

An Evaluation of the Adaptability of Nigerian Indigenous Building Tools in Modern House Construction

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ABSTRACT This study is a survey of the different types of tools and implements used for building operations in the Yoruba Indigenous Architecture of Nigeria. The tools include "Abero", "Kudunsu", "Anset" (handset), digger, hoes, "bamubamu" (a ramming device), shell, etc. They were all examined alongside their roles and efficiencies in indigenous building construction works. Also examined were the dual roles of some of these implements (as both tools and building materials), and their prospects in the drive towards fashioning a modern, home-based, house construction technology for Nigeria.

INTRODUCTION

The debate on the appropriate technology for Nigeria and her Third World counterparts has remained unsettled, even as the gap in technology widens between the developed and developing countries of the world. The two popular, but opposing schools in the technology debate have been, whether the third world countries should start to develop their technology from the basics – a continuation of the practice of their progenitors – or, import technology at its present level obtainable in the developed world. The technology question cannot be ignored; it is not only an indicator of a country's economic standing in the committee of nations, but also an undisputed parameter for measuring the adequacy of life essentials, like housing, feeding and the general welfare of the citizenry. Thus, it has been argued (Atolagbe 1997) that only by a combination of both methods: a gradual adoption, which also adapts local techniques to achieve, in the ultimate, the present level of technological sophistication obtainable in the developed world, can foster a worthwhile development in the economies of the Third World.

Architecture and the delivery of buildings for a sustainable environment is an integral aspect of technology. It is thus, in keeping with the adaptation argument, using indigenous technology to achieve modern technology update that informed this study.

Investigative studies into adaptive indigenous Yoruba Architecture have, thus far, concentrated on building materials and appropriate technology or method. Studies on the former include the use of bamboo splints for reinforce-

ment in earth construction (Akinmusuru 1985); the use of cement, lime, reeds, bitumen and grass for stabilizing clay walls (Adesina and Utigkar 1985; Chukwuali 1992; Arayela 2000); coconut palm and wood for rafters and windows (Olateju 1989; Atolagbe and Adeyemi 2002). Others focus on the use of stones, clay, soil laterite, lime, pozzolana, bricks, timber and natural fibres for affordable (low cost) housing (Keddie and Cleghon 1980; HABITAT 1981, 1989; Cambridge and Spon 1983).

HABITAT (1988) researched on, and produced a compendium of information on selected low-cost building materials. The list provides information on a range of materials including burnt clay bricks and tiles, soil construction, fibre concrete roofing and timber.

Appropriate technology has also been recommended for adequate housing in the less developed worlds. These include suitable materials and the mechanism for earth stabilization (HABITAT 1986), earth construction technology (HABITAT 1987a), low-cost technology for production of adobe, rammed earth and compressed blocks (HABITAT 1987b), and measures to strengthen indigenous technology capacities in building materials provision (UNIDO 1985). Little or no research has been directed at the qualities and adaptive potentials of indigenous tools and implements in these construction processes.

Nigeria is a country with diverse tribes and cultures. Most of these cultures had been technologically self-sustaining long before they came together as a nation. In particular, three of such tribes – Hausa, Ibo and Yoruba are dominant groups constituting overwhelming majority of the country's population (National Popu-

lation Commission – NPC 1992). The attention of this study is focused on tools and implements in the indigenous building operations of one of these dominant cultures: the Yoruba in south-western Nigeria, a sub-region where the indigenous Rammed Earth Technology constituted the main option for walls in pre-colonial housing delivery systems, and till date, remains the most affordable to the majority of the rural and low-income urban populace. A similar study could be undertaken in respect of the Hausa, Ibo, and other independent techno-cultural groups in the country. The result of such studies could be a sourcing-pool for the take-off of modern, Nigerian building technology, using locally fashioned tools. It is an attempt at understanding the past with the object of coping with the present and possibly preparing for the challenges of the future.

METHODOLOGY

The initial attempt at localizing the study area to Ogbomoso land had failed, as most of the builders available there had had their building apprenticeship (learnt their trade) during the present era of “modern bricklaying”; an era when indigenous methods had been jettisoned, in preference to new imported techniques. Consequently, a visit to one builder led, in succession, to another, in search of builders trained in the indigenous skills in randomly selected five, of the seven Yoruba States - except Lagos, the seventh, which is a metropolitan city-State. The chain of visits, in the course of the survey, eventually covered builders and building sites in Ogbomoso, Tewure, Awe, Aroje and Egbeda in Oyo State; Ilorin and Ilale in Kwara State; Osogbo, Ile-Ife and Oke-Ila Orangun in Osun State; Osan and Otun Ekiti in Ekiti State; and Orisunbare, Mofere and Owena in Ondo State. Except in Oja Igbo in Ogbomoso, where the building site was visited at every stage of the building: foundation, walling, roofing and finishing stages, other sites were visited during one of the walling or roofing stages. This was possible because the survey focused on the Oja-Igbo (and other similar on-going indigenous) buildings in Ogbomoso throughout the November 1999 to March 2000 dry season, a five-month period of the year, which Atolagbe (1996), described as the “Yoruba Indigenous Building Season”. Other towns and sites were

all investigated during the 2000/2001 building season. The diverse and scattered sites for the survey could not all be adequately monitored during the same five-month building season. More so, as Yoruba building operations (from foundation to the head course) are often carried out at five-day intervals; and whole buildings are often completed within two-three months.

