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PROFESSIONALS' PERCEPTION ON ISSUES RELATED TO ADOBE BUILDINGS FOR SUSTAINABLE HOUSING IN DAURA, KATSINA STATE, NIGERIA

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ABSTRACT - Many communities in Katsina state are experiencing a massive influx of people from rural areas resulting to high demand for housing and the growth of squatter settlements. Conventional materials have meant that housing can be provided but they are not affordable for the low-income earners. There is therefore an urgent need to assess an alternative building construction method. This research analyses the problems of earth construction in Katsina state with limitation to problems of earth buildings in Daura local government area. To this effect, primary data is collected through the use of questionnaires, direct observation and oral interview, while secondary data is obtained through synthesizing relevant literature materials. The data analysis is carried out using simple percentage technique and problems observed are presented by the aid of plates. The study indicates that there are problems militating against earth construction due to technical and performance limitations, low socio-cultural value and the non-recognition of earth construction as collaterals by institutional bodies.

Keywords: [Adobe buildings, Construction Techniques Earth Construction, Militating, Sustainable Building.]

1. INTRODUCTION

Every sustainable housing project seeks to build at most affordable and the lowest cost possible. In the tradition of earth construction, numerous building methods have been recognized reflecting the identity of the area and cultures. In Katsina state, communities like Muduru, Kalgo Gari and Abukur, the form and function of the buildings and dwellings reflect the pattern of social, religious life as well as family needs. But with the introduction of processed materials, there is poor utilization of earth construction techniques as before. Emphasis is always given the maximum use to of locally available materials, such as common adobe, It has been known for centuries, soil mixture simply needs a clay content to becomes sticky mud when mixed with water 40 percent. This soil is use to make building blocks using simple wooden molds (Balla, 2005). "Housing is one of the most essential needs of human beings. 'It is an indispensable social and physical

infrastructure whose quality and quantity serve as instruments for assessing standard of living culture and civilization of people." (Benjamin, 2006). As the population continues to grow, so does the need for housing. Thus, cheap and easily to build accommodation for the thriving masses is highly demanded in the developing world. Relatively new materials such as cement and steel have meant that buildings can be made to last for centuries, but are not affordable for most people in urbanizing areas. A possible solution to this would be to construct buildings using unbaked adobe earth blocks. Earth construction is the most common method of making cheap accommodation, since earth or soil is readily available almost anywhere on the planet. But the utilization of earth construction to sustain housing is being eclipsed by conventional materials. This research analyses the problems associated with earth construction in Daura, Katsina state. Housing is a basic social and physical infrastructure whose quality and quantity serve as instruments for assessing standard of living of a people. Rapid urbanization, population growth and the over dependence of man on imported and locally produced materials with high foreign input have made provision of housing to become an acute problem. This is because communities become more densely populated, housing become more demanded. However, "one of the major hindrances to the provision of housing in Nigeria is the spiraling cost of conventional building materials, the high cost at which they are produced, built and maintenance cost" (Benjamin, 2006). Despite this, the alternative earth construction methods that were being used to construct housing are being abandoned because of their multi-facetted problems. This research aims at exploring the problems of earth construction in Daura, Katsina State. The objective is to understand the causes of problem in adobe buildings in Daura, katsina state The need to properly identify the various problems militating against earth construction under the wing of sustainability, economy, and effective energy utilization cannot be over emphasized. This research is significant in that it is both explanatory and documentary in purpose. Therefore the significance of the study will go a long way in reviving the environmental advantages of earth construction to contribute towards alleviating the challenges of housing back logs in various localities of Nigeria.

A Historical over view of earth construction:

Houben and Guillaud, (1994) asserted that "The history of building in earth is not well documented. Interest in this material often regarded as being inferior and archaic has been eclipsed by that devoted to stone and wood, the 'noble' materials". Earth construction remains common in some parts of the world where specific climate or economic conditions dictate, and where the earth construction know-how (knowledge of construction with earth and experience in using it) is common place. Earth Building Association of Australia (EBAA) defined "Earth building as the practice of building using unfired earth material. It is a building technology with 11,000 year history and a tradition which is utilized worldwide" "Ever since man learnt to build homes and cities around 10,000 years ago, earth has undoubtedly been one of the most widely used construction materials in the world"(Houben and Guillaud, 1994). To review its relevance today is expected to inculcate interest in professionals and the society at large. Benjamin, (2006), states that the environmental advantages of using earth in building are:

I Unbaked earth does not contribute to deforestation which follows the use of organic resources for firing in the production of burnt clay. Ii It does not consume any non-renewable energy like oil and gas during its production as does the production of cement.

Iii It does not contribute to the diminishing of resources of aggregates, such as gravel and sand. "Earthen construction using either Tubali or rectangular shaped, sun dried bricks have been used in rural Nigeria and inner sections (poorer neighborhoods of our cities)". (Ibrahim, 2007) However, Isaac, et al (2015) asserted that earth building construction is no longer attractive despite being more environment-friendly.

