Attitudes towards earth construction in the developing world: a case study from Zambia

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Abstract

Despite its decline, people in many developing countries have continued to utilise earth as a building material in the traditional fashion. This produces dwellings characterised as vernacular and generally defined as indigenous. In addition, in some developing countries that have widely adopted modern building materials and techniques, scarcity and increasing prices of these materials, together with their environmental impact, have led to reconsideration of the use of earth materials. Consequently, contemporary housing schemes have been built with 'improved' earth. These schemes have usually been designed and built without consultation with future occupiers, contrary to traditional practice. This has sometimes resulted in standardised dwellings that not only have not fulfilled requirements and aspirations of their occupiers but also have reinforced people's negative attitudes towards earth construction.

This paper is based on findings of a research project that examined the viability of earth construction as a building material and technique for urban housing in Zambia. As part of the research, a case study was carried out on two selected Zambian sites where twenty residents were interviewed to gain their views on earth housing living conditions. In addition, a questionnaire survey, based on the findings from the case study, was administered to practising architects, structural engineers and contractors, to collect data for a baseline overview of the Zambian construction industry's attitude to earth construction. It was anticipated that this might give indications of the reasons for residents' attitudes.

The research findings showed that urban residents associated earth houses with poverty and low socio-cultural status. On the other hand, construction professionals were reluctant to specify and select earth materials for their projects, owing to the materials' technical deficiency and performance limitations, exacerbated by a lack of appropriate standards and codes relating to earth construction. Nevertheless, the professionals expressed their willingness to consider using earth materials if their performance could be improved. The content of this paper should be of interest to building designers, contractors, housing developers, and policy makers in developing countries, who have a crucial role in promoting the use of earth materials for housing construction.

Keywords Zambia, earth construction, codes and standards, perceptions and attitudes, housing.

Introduction

Conventional construction methods, including use of burnt bricks and cement products such as concrete, have become the norm for building worldwide. Zambia is also involved, even though 80% of its rural dwellings have been built of unburnt brick [Central Statistics Office, 2003], and many dwelling walls are made of sun dried bricks and wattle and daub, composed of clay-rich soil without straw or fibre reinforcement. Some reported that Zambia has very good soils for building purposes [Denyer, 1978]. Any potential use of these good soils to build dwellings is however hampered by a widespread socio-cultural perception that modern building techniques and materials are substantially better than traditional ones [Sojkowski, 2002].

Various earth-building awareness initiatives and performance-enhancement studies were undertaken in a number of African countries. In Nigeria, tests to improve the durability and affordability of earth building, which has been promoted as an alternative for low-cost housing for the poor, were carried out [Olotuah, 2002]. It has also been reported that compressed stabilised earth blocks were 'successfully' used in low income housing in Sudan [Adam and Agib, 2001]; users' perceptions were however not recorded. Similarly, the potential of earth building in Botswana has also been studied, with the aim of developing a suitable material mix for a compressed earth block technique, and recommendations were put forward on proportions of the block mix; mixing methods; stabilization; strengthening; and transport. The study concluded that further work was required to establish wider use of earth blocks, and it encouraged earth block use for housing in Botswana, Namibia, and Zimbabwe, given the similarity in their soils [Longfoot, 2003]. A pilot project on earth architecture was also undertaken in Uganda to promote traditional earth building. The project forwarded recommendations to promote training at all levels, carry out pilot and demonstration projects, and carry out research on local construction materials and skills. The study, however, identified several barriers to earth building in Uganda, including the need for new legislation, technical training, public awareness of sustainability, and knowledge-sharing [CRATerre, 2005]. It was suggested that some of these barriers could be overcome when promoting earth building for low cost housing in Zambian urban areas.

For Zambia to benefit from Ugandan experiences there is a need to investigate and assess perceptions and attitudes of building designers, contractors and end users towards earth building. Practical barriers to the implementation and use of earth building should also be known. Hence, this paper sets out to examine a study that was carried out with aim to investigate the viability of earth as a building material and technique for providing urban housing in Zambia.

Methodology

A twofold quantitative and qualitative research methodology was used to collect data for assessing attitudes towards earth building amongst end users, building designers and contractors in the Zambian construction industry.

- First, a case study was carried out to gain insights into users' views on living conditions in earth houses. Qualitative information was collected through surveys and semi-structured interviews with twenty residents in two selected sites: earth homesteads in Chief Nkana's area and Musonda compound; and conventional buildings in the Riverside area of Kitwe. This case study provided the basis for the formulation of a questionnaire.

