



**SCHOOL OF ENVIRONMENTAL TECHNOLOGY,
FEDERAL UNIVERSITY OF TECHNOLOGY
MINNA, NIGER STATE, NIGERIA**

EDITORS IN CHIEF

R. E. Olagunju

B. J. Olawuyi

E. B. Ogunbode

**SETIC
2020
INTERNATIONAL
CONFERENCE**

BOOK OF PROCEEDINGS

MAIN THEME:

Sustainable Housing And Land Management



3RD -5TH MAY, 2021



**SCHOOL OF ENVIRONMENTAL TECHNOLOGY COMPLEX,
FUT, MINNA, NIGER STATE, NIGERIA**

Chief Host

Prof. Abdullahi Bala. FSSN
Vice-Chancellor:
Federal University of Technology Minna, Nigeria

Host:

Prof: R.E. Olagunju mnia
Dean, School of Environmental Technology
Federal University of Technology Minna, Nigeria

**School of Environmental
Technology International
Conference
(SETIC 2020)**

3RD – 5TH MAY, 2021

**Federal University of Technology Minna, Niger
State, Nigeria**

CONFERENCE PROCEEDINGS

EDITORS IN CHIEF

R. E. Olagunju

B. J. Olawuyi

E. B. Ogunbode

ISBN 978-978-54580-8-4

SETIC 2020 International Conference:

“Sustainable Housing and Land Management”

School of Environmental Technology, Federal University of Technology, Minna
3rd – 5th, May 2021.

Proceedings of the 3rd School of Environmental Technology International Conference (SETIC 2020)

Published by
School of Environmental Technology,
Federal University of Technology Minna.
PMB 65, Minna,
Niger State Nigeria.

© School of Environmental Technology, Federal University of Technology Minna 2021

ISBN 978-978-54580-8-4

Editors-in-chief:	Prof. Olagunju Remi Ebenezer	Federal University of Technology Minna. Niger State, Nigeria
	Dr. Olawuyi Babatunde James	Federal University of Technology Minna. Niger State, Nigeria
	Dr. Ogunbode Ezekiel Babatunde	Federal University of Technology Minna. Niger State, Nigeria
Editors:	Dr. Akande Oluwafemi K	Federal University of Technology Minna. Niger State, Nigeria
	Dr. Sule Abass Iyanda	Federal University of Technology Minna. Niger State, Nigeria
	Dr. Ajayi Oluibukun Gbenga.	Federal University of Technology Minna. Niger State, Nigeria
	Dr. Odumosu Joseph Olayemi	Federal University of Technology Minna. Niger State, Nigeria
	Surv. Adesina Ekundayo A	Federal University of Technology Minna. Niger State, Nigeria
	Mr. Gbenga Morenikeji	Federal University of Technology Minna. Niger State, Nigeria
	Assoc. Prof. Dr. James O.B. Rotimi	Massey University New Zealand
	Asst. Prof. Dodo Yakubu Aminu	Gelisim University Istanbul, Turkey
	Dr. Babafemi Adewumi John	University of Stellenbosch, South Africa

No responsibility is assumed by the Publisher for any injury and/or any damage to persons or properties as a matter of products liability, negligence or otherwise, or from any use or operation of any method, product, instruction, or idea contained in the material herein.

Copyright © 2021 by School of Environmental Technology, Federal University of Technology Minna, Nigeria. All rights reserved.

This publication is protected by Copyright and permission should be obtained from the publisher prior to any prohibited reproduction, storage in a retrieval system, or transmission in any form or by any means, electronic, mechanical, photocopying, recording, or likewise.

SETIC 2020 International Conference:

“Sustainable Housing and Land Management”

School of Environmental Technology, Federal University of Technology, Minna

3rd – 5th, May 2021.

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 and 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 and physical for all poster medium presenters. Our participants are from various Universities and other sector across the globe, from countries like United State of America (USA), Turkey, Malaysia, China, Saudi Arabia, Kenya, New Zealand and South Africa 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.

ACKNOWLEDGEMENTS

The effort put together in achieving the success of SETIC 2020 is predicated on the feat of the first and second edition of School of Environmental Technology International Conference held in 2016 and 2018, respectively. The support and goodwill from Vice-Chancellor of Federal University of Technology, Dean School of Environmental Technology, Dr Dodo Y. A., Dr Moveh S. and many other highly motivated people are highly appreciated.

It is also my privilege and honour to welcome you all, on behalf of the Local Organizing Committee (LOC) to the 3rd edition of the Biennial School of Environmental International Conference (SETIC 2020). This Conference which was earlier schedule for 7th to 11 April, 2020 is holding now (3rd to 5th May, 2021) due to the challenges of COVID-19 Pandemic and the ASUU-FGN crisis which made our public Universities in Nigeria to be closed for about one year. We thank God for keeping us alive to witness the great SETIC2020 event, in an improved form exploiting the new-normal situation posed by the Pandemic for a hybrid (i.e. both physical and virtual) form of Conference participation.

The conference provides an international forum for researchers and professionals in the built environment and allied professions to address fundamental problems, challenges and prospects Sustainable Housing and Land Management. The conference is a platform where recognized best practices, theories and concepts are shared and discussed amongst academics, practitioners and researchers. This 2020 edition of SETIC has listed in the program a Round Table Talk on Housing Affordability beyond COVID-19 with selected Speakers from across the globe available to do justice on the topic of discussion.

