

ENVIRONMENTAL INFLUENCE ON TRADITIONAL BUILDING MATERIALS: A CASE STUDY OF THE SOUTHERN PART OF PLATEAU STATE, NIGERIA.

Nimlyat, P. S.
Department of Architecture
University of Jos, Plateau State, Nigeria

ABSTRACT

This paper is concerned mainly on the influence of climatic elements and environmental biological agents on traditional building materials in the southern part (lower Plateau) of Plateau State. The aim of the study is to establish a relationship existing between environmental biological agents, selected climatic elements and the traditional building materials that could lead to the achievement of optimum human comfort. The main environmental elements to be put into considerations are the climatic elements such as; water, humidity, sunshine, temperature variation and lack of ventilation. Apart from climatic elements, there is also the biological agents (such as insects, moulds, fungi, wood worm, termites and rats) which affect the materials, building structures and contents. The study is based on subjective opinion through oral interview from sampled respondents and expert judgement from the survey of the traditional building materials and their response to these elements. The findings shows that, the rate of maintenance of these traditional building materials is borned out of the impact or influence of the environmental elements. It is hoped that the analysis will be useful to architects, builders and other professionals involve in housing delivery, if there must be meaning and relevance in the architecture of the people in this area.

Keywords: Environmental, Traditional, Building Materials, Climatic Elements

INTRODUCTION

Since the beginning of time, man has been affected by climate and its influence over the earth. However, the first documentation of architectural design with climate interests in mind dated back to fourth century B.C. in Greece (Turner, 2003). It has been observed that, there is no improvement in the vast resources of traditional building materials available for the building industry as opposed to the importation of the foreign ones. The traditional architecture of a people reflects their culture, socio-historical and economic values and more importantly, the environmental conditions such as the climate. Traditional buildings are therefore usually built just below the brow of a hill on the southward slope. This way the building is protected by the hill and the surrounding shelter belts of trees (Turner, 2003). This is seen in the fact that, man as an organism with great adaptive capacity is able to live, however, only under special environmental conditions which determine his condition of life (Anderson 1977). The influence of the environment has been noticed and reflected in man's dwelling since prehistoric times, since shelter is primarily meant to keep the inhabitants free from environmental hazards. The main environmental parameters favouring the decay of materials and contents are water, humidity, temperature and lack of ventilation (Singh 1999). While the biological agents includes insects, moulds, fungi, wood worm, termites, rats etc. These biological agents can be unpleasant in temperate zones but they become a dangerous nuisance in the tropics (Singh 1999). Traditional building materials are naturally more environmentally friendly and sustainable compared to many modern construction materials (CADWYN CLWYD, 2008). The adaptive nature of these traditional building materials of an area depends on the problems presented by the climatic condition of the area. According to Rodhe, et al (2002), a number of factors contributing to future climate change are likely to have an impact on building deterioration on different time and length-scales. Trends in atmospheric composition and microclimate parameters will affect the fundamental processes causing damage to building materials. Climate has been described as one of the important factor in architectural design decision making. Apart from human comfort, climatic conditions have important effect on building materials as regards to their performance. The moderation of climate for the benefit of the people is one of the principal purpose of buildings. Folk architecture is not exclusively determined in its form by climate and available building materials, but most Folk architecture is suitable for the climate of the place in which it is built (Olgay 1973). Olgay (1973) further put it that, suitability to climate is determine by judgement and requires a balance related to climatic extremes, human comfort, the properties of materials, maintenance and energy cost. There is therefore, a need to study the role climatic elements have on traditional building materials and the need to design for a better housing units. Environmental elements in one way or the other affect traditional building

Environmental Influence on Traditional Building Materials: A Case Study of The Southern Part of Plateau State, Nigeria.

materials which form the integral part of the building itself. The aim of the study is to establish a relationship existing between environmental biological agents, selected climatic elements and the traditional building materials that could lead to the achievement of optimum human comfort.

STUDY AREA

The study area is located in the lowland plains of the Jos Plateau. It is located between longitudes 8° and 10° East, and latitudes 8° and 10° North of the equator in the middle of high Savannah plains that rises several feet above sea level. The lowland areas of the Plateau comprises of Wase, Langtang North, Langtang South, Mikang, Shendam and Qua'an'Pan Local Government areas of Plateau State. It has a tropical type of weather with an average temperature of 30°C , relative humidity that ranges between 28% and 78%, and experiences a relatively low rainfall put at about 120.4mm. The area is characterized by the harmattan wind blowing across the unobstructive "grassland" at a speed sometimes in excess of 14m/s. The building materials basically found and used in the area are: vegetable materials, corn-stalk, timber, stone, laterite and mud.