Stabilization of the Adobe Soil

"Stabilization is very ancient but it was only in the 1920s that a scientific approach could be developed" (Balla, 2005). Moisture absorption must be minimized if adobe blocks are to be a durable building material. Limiting the Clay content of the adobe mix and using the optimum amount of water can reduce the moisture absorption. However, even the best mixture can develop some cracks. Therefore, it is important to add other materials to the mix to prevent water from infiltrating the dry block. This process is called stabilization.

Importance of soil stabilization

Stabilization fulfills a number of objectives that are necessary to achieve a lasting structure from locally available soil. Some of these are; better mechanical characteristics (leading to better wet and dry compressive strength), better cohesion between particles (reducing porosity which reduces changes in volume due to moisture fluctuations) and improved resistance to wind and rain erosion. Stabilization techniques can be broken down into three categories – Houben and Guillaud (1994)

- **Mechanical stabilization** compact the soil, changing its density, mechanical strength, compressibility, permeability and porosity and is achievable with virtually any soil type.
- **Physical stabilization** ; physical stabilization technique changes the properties of the soil by acting on its texture; this can be done by controlling the mixture of different grain fraction,
- **Chemical stabilization** changes the properties of the soil by adding other materials or chemicals.

Materials for stabilization

Houben and Guillaud, (1994). Materials for stabilizing soil include:

a. Animal or vegetable stabilizers; "These stabilizers can be used in the bulk of the earth to create an anisotropic* network limiting movement". These stabilizers include animal dung, grasses, straws; stems of other grain plants that have been cut and dried which if mixed with bulk of earth, reinforces the soil.

b. Mineral or synthetic; Synthetic stabilizers combine chemical substances rather than being produced naturally by plants or animals. The practical stabilization methods are increasing the density of soil with stabilizers such as bitumen. Stabilizers such as cement, gypsum, Lime, and other powdery stabilizers produce cementation.

Study area and Methods

Daura has a very rich history which dates back to several centuries. The population of Daura town according to 2006 census is 224,884, with 115,576 male and 109,308 females (Tukul, 2018). The people are of Hausa – Fulani stock-Wikipedia (2018). What is known today as Daura is a local Government in Katsina State and is contiguous with the

province of North Eastern Part of Katsina State (comprising of People with single socio-cultural background); – Katsina state Government Diary (1987). The data for this study obtained through the use of questionnaires, oral interviews and physical survey and observation of buildings in earth construction. A total of 60 questionnaires were administered on the basis of 50 questionnaires to the randomly selected communities and 10 for professionals. The distribution was predicted on localities/communities that have high population density of buildings in earth construction. The various problems associated with earth buildings were analyzed.

Presentation of Data and Analysis of the Research Findings

Questionnaires were used to collect information from professionals in the building industry and the various communities of the study area. A total of 60 questionnaires were administered on the basis of 50 questionnaires to the randomly selected communities and 10 for professionals. The distribution was predicted on localities/communities that have high population density of buildings in earth construction.

Problems	Frequency Percentage (%) n=10	
Maintenance problems	1	10
Partial / total collapse	2	20
Map / pattern cracks on surfaces of wall.	2	10
Corner cracks	1	10
Surface and base erosion of wall.	2	20
Flaking of protective coating / crumbling	1	10
Entrapment of moisture / water in an impervious coating such as plaster.	1	10
Total	10	100
Source: Field Survey May, (2020)		

Table 1 Typical problems of buildings in earth construction (professional's response)

Deducing from the responses given by professionals in the building industry from table 1 the typical problems of earth building include all the above listed in the table.

However, during the physical survey some buildings in earth construction observed in the various parts especially in rural areas, all presented the same defects. This is presented in plates 1, 2, 3 and 4.

Causes of Problems	Frequency n=10	Percentage (%)
Unsympathetic repairs / poor workmanship	1	10
Expansion and Contraction due to wetting and drying / thermal expansion due to change or variation between day and night temperature	2	20
Rainwater / surface water penetration	4	40
Lack of proper drainage system	2	20
Excessive loading / Heavy weight of roof	1	10
Total	10	100
Source: Field Survey May, (2020)		

Table 2 Causes of Problems to Adobe Construction (professional's response)

The findings showed on table 4.2 above, reveal the possible causes of problems to earth buildings.1 representing 10%suggest unsympathetic repairs,2 representing 20% suggest; expansion and contraction due to constant wetting and drying/thermal expansion between day and night temperatures.4 representing 40% choose ;rainwater/surface water penetration while the other 3 representing 10% each suggested that; Inadequate drainage system ii Excessive loading/ heavy weight of roof.

Factors	Frequency n=10	Percentage
Technical	4	40
Social/societal	3	30
Institutional	3	30
Total	10	100
Source: Field Survey May, (2020)		

Table 3 Factors militating against earth construction (professional's response)

Table 3 indicates that the major problems militating against earth construction are **i.** Technical **ii.** Social and; **iii** Institutional 4 out of the 10 professionals representing 40% opined that inadequate expertise (technical know-how), while 3 representing 30% suggested that problems of acceptability among the people in the society(social problems) is another and 3 0thers representing 30% that make a 100% of total responses ascertained non recognition by appropriate authorities such as government, constitute the institutional problems. This shows that inadequate expertise, i.e. absence of skilled tradesmen and lack of standardization coupled with non-availability of earth construction equipment constitute the technical problems. On the other hand, the main objection to earth buildings is that they have low socio cultural status as far as modern construction methods are concerned because the sight of dilapidated earth structures is associated with poverty and lack of progress which in turn affects their acceptance and utilization in the society. This constitutes the social problems.