Distinguished Conference participants, permit me to warmly welcome our Keynote and Guest Speakers:

- Prof. Ts. Dr. Mohd Hamdan Bin Ahmad, *Deputy Vice Chancellor (Development) Universiti Technology Malaysia (UTM)*;
- Assoc. Prof. Dr. James O.B. Rotimi, *Academic Dean Construction, School of Built Environment, College of Sciences, Massey University of New Zealand*;
- Assoc. Prof. Sr. Dr. Sarajul Fikri Mohammed, *General Manager, Centre for Professional Development and Industrial Project Development School of Professional and Continuing Education (SPACE), UTM-KL*.
- Prof. Ts. Dr. Zanail Abidin Akasah, *Visiting Professor on Sustainable Solar Integrated Design Building Design, International Micro Emission University (IMEU)/HIMIN Ltd. China & Senior Research Fellow, The Architects Resourcery, Jos, Nigeria*;
- Ar. Dr. Elina Mohd Husini, *Department of Architecture, Faculty of Engineering & Built Environment, Universiti Sains Islam*;
- Asst. Prof. Dr. Yakubu Aminu Dodo, *Department of Architecture, Faculty of Engineering and Architecture Istanbul Gelisim University, Istanbul Turkey*

and the five Speakers for our Round Table Talk on “Housing Affordability beyond COVID-19”

- Dr. Muhammad Mustapha Gambo, *Manager, Policy, Research and Partnerships, Shelter Afrique, Nairobi, Kenya*;

SETIC 2020 International Conference:

“Sustainable Housing and Land Management”

School of Environmental Technology, Federal University of Technology, Minna

3rd – 5th, May 2021.

- Prof. Dr. Soumia Mounir, *Department of Architecture Ecole Nationale d'Architecture d'Agadir [The National School of Architecture of Agadir], Morocco*
- Dr. Said Alkali Kori, *General Manager, Projects and Portfolio management, Family Homes Fund, Federal Ministry of Finance, Abuja;*
- Ts. Dr. Sasitharan Nagapan, *Department of Civil Engineering, Faculty of Engineering and Built Environment, Universiti Turn Hussein Onn Malaysia, Malaysia;*
- Dr. Mercy Nguavese Shenge, *AIA Assoc. Historic District Commissioner, City of Rockville, MD, USA.*

for accepting to share from their knowledge, wealth of experience and be available to interact with participants on varied issues on “**Sustaining Housing and Land Management**”.

As reflected on the Conference program, the Conference activities will be Virtual for power point presenters to run in four parallel sessions on the Zoon platform while the participants for Poster presentations (mostly Postgraduate students) are expected to have their Posters displayed in the Environmental Complex Building of the Federal University of Technology, Minna. With a total of One Hundred and One (101) articles captured in the Conference Proceedings covering the seven subthemes of the Conference, I have no doubt that we are all in for an impactful experience at SETIC2020 as we brainstorm, exchange ideas, share knowledge and participate in evolving more approach to sustainable housing and land management drives.

I implore us all to enjoy every moment of the deliberations and ensure we maximize the great opportunity offered by the Conference to network for better research and career development as we also make new friends.

I also on behalf of myself and the LOC express our appreciation to the Dean, School of Environmental Technology and the entire Staff of the School for giving us the opportunity to steer the ship for SETIC2020. To the Reviewers and various Committees that served with us, I say thank you for helping us through despite the pressure of work.

Thanks, and God bless you all.

Olawuyi, B.J. (PhD)
Chairman, LOC
SETIC2020

COPYRIGHT STATEMENT

© Copyright. School of Environment International Conference (SETIC) 2020. The copyright for papers published in the SETIC Conference Proceedings belongs to authors of the papers.

Authors are allowed to reproduce and distribute the exact format of papers published in the SETIC Conference Proceedings for personal and educational purposes without written permission but with a citation to this source. No unauthorized reproduction or distribution, in whole or in part, of work published in the SETIC Conference Proceedings by persons other than authors is allowed without the written permission of authors or organizers of the SETIC Conference.

We have taken all necessary cautions to comply with copyright obligations. We make no warranties or representations that material contained in the papers written by authors do not infringe the intellectual property rights of any person anywhere in the world. We do not encourage support or permit infringement of copyrights / intellectual property rights by authors. Should you consider any violation of your copyrights please do not hesitate to contact the conference secretariat at setic@futminna.edu.ng

SETIC accepts no liability for copyright infringements or inappropriate use of material in any paper published. All authors developed their papers in line with the guiding principles of academic freedom and are responsible for good academic practice when conducting and reporting scientific research.

Correspondence relating to copyrights and requests for permission to use material from the SETIC Conference Proceedings should be made to: Secretariat of SETIC Conference email: setic@futminna.edu.ng

DECLARATION

PEER REVIEW AND SCIENTIFIC PUBLISHING POLICY STATEMENT

3rd May 2021

TO WHOM IT MAY CONCERN

I wish to state that all the papers published in SETIC2020 Conference Proceedings have passed through the peer review process which involved an initial review of abstracts, blind review of full papers by minimum of two referees, forwarding of reviewers' comments to authors, submission of revised papers by authors and subsequent evaluation of submitted papers by the Scientific Committee to determine content quality.

It is the policy of the School of Environmental Technology International Conference (SETIC) that for papers to be accepted for inclusion in the conference proceedings it must have undergone the blind review process and passed the academic integrity test. All papers are only published based on the recommendation of the Reviewers and the Scientific Committee of SETIC

Babatunde James OLAWUYI
Chairman SETIC2020
Federal University of Technology, Minna, Nigeria

Papers in the SETIC2020 Conference Proceedings are published on www.futminna.edu.ng,
AND ALSO SELECTED PAPERS WILL BE PUBLISHED IN REPUTABLE JOURNALS



SETIC 2020 International Conference:

“Sustainable Housing and Land Management”

School of Environmental Technology, Federal University of Technology, Minna

3rd – 5th, May 2021.

