Trends in Earthen Construction for Rural Shelter in Zimbabwe: The case of Tsholotsho in Matabeleland North Province

Lookout B Ndlovu and Sampson Ik Umenne:

1 Civil and Water Engineering, National University of Science and Technology (NUST), P O Box AC 939, Ascot, Bulawayo, Zimbabwe; E-mail: lbndlovu@nust.ac.zw or lookoutn@yahoo.co.uk; 2 Faculty of the Built Environment (FOBE), NUST, P O Box AC 939, Ascot, Bulawayo, Zimbabwe; E-mail: umenne@nust.ac.zw or sikumenne@yahoo.com

Key Words: Durability, earthen construction, rural housing, appropriate technology, sustainability

Abstract

Historically, earth and other local materials have been in dominant use in construction for both rural and urban housing in Zimbabwe. The Matabeleland Provinces in the Southern part of Zimbabwe are no exceptions. With advances in technology and noticeable improvement in living standards, people popularly tend towards a set of building materials, albeit for the purpose of securing more durability and modernity. However, the adequacy and effectiveness of these materials, in terms of affordability and sustainability in rural housing remains below expectations. The use of non-traditional materials is prevalent and the provision of affordable housing is still a major challenge in rural Zimbabwe.

This paper seeks to examine the trends in earthen construction, for housing in the Matabeleland region and specifically, Tsholotsho. It also seeks to explore the potentials for improved, affordable and sustainable earthen construction for shelter housing in Zimbabwe. Alongside, the paper addresses some of the inherent psychological factors militating against the promotion of earthen construction in general.

Introduction

In the history of human settlement development, communities have largely been concerned with locally available materials and their appropriateness to the climatic conditions and other threats. Thus shelter has evolved from olden day caves to the modern structures we have today, where the use, comfort, social customs, convenience and status are some of the factors that influence the choice of materials and construction techniques. Traditional building materials in rural Zimbabwe include adobe, timber, stone, thatch and other related locally available materials. However these are used with little or no scientific input, leading to their faster deterioration. Hence the shift from these appropriate building materials to the non-traditional materials. The communities desire to construct durable structures and reduce maintenance. Notably, these materials except clay bricks are ‘imported’, and their prices are beyond the reach of many. Their manufacturing processes and transportation consumes lots of energy. Further more environmental concerns inform the reduction of materials like timber and fired brick as deforestation in the district has risen to alarming levels. Thus the use of non-traditional materials such as steel, cement, plastic floor tiles, aluminium roofing sheets, etc easily proved inadequate. A study carried out in South Africa showed that traditional construction materials and methods were more cost effective than the conventional [3]. Despite these factors, the popularity of non-traditional building materials continues to grow in Zimbabwe, thus enhancing the ability of families to develop and own houses. Almost everyone sufficiently eligible to own a house is a victim of this negative trend. This paper embodies the outcome of a research carried out in Matabeleland to identify trends in earthen construction with focus on the promotion of sustainable earthen construction. The objectives of the research are essentially to promote earthen materials in rural housing and to investigate the aspects of further exploitation of the potentials of earthen construction in Tsholotsho District.
Recently, earthen construction has gained some recognition in the first world, where various scientific mechanisms are being applied in an effort to improve its durability, aesthetics and cost effectiveness. Regionally, there are research efforts underway in Botswana, South Africa and Zimbabwe to establish a framework for developing performance-based codes. The use of performance-based codes would certainly preserve earthen building materials and methods in Southern Africa [3]. Ngowi [7] has also done some work on improving the traditional earth construction in Botswana.

In South Africa, research on earthen construction dates back to 1950. Currently research is being undertaken on the subject by the University of the Free State (Bloomfontein), by the Peninsula Technikon (Bellville) and the Namibian Clay House Project (Windhoek and Otjiwarongo, Namibia). The University of the Witwatersrand and Hydraform Africa have achieved reasonable success in the use of earth and waste materials such as the ‘sludge’ precipitated at the water treatment plants for the production of masonry elements [6]. In 2003 the International Centre for Science and Technology an institution within the framework of the United Nations Development Organization (ICS-UNIDO) initiated a project on strengthening the capacity of Mozambique in the production of cost-effective building materials based on local clay resources.