Responses	Frequencies			Cumulative	Percentage
	Kalgo Gari	Daura town	Dunu		%
Yes	2	2	-	4	3.57
No	39	37	31	108	96.43
Total	42	39	31	112	100
Source: Field Survey May, (2020)					

Table 4 modernity of Earth buildings

The findings in table 4 above clearly indicate that buildings in earth construction are not truly regarded as modern by many people in the study area as 96.43% representing 108 respondents do not consider buildings in earth construction as modern, while 3.57% representing 4 respondents that see earth buildings However this reveal that there is lack of acceptability of buildings in earth construction as the percentage of responses rejecting earth buildings is higher.

Problems of determining the cost of buildings in earth construction

According to oral discussion with the residents, there is problem of determining the cost of structures in earth construction. 100% responded that it is difficult to ascertain the cost of the buildings. This shows that the cost of earth buildings can be difficult to estimate.

	Responses			Cumulative	Percentage
	Kalgo Gari	Daura town	Dunu		%
(a)	6	2	4	12	10.7
(b)	36	37	27	100	89.3
Total	42	39	31	112	100
Source: Field Survey May, (2018)					

Table 5 Responses to Preference of Earth Building

Table 5 reveal that modern building is more preferred over earth buildings as100 respondents representing 89.3% chose modern building while 12 representing 10.7% chose buildings in earth construction.

Responses	Frequencies			Cumulative	Percentage
	Kalgo	Daura town	Dunu		%
Partial collapse	5	5	4	14	12.5
Flaking of coatings : Renders	8	6	5	19	16.76
Erosion of wall surfaces	16	18	17	51	45.54
Cracks	13	10	5	28	25
Total	42	39	31	112	100
Source: Field Survey May, (2020)					

Table 6 Problems of Earth Buildings in Some Areas

Here observations are presented with the aid of plates to show the various forms of problems observed in the course of the study. Certainly, during the physical survey some buildings in earth construction observed in the

various parts especially in rural areas, all presented the same defects such as Patterned//map cracks on wall surfaces, partial crumbling of earthen walls, partial and even total collapse.

Plate 1: Partial Collapse of Mud Building

Plate 2: Crack at the Corner of Earthen Wall

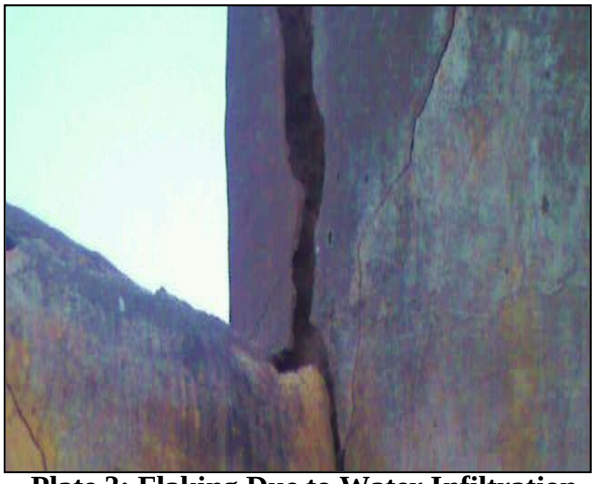

Plate 3: Flaking Due to Water Infiltration

Plate 4: Erosion of Brick Mortar Joint

DISCUSSION

This research was conducted to analyze the problems of earth construction in Daura, Katsina State. To this effect, problems of buildings in earth construction were analyzed, thereby arriving at the following findings: Firstly The findings of the research have established that earth construction is susceptible to mechanical damage such as erosion on the surfaces and bases of earthen walls, pattern cracks and cracking resulting from water penetration and constant wetting and drying. The findings of the research have also established that earth constructions do not perform well in severe weather conditions and this shows that they require frequent maintenance to safeguard their integrity. Secondly earth construction and techniques employing them are burden with poor image as the main objection to them is that they have low socio-cultural value and status in the society. The result of this is that there is problem of social acceptability of earth construction. Therefore communities now prefer conventional construction methods and lastly, there is the non-recognition of earth construction especially by financial institutions as it is difficult to estimate the cost of buildings in earth construction and the challenges of finding individuals or organizations that will consider structures in earth construction as collaterals. This is attributed to non – recognition of earth construction by subsisting buildings laws and regulations.

CONCLUSION

In view of the findings therefore, it could be rightly concluded that the major problems militating against earth construction are technical, social and institutional ones.

RECOMMENDATION

Considering the extent to which earth construction problems field, Architects and Builders should consider the merits of earth construction in the provision of housing as this will help to retain the values of earth architecture as well as provide environmentally friendly buildings.

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