ORGANISING COMMITTEE

CHIEF HOST

Prof. Abdullahi Bala
Vice-Chancellor,
Federal University of Technology Minna, Nigeria

HOST

Prof. Olagunju Remi Ebenezer
Dean
School of Environmental Technology,
Federal University of Technology Minna, Nigeria

CONFERENCE CHAIRS

Conference Chair	Parallel Sessions
Dr. Opaluwa D. Y.	Geoinformatics for Land Management
Prof. Kemiki O.	Building Cost Management
Prof. (Mrs) Zubairu S. N.	Gender Issues in Access to Land
Prof. Nuhu M. B.	Access to Finance for Housing and Land Development
Prof. Ajayi M.T.A	Policy Issues for Inclusive and Sustainable Housing
Prof. Sanusi Y.A	Rapid Urbanization, Sustainable Land Use and Spatial Planning
Prof. Jimoh R.A.	Sustainable Building Material

CONFERENCE ADVISORY COMMITTEE

Asso. Prof. Ayuba P.	HOD, Department of Architecture
Prof. Jimoh R.A.	HOD, Department of Building
Prof. Kemiki O.A	HOD, Department of Estate Management and Valuation
Dr. Mohammed Y.	HOD, Department of Quantity Surveying
Prof. Musa A.	HOD, Department of Surveying and Geoinformatics
Dr. Umaru E. T.	HOD, Department of Urban and Regional planning

SETIC 2020 International Conference:

“Sustainable Housing and Land Management”

School of Environmental Technology, Federal University of Technology, Minna

3rd – 5th, May 2021.

LOCAL ORGANIZING COMMITTEE

Dr. Olawuyi B.J.	Chairman	Department of Building, Federal University of Technology Minna, Nigeria
Surv. Adesina E. A.	Secretary	Department of Surveying and Geoinformatics, Federal University of Technology Minna, Nigeria
Dr. Muhammad I.B.	Member	Deputy Dean, School of Environmental Technology, Federal University of Technology, Minna
Dr. Ogunbode E.B.	Member	Department of Building, Federal University of Technology Minna, Nigeria
Dr. Sule A. I.	Member	Department of Estate Management and Valuation, Federal University of Technology Minna, Nigeria
Dr. Akande O. K	Member	Department of Architecture, Federal University of Technology Minna, Nigeria
Dr. Adamu A.	Member	Department of Quantity Surveying, Federal University of Technology Minna, Nigeria
Dr. Ajayi O.O.	Member	Department of Surveying and Geoinformatics, Federal University of Technology Minna, Nigeria
Dr. Morenikeji G.	Member	Department of Estate Management and Valuation, Federal University of Technology Minna, Nigeria
Dr. Mohammed B.B.	Member	Urban and Regional planning, Federal University of Technology Minna, Nigeria
Dr. Hassan I.O.	Member	Department of Building, Federal University of Technology Minna, Nigeria

SCIENTIFIC COMMITTEE

Prof. Musa A.	Chairman	Department of Surveying and Geoinformatics, Federal University of Technology Minna, Nigeria
Mr. Kuma S. S.	Secretary	Department of Estate Management and Valuation, Federal University of Technology Minna, Nigeria
Dr. Bilau A. A	Member	Department of Building, Federal University of Technology Minna, Nigeria
Dr. Ibrahim Saidu	Member	Department of Quantity Surveying, Federal University of Technology Minna, Nigeria
Dr. Musa Haruna	Member	Urban and Regional planning, Federal University of Technology Minna, Nigeria
Dr. Odumosu J. O.	Member	Department of Surveying and Geoinformatics, Federal University of Technology Minna, Nigeria
Dr. Isah A. D.	Member	Department of Architecture, Federal University of Technology Minna, Nigeria

SETIC 2020 International Conference:

“Sustainable Housing and Land Management”

School of Environmental Technology, Federal University of Technology, Minna

3rd – 5th, May 2021.

ACKNOWLEDGEMENT TO KEYNOTE SPEAKERS AND GUEST SPEAKERS

SETIC 2020 organisers wishes to thank our keynote speakers, and Guest speakers for accepting to create time to share from their rich wealth of knowledge and interact with delegates and participants on varied issues being examined at this year’s conference. A brief profile of each keynote speaker is provided here, this would allow for future interaction and networking with them.

 <p>Key-Note Speaker I</p> <p>Prof. Ts. Dr. Mohd Hamdan Bin Ahmad Deputy Vice Chancellor (Development) University Teknologi Malaysia</p>	 <p>KEY-NOTE SPEAKER II</p> <p>Prof. Ts. Dr. Zainal Abidin Akasah (Visiting Professor) Sustainable Solar Integrated Building Design International Micro Emulsion University (IMEU)/HBMW Ltd China & Senior Research Fellow The Architects Renouvery, Abu Nigeria</p>	 <p>Key-Note Speaker III</p> <p>Associate Prof. Dr. James O.B. Rotimi, Academic Dean Construction, School of Built Environment, College of Sciences, Massey University of New Zealand.</p>
 <p>Key-Note Speaker IV</p> <p>Assoc. Prof. Sr. Dr. Sarajul Fikri Mohamed General Manager, Centre for Professional Development and Industrial Project Development School of Professional and Continuing Education (SPACE) UTM-KL Malaysia</p>	 <p>Guest Speaker I</p> <p>Asst. Prof. Dr. Yakubu Aminu Dodo GREM, MyCREST MAARCHES Istanbul Gelsim University, Istanbul Turkey</p>	 <p>Guest Speaker II</p> <p>Ar. Dr. Elina Mohd Husini Department of Architecture Faculty of Engineering & Built Environment, Universiti Sains Islam Malaysia</p>

SETIC 2020 International Conference:

“Sustainable Housing and Land Management”

School of Environmental Technology, Federal University of Technology, Minna

3rd – 5th, May 2021.

