuing Education (SPACE) UTM-KL Malaysia, Global Academia, Department of Architecture, Faculty of Engineering and Architecture, Istanbul Gelisim University Istanbul Turkey, Sustainable Environmental and Technology (SET) Research Group, Department of Architecture, Universiti Sains Islam. The main theme for this year conference is "SUSTAINABLE HOUSING AND LAND MANAGEMENT". This promotes and encourage innovative and novelty for policy issues for inclusive and sustainable housing, access to finance for housing and land development, sustainable building materials, building cost management, sustainable and resilient cities, geoinformatics for land management, rapid urbanization, sustainable land use and spatial planning, gender issues in access to land.

The responses from participants for this conference are overwhelming, well attended, and successful. The operation mode was Virtual for all participants who choose the oral presentation mode. While, Physical for all poster medium presenters. Our participants are from various Universities and other sector across the globe, from countries like United State for America (USA), Turkey, Malaysia, China, Saudi Arabia, Kenya, New Zealand just to mention a few. Hence, this conference provides a good platform for professionals, academicians and researchers to widen their knowledge and approach on latest advances in research and innovation. Papers presented in this conference cover a wide spectrum of science, engineering and social sciences.

Finally, a note of thanks must go to SETIC 2020 Local Organizing Committee (LOC) for their remarkable dedication in making this conference a success. We hope the event will prove to be an inspiring experience to all committee members and participants.

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Contents

Evaluation of the Significance of Timber as a Source of Sustainable Building Material in Owerri, Nigeria

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Abstract:
In Nigeria, timber as sustainable building material is found in large quantities and varieties. As a construction material, it has come to drive the advancement of the construction process. Based on various purposes of timber utilization in building projects, timber usage in building can be classified as structural, functional and decorative/aesthetics. It possesses qualities that have made it a material of choice in millennia. The study highlights the importance of timber as a sustainable building material for residential buildings. The study was carried out in Owerri, the capital city of Imo State and a qualitative research method was adopted which involves the professionals in the construction industry who are currently involved in construction projects. A Total of 250 structured questionnaires were administered using the stratified random sampling methods, whereby 240 questionnaires were returned. The data collected was analysed using descriptive methods. The result shows that 69.3% of all the sampled professionals strongly agree that timber is very valuable and a sustainable building material for residential building. The study recommends timber as an essential building material that is very versatile, renewable and can be useful in all building types. Therefore, the use of timber should be highly encouraged in the building industry to maintain its functionality and durability in building industry.

Keywords: Aesthetics, Construction, Residential buildings, Sustainable material, Timber.

INTRODUCTION

Timber is the hard fibrous substance consisting basically of xylem that makes up the greater part of the stems, branches, and roots of trees or shrubs beneath the bark and is found to a limited extent in herbaceous plants (Amal & Halil, 2017). Timber is one of the components of housing which is among the most important basic human needs for shelter. It has been used in construction for thousands of years and is still one of the most widely used building materials. Certain properties of timber can be complex in terms of its use in construction, but despite this, engineers have successfully harnessed this natural resource to build a variety of structures. It is a vital component towards a sustainable environmental development. Sustainability has been characterized as a development of the economy that satisfies the needs of the current generation without compromising the opportunity and the potential the future generations (Amal & Halil, 2017). This study provides a wider perspective of timber as one of the main sustainable building materials used in construction. Generally, sustainability is divided into three sectors, which includes economic, environmental, and social sectors, which represent three pillars of sustainable development (Wacker, 2010). In design, sustainable construction affects the short and long term economic goals (Amal & Halil, 2017).

