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Assessing the low-cost buildings in Nigeria using Hydraform blocks as walling materials: the journey so far

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Abstract. Man's growing desire for affordable and comfortable buildings have necessitated the diversification of materials and methods in the built sector. Thus, this paper assessed the hydraform blocks as walling materials to examine its current level of usage in the Nigerian built sector. Information was generated via literature reviews, newspapers, and professional perceptions. The findings revealed that despite the concerted feats of private developers in the use of hydraform blocks as walling materials for the low-cost building construction in Nigeria, efforts by the Federal Government has yielded limited success in this regard. Also, State Governments have not fared better. Therefore, this paper recommended and proffered solutions to bridge this gap.

Keywords: Housing; sustainability; environment; low-cost buildings; local materials; building construction; hydraform blocks.

1. Introduction

The physical survival of mankind depends on housing, besides food and clothing [1, 2]. Adequate and comfortable housing influences the physical, social, and moral health, and contributes to the works' stability, efficiency, and development [3]. In 2019, the Federal Ministry of Works and Housing (FMW&H) proposed to build 2,383 housing units in Nigeria under the National Housing Programme in 36 states of the Federation and the FCT. Besides, in 2020, the FMW&H plans to build just about 2,000 homes [4]. However, to keep up with growing population and urban migration, the World Bank recommends a yearly construction of 700,000 housing units to breach a huge housing deficit in Nigeria. The World Bank estimates Nigeria's total housing deficit to be 17-23 millions [4]; though the present demand is estimated at 37 million houses [5]; and this figure increases yearly by 20%. Efforts by the previous governments to tackle housing situation in Nigeria have yielded limited success after 59 years of independence [5]. Therefore, it was added that the private sector is critical in making housing available and affordable in Nigeria, as the government cannot do it alone.

Globally, housing problems are summarized by the houses needed by the poor and low-income earners [6]. The housing deficits, particularly targeted at the poor and low-income earners have increased due to weak housing policy, rapid urbanization, and high cost of conventional building materials [6]. Report from a previous research revealed that no civil servant in the Nigerian Federal Civil Service, under grade level 13, can afford a house costing ₦4.5 million at 6% salary on a 25 years of mortgage loans [7]. This signifies that affordable housing will become ever more elusive for low-income earners. Low-cost housing is an arrangement by which the prospective house owners fulfill the periodic mortgage needs without compromising the health and other basic needs of the family members [8].

On the account of the foregoing, this paper aims to examine the usage level of hydraform blocks as walling materials in the Nigerian built sector. Data was obtained through the reviews of literature,



newspapers, and professional views. The benefits of hydraform interlocks as low-cost building blocks were appraised, while the Government efforts vis-à-vis professional perceptions of the low-cost housings were also examined. Finally, the paper concludes and recommendations are made.

2. Literature Review

2.1 The Concept of Hydraform Blocks in Nigeria

In the 20th century, traditional adobe or unfired laterite bricks were prevalent in some African countries [9]. However, in recent time, the search for more efficient, versatile, affordable, and eco-friendly blocks led to the development of hydraform blocks, otherwise called laterite interlocking blocks (LIB) [10]. Hydraform block, as shown in Figure 1, is produced from laterite, cement, and water, and compressed hydraulically with the aid of hydraform hydraulic machine (Figure 2), resulting in a high quality interlocking solid block [11], which is largely dry-stacked. Consequently, the *Nigerian Building and Road Research Institute* [NBBRI] designed an interlocking block machine, as shown in Figure 3, to produce LIBs, mainly comprised cement and laterite of ratio 1:20, respectively [12]. The designed concept was based on the LIBs with a geometric size $225 \times 225 \times 112 \text{ mm}^3$ [13]. The geometry is assembled without the application of mortar, hence making the laying concept to be differed from conventional blocks [9]. Hydraform blocks satisfied the specification of Industrial Building System [14], and have been used in many parts of the World for load bearing masonry structures [15].



Figure 1. Stacked hydraform blocks
Source: Nairaland Forum, 2020 [16].



Figure 2. Hydraform hydraulic machine
Source: Nairaland Forum, 2020 [16].