ROUND TABLE PANEL SPEAKERS



Round Table Talk
On Housing Affordability Beyond Covid-19

Main Theme

**SUSTAINABLE HOUSING
AND LAND MANAGEMENT**

Dr. Muhammad Mustapha Gambo
Manager: Policy, Research and Partnerships,
Shelter Afrique, Nairobi, Kenya.

Prof. Dr. Soumia Mounir
Department of Architecture Ecole Nationale
d'Architecture d'Agadir [The National School of
Architecture of Agadir] Morocco

Dr. Said Alkali Kori
General Manager, Projects and Portfolio
Management Family Homes Fund Federal
Ministry of Finance, Abuja.

Ts. Dr. Sasitharan Nagapan,
Department of Civil Engineering Faculty of Civil
Engineering and Built Environment Universiti Tun
Hussein Onn Malaysia, Malaysia

Dr. Mercy Nguavese Shenge
AIA Assoc. Historic District Commissioner,
City of Rockville, MD. USA.

Asst. Prof. Dr. Yakubu Aminu Dodo
GREN, MyCREST MAABICHES
Istanbul Gelsim University, Istanbul Turkey
Moderator

SETIC 2020 International Conference:

“Sustainable Housing and Land Management”

School of Environmental Technology, Federal University of Technology, Minna
3rd – 5th, May 2021.



S/N	Title	Author	Page
A	SUB-THEME 1: POLICY ISSUES FOR INCLUSIVE AND SUSTAINABLE HOUSING		1
1	Methodological Approaches to the Socio-Cultural Studies in Residential Estates	Abidoye, K.M. & Sagada, M.L.	2
2	A Critique of the Trusteeship Position of the Governor in the Land Use Act	Bokani, A.M. & Liman, Y.	10
3	E-Procurement Implementation in the Public Construction Sector in Nigeria: A Review	Abdullahi, A., Oyewobi, L., Ganiyu, B. & Shittu, A.	21
4	Assesment of the Prospects and Challenges of E-Procurement Practices on Construction Project Delivery in Abuja, Nigeria	Mobayo, J. O. & Makinde, K. J.	27
5	An Assessment of Users’ Satisfaction with the Adequacy of Security Measures in Mixed-use Buildings in Abuja	Adam A.M. & Olagunju R.E.	35
6	Allocation of Emerging Risks of E-Communication in Public Private Partnership Projects in Nigeria	Bashir, A.S. & Muhammad, A	42
7	Mechanism for Building Standards: Towards an Effective Building Control Practice in the Federal Capital Territory (FCT), Abuja	Fadare, O.A., Isa, R.B. & Bilau, A.A.	49
8	Assessment of Facility Management Practices in Selected Public Health Care Facilities in Niger State	Yusuf S., Bajere P.A. & Ogunbode, E.B.	59
9	Strategies for Disputes Reduction in the Nigerian Construction Process	Aka, A., Omotosho, A.O., & Salisu, O.I.	76
10	Assessment of Energy Conservation Measures in the Design of Postgraduate Student Hostels in Northern Nigerian Universities	Ojochegebe, I. & El-Hussain, A.	84
11	A Review of Housing Potentials in Curbing Pandemic: A Post Covid-19 Analysis	Garnvwa, J. D., Isa-Bala, C. M., Idris, H. A., Mailafiya, B. Y. & Abdulrazak, B.	92
12	Risk Assessment of Safety for Building Construction Projects in Abuja, Nigeria	Mamman, J., Yakubu M., Y., Shittu, A. & Adamu, A.	103
13	Influence of Workforce Diversity on Employee Performance In Construction Firms In Abuja, Nigeria	Anifowose, M.O. & Mohammed, M.N.	113
B	SUB-THEME 2: ACCESS TO FINANCE FOR HOUSING AND LAND DEVELOPMENT		124
14	Energy Pricing and Poverty in Sokoto City, North West Nigeria: A Lesion in Green House Gas Reduction	Ashiru, B., & Sabiu, B. Y.	125
15	Assessment of the Determinants of Risk Management Capabilities and Commitments in Public Private Partnerships Projects	Yamusa, M.A., Abdullahi, M., Bello, A.S.& Bello, A.K.	135