Timber is the ultimate renewable material and a fibrous rigid material of plant origin (Abimaje *et al*., 2014). The unique advantages of this material, its widespread availability, sustainable renewal, favourable ecological assessment and flexibility of implementation grant it valuable in the eyes of scientists and engineers. In the eyes of architects, however, the simplicity and beauty of timber as a new aesthetic are not only a visual experience - architects try to get its smell, texture and tangibility and integrate them into the architectural built environment (Obucina *et al., 2017*). Timber is generally classified into hardwood and soft wood. Hard wood is heavier and denser than soft wood and is mainly use for the construction of walls ceiling and floors. Softwoods are generally used to make more of the inner structures to the frame of hardwood, such as doors and window frames. It is also used to produce furniture (Heritage Builders Ltd, 2017). **Softwood** is a type of wood that is cut from trees belonging to

gymnosperms, such as coniferous trees. By contrast, hardwood typically comes from angiosperm, deciduous and broad-leaved trees.

LITERATURE REVIEW

Timber is one of the longest standing building materials in existence, with evidence showing homes built over 10,000 years ago used timber as a primary source for construction materials. Europe's Neolithic long house--a long, narrow timber dwelling built in 6000 BC-- is an excellent example (Sarah, 2016). As one of the largest buildings during that period, the Neolithic long house was solid and massive, with a capacity of housing around 30 people. Since then, the discovery of different elements such as bronze and steel have changed and improved the way timber is applied to building construction. Timber continues to be used to create both modest buildings such as the log cabin, and impressive structures such as Chinese temples. Boasting it's environmentally friendly, renewable and extremely durable features, wood remains an extremely popular choice for both buildings and furnishings (Sarah, 2016).

Timber has been used as a building material for thousands of years, being second only to stone in terms of its rich and storied history in the world of construction. In addition, no high-energy fossil fuels are required to produce wood, unlike other common building materials such as brick, steel or plastic (Falk, 2009). The chemical properties of timber are inherently complex, but even in spite of this challenge; human beings have successfully harnessed the unique characteristics of timber to build a seemingly unlimited variety of structure. This unique versatile material is commonly used to build houses, shelters, boats and many more, but it is also extensively used in furniture and home decoration industry as well. Perhaps one of the biggest advantages of using timber as a building material is that it is a natural resource, making it readily available and economically feasible. It is remarkably strong in relation to its weight, and it provides good insulation from cold. Timber can be fabricated into all kinds of shapes and sizes to fit practically any construction need (Falk, 2009). It is also the perfect example of an environmentally sustainable product; it is biodegradable renewable and carries the lowest carbon footprint of any comparable building material.

History of timber in building construction

Right from the dawn of man, timber was used as a construction material to build structures like shelter. Man had to seek protection from predators and harsh weather conditions using protective cover that usually comprised of dugouts, caves, reeds, twigs, wood, mud, stone and snow. It is proposed that the first primitive structure was invented when early man pulled down a tree branch with full foliage (Guilhemjouan, 2013). The use of timber in construction dates back to 500 to 100 B.C. Timber was spatially used in roof constructions by the ancient Roman and Egyptian civilizations that majorly used stone in buildings. Most noteworthy during the period is the development of the ten and mortise joints in timber framing. Over the subsequent thousand years in Europe, the use of timber frames heightened in areas with vast timber resources. Primitive construction techniques were employed and as a means of foundation, timber was either driven or laid onto the ground. Timbers were tied together using primitive rope of animal hides. Advanced joinery techniques were developed to build more permanent and decent houses using timber frames. Stone foundations provided superior support for the houses, and prevented rapid deterioration of the structural posts. Timber frames were permanently fastened using joinery techniques. In Europe, modern timber framing was developed in the 9th and 10th centuries and is characterized by exceptional building skills (BRTW, 2017). Timber framing techniques would later evolve across Asia, Africa and the undiscovered Americas.

Seasoned timber as a sustainable construction material

Seasoning of timber is the process by which moisture content in the timber is reduced to a required level. By this process, the strength, elasticity and durability properties are developed thus making it a sustainable material. As a sustainable material, it has many benefits like thermal and acoustic insulation, availability and adaptability, structural stability, easy of manufacturing, fire resistance, aesthetic qualities, cost effectiveness and low thermal conductivity (Falk, 2009). Wood structures require less energy to build and to operate, which reduces our reliance on fossil fuels. Wood can be recycled and renewed, again and again and only few other materials can match the unique combination of benefits; strength, affordability and environmental sustainability of wood (Abimaje *et al*., 2014).