Figure 3. Hydraform hydraulic machine designed by NBRI
Source: NBRI Newsletter, 2006 [12].

2.2 Benefits of Hydraform Blocks in Building Construction

The vital element in building construction is building materials. About 60-80% of building materials account for the entire cost of building construction [17]. This signifies that access to efficient, affordable, and eco-friendly buildings in Nigeria would continue to be difficult except the high cost of conventional building materials is checked and alternative materials are harnessed. However, hydraform blocks have been predominantly used in South Africa, Kenya, Uganda, Argentina, India, Mexico, and United States of America, to construct houses, schools, and general single and multi-storey buildings [18].

Hydraform blocks offer substantial cost saving by harnessing 90-95% of laterite, a locally available and subsoil material, and 5-10% cement for their production [18]. Besides, the cost of burning is eliminated. Hydraform blocks are produced on site, thus reducing the transport cost. Except in lintels and high gables, LIBs are dry-stacked, as shown in Figure 4, hence eliminating mortar in superstructure walls [18]. Confirming the foregoing assertion, previous studies revealed that about a 30% of cost and time are saved [19-21]. Also, following the interlocking concept of hydraform blocks, about a 75% of the building requires no mortar [22].



Figure 4. Dry-stacking of LIBs without mortar

Source: Nairaland Forum, 2020 [16].

Hydraform blocks offer faster rate of construction than conventional blocks [18]. In a day, about 21 m² of walls can be laid with 800 hydraform blocks by a bricklayer, hence making LIBs to be laid three times faster than conventional blocks; this also reduces the labour time per hour [18].

The use of LIBs as walling materials exhibit excellent thermal capacity (the ability to absorb and hold heat). According to *John Morris*, hydraform blocks offer three times of thermal insulation efficiency as concrete and about two times as fired clay bricks [18]. This signified that LIBs are energy-efficient building materials and can be used as walling materials in hot or arid climatic weather conditions [23, 24], and consequently, contribute to the sustainable development agenda.

Hydraform blocks yield higher impact strength compared with concrete blocks [18]. After 14 days curing, hydraform blocks attain 7 MPa of compressive strength, consisting a mix ratio 1:20 of cement and laterite, respectively. Moreover, LIBs are eco-friendly materials because they are produced under high compression from laterite, without using fuel-wood to burn or fire them [18]. It was reported that about 657 MJ/ton of energy is required to produce LIBs compared with 4187 MJ/ton for fired bricks [25]. This signified a reduction of about 85% energy input when LIBs are produced compared with fired bricks. Also, about a 41 kg CO₂/ton is emitted during the production of LIBs compared with 202 kg CO₂/ton associated with fired bricks [25]; this indicated that there was about 80% reduction in CO₂ emission during LIBs' production compared with fired bricks.

Hydraform blocks exhibit attractive surface, in terms of aesthetics, as shown in Figures 5 and 6 such that rendering, plastering, and painting may not be necessary; these also reduce the cost of finishes. Also, production and erection are simple to lay under the supervision of hydraform-trained personnel.



Figure 5. Construction of Heart Mega School using LIBs, Famese, Akure, Nigeria
Source: Aghimien, Aghimien, 2015 [26].



Figure 6. A residential building built with LIBs in Lekki, Lagos, Nigeria
Source: Adegboye, 2012 [2].

3. Research Methods

On the basis of methodology used in carrying out this study, qualitative investigation was conducted to obtain knowledge as well as to collect data via reviews of literature, website/internet accesses, newspapers, and professional perceptions of the built industry.

4. Results and Discussion

4.1 Application of hydraform blocks in the Nigerian built sector: the journey so far

In 1991, compressed stabilized interlocking earth blocks (CSIEB) were reportedly first used to construct 60 housing units estate at the University of Lagos, Lagos, Nigeria [27]. Afterward, the use of CSIEB

has continued to enjoy patronage as low-cost building materials; this ultimately resulted in the introduction of CSIEB as hydraform blocks in the Nigerian built sector [28]. Although, hydraform innovation is South African technology, which has been in existence 30 years ago [22].

