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ARCHITECT'S RESPONSE ON UTILISATION OF INTERLOCKING STABILISED SOIL BLOCKS AS AN ALTERNATIVE BUILDING MATERIAL FOR HOUSING PROJECTS IN SOUTHWEST NIGERIA

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ABSTRACT

Housing has become a major concern in Nigeria and requires sustainable intervention. The United Nations' position on the advantages of Interlocking Stabilised Soil blocks (ISSBs) in the year 2009 is fundamental to its usage for affordable housing delivery in developing nations. Considering the fact that the recent global economic challenges impacted the Nigerian economy, housing, recorded to be deficient by the Ministry of Housing in 2015 is a concern due to the tremendous rise in the cost of materials. This study assessed architects' response to the adoption of ISSBs as an alternative building material for Housing Projects in Southwest Nigeria towards recommending its widespread adoption for economical building construction works. The objectives were; to examine the role of architects in building material specifications; to explore characteristics of ISSBs that make them viable as an alternative building material, and to assess architects' response to the adoption of ISSBs. The study adopted a Mixed Method of Research in carrying out the assessment. Relevant literature was reviewed and necessary data were collected through interviews granted to the targeted respondents towards providing in-depth knowledge of ISSBs. Structured Questionnaires were administered to architects who are lecturers in selected schools of architecture who are members of the Association of Architectural Educators or registered with the Architects Registration Council of Nigeria. A total of 66 questionnaires were returned from the 70 administered. Findings revealed that architects have a huge role in building material specifications. ISSBs offer a passive solution to building challenges (better thermal comfort, quality indoor environment and low construction and maintenance cost). ISSBs were recommended for exploration beyond walling systems considering roofing and flooring systems. The level of skillfulness required for a successful construction using ISSBs and the efficiency of equipment used in the production were recommended for further study.

Keywords: Building Cost, Economical Building Materials, Interlocking, Low-Cost Construction, Maintenance

INTRODUCTION

The housing situation in the nation is of great concern and has been greatly impacted by the choice of building materials, weather condition, economic instability, machine equipment and expert operators in the building construction industry. Indigenous building materials like the use of earth has been neglected over time. Earth is an advantageous building material starting the discuss from its availability and flexibility such that it does not require high level experts for its use.

Interlocking Stabilised Soil blocks (ISSBs) is one of the enormous building materials earth offers. ISSBs is a cutting-edge building technique which uses dry stacking processes and locally sourced raw materials like sand and laterite to produce beautiful and long-lasting bricks with little or no cement. Interlocking Stabilized Soil Blocks (ISSB) are made from hydraulically or manually compacted laterite or earth/mud (Ibitoye, Alagbe, & Dare-Abel, 2022). The adoption of Interlocking Stabilised Soil blocks (ISSBs) has been challenged by its competing building material, sandcrete blocks. Sandcrete blocks is said to be generally acceptable due to its wide spread of use in the building industry (Sholanke, Fagbenle, Aderonmu, & Ajagbe, 2015). Sandcrete blocks are composed of sand, water, and a binder. Cement, often used as a binder, is the expensive indices in sandcrete block production.

The Nigerian Raw Materials Research and Development Council addressed the need of using locally produced building materials instead of imported ones when discussing the availability of indigenous building materials. ISSBs is not just one type of material that can be used as a substitute for sandcrete blocks in Nigeria. Other materials such as sundried (Adobe), soil blocks, burned clay bricks and blocks, mud and straw, lime, and stone crete blocks can also be used in its place. ISSBs offers a wide range of advantage over the generally accepted sandcrete blocks ranging from availability of raw materials, time benefits such as speed in construction, its flexibility, better thermal quality, does not require expert technicians, low maintenance cost, better indoor quality and aesthetically appealing (Ibitoye et al., 2022).

In recent years, there has been a resurgence of renewed research interest in ISSBs because of their distinctive strengths, such as structural integrity, thermal transmittance, and durability, which make the material an excellent walling material when compared to other masonry materials currently used in construction (Sadek, & Roslan, 2011). The interlocking stabilized soil block is a cutting-edge material that employs avant-garde technology to make it possible to construct building walling systems without the use of traditional binders like mortar and gums. The consumption of cement for building walls can be drastically reduced, thanks to this modern technique (Ibitoye et al., 2022).

The adoption of ISSBs has been greatly influenced by users' perception, technological know – how, flexibility in construction and aesthetic concerns. This study examines architect's response on its adoption as an alternative building material.

