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DEMOGRAPHIC CHARACTERISTICS OF HOUSING ESTATES DEVELOPED WITH ISSB TECHNOLOGY IN SELECTED SOUTHWESTERN NIGERIAN (SWN) CITIES

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ABSTRACT

Interlocking Stabilized Soil Blocks (ISSB) is a locally available indigenous building material that has been promoted by united nations, ISSB promoters and built environment experts as a sustainable construction material. Research efforts have shown that ISSB offers reasonable benefits over conventional blocks. Nowadays, notable ISSB promoters, stakeholders, and residential estates built using ISSB techniques are rapidly appearing in SWN and surrounding areas. This study aimed at examining the demographic characteristics of ISSB buildings of selected estates in Southwest Nigeria (SWN) towards promoting awareness on ISSB as an alternative construction material in Nigeria. Datas were collected from interviews, observations, and documentaries from ISSB promoters and users of ISSB buildings in SWN. The study found that the following estates in SWN were built with ISSB: Obasanjo Estate, Ekiti with a total of One hundred and fourty eight(148) completed buildings; Redemption city, Mowe Ogun state with a total of forty eight (48) completed buildings; Amen estate, Lagos state with a total of three hundred (300) completed housing units. Based on the demographics of ISSB buildings shown in this study, the population's preference for ISSB as the preferred building material is relatively low when compared with Sandcrete blocks. However, ISSB is becoming increasingly attractive as a sustainable construction material in Southwest Nigeria. In conclusion, the study suggested that with an increasing awareness about ISSB, improving technologies, increasing the number of promoters of ISSB, and government support, ISSB will quickly become the affordable building material of choice in Nigeria.

Keywords: Affordable Housing, Alternative Building material, Interlocking Stabilized Soil Blocks

INTRODUCTION

Interlocking Stabilized Soil blocks (ISSBs)

One of the wide ranges of building materials that the earth provides is interlocking stabilized soil blocks (ISSBs). ISSBs is a cutting-edge construction method that creates beautiful and durable bricks with little to no cement by using dry stacking procedures and locally produced raw materials like sand and laterite (Olaleye & Ibitoye, 2023). The blocks are compressed using a manual or motorized press, which creates an interlocking pattern on the top and bottom of the block. The interlocking pattern allows the blocks to be stacked without the use of mortar, making them a popular alternative to traditional bricks and blocks for construction in many parts of the world. They are particularly common in areas where good quality bricks are not easily available and where the cost of transportation of traditional building materials is prohibitive (Bredenoord, 2017).

Interlocking Stabilized Soil Blocks (ISSBs) are becoming increasingly popular as an alternative building material in many parts of the world due to their affordability, sustainability, durability and ease of construction. ISSBs are typically much cheaper than traditional building materials such as bricks or concrete blocks, making them an attractive option for low-cost housing projects and community buildings (Sanewu et al., 2022). They are made from a mixture of soil, cement, and water, which are all locally available and renewable resources. ISSBs can be made locally, which lowers the cost of transportation and carbon emissions associated with the transportation of traditional building materials. These attributes make ISSBs a sustainable building material. Its ease of construction also offers reduced construction time and cost thereby making it suitable for low-cost or community-led projects. ISSBs have good thermal insulation properties which help to regulate indoor temperature and reduce energy consumption for heating and cooling.

Interlocking Stabilized Soil Blocks (ISSBs) technology

The process of producing ISSBs involves stabilizing the soil with cement, which improves its strength, durability and water resistance. This makes the blocks more suitable for construction in areas with poor soil quality, as well as in areas that experience heavy rainfall or flooding.

Soil has been employed as a traditional building material in the construction of houses predominantly in Africa (Sonebi et al., 2022). The use of adobe bricks with mud mortar and sun-dried or kiln-fired adobe is one of the most popular earthen masonry techniques. Although this method is less expensive, the shape, strength, and longevity of the bricks vary greatly. Compressed earth bricks are now being used as a result of this. Using a manual or hydraulic press and a mould, stabilized soil is compressed to create these blocks, which are then dried. These blocks were discovered to have more consistent geometric shapes and improved durability.

Stabilized local soil is utilized to create interlocking stabilized soil blocks, which are then crushed in a hydraulic press mould and allowed to cure for seven days before being used to build walls (Sanewu, 2020). The block sizes are rectangular and modular. The soil's properties and the necessary strength are the key determinants of stabilizing quantity. The optimum soils must be sandy, include a majority of non-expansive clay minerals (such as kaolinite), have a sand content greater than 65%, and have a dry weight of 18 kN/m3, according to George's (2014) earlier research on the manufacture of soil-cement blocks. Lime stabilization, on the other hand, has been discovered to be appropriate for soils with high clay contents (Ogila, 2021).