At each of the towns/sites visited, indigenous builders were interviewed and inventory of any available indigenous tools taken. In a few of the Towns as in Tewure, Ogbomoso, Ilale and Orisunbare some of the tools were in practical use on on-going indigenous building projects as at the time of visit. Such operations were exclusively wet, mud walls to be covered with metal roofing sheets in all the towns; and thatch in some of the farmhouses as in Orisunbare, Mofere (Ondo State) and a suburb of Oke-Ila Orangun in Osun State.

In the series of discussion with the mostly, elderly builders, the investigator sought to know, in the respondent’s opinion, some of the followings:

- Which of the tools remained relevant to “modern” indigenous building processes?
- Which of the tools, in their reckoning, have been out-classed by some modern alternatives for the rammed earth technology
- What innovative improvements are possible to update the relevance of any of the tools?
- What are the notable shortcomings in any of these age-long tools?
- What is the current level of acceptance of these tools for indigenous building operations?

FINDINGS AND GENERAL INFERENCES

From the result of the survey, there was a sufficiently adequate range of tools for carrying out building operations in the Yoruba indigenous Architecture. This range include cutlasses, hoes, diggers, axes, ropes, plumbing stave, abero, kudunsu, anset, locally fashioned mallet (rammer), tying (metal) straps - more ancient Yoruba used ropes; shells (from snails and earthenware pots). For convenience, these tools and implements, and their uses are discussed under the different building stages.

Foundation: Indigenous building operation starts with site clearing and setting out (putting the outline of the proposed building on ground). Indigenous tools for these include *Cutlasses* and *axes* for cutting and clearing of bushes and felling of trees. *Ropes* are tied to upper trunks of trees and pulled towards the direction desirable for the trees to fall. They are, also, together with *hoes*, *pales* and *pegs* (wooden) used to mark out bounds and maintain straight lines and building edges. *Diggers* and *hoes* are used for digging out trees from their roots, grubbing out foundation trenches and softening, turning and mixing building earth. Trenches are dug to the size / thickness of the foundation of rooms, and other functional spaces and are measured out. Measuring modules include step (foot), stride, ankle and palm lengths which are often calibrated out in long plumb poles for use throughout this building and other similar future operations.

Walling: Walls are built on, and along the foundation trenches. Relevant tools here include *diggers* and *hoes* for digging, turning and mixing of the earth respectively. Other tools at this stage include the “*abero*”, “*kudunsu*” and guiding or plumbing *stave*. Two slightly different fashions of this tool, found in Ogbomoso, is a rectangular spade-like metal blade with a long wooden handle (Fig. 1). The second type seen

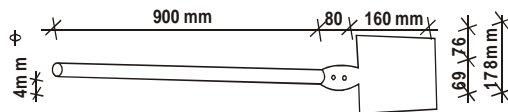


Fig. 1. Abéro with rectangular blade

in a site in Tewure has a triangular metal blade dovetailing into a cylindrical posterior, into which the long wooden handle is inserted and nailed (Fig.2). In whatever fashion, *abero* is

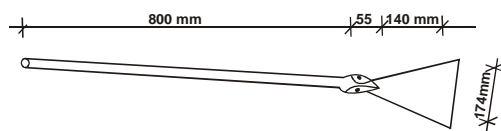


Fig. 2. Abéro with triangular blade

used in peeling off excess mud from walls (before they harden) to maintain a uniform wall thickness. In a number (majority) of the sites visited, cutlasses were improvised in place of

abero for this purpose. It is, however, generally admitted that *abero* is more efficient than the cutlass for peeling off wet earth. By virtue of its long handle, it covers a wider range and can be used from any position around the wall, especially, atop a relatively high one. It is less strenuous to use as it has a much higher Mechanical Advantage.