In Zimbabwe, the Scientific and Industrial Research and Development Centre (SIRDC) through its Building Technology Institute (BTI) has perfected and promoted rammed earth Technology in Zimbabwe. BTI built rammed earth structures at their premises (1997), in Insiza district (2003), and in Mutoko (2003) and launched a National Pilot Project with the Ministry of Science and Technology. BTI in conjunction with the Standard Association of Zimbabwe (SAZ) also developed standards for rammed earth construction. SIRDC and Practical Action worked on the promotion of stabilized soil blocks as well. In another initiative sponsored by the Department for International Development (DIFD), BTI identified Kalahari sand, river sand and cement as potential materials for stabilized soil brick production for blair latrine construction in Tsholotsho and Lupane Districts where the geological formations are the predominantly unstable Kalahari sands [8]. These are some attempts to promote sustainable use of earthen construction in Zimbabwe.

Although much has been done in the development of earthen construction technology locally and internationally, the innovative earthen materials ideal to ease shelter problem have remained largely unimplemented as a result of a number of challenges. These include but not limited to stigma and perception, social status, psychological mindset, poor marketing of earthen products, ineffective dissemination of research results and the gap between supply and demand. It is therefore vital to address these challenges, which have affected the promotion of earthen materials in Zimbabwe.

**Features and Retrospective Issues of Study Area**

The study was carried out in Tsholotsho District in the Matabeleland North Province. The District is administratively divided into 20 Wards, and each Ward into six Villages (Fig.1).

Fig. 1. Location of study area showing the subdivisions of the Wards

The housing situation in Tsholotsho is below acceptable standards for a contemporary rural community. The province has poverty levels averaging 81.1% [2]. It is a general a generally drought prone area. Settlement patterns in Tsholotsho are generally linear or clustered. Generally, the settlement is divided into residential, arable and grazing blocks. A homestead in the District normally consists of an area made up of 4-8 shelter units. These units include: separate main house for the parents/family head, girls’ house, boys’
house, other relatives’ houses as well as the kitchen. Normally, new units are erected as the need arises. The need factors include: family expansion and rebuilding old dilapidated units. Granaries for storing maize and other grains are built closer to the kitchen. A typical homestead in Tsholotsho is shown in Fig.2.

In history, shelter construction can be traced to the eighteenth century when the Ndebele settled into the area, now western Zimbabwe. They migrated after they broke away from the Zulus and headed north from South Africa. The original dwelling type was the Zulu bee hive structure with no distinction between the wall and the roof (Fig.2).

*Fig. 2. Typical homestead Fig. 3. Traditional beehive housing. Source [4]*

By evolution in time, the houses acquired the form with distinct separation between the walls and roof. Walls are made of straight poles with mud infills. These materials soon gave way to sun-dried bricks (adobe) and hand made in-situ bricks (cob). Figure 4. indicates the separation of walls and roof. Colourful clays are then used on both walls to give a unique decorative finish. These three earthen construction methods co-exist even today. Thatching using grass was, and is still the dominant roofing material. In earthen walls, the roof is supported by a central wooden post and a ring of poles (columns). The crossbeam technique was introduced by the Europeans around 1930. Here, a ring of poles 338 with connecting horizontal poles at the top replaces the central structural support system as illustrated in Figure 5. This technique was later adopted in the modern building methods and marks a remarkable deviation from the traditional method.

*Fig 4. Roof supported by the walls Fig 5. Cross beam technique of supports*

In Tsholotsho where there was a high degree of social cohesion and housing construction, the act of shelter building was a major community event in which all able bodied men and women participated [5]. The actual construction work was a culmination of several weeks of assembling of the materials, etc and preparation of the building site. At the end the participants were treated to food and local beer party. This enhanced the continuity of indigenous knowledge in traditional building practices and environmental conservation.

**Earthen Construction Practices and the Factors of Change**

Until the establishment of the Ministry of Rural Housing and Social Amenities in 2005, there was no Government arm that dealt specifically with rural housing. Although this development is commendable, it is worrying some that the schedule of materials for their model homestead specifies non-traditional materials. Initiatives from other organisations like the Non Governmental Organisations (NGOs) have been restricted to relief and disaster management projects with none addressing the issue of earthen construction materials in their housing programmes. Earthen construction in rural areas is not regulated by any codes, standards or building by laws. The absence of bye-laws and standards has led to a range of sizes of plots, building heights, spaces, material specifications, etc. On the other hand, it encourages creativity and diversity in earthen construction.

There are environmental, geographic, social, cultural and economic factors that influence the design and construction of rural houses and hence the trends in earthen construction. In Tsholotsho, the choice of materials and techniques is attributed to the following: climate, aesthetics, tradition, durability, cost, external influence, source of procurement, government policy, income levels, agricultural practices, diversity of geology etc.