METHODOLOGY

The study was carried out randomly in selected location in three local Government areas of the lower Plateau, viz: Wase, Langtang South and Mikang. The work deals with the analysis of data sourced from expert judgement as well as personal interview with skilled local builders and elders within the study area. The interrelationship between traditional building materials and environmental factors especially, climate were studied in detail. The focus is on moisture, wind, solar radiation, fungus growth and termites which are the major environmental factors. An attempt at spelling out the climatic requirements and the properties of the traditional building materials were also made through subjective opinion, expert judgement and summaries from literature review inferences. Also, the available traditional building materials in the area were analysed based on how they are affected by these environmental factors. The data collected here provided information in the nature rather than the level of satisfaction of individual with these traditional building materials as used in construction.

IMPACT OF ENVIRONMENTAL ELEMENTS ON THE TRADITIONAL BUILDING MATERIALS IN THE AREA

The major climatic elements of influence in the study area are; rainfall, wind, temperature and sunshine. These elements either caused degeneration in the traditional building materials or mechanical damage. According to the English Heritage (2007), we are familiar with the effects of temperature and humidity, especially during warm, 'muggy' summers. Humidity that is too low can also be a problem, making the air feel too dry. Apart from climatic elements, there is also the biological agents (such as insects, moulds, fungi, wood worm, termites and rats) which affect the materials, building structures and contents. The fabric of a traditional building needs to 'breathe': to release and absorb moisture, for example from rising damp, driving rain, defects and condensation. Moisture can move through traditional building materials until it evaporates, internally and externally (English Heritage, 2007). This helps in accelerating the decay processes of the building materials.

Vegetable materials: They include grasses, bamboo and corn-stalk. These building materials are water proof and having high heat retention but susceptible to storm and wind damage and of high fire risk (see figure 1). With excessive rainfall and sunshine, grass and corn-stalk can decay rapidly making it prone to termites and fungi attack (see figure 2). The effect of these elements is reduced by impregnation with poisons, spraying or submersion in starch solution for a limited period.



Figure 1

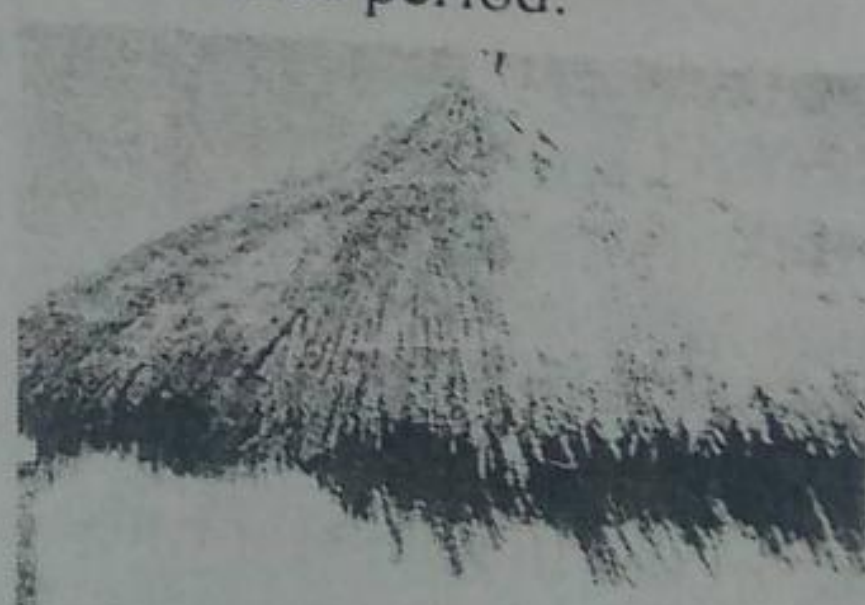


Figure 2

Timber

The cells of timber degenerate due to the effect of water penetration, heat and wind. Where timber is used and properly constructed, it has high resistance to storm and occasional moisture. The environmental elements that affect timber cannot be eliminated in totality but their influence can be reduced to a tolerable level.

Mud

What could be more basic to life on earth than mud and straw? The dirt beneath your feet brings forth grasses that become straw, when you combine these two elements with loving care you can create an enduring beauty that will thrill your soul, and the home that will embrace and protect you (Hart, 2008). Mud contents are easily wash away when exposed to continuous rainfall although, it has the qualities of good heat insulation, heat storage capacity and can withstand wind. Biological agents such as rats, termites and insects cause serious damage to mud by hollowing large part of it but leaving a thin shell for protection. This results into some loss in toughness and cohesion while moulds growth on the surfaces of mud resulted into patchy surface decoloration (see figure 3 and 4). The effect of rain and sunshine on mud can be prevented or reduced with large roof overhangs while the risk of biological agents is reduced by plastering. The mud used for plastering is either mixed with bitumen or waste water from fermented cassava which increases its ability to withstand all these environmental elements.