According to Okereke (2006), a sustainable material should possess the following characteristics:

i. Easily available and affordable, preferably locally

ii. Meets with the requirements as specified in National Standards; in terms of durability and maintainability

iii. Should be environmental friendly and should not constitute any health hazard;

iv. Should be versatile in usage, that is, it could be used for different purposes (as walling materials, flooring, etc). It is obvious that timber has these qualities of a sustainable building material.

The sustainability of timber can also be determined by comparing its impact on the environment with three other common building materials in terms of fossils emission, carbon dioxide emission and thermal conductivity as presented by (Abimaje *et al*., 2014). Rough sawn timber uses 750 MJ/m3, steel uses 266000 MJ/m3, concrete uses 4800 MJ/ m3 and aluminium uses 1,100,000 MJ/m3 of fossil fuel. Burnt fossil fuel emits greenhouse gases such as carbon monoxide, sulphur dioxide and methane into the atmosphere (Abimaje *et al*., 2014). These gases have negative impact on the environment. Timber requires less fossil fuel to manufacture than steel, concrete and aluminum therefore is more sustainable and environmental friendly. In the aspect of carbon dioxide emission, rough sawn timber releases 30 Kg/t of Carbon dioxide, while steel, concrete and Aluminium release 700Kg/t,50 Kg/t and 8700 Kg/t respectively. It also shows that rough sawn timber stores 250 Kg/m3 of Carbon dioxide while steel, concrete and aluminium do not store any. It obvious that timber releases the least and stores the highest amount of carbon dioxide during its manufacture, hence it releases less greenhouse gases into the atmosphere (Abimaje *et al*., 2014). Also in the aspect of thermal conductivity of some building materials, it shows that Fired clay has 1.0 J/m-IK -I , cement board 0.6 J/m-I k -I , limestone gravel 0.6 J/m-I k -I , concrete 1.4-2.9 J/m-IK -I , stone 1.5- 3.0 J/m-IK -I , wood 0.05-0.0.15 J/m-I k -I and steel 19.0-21.0J/m-I k –I (John, 2003). This made it clear that timber require less insulation to retain their warmth. This will be a great need to tropical regions that has excess heat gain in buildings built with concrete and steel. The use of timber will promote energy saving in cooling houses. The use of timber is classified into aesthetics, functional and structural purposes. Table 1 gives classification of various wood species in building project as well as their purpose of use.

Table 1 and Figure 1 show the purpose of various woods in building construction. It shows that some timber like afara, pine, oak, redwood, omo performs all the functions (use for functional, aesthetics and structural purposes) while some timber perform dual function, some also performs only single function as being a good structural material

Table 1: Classification and Purpose of use of various wood species in building projects

Local Name	Botanical Name	Purpose of use		
		Aesthetics	Functional	Structural
Mohagamy	khayaivorensis	—	✓	✓
Iroko	melicea excels	—	✓	✓
Ayin	anogeissusleicarpus	—	—	✓
Teak	tectonagrandis	—	✓	✓
Opepe	naucleadiderrichii	—	✓	✓
Araba	ceibapentandra	—	—	✓
Oak	quercus borealis	✓	✓	✓
Afara	terminaliaivorensis	✓	✓	✓
Omo	cordial millenii	✓	✓	✓
Pine, red	pinusresinosa	✓	✓	✓
Apa	afzeliaafricana	—	—	✓
Apado	conluuoagrandiflora	—	—	✓
Arere	triplochitonacleroxylon	—	—	✓
Aspen	populustremuloides	—	—	✓
Redwood	sequoia sempervirens	✓	✓	✓
Agbonyin	piptadeniastrumafricanum	✓	—	✓

✓ Means "Used for", — means "Not used for".

