A Proposed Method of Exploring the Use of Kinetic Architecture for Housing the Migrant Fulbe in Nigeria

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Abstract

This paper presents an investigation on methods of exploring the use of kinetic architecture for housing of Fulbe Migrants. The Fulbe are the pastoral group who occupy the Northern part of Nigeria, Northern Cameroon, Guinea, and Senegal. They are predominantly herders with a strong drive for movement in with their cattle, sheep and goats. They are in constant movement in search of pasture for grazing of their livestock. Due to their high-level of mobility, they occupy tiny tents and hamlets. The aim of this study is to explore the use of kinetic architecture to meet the housing demand of nomadic Fulbe by providing kinetic buildings or structures with variable location or mobility such as portable buildings like caravans, tents and prefabricated barracks model that can be implemented by the government and stakeholders.

1. Introduction

The dynamics in the standard living of a man over the ages have numerous effects on the housing and the environment. These changes therefore call for constant checks on housing conditions and requirements of the people for the purpose of keeping them up to acceptable standards. Nomads in Africa constitute about 6 percent of the total population and are to be found in at least 20 African countries (Stephen, 2006). In many of these countries, statistics indicates that education provision has failed to reach nomadic communities. Despite high investment levels and rapidly rising enrolment ratios, nomads are still underserved and...
disparities within countries are apparent (Danaher, 1999). Providing education to nomadic communities is one of the most challenging and urgent issues currently facing education policy makers, practitioners and other actor within the field (Anyanwu, 1998). In Nigeria, Nomadic Education Programme was set up by the Federal Government in 1990 to take care of educational needs of the nomads. The programme had effects on the reasoning, aspirations and needs of the nomads but there was never any attempt by the government in terms of housing provision (Aminu, 1999).

In most nomadic population, the housing provisions are essentially carried out by the individuals and their communities’ in order to meet the increasing housing needs of the people whereas assistance from the government is not readily available in most of the Nomadic areas. The nomads however, neither live in the urban areas nor ordinarily in the rural areas; rather they inhabit a region of the rural areas that can best be described as the core of the rural areas. This is to explain that they are further into hamlets and bushes where they seek sustenance of their animals and themselves through the mercy of ecology (Chatty, 2010).

From the review of selected nomadic communities around the world, it was observed that the some governments has played a leading role in steering the communities into more consciousness, through their unceasing attempts to make them sedentary, but has played little or no significant role in enhancing their comfort through the practical involvement in the housing scheme.

The apparent omission of a specific housing scheme for the nomads in the series of reports of the on-going “Agenda 21” of the United Nations, under the Global Shelter Strategy to the year 2000 and beyond, has further established doubts in genuine intention of the state in enhancing the quality of life of the nomads. This omission becomes more serious in view of the fact that the nomads constitute about 40% of the total rural population in the world (Doxiadis, 1972) this makes their population highly significant for consideration. There seems to be a belief that the nomads area group of “housing carefree” individuals with no natural instinct for housing. This is indeed erroneous as preliminary studies carried out on some nomadic groups in Nigeria, has established a number of housing needs and their requirements (Awotona and Daramola, 1996). Housing should be seen as a life necessity aimed at housing provision in form of a home, and of adaptation to built environments (Awotona, 1989). Such adaptation symbolizes the values, desires, and adaptive capabilities of the people as a group.

1.1 Background into Fulbe Migrants
The Fulbe are the pastoral group who occupy the Northern part of Nigeria, Northern Cameroon, Guinea, and Senegal. They are predominantly herders with a strong drive for movement in with their cattle, sheep and goats. They are in constant movement in search of pasture for grazing of their livestock. Due to their high-level of mobility, they occupy tiny tents and hamlets (Sa’ad, 1983). Their temporary or semi-temporary settlements are mainly tents and huts which according to Doxiadis (1972) mark their mobile outlook as the nomads take their tent with them to where ever they go, while they abandon the huts whenever they have to move.