Figure 3

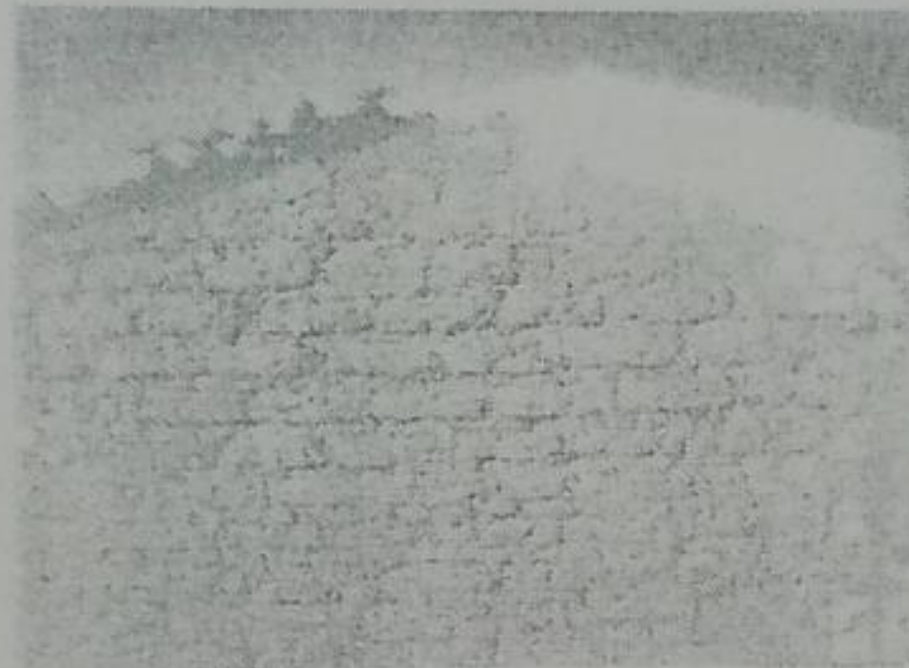


Figure 4

INFLUENCE OF THE ENVIRONMENTAL ELEMENTS ON THE BUILDING COMPONENTS

FOUNDATION

The construction of foundation is not more than 200mm deep into the ground as such, wind and rain water tend to wear out the surface of the soil exposing the mud foundation to erosion (see figure 5). The mud foundation is also affected by environmental biological agents such as rodents, termites, lichen, algae and mosses which dig holes into the foundation thereby weakening its strength (see figure 3). Stone which can withstand most of these environmental elements is only used as foundation for granaries and barns. Due to its location underneath walls and part of it buried inside the ground, it is less affected by the climatic variables. But biological agents such as algae and fungi in symbiotic association penetrate into the stone opening cracks and crannies, and also generate organic acid which dissolves the stone material.