Blocks constructed from cement and soil that are compressed in a block press to produce interlocking stabilized soil blocks (ISSBs) are air-cured as opposed to being burned (Nambatya, 2015a). The interlocking blocks are made with frogs (tongue and groove joints), which enables the construction of dry stack walls by interlocking the units as a result of the blocks' keying action. ISSBs are earth construction materials that have been chemically and physically stabilized by the addition of cement and compressed in a block press. Stabilization generally allows for greater cohesion, compressive, tensile, or shear strength, reduces porosity and the associated susceptibility to shrinkage and expansion, improves waterproofing, and resists erosion or abrasion(Ramdas et al., 2021). The advantages of ISSBs over conventional sandcrete blocks are numerous, including the availability of raw materials, time advantages during construction, flexibility, better thermal quality, lack of need for specialized technicians, low maintenance costs, better indoor quality, and aesthetic appeal (Olaleye & Ibitoye, 2023). The perception of users, technological expertise, construction flexibility, and aesthetic considerations have all had a significant impact on the acceptance of ISSBs.

Performance of Interlocking Stabilized Soil Blocks (ISSBs) masonry walls

The performance of interlocking stabilized soil block (ISSB) masonry walls can vary depending on factors such as the quality of the blocks, the construction techniques used, and the environment in which they are built. However, in general, ISSB masonry walls can offer good performance in several areas:

Technical performance

ISSBs are a potential replacement for burned bricks (BBs) due to their superior technical performance. Comparing the dry compressive strength (N/mm2), ISSBs are 80% stronger than burned bricks and slightly higher in thermal conductivity. Clay bricks that have been burned have higher values for embodied energy and carbon in construction materials than cement-stabilized soil blocks with 5% cement. The most energy-efficient alternative material for walling was found to be soil-cement block, which used only one-fourth of the energy needed to burn clay brick (Jagtap & Dhawade, 2016). By eliminating the need for firewood, stabilized soil blocks help to preserve natural trees and reduce carbon dioxide emissions, which in turn preserve the ozone layer.

Table 1: Comparison of interlocking stabilized soil blocks and burnt bricks' technical performance.

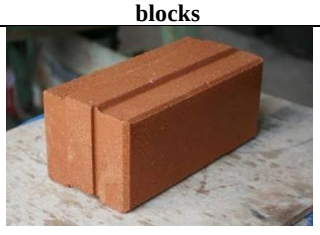
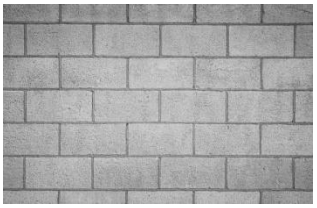
Parameter	ISSBs	BBs	Remarks
Wet Compressive Strength (N/mm2)	1.5	0.5	Minimum values
Dry Compressive Strength (N/mm2)	2.5 – 6.7	0.27 – 2.2	ISSB is 80% stronger than BB
Thermal Conductivity (W/moC)	0.8 – 1.4	0.7 – 1.3	ISSB slightly higher
Density (kg/m3)	1700 – 2200	1400 – 2400	
Embodied Energy of material (MJ/kg)	0.68 @ 5 % 3.00 cement		ISSB lower 3.00 is for general clay brick. In Uganda, it is 17.136 for BB

Source: (Nambatya, 2015a)

Aesthetic appearance

Interlocking stabilized soil blocks offers a distinctive physical appearance that is aesthetically pleasing over other alternative walling materials. Table 2 below shows the aesthetical comparison between interlocking stabilized soil blocks. Burnt bricks and sandcrete blocks.

Table 2: Comparison of interlocking stabilized soil blocks, burnt bricks and sandcrete blocks' aesthetical appearance.

	Block walls		
	Interlocking stabilized soil blocks	**Brunt bricks**	**Sandcrete blocks**
Unit block appearance			
Block walling appearance			

Source**:** Author's fieldwork

Environmental performance

The use of interlocking stabilized soil blocks in construction offers a sustainable and environmentally conscious alternative to traditional building materials. These blocks are cured over 28 days without being fired, which eliminates the need for energy-intensive firing processes and reduces the carbon footprint of construction projects, thereby minimizing the negative impact on the environment (Nambatya, 2015). In addition, this curing process greatly reduces the rate of deforestation, specifically in fragile ecosystems such as wetlands and forests, as it reduces the demand for wood as a fuel source for traditional brick firing. Consequently, the use of interlocking stabilized soil blocks is an excellent way to address the challenges of climate change and deforestation while still providing a reliable and affordable building material. By lowering the requirement for wood, using ISSBs lowers embodied energy and greenhouse gas emissions (Bredenoord, 2017).