This study assesses architects' response to adoption of Interlocking Stabilised Soil Blocks (ISSBs) as an Alternative Building Material for Housing Projects in Southwest Nigeria towards recommending its widespread adoption for economical building construction works. It examines the role of the architect in the choice of building materials for housing construction.

It explores characteristics of ISSBs that make it viable as an alternative building material and also assesses architects' response to adoption of ISSBs as an alternative building material.

Most of the conventional building materials are unaffordable to a developing nation like Nigeria. It is therefore imperative to examine alternative building materials that are as efficient as the conventional building materials or even more efficient and affordable. Interlocking Stabilised Soil Blocks (ISSBs) as one of the alternative building materials adopts dry stacking method during wall construction, and offers other advantages like better thermal comfort, which reduces Heating Ventilation and Cooling (HVAC) costs thereby drastically reducing the building overall cost. There are other affordable building materials with more efficiency than the conventional building materials that need to be examined and proposed for adoption. This study thus focuses on examining the architects' response to the adoption of ISSBs as one of the alternative building materials.

This study focuses on assessing Architects' response to adoption of ISSBs as an Alternative Building Material for Housing Projects in Southwestern Nigeria considering architects in selected Universities (University of Lagos (UNILAG), Akoka; Ladoke Akintola University of Technology, Ogbomoso (LAUTECH); Bells University of Technology (BELLSTECH), Ota, and Caleb University, (CUL), Imota in the Southwestern Nigeria. The institutions selected are chosen from the categories of universities in Nigeria as extracted from the NUC report, 2022. The University of Lagos, Akoka is in the category of Federal institutions; LAUTECH is a state government institution, while BELLSTECH and CALEB UNIVERSITY are Private institutions.

METHODOLOGY

The study adopted Mixed Method of Research (MMR) in carrying out the assessment. Relevant literature was explored in providing in-depth knowledge of ISSBs. Interviews were granted and questionnaires were administered to architects who are lecturers in selected schools of architecture in Southwest Nigeria and are registered with either the Architect's Registration Council of Nigeria (ARCON) or Association of Architectural Educators (AARCHES).

The sample population for this study was taken from the selected institutions in Nigeria as extracted from the NUC report, 2022. The University of Lagos, Akoka is in the category of Federal institutions; LAUTECH is a state government institution, while BELLSTECH and CALEB UNIVERSITY are Private institutions.

The sample size for the study (Architects who are lecturers in the department of Architecture and are either registered with ARCON or AARCHES) was determined from the targeted respondents in the selected universities. The number of lecturers in the department was adapted from the institutions' handbook.

Table 1: Sample population

S/N	Name of Institution	Lecturers in the Dept of Architecture	Lecturers registered with ARCON or AARCHES	Sample size
1	(University of Lagos, Akoka (UNILAG)	24	24	70
2	Ladoke Akintola University of Technology, Ogbomoso (LAUTECH)	22	20	
3	Bells University of Technology, Ota (BELLSTECH)	28	22	
4	Caleb University, Imota (CUL)	27	19	
	Total	**99**	**85**	

The Taro Yamani sample size method was employed to determine the appropriate sample size in this study. Where" n" is the sample size,

"N" is the population of the study = 99 units

"e" is the significant level (i.e., 95% or 5%)

Using significant level of 5%, the sample size for the study is

Substituting the value accordingly,

$n = \frac{85}{1+85(0.05)^2} = 70.10$ units

Therefore, sample size is equal to 70

Table 2: Methodology used

Objective	Methodology used	Analysis
Explore the role of architect in the choice of building materials for housing construction.	Interview and literature review	Content analysis
Assess the Characteristics of ISSBs that makes it viable as an alternative building material.	Literature review	Content analysis
Assess architects' response to adoption of ISSBs as an alternative building material.	Questionnaire and Literature review	Statistical analysis and Content analysis

RESULTS AND DISCUSSIONS

Role of Architects in the choice of building materials for housing construction

Generally, architects' role on a project starts with brief documentation to the development, construction and to also coordinate ally professionals to achieve the project goal and to help the clients in decision making (CORTES, 2018). Material specification is one of architects' key responsibilities. Architects are vast in the knowledge of building materials and regulations; and thus, can recommend the appropriate materials most applicable to the building type, construction method employed and the building function. The choice of materials is influenced by several factors beyond aesthetics. Building regulations and standard codes, material

properties, building form, architectural elements, cost, neighborhood profile, culture, climate, historical value, user type, durability and resistance against weather are factors considered before the selection of a material. The Characteristic value of building materials dictates its use (Almusaed, 2015).