In a study carried out by (Daramola, 2006) on Nomadic Homestead and Role Structure amongst Fulbe nomads, discovered that some subtle developments around the homestead of the Fulbe nomads in Nigeria. These contemporary developments are in the area of their homestead settings, furniture arrangement, academic pursuit, dressing and the entire family set-up. The nomads are greatly influenced by on-going development around them. The study further established that age structure, size of family and nature of movement are the three major factors that influence the housing needs of the Fulbe nomads. Another research done by Stephen, (2006) in Sudan on Nomadic Settlement, discovered serious competition over natural resources and land for settling the nomads. The study went ahead and recommended integration of the nomads as a policy, provision of all needed services as a package to active functional integration within the spatial dimensions which include housing provision. Also in a further study on Nomadology in Architecture, Ephemerality, Movement and Collaboration by Cowan in 2002, he identifies the significance of nomads as users and exponents of architecture despite exclusion from architectural history. He further found in cultures and sub-cultures the ephemeral, mobile and the collaborative as strategies for making their architecture. In the same study, he recommended the continuing research into, and interpretations of nomadology in architecture are proposed as a basis for critical theorization and reflective practice of architecture.

Nomadic Fulbe temporary structures represents an architecture that evolved organically as a response to the needs of its beholders and consist mainly in the provision of functional spaces, using light and easily erectable components which are not required to last for more than one year (Kawuwa, 1999).

In terms of weather, the migrant Fulbe structures does not protect the occupants from attack as the materials are not strong, hard and durable; hence not resistant to climatic agents and unhygienic to the users, moreover they are prone to attacks form reptiles and rodents. The creation of this housing contributes a lot...
to the desertification of the environment especially in the study area by cutting trees and not planting any. This affects the ecology of that environment.

Another important issue is the mobility of these people that demands a housing situation that will suit their lifestyle; satisfy their housing requirements without affecting the nature and ecology of any environment that they would find themselves. In terms of Sustainability the creation of this structure serves as one of the major stressor of the environment; and balance is not maintained between use and conservation of environmental resources which is use as materials for construction by the nomads. The whole process of constructing a typical nomadic shelter does not help in reducing environmental waste and pollution associated with buildings and above all cannot save cost and time.

Due to the transient life, the architectural character has been less permanent because it is vegetable oriented piece, this implies that the structures created are collapsible and perishables. Because of the defect of existing housing situation there is need to explore an architecture that can meet and improve on this condition.

Figure 1. Fulbe concentration in West Africa

I. Kinetic Architecture
Generally, kinetic structures in architecture can be defined as buildings and/or building components with variable mobility, location and/or geometry (Fox 2001a), i.e. kinetic architecture can refer to buildings or structures with variable location or mobility such as portable buildings like caravans, tents and prefabricated barracks (Kronenburg 2002). However, it can also be buildings or structures with variable geometry or movement, i.e. soft form buildings with transformation capacity made by membrane structures, cable-nets pneumatic structures, or rigid form buildings with deployable, foldable, expandable or rotating and sliding capacity of rigid materials which are connected with joints (Güçyeter 2004, Korkmaz 2004).

A kinetic construction is a construction or a constructional element which function is made possible due the fact it can move. Some examples of kinetic constructions are stadium roofs, that can slide away, movable sun protection or bridges that can be lifted up and down. The main advantage of such structures is that they can adjust to the environment: they can be modified to the needs of the people.

Kinetic structures can also be classified according to their structural system. In doing so, four main groups can be distinguished: spatial bar structures consisting of hinged bars, foldable plate structures consisting of hinged plates, strut-cable (tensegrity) structures and membrane structures (Hanaor and Levy 2001, Temmerman, 2007). These structural systems have been classified by their morphological and kinematic characteristics in Figure 1 (Hanaor, et al. 2001). Much research has been done with respect to improve the efficiency of these kinetic structural systems which can facilitate a flexibility in building design and give rise to a search for responsive architecture which can physically convert themselves to adapt to the ever-changing requirements and conditions (Zuk, et al. 1970, Fox 2001a, Temmerman 2007, Liew, Vu and Krishnapillai 2008). This could theoretically be buildings consisting of rods and strings which would bend in response to wind, distributing the load in much the same way as a tree. Similarly, windows would respond to light, opening and closing to provide the best lighting and heating conditions inside the building. However, any approach to producing responsive, adaptive architecture must consider architectural and engineering knowledge to ensure robustness of the structure.