Source: Adesogan, (2013)

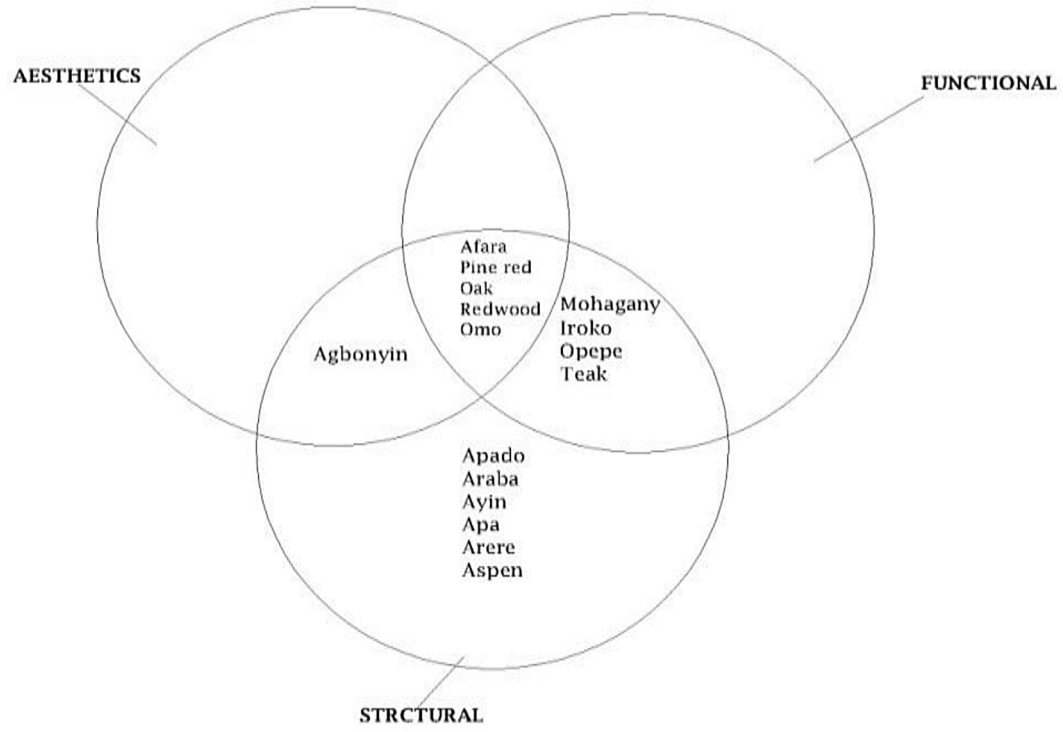

Figure 1: Diagram shows the purpose of various woods in building construction.

Source: Adesogan, (2013)

.STUDY METHODOLOGY

The study was carried out in Owerri – the capital city of Imo State in Nigeria. It is also the State's largest city, followed by Orlu and Okigwe as second and third respectively. Owerri consists of three Local Government Areas which include Owerri Municipal, Owerri North, and Owerri West. It is an urban area with high level of building construction. The data was collected by the use of structured questionnaire distributed to the professionals in building industry to evaluate the use and need of wood as a sustainable material with particular reference to residential buildings. A total of 250 respondents were involved in the study. The questionnaires was structured on the sustainability of wood based on the following; (i) Structurally strong, (ii) Natural insulator (iii) Durability (iv) cost effectiveness (v) Aesthetics (vi) Employment (vii) Fast and efficient to build with. The class of each structured questionnaire was determined using the following score as below: SA= strongly agree, A= Agree, U= Uncertain, D= Disagree, SD= strongly disagree. Table 2 shows determination of the population of the study. The questionnaires were distributed among the following professionals in the State such as Civil Engineers, Architects, Quantity Surveyors, Builders and Artisans. The population was chosen on the registered professionals from their respective professional bodies.

Table 2: Determination of the population of study area

Respondents	Owerri Municipal	SSOM	Owerri North	SSON	Owerri West	SSOW	Total Population
Civil Engineers	12	12	15	14	17	16	44
Architects	28	26	22	21	16	15	66
Quantity Surveyors	15	14	19	18	11	12	45
Builders	10	10	17	16	11	12	38
Artisans	21	20	17	16	19	18	57
Total	86	82	90	85	74	73	250

Key Notes: SSOM= Sample size for Owerri Municipal, SSON= Sample size for Owerri North, SSOW= Sample size for Owerri West.
Source: Researchers' fieldwork, (2019).