Architects help in the decision-making process of the choice of building materials. Architecture is art and science which allows for technical reasoning and creates a balance to relate with clients and other building allies who may be one sided. Building materials should offer passive solutions like better thermal comfort and indoor air quality offered by Interlocking Stabilised Soil Blocks (ISSBs).

Participation of professional bodies in the promotion of Alternative Building Materials

Educators in architecture institutions must have been registered with the Architects Registration Council of Nigeria (ARCON) which certifies them as experts. Association of Architectural Educators (AARCHES) influences the choice of building materials through the students' study curriculum. Students get familiar with what they were taught in school first before exploring other available options. Only a few students go the extra mile to explore alternative building materials. Academic curriculums should be updated with an increase in the discovery of alternative building materials. Students, with the aid of their supervisors could test the viability of these materials as a project and present their results at seminars to recommend further actions be it further study, practical or present the materials to be viable and fit for use.

Characteristics of ISSBs that makes it viable as an alternative building material

Construction and Maintenance Cost of ISSBs

A typical earthen house's building cost is influenced by the cost of stabilizers, transportation needs, labour availability (if necessary), and the involvement of engineers and designers (Kulshreshtha, 2020). The drastic reduction in cement consumption and other industrial materials reduces the construction costs drastically (Jagadish, 2005, Adedeji, 2008, & Alagbe, 2009), (Ibitoye, et al, 2022). ISSBs saves cost through its dry stack construction method which requires no mortar for locking and bonding of blocks and with no need for plastering and rendering of walls. ISSBs also saves maintenance costs as it does not require painting of walls. Polish for cleaning of ISSBs are affordable.

Thermal Comfort

Houses constructed with ISSBs control indoor humidity and temperature, resulting in a suitable indoor environment throughout the year. This was deemed to be the most advantageous feature of houses constructed with Interlocking Stabilized Soil Blocks (Hanafi, 2021).

Indoor Air Quality

The wellness and efficiency of building occupants is affected by the indoor environmental quality. Indoor environmental quality is influenced by the choice of building materials used. Building materials release toxic waste that affects the occupants' health. The major constituent of ISSBs is earth which is a natural material that aligns and supports the wellbeing of humans and provides a quality indoor environment. A better indoor quality can be achieved most effectively by choosing building materials with low off-gassing potential, employing effective ventilation techniques, allowing for sufficient access to daylight and views, and ensuring maximum comfort through the management of lighting, humidity, and temperature levels (Kibert, 2016).

Users' Perception

Buildings with Interlocking Stabilized Soil Blocks are perceived to be housing for the poor. ISSBs is an alternative building material with immense contribution to sustainability through its self-sustaining or passive measure of cooling, reuse, and better indoor air quality. The indoor climatic conditions of ISSB-built homes are superior to those of other contemporary building materials (Ombiro, 2018).

Architects' Response to Adoption of ISSBs

Table 3: Assessing technical know-how of workers using ISSBs

Variable		Frequency	Percentage
Technical know how	Strongly disagree	4	6.06
	Disagree	5	7.58
	Neutral	1	1.51
	Agree	14	21.21
	Strongly agree	42	63.64
	Total	**66**	**100**

Table 3 above shows the distribution of the respondents assessing technical know-how of workers using ISSBs. 4 respondents which constitutes 6.06% of the respondents strongly disagree that workers using ISSBs are skilled; 5 respondents which constitutes 7.58% of the respondents disagree that workers using ISSBs are skilled; 1 respondent which constitutes 1.51% of the respondents is neutral; 14 respondents which constitutes 21.21% of the respondents agree that workers using ISSBs are skilled while 42 respondents which constitutes 63.64% strongly agree that ISSBs workers are skilled and do not require intensive technical training.

However, results from this study shows that ISSBs workers do not require intensive technical training.

Table 4: Assessing flexibility during construction using ISSBs

Variable		Frequency	Percentage
Flexibility during construction	Strongly disagree	8	12.12
	Disagree	21	31.82
	Neutral	8	12.12
	Agree	26	39.39
	Strongly agree	3	4.55
	Total	**66**	**100**

Table 4 above shows the distribution of the respondents assessing flexibility of ISSBs during construction. 8 respondents which constitutes 12.12% of the respondents strongly disagree that ISSBs are flexible during construction; 21 respondents which constitutes 31.82% of the respondents disagree that ISSBs are flexible during construction; 8 respondents which constitutes 12.12% of the respondents are neutral; 26 respondents which constitutes 39.39% of the respondents agree that ISSBs are flexible during construction; while 3 respondents which constitutes 4.55% of the respondents strongly agree that ISSBs are flexible during construction.