Wall thicknesses vary depending on shelter type and adobe blocks. The walls rest directly on the ground, as there are no formal foundations. Rectangular houses are now the
most common type because they can easily be partitioned. The circle is the prime shape for kitchens. The superstructure was found to be of adobe, cob, and pole and dagga. Floors were done by ramming in an appropriate quantity of earth after the removal of top soil. This incremental beating of mud results in floors as durable as cement. Earthen floor finishes are a product of an earthen mix and cow dung and are smoothed with the regularly shaped coal blocks. In Tsholotsho high quality thatch roofing increases the life span of the earthen walls.

There are no earthen roofs. As this is a generally dry area with an average rainfall between 400mm and 450mm per annum, the buildings have small overhangs. There is also no evidence of longer overhangs on the windward side to protect walls from wind driven rains, neither are there wind breakers nor buffers on the windward side.

Traditionally, the community has a good building maintenance culture. This is done at least once a year during the dry season i.e. between April and October. Normally, plastering, plinthing and re-roofing are the main tasks. Earthen plaster is normally applied externally for waterproofing and internally for appearance and to even out the wall surfaces. It is a common practice to retouch the plastering of the internal wall of granaries. Families either put new buildings or demolish existing ones to create space for a new structure. Three Wards, namely 13, 18 and 20 were selected for case studies. The criteria for their selection are: Ward 13 is a flood prone area; Ward 18 is one of the first areas to be inhabited in this District; Ward 20 is a former commercial farming zone and now a resettled area. In the Villages in the later Ward, save for Dhlula Villages were occupied under the government fast track resettlement programme between 1998 and 2002. Dhlula was set up by ex-farm workers when the previous owner moved out of the country in the early eighties.

**Ward 13 Villages**

These are Villages along the Gwayi Riverbanks, the main river in the District. As such, they are affected by floods due to the seasonal bursting of the riverbanks during heavy rains. The most severe was the Cyclone Eline induced floods in 2000 and river floods in 2001. Although flash floods occur anywhere in the district, villages in the Gwayi River flood plain have been the most affected especially as was the case in 2005. Floodwater destroys homes, household property, livestock and other important utilities, which suffer extensive structural damage. When people have lost their homes to such natural calamity, only local materials are available for reconstruction. Relief agencies through the Civil Protection Unit (CPU) can only assist in rescuing operations, and provision of relief labour and temporary shelter. In the ensuing scenario the victims have to respond to the situation at a very short space of time using locally available materials mainly in their raw state. Normally the fastest construction techniques are employed, resulting in structures with low durability, unable to withstand the next seasonal floods. Consequently, adobe, grass and wood remain the main building materials in the Ward. Despite the frequency of floods in the area, the communities have not been pro-active in developing technologies/strategies for post flood construction. Thus flooding, speed of construction, availability of materials, external influence and rising incomes are the major factors affecting the trends in earthen construction in this Ward.

**Ward 18 Villages**

The political situation before independence and the civil strife between 1980 and 1987 led to the slow rate of socio-economic development of this area. Driven out by poverty, unequal opportunities and political unrest, economically active members of the
community trekked to South Africa and Botswana as refugees. The males (mainly craftsmen) were more mobile during the civil disturbances. The resultant attrition of the expert builders created unwanted gap in continuity of building culture and led to low quality shelter construction outputs. Unfortunately, the migration trend has persisted with negative impacts on continuity of sustainable building practices.

Today, Tsholotsho’s wealthy sons and daughters in diaspora especially in South Africa give Ward 18 a comparative advantage in infrastructure development over neighboring districts such as Lupane, Hwange and Bubi. Equally true is the rapid disappearance of the local architectural milieu and building practices in favour of diasporian practices in non-traditional materials. Consequently, foreign influence, higher aspirations and rising incomes led to a revolutionary transformation of the architectural landscape of this Ward. Today, more and more people find appealing the use of nontraditional materials and technology to the detriment of appropriate local materials.

However not all families have members who earn their livelihoods outside the country. There are still a lot of people who are unemployed who channel their meager resources to their housing needs. They hire out their labour locally for their livelihoods. Their success is solely on fate and chance. This has led to the stratification of the communities in terms of the haves and the have-nots. These factors have brought negative trends in shelter development using earthen construction technology. Regularly shaped adobe bricks are the most common type of earthen materials in this area. Deforestation has led to reduced use of pole and dagga. Due to the increasing distance to locations of colourful clays, decorators are opting to use low quality mud and other materials.