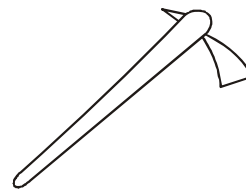


Fig. 3. Kúdúnsú

The *kudunsu*, (Fig.3), is shaped like the hoe but unlike the hoe has a small but thicker triangular metal blade shooting out of the end, short, wooden handle almost at a right angle. It is used for cutting off hardened walls in small bits, especially when preparing walls to receive plasters. The guiding or *plumbing stave* is a long, straight, sawn plank, carried by the builder to guide the casting of the wall along a straight line (Fig.4). The “*anset*”, (Fig.5), is a small

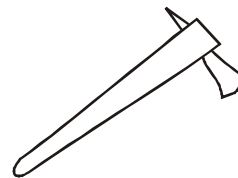


Fig. 4. Anset

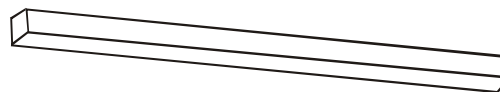


Fig. 5. Plumbing Stave

axe-like tool used to chip off bigger lumps of hardened mud wall, especially when door and window frames are to be inserted in place. *Straps* are long, flat strips of metal inserted at intervals across the middle of the penultimate top wall courses, folded around, lapped and nailed to the wall plate above the topmost wall courses, thereby fastening the wall plate (of *pales*) to the walls. Rafters (also of *pales*) are then nailed to the wall plate with appropriate

nail sizes. In much older times, when roof thatches were in vogue, ropes were used in place of these metal straps and nails.

Roofing: In the Yoruba older indigenous architecture, roofing was done of leaf and reed thatches on a skeleton of pales and stakes tied together with ropes. Other roof covering types included the bamboo, each slit into two halves and arranged according to specific intricate details that may form a subject of future work.

In present times, metal sheets are fastened with nails to purlins over rafters that have also been nailed in place.

Flooring: Solid domestic floors were once achieved with moist lateritic soil (sand and clay) in the approximate ratio of 3 and 2 respectively. These were rammed into place with wooden *mallet* or *rammers* fashioned from the petioles of palm branches (Fig. 6).

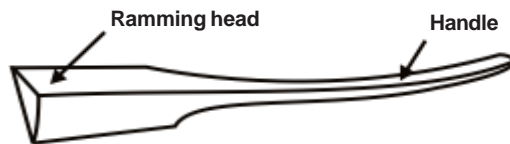


Fig. 6: Rammer of palm petiole

Finishes and Decoration: Finishes can be applied on walls, floors and roofs. In Yoruba indigenous architecture, finishes are common on walls and floors; and carving on posts, doors and windows in King's palaces, shrines and religious buildings. Floor finishes still include rough trowelling of rammed lateric floors with small calabash or earthenware shells. It could also be tiling with palm kernel, snail shells or earthenware shells. Modern examples of the latter are as demonstrated in the preserved building behind St. Mary's School, Eleyele, Ibadan, Oyo State and the palace of the Ooni, the paramount ruler of Ile-Ife in Osun State both in the Yoruba sub-region of Nigeria. Thus, shells generally double as both building tools (for smoothing and patterning), and as materials (for tiling).

Mural (or wall) finishes include plastering with stabilized clay, chalk and shell patterning and shell tiling as exemplified at the external walls of "The International Hotel" in Awe, Oyo State, Nigeria.

Doors and posts decorations are carved into fancied figures and patterns with *carving knives*, *chisels*, *punchers* and smoothed with

abrasive, dry, *sand leaves*, *Gutenbergia nigritana* (Gbile 1984) or '*Erinpin eluju*' in Yoruba. Sand leaves were used in place of emery papers for abrasion and smoothing.

OBSERVATIONS AND DISCUSSIONS

Generally, majority of the indigenous tools and implements are today no longer in popular use. In fact, out of the sites in fifteen towns visited all over Ekiti, Oyo, Osun, Ondo and Kwara States, where indigenous building operations were on, only in four were any of the three unique building tools (*abero*, *kudunsu* and *anset*) found. *Abero* was in use at a site each in Tewure and Ogbomoso only, (both in Oyo State), while the *anset* was used in the only site visited in each of Ilale and Mofere in Kwara and Ondo States respectively. Curiously, the builder at the Mofere building site (in Ondo State) where the *anset* was seen for the second time in the course of the survey hailed from Ipetu Igbomina, about eight kilometers from Ilale, where the tool had been seen for the first time. Ilale and Ipetu Igbomina belong to Oke – Ero and Irepodun, two adjacent Local Government Areas in Kwara State. Thus, despite the apparent degree of dispersion noticeable in the two sites (Ilale and Mofere) where these tools were seen, current usage may have been more popular in Ekiti and Igbomina the Yoruba ethnic groups to which Ilale and Ipetu towns belong respectively.