However, results from this study shows that ISSBs are flexible during construction.

Table 5: Assessing structural stability of ISSBs in construction.

Variable		Frequency	Percentage (%)
Structural stability	Strongly disagree	4	6.06
	Disagree	9	13.64
	Neutral	3	4.55
	Agree	9	13.64
	Strongly agree	41	62.12
	Total	**66**	**100**

Table 5 above shows the distribution of the respondents assessing structural stability of ISSBs during construction. 4 respondents which constitutes 6.06% of the respondents strongly disagree that ISSBs are structurally stable; 9 respondents which constitutes 13.64% of the respondents disagree that ISSBs are structurally stable; 3 respondents which constitutes 4.55% of the respondents are neutral; 9 respondents which constitutes 13.64% of the respondents agree that ISSBs are structurally stable; while 41 respondents which constitutes 62.12% of the respondents strongly agree that ISSBs are structurally stable.

However, results from this study shows that ISSBs are structurally stable.

Table 6: Assessing sustainability (reuse) of ISSBs in construction.

Variable		Frequency	Percentage
Sustainability (Reuse)	Strongly disagree	5	7.58
	Disagree	3	4.55
	Neutral	2	3.03
	Agree	9	13.64
	Strongly agree	47	71.21
	Total	**66**	**100**

Table 6 above shows the distribution of the respondents assessing the reuse of ISSBs. 5 respondents which constitutes 7.58% of the respondents strongly disagree that ISSBs are reusable; 3 respondents which constitutes 4.55% of the respondents disagree that ISSBs are reusable; 2 respondents which constitutes 3.03% of the respondents are neutral; 9 respondents which constitutes 13.64% of the respondents agree that ISSBs are reusable; while 47 respondents which constitutes 71.21% of the respondents strongly agree that ISSBs are reusable.

Results from this study shows that ISSBs are reusable.

Table 7: Assessing aesthetic balance of ISSBs in construction.

Variable		Frequency	Percentage
Aesthetical balance	Strongly disagree	9	13.64
	Disagree	6	9.09
	Neutral	2	3.03
	Agree	12	18.18
	Strongly agree	37	56.06
	Total	**66**	**100**

Table 7 above shows the distribution of the respondents assessing the aesthetics of ISSBs. 11 respondents which constitutes 15.71% of the respondents strongly disagree that ISSBs are aesthetic; 6 respondents which constitutes 8.57% of the respondents disagree that ISSBs are aesthetic; 2 respondents which constitutes 2.86% of the respondents are neutral; 13 respondents which constitutes 18.57% of the respondents agree that ISSBs are aesthetic; while 38 respondents which constitutes 54.23% of the respondents strongly agree that ISSBs are aesthetic.

Results from this study shows that ISSBs are aesthetic.

CONCLUSION AND RECOMMENDATION

ISSBs is one of the most viable alternative building materials with efficient characteristics ranging from minimal construction and maintenance cost to being a passive solution to indoor problems associated to building materials. Building materials largely influence the indoor air quality and thermal comfort which are principal to the building occupants' health. This study examined architects' response to the adoption of Interlocking Stabilisied Soil Blocks (ISSBs). Research reports that there is an average technical know-how of workers using ISSBs. ISSBs does not require an expert for its construction but requires certain level of skillfulness because of the technicality of the construction method. Architects disagree that ISSBs are flexible during construction. This alone must have affected the rapid adoption of ISSBs. The construction industry is rapidly growing with interest in exploring forms which require flexible and adaptable building materials. Structural stability and contribution of building materials to a sustainable environment through the reuse of the blocks was accredited to ISSBs. ISSBs are stabilised blocks in units which its interlocking bond construction method provides a more stabilised building element. ISSBs can be reuse which

in turn contribute to a sustainable environment. This research shows that ISSBs are aesthetically pleasing. Earth, as one of the major constituents of ISSBs replenishes; it can be enhanced by polishing the exterior surface. The maintenance cost of Interlocking Stabilisied Soil Blocks (ISSBs) is relatively low. ISSBs can be explored beyond walling system only. The abundance and low cost of earth should be maximized as an alternative building material to reduce construction cost and provide a sustainable community. ISSBs for roofing system and flooring system are recommended for further study. The level of skillfulness required for a successful construction using ISSBs should also be explored, and the efficiency of equipment used in production of Interlocking Stabilised Soil Blocks.

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