- Second, a questionnaire was used to collect data for a baseline overview of the Zambian construction industry's attitude to earth construction. It also examined the levels of support and involvement of building designers and contractors in promoting use of earth for housing. Sixty questionnaires were randomly distributed to architects, structural engineers, and contractors specialising in housing.

Research findings

Interview results

During fieldwork, it was observed that most traditional houses, mainly in rural areas, generally took one of four shapes: rectangular, L-shaped, square, or circular. Sun dried earth bricks, wattle and daub, and clay content soil mortar, were the most commonly used materials in the construction of the visited dwellings. In a few cases, cement was added to the mixture to enhance bonding strength. Internal walls were generally plastered with clay and had various tinted finishes, depending upon the colour of clay used (Fig.1). Externally, cement and sand plaster were also used as rendering finishes and walls were left in either grey cement colour, or painted to a colour of the owner's preference (Fig.2). Dwellings have a life span of about 25 to 30 years, according to interviewees.

Ten residents living in rural earth-constructed dwellings were interviewed on five key issues: affordability; durability; living conditions, aesthetics; and general preference between living in an earth dwelling or a modern house.

Whilst all interviewees confided that earth dwellings were very affordable compared to houses built with conventional materials, only half of them stated that their houses were durable as they lasted for more than 20 years; the other half reported a dwelling life span of less than 10 years, requiring regular maintenance exacerbated by two major problems: rain water washing away walls and foundations of the house, and termite damage.

Nevertheless, eight out of the ten interviewees acknowledged that living in an earth built dwelling was very comfortable; earth offered a very good thermal environment. They added that when a house is roofed with thatch it is even more comfortable, presenting occupants with a well-humidified and thermally-regulated interior. Conversely, the remaining two indicated that their houses tended to be very hot in summer and very cold in winter. This was mainly caused by use of corrugated iron sheet roofs and absence of ceilings. Heat transmission was therefore excessive, creating an uncomfortable environment in winter and summer.

Fig.1 Clay plastered earth wall (Authors, 2004)

Fig.2 Cement sand plastered earth walls (Authors, 2004)

There was no unanimous consensus on aesthetics as only four out of the ten interviewees did not like the appearance of earth built houses; two were indifferent; and the remaining four liked the different colour effects of the clay as a façade finish. However, if the walls are plastered with cement sand plaster, paints of various colours could potentially be used, thus giving scope for a range of decorative surface renderings. This may not however be a viable rendering solution due to the long term bonding problems between cement mortar and the earth walls.

Overall, if given enough financial resources, seven out of the ten interviewees reported that they would not live in earth houses as for them these are culturally associated with poverty and low social class. It is interesting to note, however, that a third of residents agreed that they would live in earth houses provided construction methods and finishes are improved.

In addition, ten people living in urban conventional medium to high cost houses in Riverside were asked if they would consider buying or renting an earth house. All interviewees said they would not be willing to live in or own an earth built house, owing to it being a symbol of low societal status. Additionally, they perceived earth houses as unattractive in appearance and not durable, and concurred that poor design and construction standards are major disincentives.

Questionnaire results

Of the 60 questionnaires circulated to design practices and contracting companies, 22 were completed and returned, a response rate of 37%. Responses from the survey were analysed using the Statistical Package for Social Sciences (SPSS). Analysis of the five-point Likert scale answers was carried out by comparing the means by 'one sampling T-test'.

The majority of respondents said they undertook more residential projects than any other category of building type. Sustainable practices were not very common amongst responding consultants and contractors, and none had a sustainability policy in place. Conventional materials were commonly used, while traditional building materials were scarcely employed. Indeed 73% of respondents never used earth in their projects. There was, however, a strong indication of its potential use in the future, as long as technical weaknesses are adequately addressed. Additionally, they recognised that the government has a major role to play by taking deliberate steps to promote earth construction and regulate its use.

Respondents were asked to rate a range of criteria for potential specification and selection of earth as a building material in their projects against a five-point Likert scale. The results, shown in Fig.3, indicate that 'material cost' was accorded the highest mean importance rating (4.58); followed closely by availability (4.37) and easy workability (4.11).