16	Conceptual Framework for an Effective Management of Public-Private Partnership Infrastructure Project Stakeholders to Minimise Project Failure in North Central, Nigeria	Yusuf, B. G., Bashir, O. G., Luqman, O. O. & Abdulganiyu, A. O.	145
17	Assessment of Factors Influencing the Various Procurement Methods in the Delivery of Commercial Building Projects in Abuja, Nigeria	Ibrahim, A. & Shittu, A.	155
18	Assessment of Procurement Risks in FIRS Building Construction Projects in Nigeria	Zubairu, H., & Saidu, I.	163
19	Assessment of the Adoption of Building Information Modelling (BIM) in the Nigerian Construction Industry	Monejo, T. B. & Makinde, J. K.	173
20	Land Use Changing Pattern and Urban Growth Felele Area, Lokoja Nigeria	Balogun J. O.	185
C SUB-THEME 3: SUSTAINABLE BUILDING MATERIALS			197
21	Sustainable Building Material for Green Building Construction and Conservation	Ninalowo, R.O. & Zubairu, S.N.	198
22	Comparative Compressive Strengths of Concrete Using Wood Ash and Cow Bone Ash as Partial Replacement for Cement	Olaleru, J., Baba, T. & Abdullahi, A.	205
23	Assessing Some Mechanical Properties of Reinforcement Bars Made from Recycled Metals as a Panacea to Sustainable Use of Reinforcement as Building Material	Bello, U. and Thabita, S.	212
24	Optimizing the Compressive Strength of Binary Mixtures of Laterite-Sand Cement Mortar	Adetona, A. & Alao, T.O.	219
25	Assessment of Lean Techniques for Building Materials Waste Minimisation in Abuja, Nigeria	Ango, A. & Saidu, I.	228
26	Evaluation of the Significance of Timber as a Source of Sustainable Building Material in Owerri, Nigeria	Emechebe, L.C., Eze, J. C. & Akande, O.K.	238
27	Evaluation of the Compressive Strength of Concrete Using Bush Gravel as Coarse Aggregates Partially Replaced with Broken Bricks	Baba, T., Olaleru, J., & Alhaji, B.	247
28	Influence of Magnesium Sulphate on the Compressive Strength of Internal Cured (IC) Rice Husk Ash based High Performance Concrete	Mudashiru, S. A., Olawuyi, B. J., Ayegbokiki, S. T., & Ndayako, S.K.	253
29	Influence of Material Waste Management on Construction Project Delivery in Abuja, Nigeria	Garba. Y. Y., Yisa. S. N. & Umar. M. I.	261
30	Effective Implementation of Health and Safety Practices on Construction Site: Barriers and Movers	Eigege, J., Aka, A. & Agbo, A.E.	266
31	Utilization of Quarry Dust as Partial Replacement of Sand in Sandcrete Blocks	Garba, A., Saidu, A., Adamu, A.I. & Dalhat, A.S.	272



32	Assessment of Shredded Waste Poly-Ethylene Terephthalate (PET) Bottles Usage as Coarse Aggregate in Lightweight SHA Based Concrete Composite	Daniya N. S., Ogunbode E. B., Yahaya T. A. & Alao T.O.	278
33	Characteristics and Properties of Rice Husk Ash Based Fibrous Concrete Manufactured with Waste Metallized Plastic Film Fibre	Ogunbode E. B., Alhaji_Minin, N., Shehu M. A. & Lukman, M.L.	286
34	Evaluation of Shear Bond Strength of Geopolymer Mortar Containing Cassava Peel Ash and Metakaolin	Wuna, M.A., Nmadu, H.G., Ogunbode, E.B. & Mohoro, I.S.	295
35	Determination of the Compressive Strength Properties of Alkali-activated Millet Husk Ash - Calcium Carbide Mortar	Onuche, G., Olawuyi, B. J. & Saka, R. O.	303
36	Compressive Strength Characteristics of Mortar Containing Pulverised Volcanic Ash and Metakaolin as Cement Replacement	Hassan, I.O., Ali, S.U. & Yunusa, A.	312
37	Piping Investigation of Kiri Dam Located in Shelleng L.G.A, Adamawa State, Nigeria, Using SEEP/W	Ahmed Bafeto Mohammed	322
38	Assessment of Sustainable Traditional Building Materials to Modern Residential Housing in Ibadan, Oyo State, Nigeria	Agboola, B.A. & Eze, J.C.	330
39	Evaluation of the impact of the Use of Roof Concrete Fascia on Embodied Carbon Emission of Residential Buildings in Nigeria	Udomiaye, E., Odom, C.U., Umuogbara, R.E., Kalu C. K., Ntaji, P. & Unyime, I.	341
D	SUB-THEME 4: BUILDING COST MANAGEMENT		349
40	Influence of Supervision on Labour Productivity of Finishing Works in Ibadan, Oyo State	Jibril, H.I., Saidu, I., Alhassan, M.I. & Mohammed, M. N.	350
41	Analysis of Stakeholder Management of Construction Project in Abuja, Nigeria	Alayande, A. & Ola-awo, W.	359
42	Factors Influencing Building Materials Price Fluctuation in Abuja, Nigeria	Omede, V., & Saidu, I.	369
43	Assessment of the Effect of Materials Procurement Risks Factors on Time, Cost and Quality Performance of Building Projects in Abuja, Nigeria	Muhammad, M. C., & Saidu, I.	379
44	Participation of Female Quantity Surveyors in the Nigerian Construction Industry	Nnamoko, C., & Ola-awo, W.	390
45	Effects of Skill Gap on Labour Productivity on Construction Sites in Abuja	Bilau, T.O. & Bamgbade, A.A.	398
46	Evaluation of Cost Management in Building Maintenance by Contractors	Bello, U. & Nasir, G.	405
47	Effect of Cash Flow on Contractors' Performance in Building Construction Projects in Niger State	Alhassan, I., Shittu, A., Mohammed, M. & Jibri, I. I.	411
48	Assessment of Cost Control Techniques on Road Construction Project Delivery in FCT Abuja, Nigeria	Alabi, S.S., Anifowose, M.O. & Ochepe, S.	420