Economic performance

ISSBs are made from locally available soil, which ensues a significant reduction in the cost of materials and transportation (Sangori, 2021). ISSBs can be produced on-site using a manual or motorized block-making machine, which in turn leads to lower labour costs compared to traditional building materials such as bricks. ISSBs have excellent thermal insulation properties which lower energy costs in buildings over time. This is very beneficial in areas with extreme temperatures, where the use of ISSBs can reduce the need for air conditioning and heating, resulting in lower energy bills for building occupants. Interlocking stabilized soil blocks are sustainable building material that reduces the carbon footprint of construction projects, making them an attractive option for environmentally conscious developers and investors (Omoregie et al., 2016). ISSBs are larger than traditional bricks, which means that they require less time and labour to lay, further reducing labour costs during the construction process.

The economic performance of ISSBs is very favourable, with potential cost savings in materials, labour, and transportation, as well as long-term energy savings (Presswood et al., 2021). The adoption of ISSBs can lead to more affordable and sustainable construction practices, while also promoting local economic development.

Promoters of ISSBs

There are several organizations and individuals who have promoted the use of interlocking stabilized soil blocks (ISSBs) as sustainable and affordable building materials. Here are some examples:

i. Non-governmental organizations (NGOs): NGOs such as Habitat for Humanity, Build Africa, and the African Women's Development Fund have all supported the use of ISSBs in their construction projects. These organizations have provided training and technical assistance to local communities on how to produce and use ISSBs.
ii. Government agencies: Some governments, such as the government of Kenya, have actively promoted the use of ISSBs as part of their sustainable housing policy. The Kenyan government has provided financial incentives for builders who use ISSBs and has also provided technical assistance to local communities on how to produce and use these blocks.
iii. Private sector: In some cases, private companies have promoted the use of ISSBs as part of their corporate social responsibility (CSR) initiatives. For example, LafargeHolcim, a global building materials company, has partnered with NGOs to promote the use of ISSBs in their construction projects.
iv. Individuals: There are also individuals who have promoted the use of ISSBs as a sustainable building material. For example, Dr Moses Musaazi, a Ugandan engineer, has developed a manual ISSB-making machine that can be used by local communities to produce blocks on-site.

The followings are some of the construction firms or companies in Southwestern Nigeria that specialize in using interlocking stabilized soil blocks for building construction: Bolyn Construction Company Limited, Ikorodu, Lagos state, Ipinle Earth synergy, Redemption Camp, Ogun state, Dura bricks, Irele, Ondo state, Earth Building System Limited, Lekki Phase 1, Lagos, Middle Brook Farm, Domkinut Steel Fabrication Ltd, Osogbo, Credit Bureau Investment Sapele road, Ondo state, Ecologic Brick, Lagos, Global Brick Solution, Osogbo and Brick Home Construction ltd (Ibitoye et al., 2022).

MATERIALS AND METHODS

Relevant pieces of literature relating to interlocking stabilized soil blocks (ISSBs) technologies were reviewed. Through qualitative research method, interviews were granted to identified promoters of ISSB and users of identified ISSB buildings in Southwest Nigeria. Through observations and documentaries, the study revealed that the notable estates built with ISSBs in SWN as follows:

i. Olusegun Obasanjo Estate in Ekiti State;
ii. Residential buildings in Redemption city estates in Mowe, Ogun State, and
iii. Amen Estate in Lagos State.

I. Findings

a. Olusegun Obasanjo Estate, Ekiti State;

Figure 1: Google earth image showing the layout of Obasanjo Estate, Ekiti State **Source:** (Afolami & Oyebamiji, 2017)

Figure 2: Pictorial view of some buildings in Obasanjo Estate **Source:** (Afolami & Oyebamiji, 2017)

The Federal Government of Nigeria came up with the idea for the Olusegun Obasnjo estate as part of the Presidential directive to build 500 housing units in each of the federation's states and the Federal Capital Territory. The state government provided logistical and material support to NBRRI for their production of building materials of indigenous origins. Also, the project actively encouraged local engagement (Afolami & Oyebamiji, 2017). Findings revealed that Olusegun Obasanjo estate, Ekiti has a total of 148 buildings developed using interlocking stabilized soil blocks.

Table 3: General Properties of Buildings at Olusegun Obasanjo Estate, Ekiti State

S/N	Parameters	Findings
1	Total number of buildings	148 buildings
2	Provision of expansion	Yes
3	Colour	Red bricks colour

4	Plastering/rendering	No
5	Columns at corners of the wall	Yes
6	Roof colour	Red
7	External walls – Sandcrete	No
8	External walls – ISSBs	Yes
9	Affordability	Yes
10	Building coded name	No
11	Type of machine used in production of ISSBs	Locally fabricated machines

b. Redemption City, Lagos State

Plate 1: Pictorial view of some buildings in Redemption City
Source: Author's fieldwork

Plate 2: Pictorial view of some buildings in Redemption City
Source: Author's fieldwork

Plate 3: Pictorial view of some buildings in Redemption City
Source: Author's fieldwork