In a bid to increase the durability, reduce frequent maintenance and improve appearance, there has been an increased use of impervious/waterproof plasters on external walls, cement mortar and plaster on floors and walls. Although this approach improves the outlook, the plasters often delaminate within two years after application because of weak bonding. This also justifies the use of non-traditional materials eg; cement mortar, for the repairs of earthen structures. The tendency towards application of non-traditional materials on earthen construction is a pertinent issue of concern requiring concerted research for optimization.

Ward 20 Villages

The resettled farmers in this Ward were all originally from different communities within the District. Local materials are available in abundance. However, owing to the shortage of skilled builders, the output quality is poor. Besides, villagers walk up to 10km to fetch water for building purposes. Therefore the scarcity of water contributes to the poor quality of the earthen products. Thus the bricks soon exhibit cracks and other defects. In addition, the high speed of construction affects the durability of the structures. The use of pole and dagga has become the most common earthen construction method. Naturally, the newly resettled farmers need to build many structures to establish their homesteads. These include kraals, houses, perimeter walls and external works. Normally, developments in a homestead are incremental. Building works are normally done during the period of May to October. Except in some special circumstances, only family labour will be available in this period as most households are preoccupied with their pressing commitments.

The prevalent building material used in the Ward is sun dried earth bricks. The moulds are cut from disused five litre cooking oil containers. The pole and dagga technique is not refined and produces irregularly shaped walls. Lack of adequate infill on walls has lead to frequent maintenance as the infill falls away in rainy season. Floors in this area are also earthen. Rendering and painting are practiced here but time constraints
have led to fewer houses being rendered.

Trends and Impacts
The desire to build shelter with less frequent maintenance has brought about understandable paradigm shift in shelter construction amongst the communities. It has certainly resulted in a changed architectural milieu. Foreign influence and sub-contracting has brought about the weakening of strong family ties. Developments in earthen technologies have resulted in a discernible level of expertise on traditional practices. Arguably, this has improved family incomes and diversified source of their livelihoods. However much of the familiar archi-forms are fast disappearing in the process. Although burnt bricks are the prime choice at the moment and locally produced in the District, its production entails the use of wood resulting in deforestation and environmental degradation. In spite of the fact that cement stabilized earth blocks are growing in popularity within the district, their rate of use is limited by the hyper inflationary state of the economy and a very erratic supply of cement since 1997. High-pressure compaction machines like the Cinva Ram and the Amandla Press have been promoted by BTI. The dependence syndrome created by the NGOs has made it difficult for many families to acquire these machines.

Government policy for shelter and infrastructure provision for rural communities based on new concepts and materials has a further discouraging impact on the communities who see their indigenous houses as inferior [7]. It further strengthens their perception that traditional earthen houses do not qualify for modern life conditions. There is therefore a need to urge the Ministry of Rural Housing and Social Amenities to reappraise the current rural housing policy with a view to popularizing innovative materials and technologies.

Conclusion
On the strength of its affordability, abundance and availability, earthen materials will continue to be of fundamental importance in rural housing and as one of the main building materials for rural as well as urban communities in the near future, despite the attendant social stigma and the apparent popularity of non-traditional materials. Naturally, earthen houses provide an environment compatible with the life style, social, and cultural values, economic and physical needs of the rural communities. Doubtless, earthen materials remain the tested and true for human settlement development. From the evaluation of the case studies, it is evident that geographic, physical and climatic conditions in the district affect the layout and choice of earthen construction systems. The prevailing conditions with regards to rising incomes, external influence, migration etc., have led to a high rate of social changes and consequently favour the use of non-traditional building materials. Culture and tradition, natural disasters, database of traditional building skills, poverty, speed of construction, availability of labour were the main reasons for continued use of traditional earthen practices. In the cost analysis factor for earthen construction, the procurement/hiring of compacting equipment and stabilizers should be inclusive. As the cultural, physical, social and even psychological needs change with time, earthen construction must be developed to move with them. Thus from the findings of this research there is a valid case for promoting indigenous earthen dwellings through improved and appropriate earthen construction techniques.

The communities of Tsholotsho and rural Zimbabwe in general should not abandon locally available material, but new technologies must be designed to enhance their quality and durability as sustainable technology is crucial for shelter delivery in Zimbabwe. This
will not only help in sustainable rural development but also have long-term positive impact on the well being of rural Tsholotsho communities.

References
343