In Oke-Ila Orangun and Osogbo, both in Osun State, local builders described the trio of *abero*, *anset* and *kudunsu* with utmost familiarity, referring to them as the most important Yoruba building tools that till date have no better replacements for wet earth construction, even in modern times. They express resentment at builders without these tools taking commissions on earth buildings. Little wonder, they reasoned, that recent mud structures are weaker and mostly crooked unlike those of older times. When this interviewer suggested the possibility of the use of formworks to achieve straight and even walls instead of *abero*, the idea was scorned at. The majority of them argued, like most other builders in Ondo, Oyo and Kwara, that the introduction of formwork as replacement for *abero* (or an improvised cutlass) would unreasonably increase the cost of materials (timber and nails) and labour of earth

building operations. Besides, the smooth earth wall resulting from the use of formwork would require additional treatment (cutting grooves into them) to receive plaster.

Building and decorating with shells, patterning with clay and chalk, would, from this survey, appear to have been generally discontinued entirely, except in the three places testifying to their ancient use - Awe and Ile-Ife in Oyo and Osun states; and Osan-Ekiti in Ekiti State of Nigeria.

The use of plumbing stave to achieve straight and level walls and ropes, now in the form of strings and twines, for transferring buildings to the ground, are still without better replacements even in modern bricklaying.

Diggers, hoes, and rammers, may have found good replacements in excavators (excavating machines), soil burrows, shovels, spades, concrete mixers, soil grubbers (grubbing machines) and compactors (electrical and mechanical). These replacements are not only heavy duty in nature, they are much cost intensive and require infrastructure facilities (roads, rails etc.) and services (constant electricity supply, potable water etc), all of which are to a large extent, still a luxury, even in some Nigerian urban centers. Thus they are not viable replacements for low-cost construction that is so much the problem with the majority of Nigerians.

Earth construction all over the world, including those reviewed under "Previous Studies" above, consists of any, or variants of five basic forms. These forms are Adobe – sun dried earth brick, Wattle and Daub – earth covering over wooden skeleton, and Cob or Swish Pudding – wet, plastic earth balls, shaped into monolithic wall courses. Others are Tubali, a hand-made, pear-shaped earth brick with grass binders, and Poured Adobe - or Puddle Mud poured between wooden frameworks (Agarwal 1981; Fatiregun 1999 and Akande et al. 2007). The construction of any of these forms involves a similar operational process which includes site clearing and grubbing; foundation trenching which includes excavation and plumbing; and preparing, harvesting and processing of earth material for the walling process. The relevance of *abero* as a building tool is in the peeling off of excess mud from freshly made walls. It is thus a viable tool in the construction of Cob (or Swish Pudding) and Wattle and Daub construction forms. All other tools evaluated

in this study are not only relevant but also applicable and complimentary to all forms and techniques of modern earth construction.

CONCLUSIONS AND RECOMMENDATIONS

Many modern equipment abound that can perform the functions of some Yoruba building tools. Such equipment includes the excavators, scoopers and spades/shovels that can replace the digger and the hoe in the digging and scooping of earth. The concrete mixer also enables proper mixing without the use of traditional hoes. However, these equipments are designed for use in modern concrete buildings. They are not yet adaptable to wet earth construction. The concrete mixing machine may mix but cannot thread earth into the consistent, sticky, mastic mass, required for the indigenous earth walls.

More specifically, there has been no economically viable replacement for Yoruba indigenous building tools. Where adaptable, as in burrowing, excavating and scooping machines, they are too cost-intensive for use in the desirable low-cost indigenous building methods. They also require availability of infrastructure facilities and services, which are not only in short supply but also unaffordable especially in rural communities where this method (earth construction) is most popular.

Despite the pessimistic views expressed by indigenous builders with regards to the economic viability of formwork in place of *abero* and plumbing stave for straight, smooth and even walls; improvement along this direction cannot be foreclosed. Rammed earth has been built for long in Morocco using formwork of wooden shutters with standardized widths and lengths. They are designed so that they can be readily dismantled and moved forward for the next section of the wall (Spence and Cook 1983). An improvement on this can be adapted to the Yoruba layered (or coursed) earth walls. Roughly, this would entail adjustable sets of vertical stands in steel or timber, to which can be mounted horizontal sheets of timber or steel, designed to the height of the Yoruba mud wall courses or layers. The details of this possibility may be a subject of future work. Such a device can be rented for any indigenous building and they have been acclaimed as reducing the construction time of indigenous walls by about 80% (Spence and Cook 1983).

In recent years, more of the Yoruba indigenous mud construction techniques have resurfaced (Atolagbe 1995). Some of these have not conformed to the characteristic form with firm (without cracks), solid, and even (in thickness) wall, noticeable in older mud structures. This is partly due to the decline in the indigenous skill and the paucity of appropriate indigenous working tools. Modern indigenous builders should not only acquaint themselves with this skill but also ensure acquisition of adequate tools and implements that go along with the skill.

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