Figure 5

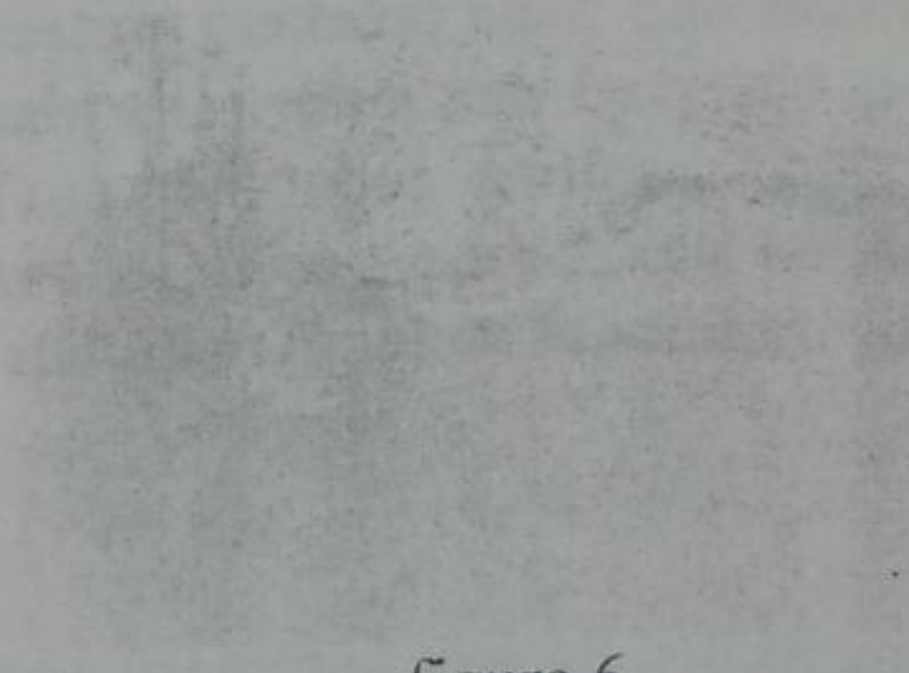


figure 6

Floor

Due to the non-exposure of floors and its admixture, it is not mostly affected by the climatic elements. Floor made from mud mixed with a solution of locust bean shell withstands any weather conditions for a longer period of time. The untreated floor is affected by termites and rodents which live within the floor.

Environmental Influence on Traditional Building Materials: A Case Study of The Southern Part of Plateau State, Nigeria.

Walls

The most prevalent traditional walling material in this area is mud. Stone is also used for walling but embedded in mud for proper bonding. With long exposure to climatic elements especially rainfall, mud walls gradually reduced in thickness due to the surface being eroded (see figure 4). The mud walls are sometimes affected by heavy storm (see figure 6). Moulds, algae and fungi are common growth on mud plastered walls. These plants caused chemical biodeterioration of walls and the damage caused by them is confined to the surface discoloration of the wall (see figure 3). The cracks and crevices on walls resulting from the activities of some of the biological agents create micro-environment suitable for microbial growth. The continued accumulation of these minerals allowed for the germination and sometimes growth of higher plants (see figure 7).

Roofs

Roofs are the most exposed building materials to the climatic conditions. The major materials of roof construction (thatch, corn-stalk, straw and reed) have a higher risk of fire. They are easily blown up by storms and winds. (See figure 6) Where the roof is constructed of thatch over mud as found in their barns and granaries, the problem of wind and storm can be reduced drastically. (see figure 8)



Figure 7

CONCLUSION

This study discovered in the area of study that the extensive used of traditional building materials are now giving way to the conventional ones hence, the possibility of discovering a great deal of their qualities is gradually fading out. However, the limitations of the traditional building materials as a result of the environmental influence on them do not outweighs their potentials. The findings show that thatch deteriorates under water action, succumbs to strong winds and of high fire risk but has a good ventilation property. On the other hand, mud which suffers considerable damage when exposed to continuous rainfall and direct sunlight is also discovered to having good heat storage and insulation properties. The rate of maintenance of the traditional building materials used in the study area is borned out of the impacts of these environmental elements. The improper application and maintenance of these building materials always lead to their deterioration. Where the thatch roof is made very steep with wide overhang, it reduced the exposure of walls to rain and allowed rain water to drop off easily. Also, trees planted around some of the buildings created a good micro-climate serving as shades and wind breakers protecting the building components from wind and storm damages. The study further observed that mud walls plastered with a combination of muds and admixtures withstand the effect of rain, sunshine and other environmental conditions even when exposed to them. It is therefore important to protect the buildings against environmental influence and improving the qualities and properties of the traditional building materials for maximum used.

REFERENCE

- Cadwyn clwyd (2008). Traditional Building Skills. Project Summary. www.cadwynclwyd.co.uk/content.
- English Heritage (2007). Energy Conservation in Traditional Buildings. www.helm.org.uk.
- Godwin C. (1991). Traditional Architecture and Search for Shelter for all by the year 2000. Housing Today Magazine. Vol. 8 (1)
- Hart Kelly (2008). The Beauty of Mud and Straw. Green Home Building.com. www.greenhomebuilding.com/articles/mudandstraw.htm.

- Hawkers D. (1996). The Environmental Tradition: Studies in the Architecture of Environment.
- Olgay V. (1973). Design with Climate. New Jersey: Princeton
- Rodhe H., Denter F. And Schalz M. (2002). The Global Distribution of Acidifying Wet Deposition. Environmental Science Technology 2002, 36, 4382 – 4388.
- Singh J. (1999). Biodeterioration of Building Materials; In Garg K. et al edition. Vol. 8(1).
- Staurt J. (1993). Environmental Impact of Property. Greener Buildings. Hongkong.
- Turner Lauren (2003). Climate and Architecture – A Report for Honor's Section 8 of MET1010 Introduction to the Atmosphere Florida State University.