In 2005, the Federal Government of Nigeria, through the Association of Housing Corporation of Nigeria (AHCN) in collaboration with the NBRRI, flagged-off the construction of 500 low-cost housing units in each state of the federation and the Federal Capital Territory (FCT) using LIBs [29]. NBRRI provided the fabricated interlocking block-making machines, while the Federal Mortgage Bank OF Nigeria (FMBN) provided the funds needed for the construction. Consequently, Ekiti State, through the Ekiti State Housing Corporation, executed the project, completed, and named it as Olusegun Obasanjo Housing Estate, Ado-Ekiti, Nigeria, as shown in Figure 7. The housing units were allocated to civil servants, mostly, the low-income category.



Figure 7. Pictorial view of Olusegun Obasanjo Housing Estate, Ado-Ekiti, Nigeria
Source: Oyebamiji [30].

Kwara State Government, through the Private Developer (International Business Bureau Limited), executed the housing units, comprising two-bedroom standard, two-bedroom luxury, and three-bedroom standard bungalows located at Akerebiata, Sobi Road, Ilorin, Nigeria. In the same vein, FMBN provided the funds, while the Kwara State Government provided the land. The phase 1 (250 units) of the buildings was completed and commissioned in 2009, while the other phase remains undeveloped, not only in Kwara State but also, other states of the Federation [31]. The low-cost housing units, two-bedroom standard, two-bedroom luxury, and three-bedroom standard bungalows were allocated to the low-income earners and sold for two millions (₦2,000,000.00), two millions and five hundred thousand (₦2,500,000.00), and three millions (₦3,000,000.00) naira only, respectively [21, 31].

In 2010, Osun State Government, through the Osun State Property Development Corporation (OSPDC) purchased hydraform block-making machines, purposely, to construct low-cost housing for low-income earners, and to build elementary schools for teaming students in the state [32]. Moremi housing estate at Ile-Ife and Atakunmosa West Local Government elementary school, Osun State, Nigeria, were built. However, despite all efforts by the OSPDC, the existing reality revealed that the mandate is far from being attained [32].

In 2017, chairman, Hydraform Nigeria, *Platter* [33] asserted that over 5000 low-cost housing units have been built in Nigeria by the Hydraform Nigeria using hydraform blocks. It was further reported that over 4000 low-cost housing units have been built in Abuja (FCT) alone, and the Hydraform Nigeria had also worked in Jigawa, Anambra, Enugu, Yobe, Lagos, and some other states in Nigeria in building affordable houses for low-income earners. However, it was discovered that Government at all levels failed to take the lead in tackling the problems of affordable buildings in Nigeria using hydraform blocks [33]. Moreover, in 2016, Hydraform Nigeria sold a three-bedroom bungalow built with hydraform blocks for four millions and five hundred thousand naira only (₦4,500,000.00) and was the cheapest in the built sector at that time [34].

4.2 Government efforts vis-à-vis professional perceptions

The investigations on the promulgated National Housing Scheme of 1991 revealed that the programme was faulty and weak [34]. Most estates constructed under the low-cost housing programme of the previous regimes, have been in moribund owing to the fact that those housing units were unacceptable to the prospective users [34]. The reports showed that the end-users were neither asked nor consulted for any contribution during the planning stages. Some estates were built in a vulnerable area, while some were built under the low-cost housing programme but were bought by the rich and rented to the low-income earners at high cost, whom the scheme was meant for in the first place [34]. Thus, housing affordability becomes a challenge. Consequently, the Federal Ministry of Works and Housing, in 2015, adopted a novel approach to address the deplorable situation of low-cost housings in Nigeria [34]. A team of Architects, Surveyors, and Town Planners were selected across Nigeria and inaugurated with a responsibility to consult Nigerians in the six geopolitical zones on their acceptable kinds of houses. The consultations were conducted between 2016 and 2017. The results revealed that most Northern States and Southern States of Nigeria preferred bungalows with courtyards and flat blocks, respectively [34]. These results have been incorporated into the current National Housing Scheme, presently undertaking in 34 of the 36 states of the federation and the FCT. Moreover, FMBN, a facilitator and guarantor, was empowered by the Federal Government of Nigeria to grant mortgage loans to loan seekers at very affordable interest rates. Many in-built innovations were also added to the programme to make it more inclusive and sustainable [34].