General Kinetic Typologies In Architecture

1. Embedded Kinetic Structures
These are systems that exist within a larger architectural whole in a fixed location. The primary function is to control the larger architectural system or building, in a response to changing factors. Changes are brought by both environmental and human factors and include axial, torsion, flexural, instability, vibration and sound.

2. Deployable Kinetic Structures

These typically exist in temporary location and are easily transportable. Such systems possess the inherent capability to be constructed and deconstructed (Kronenburg, 1998a).

Application may include travelling exhibits, pavilions and self-assembling shelters in disaster areas. An example is may be transportable public computer terminals, which can automate their own security (Zuk, 1995).

3. Dynamic Kinetic Structures

Dynamics act independently with respect to architectural whole. Application may include louvers, doors, partitions, ceilings, walls and various modular components. An example may be an auditorium with ceiling configurations that can change depending on the audience and the performer locations for obtaining optimal acoustic properties (Yeh, 1996).

These dynamic structures can be explored categorically as mobile, transformable and incremental kinetic systems (Zuk, 1995).

II. Application Of Kinetic Architecture On Housing

1. Existing Kinetic Buildings

In all periods of human history, man has wanted to create buildings or building parts that move, either in response to the environment or the needs of people. A large number of kinetic structures have been proposed and are currently used for a wide variety of activities such as sporting, conferences, music and performing art events. It is a response to this wide variety of uses that kinetic architecture has been developed and found in some cases to be more economically and more attractive.
In ancient times, kinetic structures were built with flexible outer skins from the simple nomadic tent to the large-scale awnings. The first convertible structure in history has been the simple tent construction. In tent constructions of early ages, the cover material, which played the role of a roof, could be carried away and by this way different needs were responded. The possibility of convertibility in tents was a part of construction. Afterwards Greeks and Romans used large-scale awnings to protect the spectators from the sun and the rain at their amphitheatres.

Awning constructions became widespread in Europe in 18th century. Large open spaces and streets were covered again in sunny and rainy days. Plate 15 shows a large convertible awning constructed in Italy in 1795. The structure, which has been supposed to block sunlight, has been fixed to a building with five points. Five cables coming out of these points lied towards ground and are fixed to foundations. The cover materials are hung between these cables and move easily.

### III. Representation of Results

#### Table. 1 Estimated population of Nomads in States of Northern Nigeria

<table>
<thead>
<tr>
<th>State</th>
<th>Fulbe</th>
<th>Shuwa-Arab</th>
<th>Baduma</th>
<th>Kwanyaro</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abuja</td>
<td>800,000</td>
<td></td>
<td></td>
<td></td>
<td>800,000</td>
</tr>
<tr>
<td>Adamawa</td>
<td>1,300,000</td>
<td></td>
<td></td>
<td></td>
<td>1,300,000</td>
</tr>
<tr>
<td>Bauchi</td>
<td>700,000</td>
<td></td>
<td></td>
<td></td>
<td>700,000</td>
</tr>
<tr>
<td>Benue</td>
<td>200,000</td>
<td></td>
<td></td>
<td></td>
<td>200,000</td>
</tr>
<tr>
<td>Borno</td>
<td>600,000</td>
<td>1,011,519</td>
<td>105,000</td>
<td>60,000</td>
<td>1,176,519</td>
</tr>
<tr>
<td>Gombe</td>
<td>900,000</td>
<td></td>
<td></td>
<td></td>
<td>900,000</td>
</tr>
<tr>
<td>Jigawa</td>
<td>350,000</td>
<td></td>
<td></td>
<td></td>
<td>350,000</td>
</tr>
<tr>
<td>Kaduna</td>
<td>400,000</td>
<td></td>
<td></td>
<td></td>
<td>400,000</td>
</tr>
<tr>
<td>Kano</td>
<td>1,000,000</td>
<td></td>
<td></td>
<td></td>
<td>1,000,000</td>
</tr>
</tbody>
</table>
Data will be collected from both primary and secondary data sources. For the primary sources, the following techniques will be adopted:

2. Selection Study Area:

As seen in Table 1, Adamawa State being located in Semi-Arid Zone of the country and having the state with the highest population of pastoral Fulbe nomads, it was selected as case study for the group. Also, the movement of pastoral Fulbe nomads is usually from the far northern end of Adamawa state to the southern end of the state in search of grazing field for their flock of cattle and other livestock. The following five locations were selected to serve as the study area; Jada (Jada Village), Mayo-belwa (Sebore), Numan (Savannah), Song (Jabbi-Lamba) and Yola (Ngurore). The selection is based on centrality of their locations (pastoralist Fulbe), and these locations experienced a large concentration of the nomads at different periods of the year. The pastoralists Fulbe are seen passing to and from their point of origin to destinations, the locations are situated within the upland and lowland of the state with diverse vegetation potentials.

3. Time of Survey:

<table>
<thead>
<tr>
<th>State</th>
<th>Population</th>
<th>Percentage</th>
<th>Location</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katsina</td>
<td>500,000</td>
<td></td>
<td></td>
<td>500,000</td>
</tr>
<tr>
<td>Kebbi</td>
<td>300,000</td>
<td></td>
<td></td>
<td>300,000</td>
</tr>
<tr>
<td>Kwara</td>
<td>420,000</td>
<td></td>
<td></td>
<td>420,000</td>
</tr>
<tr>
<td>Kogi</td>
<td>400,000</td>
<td></td>
<td></td>
<td>400,000</td>
</tr>
<tr>
<td>Niger</td>
<td>400,000</td>
<td></td>
<td></td>
<td>400,000</td>
</tr>
<tr>
<td>Plateau</td>
<td>450,000</td>
<td></td>
<td></td>
<td>450,000</td>
</tr>
<tr>
<td>Sokoto</td>
<td>650,000</td>
<td></td>
<td></td>
<td>650,000</td>
</tr>
<tr>
<td>Taraba</td>
<td>1,200,000</td>
<td></td>
<td></td>
<td>1,200,000</td>
</tr>
<tr>
<td>Yobe</td>
<td>500,000</td>
<td>315,723</td>
<td></td>
<td>815,723</td>
</tr>
<tr>
<td>Zamfara</td>
<td>250,000</td>
<td></td>
<td></td>
<td>250,000</td>
</tr>
<tr>
<td>Total</td>
<td>11,320,000</td>
<td>1,327,242</td>
<td>105,000</td>
<td>12,812,242</td>
</tr>
</tbody>
</table>
The pastoralists Fulbe are more relaxed and receptive during the rainy season when there are no problems of getting grazing land and spaces for their animals. The months between May and October are the best period to achieve the best result for any research associated with nomadism. However, the pilot survey will be carried out between September and November; this time is the ending period of the rainy season and transhumance still very active in the selected study areas.

4. **Population of Study:**

Asika (2006) stated that a population is made up of all conceivable elements, subjects or observations relating to a particular phenomenon of interest to the researcher. Subjects or elements are individual items that make up the population. The 1992 and 2006 Census did not make provision for tribal enumeration which makes it difficult to ascertain the actual number of the pastoralist nomads. But in a study carried out by the National Nomadic Education Commission (NNEC) in 2009 put the estimated population of nomads in Adamawa State 1,300,000 million. For the purpose of this research, this estimated figure will be the reference population.