In Table 2, a total population of 44 Civil engineers, 66 Architects, 45 Quantity surveyors, 38 builders and 57 Artisans were determined amounting to sample size of 250. The population was chosen based on the registered professionals from their respective professional bodies. Table 3 shows sample size distribution for the three L.G.A in Owerri, Nigeria.

Table 3: Sample Size distribution and calculation for the three L.G.A in Owerri, Nigeria

Respondents	Total Population	PTP	Sample Size	NOQA	NOQR	PQR
Civil Engineers	44	18	40	44	42	17
Architects	66	26	55	66	64	29
Quantity Surveyors	45	18	40	45	44	13
Builders	38	15	35	38	35	17
Artisans	57	23	50	57	55	24
Total	250	100	220	250	240	100

Key notes: PTP = % of Total Population, NOQA= No of questionnaire administered, NOQR= No of questionnaires Returned, PQR= % of questionnaires returned.
Source: Researchers' fieldwork, (2019).

The Table 3 above shows sample size distribution for the professionals. The percent of sample size distribution of Civil engineers was 18%, the Architects =26%, Quantity surveyors=18%, Builders=15%, Artisans =23%, and it was distributed proportionally across the five mentioned professionals in the study area. During the field work 250 questionnaires were distributed among the five professionals according to the proportion of sample size found in each Local Government area. A total of 240 questionnaires were returned.

RESULTS AND DISCUSSION

Based on the need for seasoned woods and its level of importance as a construction material, Figure 2 explains the need and the sustainability of timber in construction by the respondents. The level of importance is scored by 50%. The total of 240 questionnaires was returned, 49 respondents believe in its structurally strength, 36 respondents believe in its natural insulator, 45 respondents believe in its durability, 13 respondents believe in its cost effectiveness, 37 respondents believe in its aesthetic value, 23 respondents believe in its employment features, 30 respondents believe in its fast and efficient to build with. The information is demonstrated on the table below.

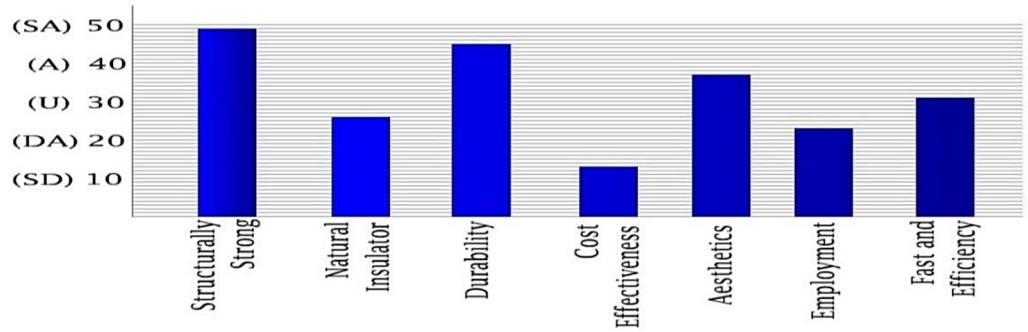

Figure 2: Sustainability of wood in building industry based on the respondents.
Source: Researchers' fieldwork, (2019).

Figure 3 shows the number of respondents on the need of wood in construction industry. The result shows that 18% of Civil Engineers, 27% of architects, 23% of Artisans, 18% of quantity survey, 14% of builders believe that wood has a great value and is well needed in building industry.