Reacting to the foregoing efforts by the Federal Government of Nigeria, many professionals in the Nigerian built sector affirmed that the programmes were not meant for the poor, house seekers, and low-income earners in the society. In 2019, an expert in the low-cost housing development, *Plattner*, who also doubled as Chairman, Hydraform Nigeria, stated that most housing projects initiated by the Federal and State Governments were not designed to cater for low-income earners due to the uses of conventional blocks as walling materials without recourse to the locally made available materials, LIBs [33]. Therefore, Government at all levels must adopt new technologies and local materials as alternative means of providing affordable houses. Moreover, *Fatoki*, an estate surveyor and valuer and former chairman, Lagos State Branch of the Nigerian Institution of Estate Surveyors and Valuers (NIESV) [2], and *Eleh*, a former president, NIEV [17], stated that Nigerian housing delivery was a failure and would remain a thorny challenge if the Land Use Acts and the cost of building materials were not reviewed. Furthermore, *Zubairu*, project manager, Niger State Urban Support Programme [5] asserted that both Federal Government and the State Government are yet to formulate an effective and sustainable programme for affordable houses of low carbon footprint to Nigerians, particularly, the poor and low-income earners. In 2019, it was also reported that the National Housing Policy Formulation was not integrative in that State and Local Governments were not involved in the housing provisions; this makes the affordable houses unrealizable, despite high promises by the Federal Government [5]. In the same vein, *Lufadeju*, Chairman, Board of Trustees, Real Estate Developers Association of Nigeria (REDAN), reported that policy failure and lack of priority have undermined the provision of affordable houses [5]. Besides, lack of political will and lukewarm and penchant attitudes of Nigerians to the patronage of cheaper building materials, LIBs, are not helpful. The president, Association of Housing Corporation of Nigeria (AHCN), *Adamu* [5] posited that the challenges of mass and low-cost housing provisions was due to usurpation of statutory responsibilities by the Governments agencies governing the housing provisions. On the other hand, *Awobodu*, President, Nigerian Institute of Building (NIOB), substantiated that low-cost housing delivery in Nigeria still remains a mirage because Government fails to strike balance between the building material cost and the purchasing power of Nigerians [5]. It was further noted that real estate developers have resorted to obtaining loans from the commercial banks at about 24-28% interest rates since 2012 till date when Estate Development Loan (EDL) was suspended by the FMBN; this impacts negatively on the housing cost in Nigeria.

5. Conclusions and Recommendations

This paper examined the low-cost buildings in Nigeria using LIBs as walling materials. It was shown that harnessing the naturally occurring subsoil material, laterite, to build the sustainable housing units would alleviate suffering, remove cost burden on the beneficiary units, and make houses affordable for the less privileged and low-income earners. For effective and efficient low-cost housing provisions in Nigeria, the following recommendations are made:

- i. Government should take the leading roles in creating an enabling environment for the provision of low-cost housing units using LIBs as alternate to concrete blocks.
- ii. NBRRI should be more proactive in its partnership with the Hydraform Nigeria to train more Nigerians on the production and laying mechanisms of hydraform blocks; this would not only reduce the problems of housing affordability in Nigeria but also create jobs for the teeming jobless Nigerian youths.
- iii. Stakeholders in the Nigerian built sector must collaborate with strong advocacy and synergy to market and recommend hydraform blocks as energy-efficient, sustainable, and affordable building blocks by influencing policy formulation and implementation at all levels of government.
- iv. National Housing Programme should be integrated such that State and Local Governments would also be actively involved in low-cost housing provisions using LIBs. This would allow the Governments to focus on implementation, monitoring and evaluation, and impact assessment while eliminating direct construction by all tiers of government.
- v. All tiers of government must create a conducive atmosphere and a favorable condition for the manufactures of hydraform blocks to reduce the cost of building material while competing with the cheaper and substandard imported brands and providing employment opportunities.

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