In determining the sample size the 1.3m will be further divided into household sizes using an average person/household formula. It should be noted here that the pastoral Fulbe nomads are homogenous group which share a lot of things in common. A small family unit will therefore represent a very large one.

5. **Study Target Respondents:**

The head of each household as earlier mentioned will be the target of respondents because they are trustees of the household funds and responsible for the activities in their household. Amongst the pastoral Fulbe, the male are the household heads and in most cases lead the itinerary. Only responses from the household heads who are actively involved in nomadic lifestyle will be used for analysis.

6. **Data Collection Techniques:**

The need to improve the housing condition of migrant Fulbe calls for a thorough understanding of who they are. In order to achieve this, the following will be adopted for this research work; Semi-structured interview, Observer and Focus group interview.
(i) Semi-Structured interview: this study will apply this technique because of the exploratory nature of the study; the technique will enable the respondents to answer questions freely, without necessary guidance. It will also enable them to answer questions outside the main question and will build up a qualitative profile of an individual group, family and e.t.c.

(ii) Observer: This will involve observer and participant which is recommended for most ethnographic studies. The entire environment and life-style profile will be observed, together with the physical environment including building materials as well as the activities that go around it. According to Ziesel (1984), observing physical traces can be invaluable at the beginning of the project

(iii) Focus Group Discussion: This approach will be used in establishing the honesty of the respondents. Sometimes respondents hide or give false information during person-to-person interview, but at group level becomes difficult. Specialists groups such as National Nomadic Education Commission (NNEC), Miyetti Allah Cattle Rearers Association, Pastoral Resolve and others will be contacted and interviewed

(iv) Measured Drawings: Measured Drawings will be used to collect data; this involves measuring the volumetric aspect of the existing nomadic shelters and describing them in their present condition. With traditional graphic tools of architecture, plans, elevations, sections, and axonometric views as well as interior elevations and details will be shown. This will provide architectural representations drawn to scale of their existing buildings.

7. Data Analysis Techniques

The nature of the survey in this research calls for qualitative rather than quantitative data analysis. Descriptive analytical techniques such as the study model, focus group discussions, data summarization models, cross tabulation and percentages will be employed in the course of this study. The findings of the research would be thoroughly discussed so as to come out with inferences that will assist in improving their shelter (nomads) using the technology of kinetic architecture.

Since the major goal of this research is explore, identify, explain in an objective way and application of kinetic architecture to pastoral Fulbe housing need. Within the spatial context, two multivariate analytical techniques will be employed, they are factor analysis and the standard score additive model (Z – score). These methods have been used in spatial trends and spatial analysis of some phenomena. The factor
analysis has the advantage of being able to reproduce both positive and negative coefficient in a data set. The techniques will explain the relationship to be observed for demographic, environmental, cultural, socio-economic, mobility and settlement variables.

Conclusion

In recent years, due to urgent need for multi-functional buildings and also the necessity to maintain and respect the environment in front of building’s wastes, the demands for kinetic, transformable, and changeable structures has increased rapidly. The contemplation of contemporary architectural designs shows an increasing demand for the development of more mobile, adaptable, flexible and transformable structures. This structure can adapt with different environmental conditions and meet different functions and helps in reducing environmental waste and pollution associated with many buildings and above all can save on cost and time. In conclusion, this study is a provision of more adaptable and habitable building model for a typical nomadic Fulbe house and probably for the development of a blue print for the transient cultures of the country. The present examples of how various ways of kinetic architecture has been used in housing and determine nomadic Fulbe vernacular architectural elements, thereby creating a national pride in belonging to a culture that gave birth to such. The study also shows that using kinetic modular designs can create a changeable module that is not only able to respond to different functions and environmental changes but it is also able to shape different configuration which will be able to respond to different user's ambitions. The compactability of this structural model will make its transportation fast and with minimum costs. These capabilities will make this structure suitable for not only nomadic Fulbe but also temporary buildings such as exhibitions centers, temporary settlements or hospital in damaged areas during disasters.

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