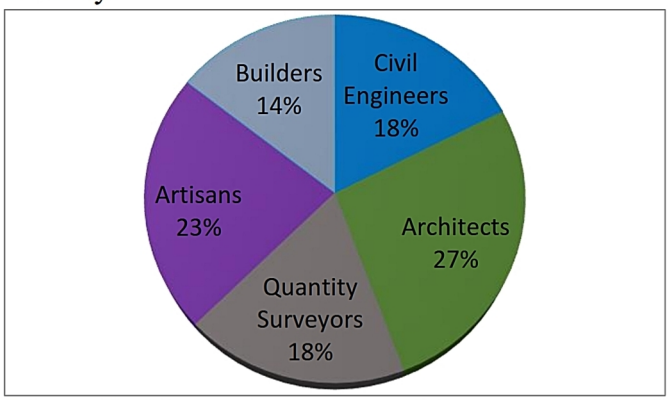

Figure 3: Shows the degrees of the respondents based on the need of wood in building and construction industry.
Source: Researchers' fieldwork, (2019).

The number of respondents was gotten based on the number of returned questionnaires. A total of 240 retuned questionnaires were used for the analysis. The analysis is illustrated in the pie chart diagram

Table 4: Questions asked to respondents to ascertain the use of wood.

OUESTIONS	SA	A	D	SD	Total
Timber acts as a structural material.	182	51	7	0	240
Timber is durable in construction	154	64	15	7	240
Timber has high Aesthetics value	171	49	9	11	240
Timber creates an avenue for employment	185	30	16	9	240
Timber is efficient and fast to build with	151	59	18	12	240
Timber acts as a natural insulator	152	68	17	3	240
Timber is cost effective to build with	169	44	19	8	240
Sub- Total	1164	365	101	50	1680
Total Percentage (%)	69.30%	21.70%	6.00%	2.90%	100%

Key notes: SA = Strongly Agree, A = Agree, D = Disagree, SD = Strongly Disagree
Source: Researchers' fieldwork, (2019).

Table 4 shows some questions asked by the respondents to know the need of wood in building industry. The number of respondents used was the number of returned questionnaire. 240 was the actual number of questionnaires returned and it was used to determine the values. The questions were asked to know the number of people that strongly agree that wood is really a valuable material in building industry. The question is rated on the table above. The result shows that 69.3% strongly agree that wood acts as a valuable material based on the responded questions. The questions were also subjected to 5 point likert scale for assessment shown in Table 5.

Table 5: Respondents' Consensus Opinion in determining the use and importance of Timber

S/N	Survey Statement	Respondents' Ranking				∑F	∑FX Sum	Mean Score	RII	RANK	Consensus Opinion
		SD	D	A	SA						
		1	2	3	4						
1	Timber acts as a natural insulator/structural material	0	7	51	182	240	895	3.73	0.746	1st	Strongly Agree
2	Timber is durable in construction	7	15	64	154	240	845	3.52	0.704	6th	Strongly Agree
3	Timber has high Aesthetics value	11	9	49	171	240	860	3.58	0.716	3rd	Strongly Agree
4	Timber creates an avenue for employment	9	16	30	185	240	871	3.62	0.725	2nd	Strongly Agree
5	Timber is efficient and fast to build with	12	18	59	151	240	829	3.45	0.69	7th	Strongly Agree
6	Timber acts as a natural insulator	3	17	68	152	240	849	3.53	0.708	5th	Strongly Agree
7	Timber cost effective to build with	8	19	44	169	240	854	3.55	0.712	4th	Strongly Agree

Mean ranges: 1- 1.75 = Strongly Disagree, 1.76 – 2.50 = Disagree, 2.51- 3.25 = Agree and 3.26 – 4.00 = Strongly Agree. **Source:** Researchers' fieldwork, (2019).

Table 5 shows Respondents' Consensus Opinion in determining the use and importance of Timber. The respondents strongly agreed that timber is highly valued and a sustainable building material. The results shows "Timber acts as a structural material" ranked 1st with mean score of 3.73 and relative index of 0.746, "Timber creates an avenue for employment" ranked 2nd with mean score of 3.62 and relative index of 0.725, "Timber has high Aesthetics value" ranked 3rd with mean score of 3.58 and relative index of 0.716, "Timber cost effective to build with" ranked 4th with mean score of 3.55 and relative index of 0.712, "Timber acts as a natural insulator" ranked 5th with mean score of 3.53 and relative index of 0.708, "Timber is durable in Construction" ranked 6th with mean score of 3.52 and relative index of 0.704, "Timber is efficient and fast to build with" ranked 7th with mean score of 3.45 and relative index of 0.690. This shows that the respondents strongly agree that timber is a sustainable building material.