49	Cost of Implementing Health and Safety Measures in Construction Projects in Abuja, Nigeria	Hassan, K.M., Mohammed, Y.D. & Nmadu, H.G.	428
50	Conceptual Framework for an Effective Management of Public-Private Partnership Infrastructure Project Stakeholders to Minimise Project Failure in North Central, Nigeria	Gognaje, Y.B., Ganiyu, B.O., Oyewobi, L.O. & Oke, A.A.	434
51	An Evaluation of the Challenges of Tendering Procedures on Building Projects in Kaduna, Nigeria	Usman, F.A.; Adamu, A.D. & Saidu, I.	443
E SUB-THEME 5: SUSTAINABLE AND RESILIENT CITIES			451
52	Integration of Passive Energy Efficient Design Elements for Office Complex, Abuja, Nigeria	Idris, M. & Muhammad, I.B.	452
53	Liveability of Public Housing in Nigeria: A Study of Residents’ Satisfaction in Some Selected Public Housing Estates in Niger State	Haruna, P.B. & Zubairu, S.N.	460
54	Assessment of Climate Responsiveness of Public Office Buildings Designs in Selected Tertiary Institutions in Niger State towards Energy Efficient Buildings in Nigeria	Adebisi, G.O. & Alonge, D.O.	470
55	The Characteristics of Kaduna Metropolitan Solid Waste Management Practices	Habila, S.K. & Rikko, L.S.	478
56	Assessment of Crime Prevention through Environmental Design (CPTED) in Shopping Malls in Nigeria: A Case of Ceddi Plaza Abuja, Nigeria	Aliyu, U. & Zubairu S. N.	488
57	Assessment of Eco-Friendly Principles in the Design of a 3 Star Hotel at Life Camp in Abuja, Nigeria.	Ogwanighie .O.A. & Abdulrahman .M.E.	499
58	Climate Change Adaptation and Sustainable Eco-Friendly Urban Mass Transit Development in Abuja, Nigeria	Dukiya, J.J.	510
59	Water Scarcity Problem and Households’ Adaptation Strategies: Evidence from Literature	Owuri, A. & Sanusi, Y.A.	521
60	Assessment of the Resilience-related Capabilities of Households in Bida Town, Niger State, Nigeria	Usman, M. Y. , Saidu, M. B. & Yahaya, S.	531
61	Appraisal of Households’ Resilience to Social Shocks in Bida Town, Niger State, Nigeria	Usman, M. Y., Aliyu, A. A. & Wanciku, Y.	540
62	A Review of Sustainable Energy Conservation for Residential Buildings	Adeniji, S.M., Muhammad, I.B. & Isah, A.D.	550
63	Assessment of an Integrating Design Approach of Passive Cooling Principles in Hotels in Minna, Nigeria	Ioron, S. & Ayuba, P.	560
64	Evaluation of Market Fire Hazard Awareness and Preparedness in Minna Metropolis	Ayinla K., Akanmu W. & Oyerinde D.	569
65	Employing Proxemics Communication Strategies in Evaluating Prototype Design in Educational Buildings	Kabir, M.A., Alkali, I.A., El-nafaty, A.S. & Dodo, Y.A.	579



67	Behaviour and Functioning of Children Hospitalized in Nigerian Conventional Hospital Ward Setting	Usman B.W., Ojobo, H., Umar, A., Isa, A.A. & Ogunbode E.B.	597
68	Indoor Occupancy Detection using Machine Learning Techniques	Aliyu, A. A., Ojobo, H., Nusa, D. J. & Dodo, Y. A.	607
69	Assessment of Factors Affecting Performance of Construction Organisations in Abuja, Nigeria	Okigbo, O. N., Saidu, I., Olawo W. A. & Adamu, A. D.	615
70	Project Managers’ Performance on Sustainable Construction of Residential Estates in Abuja, Nigeria	Belgore, U. & Makinde, J. K.	623
71	Residential Property Use Conversion and Rental Value Trends in Osogbo, Nigeria	Ankeli, A. I., Nuhu, M. B. , Sule, A. I., Popoola, N. I., & Ankeli, U. C.	633
72	Evaluation of Passive Cooling Design Considerations in Faculty of Basic Medical Science Buildings in Northern Nigeria	Usman, S. M & Ayuba, P.	642
73	Policy Issues and Integration Settlement for Sustainable Development in FCT Abuja	Unah, M. O	650
74	Assessment of Design Method on Fire Prevention Strategies for High Rise Buildings in Lagos, Nigeria	Muhammad R. & Eze, J. C.	659
75	Evaluation of Factors Influencing the Adoption of Building Information Modelling for Facility Management in Abuja, Nigeria	Adelusi, C., Adamu, A. D. & Shittu, A.	667
76	Assessment of Shared Parking in Mixed-Use Buildings in Kano State	Iklimah, S. & Salihu, S.	678
77	Influence of Urban Recreational Facilities Quality on Domestic Urban Tourists Patronage of Parks in Abuja City, Nigeria	Mohammed, B.B., Akanbi, M., & Mohammed, M.	686
78	Passive Design Strategies for Sustainable Operation of NYSC Camp Buildings, Minna, Nigeria	Adedayo D. I. & Akande O. K.	692
79	Integration of People’s Perception of Landscape in the Design of Recreational Parks, Minna, Nigeria	Aboh, M.E., Muhammad, I.B. & Isah, A.D.	700
80	Impacts of Urban Poultry Farm Activities on Water Quality in Kuje Suburbia, Abuja	Auta, F.D. & Musa, H.D.	710
81	An Analysis of the Relationship between Neighbourhood Ties and Crime Perception in Minna, Niger State	Abdullahi, M. U. & Musa, H.D.	717
82	User Centred Approach to Interactive Architectural Spaces For Sustainable School of Architecture Buildings in Nigeria	Gana, G. & Akande, O.	723
83	Integration of Interactive Spaces in the Design of an Autism Centre, in Kaduna State, Nigeria	Saliu, S.R. & Eze, J.C.	732
84	Assessment of Green Design Strategies in Tech Innovation Hubs in Abuja, Nigeria	Ndanusa, A.M. & Zubairu, S.N.	740