Respondents were asked to rate a number of limiting factors that impede the use of earth in the Zambian construction industry. According to Fig.4, the majority (69%) strongly believed that structural weakness (mean value of 4.50) was the key constraint in specifying earth in their projects, followed closely by lack of interest by clients, with a mean value of 4.31. Additionally, respondents rated equally (3.50) the lack of technical knowledge on earth construction and the perception of earth as not suitable in up-market development as critical barriers. Similarly, poor water resistance and the perception by

society of earth as a sign of unattractive old architecture were seen as serious impediments to its wider use.

Fig.3 and Fig.4 clearly illustrate the challenges faced by earth construction in Zambia. These are valuable pointers to formulating recommendations for the Zambian policy makers and construction industry stakeholders.

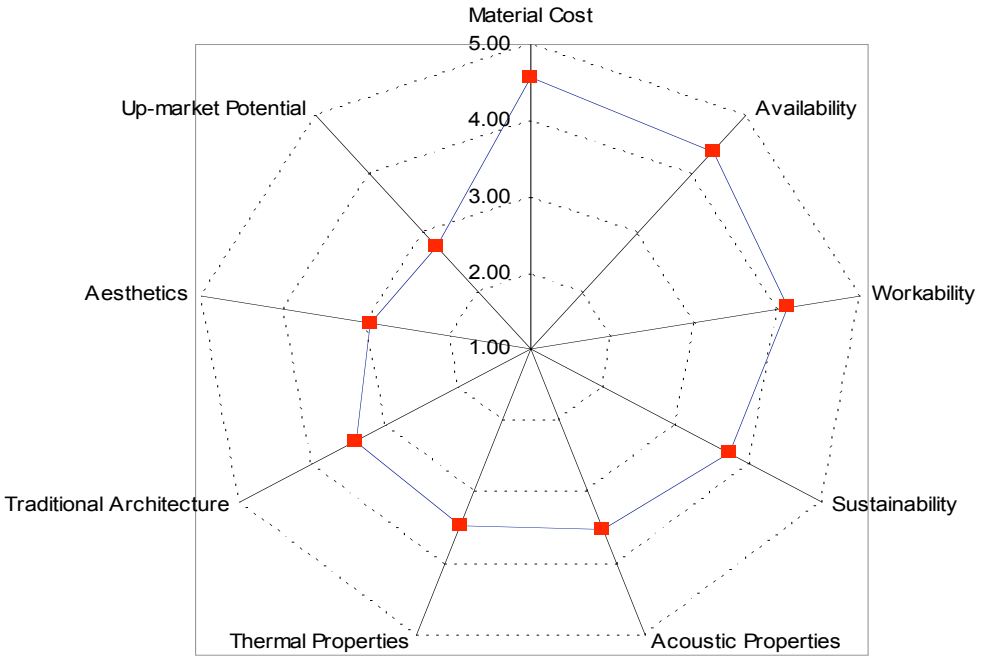

Fig.3 Factors influencing potential specification of earth in the Zambian construction industry

Discussion

The rapid urban expansion of Zambian cities has led to an alarming growth of slums, where 74% of the urban population live in informal settlements. This proportion is set to increase as the urban population increases, unless critical issues of housing provision are adequately addressed.

Earth as a building material and technique has the potential to offer a viable alternative that can effectively and cheaply reduce the housing shortage in Zambia's urban areas. However, a number of barriers need to be addressed before earth building could be embraced by the Zambian construction industry, regulators and end users, as discussed below.