Plate 4: Pictorial view of some buildings in Redemption City
Source**:** Author's fieldwork

Redemption City is a city located in Lagos State, Nigeria. It is a religious city built by the Redeemed Christian Church of God (RCCG) and is home to the church's headquarters, known as the Redemption Camp. The city covers an area of approximately 2,000 hectares and is located along the Lagos-Ibadan Expressway, about 50 kilometers from Lagos. It was established in 1983 as a prayer camp by the General overseer of the RCCG, Pastor Enoch Adeboye, and has since grown into a large city with various amenities. Redemption City is known for its large auditorium, which is capable of accommodating millions of people for religious events and conventions. It also has several other facilities including residential quarters, schools, hospitals, banks, a police station, a shopping mall, and a transportation network. The residential buildings were developed using interlocking stabilized soil blocks. Findings revealed that Redemption city, Lagos has a total of 48 buildings (55 housing units) developed using interlocking stabilized soil blocks. Redemption City, Lagos State was developed by Ipinle Earth synergy, Doyen and Urbanc8tors

Table 4: General Properties of Buildings at Redemption City, Ogun State

S/N	Parameters	Findings
1	Total number of buildings	48 buildings
2	Provision of expansion	Yes
3	Colour	Red bricks colour
4	Plastering/rendering	No
5	Columns at corners of the wall	Yes
6	Roof colour	Red
7	External walls – Sandcrete	No
8	External walls – ISSBs	Yes
9	Affordability	Yes
10	Building coded name	No
11	Type of machine used in production of ISSBs	Locally fabricatedand imported machines

c. Amen Estate, Ibeju-

Figure 3: Google earth image showing the layout of Amen Estate, Lagos
Source: Google earth (2023)

Plate 5: Pictorial view of some buildings in Amen Estate
Source: Author's fieldwork

Plate 6: Pictorial view of some buildings in Amen Estate
Source: Author's fieldwork

Amen Estate is a luxury residential estate located in Ibeju-Lekki, Lagos State, Nigeria. It is a gated community developed by Redbricks Homes International Limited and designed to provide a high-end lifestyle for residents. The estate covers an area of over 100 acres and comprises various residential buildings such as villas, terraces, and apartments, as well as amenities such as parks, playgrounds, a clubhouse, a swimming pool, a tennis court, and a shopping center developed with interlocking stabilized soil blocks. Amen estate is one of the estates at the forefront of using alternative building material with focus on developing a sustainable community. Findings revealed that Amen estate, Lagos has a total of 122 buildings (300 Housing units) developed using interlocking stabilized soil blocks. Amen Estate, Ibeju-Lekki, Lagos State was developed by Redbricks Homes International Limited.

Table 5: General Properties of Buildings at Amen Estate, Lagos State

S/N	Parameters	Findings
1	Total number of buildings	122 buildings
2	Provision of expansion	Yes
3	Colour	Red bricks colour
4	Plastering/rendering	No
5	Columns at corners of the wall	Yes
6	Roof colour	Red
7	External walls – Sandcrete	No
8	External walls – ISSBs	Yes
9	Affordability	No
10	Building coded name	Yes
11	Type of machine used in production of ISSBs	Locally fabricatedand imported machines

CONCLUSION

This study assessed the Demographic Characteristics of ISSB Buildings of selected Estates in Southwestern Nigeria towards promoting the awareness of ISSBs as an alternative building material in Nigeria. The adoption of Interlocking Stabilized Soil Blocks (ISSBs) as an affordable and sustainable building material in Nigeria largely depends on increased awareness, improvement in technologies, increment in the number of ISSB promoters, and government support.

RECOMMENDATION

Awareness campaigns about benefits and advantages of interlocking stabilized soil blocks over traditional building materials is crucial to its wide adoption. This can be achieved through education campaigns, workshops, and training programs for builders, architects, and other stakeholders in the construction industry. The production technologies of interlocking stabilized soil blocks must be improved to increase the quality and efficiency of production blocks. This will require the development of better equipment and machinery, as well as the training of local communities on how to produce high-quality ISSBs. Governmental policies and incentives that promotes the use of sustainable building materials like ISSBs should be enacted. Likewise providing financial support and subsidies for the production and construction of ISSBs. Findings revealed that ISSBs is gaining notable attraction as a sustainable building material in Southwest Nigeria as some notable estates had recorded enormous quality and sustainable houses. Olusegun Obasanjo estate, Ekiti has a total of 148 buildings (55 housing units); Redemption city, Lagos has a total of 48 buildings (55 housing units) and Amen estate, Lagos has a total of 122 buildings (300 Housing units). This demography of the ISSB buildings assessed indicates that the choice of ISSB as the favourite building material

is low when compared to Sandcrete blocks but ISSB is gaining notable attraction as a sustainable building material in Southwest Nigeria.

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