F	SUB-THEME 6: GEOINFORMATICS FOR LAND MANAGEMEN	748
85	Solid Waste Disposal Site Suitability Analysis within Jalingo Metropolis, Taraba State, Nigeria	Gbedu, A.M., Atenji, D. E. & Adeniyi, G. 749
86	Development of a Geospatial Information Software for Cadastral Survey Data Processing and Management	Ajayi, O.G., Ajibade, S.A. & Abdullahi, A.K. 758
87	Application of Location Based Service for flood Vulnerability Assessment of Part of Minna, Niger State, Nigeria	Adesina, E.A., Adewuyi A. I. & Berthran C. B. 768
88	Flood Inundation Mapping of Gbaganu Area Minna, Niger State	Adesina, E.A., Saka T. T., Adewuyi A. I., Ayoade S.A and Ayandegi, M.A 779
89	Spatio-Temporal Analysis of Urban Sprawl and its Impact on Economic Trees in Gidan Mangoro-Minna, Niger State, Nigeria	Hauwa Ahmed Ndagi. 783
90	Appraisal of Informal Access to Land for Housing Delivery in Karu Urban Area of Nasarawa State, Nigeria	Sulyman A. O., & Danladi A. A. 793
91	Automatic Extraction of Farmland Boundary Lines from Satellite Imagery Using Fully Convolutional Networks – A Review	Isa, A.M. & Ajayi, O.G. 804
92	Prospectivity Mapping for Gold (Au) Mineralization Using LandsAT 8 OLI Data in Part of Niger State, Nigeria	Aransiola, A. B. & Odumosu, J. O. 814
93	Assessment of Geothermal Potential Within the Basement Region of Kogi State, Using Aeromagnetic Data	Fidelis I. K. & Adetona, A. A. 823
94	Delineation of Structures for Solid Minerals within Kubil (Sheet 128) and Wawa (Sheet 159) North Central, Nigeria from Aeromagnetic Data	Kolo, Y.R., Abbas, A.A. & Salako, K. 830
95	Effects of Density of Ground Control Points on the Accuracy of Maps Produced Using UAV: A Review	Muhammad, B. & Musa, A. 837
96	Factors Influencing Land Use Changes and Conversion: A Critical Review	Gwamna, E., Usman, M., Salihu, N. & Alalade, G. 845
97	Valuation of Agricultural Properties: Empirical Evidence from OXFARMS Minna, Nigeria	Olatunji, A., Adama, U., Adoga, O., Ojetunde, I. & Shittu, A. 854
98	Application of Electrical Resistivity Method to Delineate Construction Sites at Gidan Kwano Campus, FUT, Minna, Niger State, Nigeria	Ebute, O.R., Alhassan, U.D. & Rafiu, A. A. 865
99	Computational Fluid Dynamics (CFD) Investigation of Pressure Drop across Highly Porous Metallic Structure	Muhammad, M.S. & Otaru, A.J. 875



100	Delineation of Solid Mineral Structures within Upper Part of Nasarawa State from Aeromagnetic Data	Uchenna, C. I. & Abass A. A.	881
101	Evaluation of Passenger Perception of Public Transport Hubs in Abuja-Nigeria	Aminu, B.A. & Eze, J.C.	891
102	An Empirical Approach For Determination of Building Stability Using CORS Data	Adeniyi, G., Gbedu, A. M. & Opaluwa, Y. D.	898
103	Industrial Excavation Pits and its implications on enhancing Sustainable Land Management in Nigerian Cities: A Case Study of Bida Urban Area	Tabiti, S. T., Aremu, S. & Daramola, J.	907
G	SUB-THEME 7: RAPID URBANIZATION, SUSTAINABLE LAND USE AND SPATIAL PLANNING		920
104	Influence of Igala Culture on Spatial Relationships and Space Distributions within Households in Anyigba Kogi state	Musa, I. A. & Muhammad, I. B.	921
105	Assessment of Fire Safety Compliance (FSC) in Nigerian Markets: Case Study of Selected Markets in Three (3) Geopolitical Zones	Longtau, P., Majidadi, T. S. & Arowolo, T.	930
106	Evaluation of Passive Security Measures for Tourism Development in Nigeria	Hayes, N.Y. & Isah, A.D.	939
107	Terrain Analysis for Effective Spatial Coverage of FM 92.3Mhz Signal in Minna Metropolis	Gbedu A.M., Adeniyi, G., & James, I.S.	947
108	Effect of Urban Land-Use Planning Regulations on Residential Property Investment Returns: Evidence From Literature	Salihu, N., Nuhu M. B., Sanni M. L., Sule I. A. & Emmanuel S. G.	954
109	Potentials of Effective Urban Planning as Tool for Disaster Risk Reduction in Nigeria	Sanni, L. M.	963
110	Analysis of Urban Densification and Housing Market in Bida, Niger State, Nigeria	Mohammed, J.K. & Sulyman, A.O.	972
111	Exploring Community-Based Facilities Management Principle Towards a Sustainable Urban Land Management in Minna	Adama, U.J., Morenikeji, G., Kemiki, O.A., Popoola, N.I. & Ajayi, M.T.A.	982
112	Management Options for Some Selected Peri-Urban Areas of Kaduna Metropolis, Kaduna State, Nigeria	Habila, S. K	989
113	Assessment of Household Knowledge and Practice of Solid Waste Characterization in Kaduna Metropolis	Yakubu, K. N. & Babagana, A.	999
114	Assessment of Indoor Thermal Performance for Sustainable Senior Housing Facility in Minna, Nigeria	Idiagi, E. & Ayuba, P.	1009
115	Nexus between Social Infrastructure and Residents Wellbeing: A Review	Ijuo, S. & Musa, H. D.	1020



116	Impact of the Land Use Act on Sustainable Housing Development in Nigeria from 1978-2018	Bokani, A.M. & Mohammed, A.W.	1029
117	SQL-Driven Spatial Database Transactions in Support of Compulsory Land Acquisition for Road Expansion Projects	Ataguba, J.O. & Kemiki, O.A.	1040
118	Africa’s Population Growth: Adopting the Smart City Model in Nigeria as a Blueprint for its Future Cities	Ezeugwu, N.C. & Isah, A.D.	1050
119	Appraisal of Landscape Elements within the Hospital Environment in Lokoja, Nigeria	Isah, O.S. & El-hussein A.S.	1063
120	Enhancing the Hospital Environment through Healing and Therapeutic Landscape in Hospital Design	Isah, O.S. & El-hussein A.S.	1067