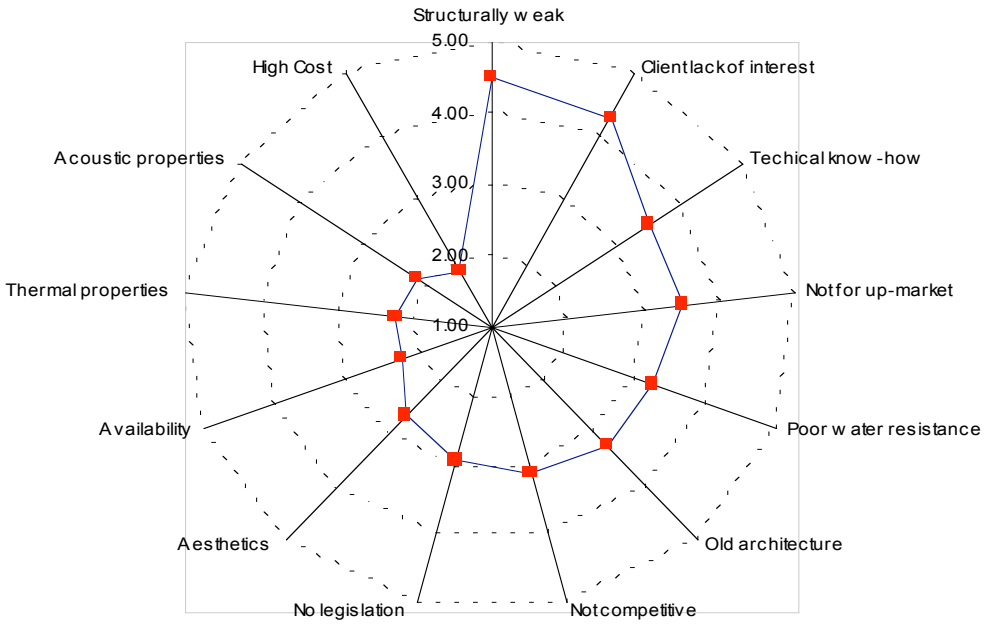

Fig. 4 Barriers to earth construction in Zambia

The case study shows that earth buildings are perceived as not durable and aesthetically unpleasant; and are believed to be a sign of poverty and backwardness. Additionally, designers and contractors were reluctant to specify and select earth materials due to their technical and performance limitations. In effect, the use of earth building materials and techniques is not a high priority during design and construction. However, earth buildings potentially offer good interior conditions, maintain pleasant thermal comfort, and are affordable by the majority of the poor. There was consensus therefore amongst construction professionals that earth has potential due to its cost effectiveness, availability, ease of workability, and positive impact on the environment, particularly its low embodied energy and positive contribution to resource efficiency.

The results of this study also highlighted a number of barriers that impeded the use of earth in the Zambian construction industry, including the absence of codes and standards for earth building construction, and a lack of government initiatives. This was echoed by the findings of Mususa and Wood who reported that current building codes and regulations are favouring conventional methods, and preventing the use of traditional materials such as earth [Mususa and Wood, 2004]. Similarly, Tyrell argued that under pressure for modernisation, the Zambian government has so far neglected the promotion of vernacular construction methods and materials [Tyrell, 1996]. Conversely, it is interesting to note that the Zambian Institute of Scientific Research and the Copperbelt University carried out research on traditional construction technologies, but the dissemination of their findings has not been implemented effectively [Mususa and Wood, 2004].

Urban residents associated earth houses with poverty and low socio-cultural status. The latter aligns with the findings of Sojkowski who reports that earth materials and techniques are perceived as "substandard" or "second class", while modern construction methods and materials are seen as "civilized" or "symbols of affluence" [Sojkowski, 2002]. This suggests that the role of architects, engineers and building contractors could be very significant in influencing cultural change and the production of suitable earth-built housing by leading the debate, designing and constructing desirable earth dwellings, and offering confidence to developers and the general public. However, the role of government is equally important: to develop policies, codes of practice, and training programmes to help building designers and contractors use earth building materials and techniques in their projects.

Conclusions

This research investigated stakeholders' perceptions towards the use of earth building in the provision of housing schemes in Zambia, given its current housing situation. Zambia is still faced with issues concerning negative perceptions and attitudes towards earth building on the one hand, and a lack of technical knowledge and building codes on the other.

The majority of interviewees would not consider living in earth houses, which are thought to be a sign of poverty and unsuitable architecture. Hence, a number of social attitudes should be addressed through publicity, public consultations, and demonstration projects. Additionally, short courses and workshops should assist designers, contractors and developers to specify and use earth in their housing projects. However, there is a need for research and implementation of earth design and construction improvement techniques and methods to address aesthetic, performance, and maintenance as limiting factors. Furthermore, national and international incentives and information-sharing are needed to help convince all parties of the advantages of earth as a viable building material and technique.

In their quest to promote earth as a viable building material and construction technique, key stakeholders in the Zambian construction industry should consider establishing knowledge-transfer partnerships with countries where earth building is standardised and successfully used. In addition, they should also aim at developing earth building codes and standards, to ensure sustainable development, which should be based on scientific research and experiments on earth construction, including earth block stabilisation and manufacturing, and address design and performance of earth materials and construction techniques. Raising awareness of and training people on sustainable earth construction at all levels (professional and vocational) are also issues which should be given enough consideration.

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