CONCLUSION AND RECOMMENDATION

The result shows that 69.3% of the sampled professionals strongly agree that timber is very valuable and a sustainable building material for residential building. Hence in the modern building practice, timber and other wood products are extensively useful in construction as well as prefabricated standard wood cottages. It is an asset in building industry and also valued by all the professionals in the construction industry. A large quantity of wood is consumed in building and installation work for making piles, poles, scaffolds and many loads bearing functions. It is widely used for all purpose especially for structural, aesthetics and functional purposes because of its sustainability features.

This study recommends that government authorities should consider a holistic picture ranging in scale from the science of the cell wall to the engineering and global policies that could maximize forestry and timber construction as a boon to both people and the planet. This will highly promote the rate of wood usage and help to promote the economy and also aid in job creation. Also a good technical knowledge of timber is necessary for its application and its preservation to avoid biodegradation, possible failure of timber structure. Is very vital to subject timber to possible prophylactic treatments inform of seasoning and application of chemical preservatives.

REFERENCES

Amal, G. M. & Halil, Z. A. (2017). The Use of Traditional Building Materials in Modern Methods of Construction (A case Study of Northern Nigeria). *Internal journal of Science Technology and research (IJESTR),* 2 (6) 30-40.

Adesogan, S. O. (2013). Wooden materials in building projects: Fitness for roof construction in southwestern Nigeria. *Journal of Civil Engineering Construction Technology.*4 (7)217-223. Retrieved from https://www.researchgate.net/publication/304394667_Wooden_materials_in_building_projects_Fitness_for_roof_construction_in_southwestern_Nigeria

Abimaje, J. & Baba, A. N. (2014). An assessment of timber as a sustainable building material in Nigeria. International Journal of Civil Engineering, Construction and Estate Management.
1(2)39-46.

Blue Ridge Timber Wrights, (2017). Special timber home living. Designing, creating and raising innovative timber frames worldwide. Retrieved from www.brtw.com

Falk, R. H. (2009). Wood as a sustainable building material. *Forest Products journal*, 59 (9) 6- 12 Retrieved from https://www.fpl.fs.fed.us/documnts/pdf2009/fpl_2009_falk001.pdf 10th July 2019.

Guilhemjouan, (*2013*). History Of Timber In Construction Construction Essay. Retrieved from https://www.uniassignment.com/essay-Samples/construction/history-of-timber-in-construction-construction-essay.php? ref=1.

Heritage Builders Ltd, (2017) (Designing buildings) Share your construction industry knowledge retrieved from http:/www.designbuildings.co.uk/wiki/the_use_of_wood_in_construction. 10th July 2019

Obucina. M; Manja k. K; Dick S. (2017). Use of sustainable wood building materials in Bosnia and Herzegovina, Slovenia and Sweden. University of Sarajevo, Mechanical Engineering Faculty, Department of wood Technology. Retrieved from http://ltu.diva-portal.org/smash/get/diva2:1140697/FULLTEXT01.pdf

Okereke, P. A. (2006). The Use of Sustainable Materials and Equipment for Construction Process. In Proceedings, Thirty- six Annual General Meeting of The Nigerian Institute Of Builders; Sustainable Development and the Built Environment; 13-18.

Sarah, W. (2016). A history of wood from the stone age to the 21st century. The journal of the American Institute of Architects. Retrieved from https://www.architectmagazine.com/technology/products/a-history-of-wood-from-the-stone-age-to-the-21st-century_o

Wacker, J. (2010). Use of wood in buildings and bridges. Wood handbook: Wood as an engineering material: chapter 17. Centennial ed. General technical report FPL; GTR-190. Madison, WI: U.S. Dept. of Agriculture, Forest Service, Forest Products Laboratory. 1-17. Retrieved from https://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr190.pdf