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

Emechebe, L.C.^{1a}, Eze, J. C.^{1b} & Akande, O.K.^{1c}

¹Department of Architecture, Federal University of Technology, Minna

^aemechebechioma@yahoo.com; ^bezechuks@futminna.edu.ng; ^cfkande225@googlemail.com

Corresponding Author: Email Address: emechebechioma@yahoo.com

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 its 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)

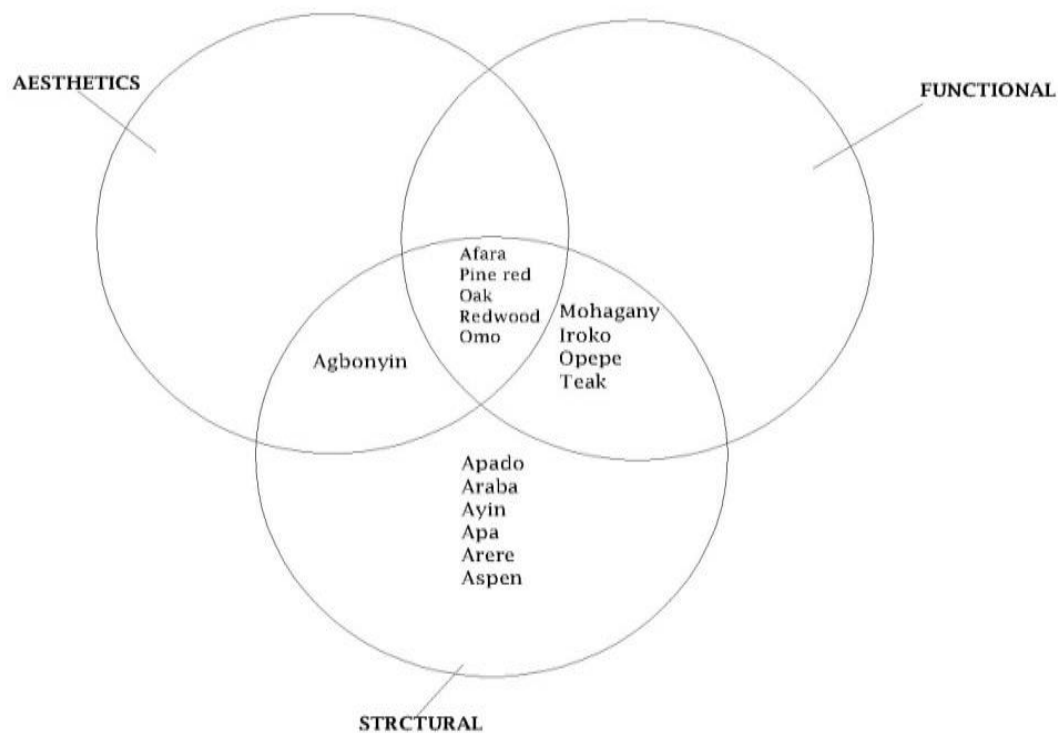


Figure 1: Diagram shows the purpose of various woods in building construction.

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.

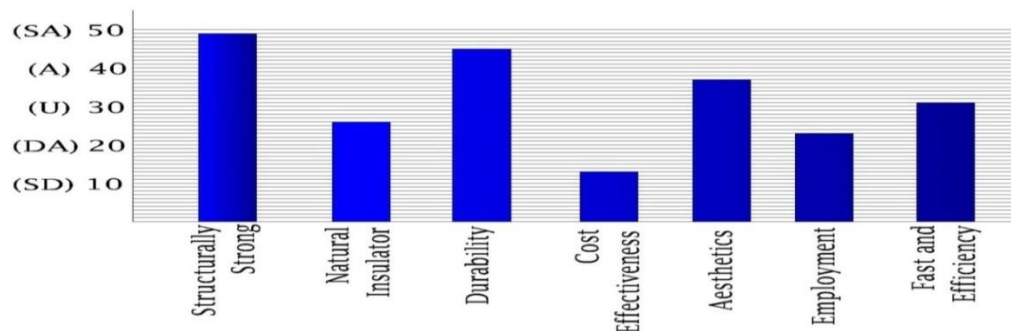


Figure 2: Sustainability of wood in building industry based on the respondents.

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.

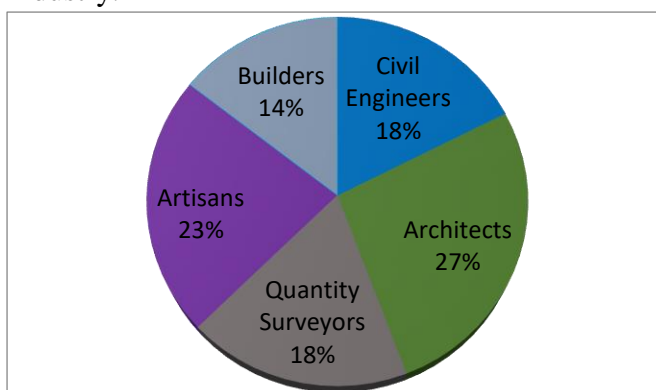


Figure 3: Shows the degrees of the respondents based on the need of wood in building and construction industry.

Source: Researchers' fieldwork, (2019).

The number of respondents was gotten based on the number of returned questionnaires. A total of 240 returned 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.

QUESTIONS	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				ΣF	ΣFX 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://tu.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