SUSTAINABLE HABITAT IN BURKINA FASO: SOCIAL TRAJECTORIES, LOGICS AND MOTIVATIONS FOR THE USE OF COMPRESSED EARTH BLOCKS FOR HOUSING CONSTRUCTION IN OUAGADOUGOU

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ABSTRACT

This study explores the logics, motivations and issues related to the construction of sustainable housing made of compressed earth blocks (CEB) material in the city of Ouagadougou. In Burkina Faso, a landlocked country with limited natural resources and predominantly warm dry climate, most buildings are made of local materials. Historically, people built their habitats using mud brick (adobe). However, with the irreversible process of urbanization, the construction sector recorded changes with an increase in concrete-based, hollow cement blocks (HCB) constructions. Besides this trend, individualistic strategies are moving towards other types of materials such as CEB. Throughout a qualitative approach, the present study intends to show that the use of eco-materials, like the CEB, is the concern of middle class population who has broken with the "all in concrete" in the construction of their housing. This study also reveals that the owners of CEB-based housing are mostly city dwellers endowed with considerable cultural and economic capital. It also briefly reveals that the logic behind the use of the CEB is based on the social distinction of city dwellers, having both a romantic and Romanesque vision of earth-based construction. Moreover, this mode of construction is associated with a post-modern vision of sustainable development (less energy and resources consuming constructions, reduction of the electricity bill, etc.), but also with an ecological reasoning that cannot be afforded by the common population in Burkina Faso.

Keywords: compressed earth block, housing, social distinction, sustainable development, Burkina Faso.

1 INTRODUCTION

In sub-Saharan Africa, the access to decent housing is an acute challenge, in view of the high rate of urbanization recorded in this part of the globe. According to the 2014 predictions of the UN Habitat [1], the urban population is expected to reach 50% in 2020 and 65% in 2050 in the West Africa. This population growth poses numerous challenges and stakes in terms of the production of decent and comfortable housing adapted to the climatic context of different countries. Burkina Faso, like other countries in sub-Saharan Africa, is also experiencing high demographic growth, implying high demand for decent and sustainable housing. In fact, the total population of Burkina Faso is estimated at 20 million inhabitants in 2020, with an estimated 3 million in the administrative and political capital of Ouagadougou [2]. Moreover, with an urbanization rate of 32% in 2016, this rate is estimated to reach 34% in 2020 and 40% by 2025 [1], [3].

In the city of Ouagadougou, the dwellers experience constraints in terms of access to quality building materials adapted to the warm-dry climatic conditions. As illustrated by Delaunay and Boyer [4], the share of constructions made of the so-called "durable" building materials, such as concrete and cement blocks, represents 79% in urban areas against 21% in

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the suburban areas with non-cadastral zoning. Regarding the adobe mud brick (banco), this fraction is about 34% in the urban areas against 66% in areas with non-cadastral zoning. In addition, while there is a diversity of building materials such as cement building block, cut laterite block, adobe, and compressed earth block (CEB); there is also a strong propensity to use the cement block in housing construction [5].

Various public policies for the rehabilitation of earthen construction material such as CEB in the 1980s and 1990s have had mixed results in Burkina Faso [6]–[8]. Despite, the training and support provided to the actors such as the production companies, architects and technicians, etc.; different inherited inadequacies constituted obstacles towards the wide dissemination and usage of CEB. On the one hand, the inadequacies in terms of poor design and production are shortcomings that reinforce stereotypes among urban population about the CEB. These inadequacies also constitute bad publicity for CEB toward the acceptance by the population. On the other hand, the socio-cultural perceptions that consider CEB as the building block for the poor [9] further challenges the various policies for the development of CEB in Burkina Faso. Despite these shortcomings inherited from the various public policies and negative perceptions by the common population, a minority of the population is reorienting towards building using CEB in Ouagadougou.

The present study attempts to answer to the question "*what are the motivations, logics and reasoning behind the form of housing production using CEB in the city of Ouagadougou?*" This investigation also aims to explore new avenues for raising the awareness of urban population and disseminating the potentials of CEB on issues related to sustainable housing in the context of Burkinabe. The ultimate goal is to change the narrative and perception of the common population about the CEB.

2 METHODOLOGY

The present study focused on owners of CEB-based housing, who are minority users, in the city of Ouagadougou. In fact, there is limited fraction of the population that has adopted CEB, while cement block and adobe are the most used building materials masonry. Therefore, the present empirical study was carried out on this minority, users of CEB as wall masonry, aiming to understand the motivations related to this choice. The study adopted a qualitative approach to assess the content and meaning conveyed by this form of construction toward the users. In fact, the qualitative approach does not seek for statistical representativeness of the sample, but the content and meaning conveyed by the actors throughout their practices. According to Creswell [10], in a qualitative approach, "*researchers study things in their natural environment, trying to make sense of phenomena or to interpret them according to the meaning that people give them*". In this perspective, taking into account the low popularity of construction using CEB, semi-directive interviews were carried out with the few users of CEB-based housing. As stated by Ruquoy [11], "*the interview is the most suitable instrument for identifying the representations, values and norms conveyed by an individual*".

The choice of semi-structured interviews is justified by the limited number of CEB users. This is why, the heterogeneity of users' points of view was taken into account in order to understand the motivations and opinions surrounding the construction using CEB. According to Quivy and Campenhoudt [12], "*if the researcher is considering a semi-directive interview method, it is usually affordable to interview only a few dozen people. In this case, the selection of interviewees should consider the maximum diversity of profiles with regard to the problem being studied. The criterion that allows to know that all the cases have been covered is redundancy of views*".

In sum, throughout this method, a dozen semi-directive interviews were conducted with owners of CEB-based housing in Ouagadougou in 2017, 2018 and 2019. There were six (06)

nationals, three (03) mixed couples, two (02) expatriates residing in Burkina Faso and one (01) non-resident expatriate. The qualitative data were interpreted according to the technique of thematic content analysis. Thus, pseudonyms were attributed to all the respondents in order to preserve their anonymity. Based on this empirical data, the hypothesis was formulated that construction using CEB responds to four (04) hierarchies of interconnected values such as (1) the break with the "all in concrete", (2) the adaptation of architecture to climatic conditions, (3) the expression of social distinction and (4) the ecological reasoning of a fraction of the population. These aspects were further substantiated in the sections devoted to the results and discussions.

3 RESULTS AND DISCUSSIONS

3.1 Construction using compressed earth block as an expression of breaking with "all in concrete"

This case study shows that the motivations and logics behind the construction using CEB are driven by the break with "all in concrete" in the construction of housing. According to most of the households surveyed, the use of CEB as building masonry consists of a quest for disconnection with cement blocks. Among factors justifying the choice of CEB in Ouagadougou are the climatic conditions marked by high temperatures (40°C and plus in summer), on the one hand. On the other hand, this choice is justified by previous experiences about cement-based housing. According to François, living in a mixed couple, "*CEB is more economical and it keeps the house cooler that cement blocks*". Thus, the couple was looking for an alternative solution to concrete. Similarly, "*Monique did not want to build using cement blocks, knowing that CEB are materials that are known to be bio–thermal*"; CEB improves hygro-thermal comfort inside the building.

It is clear that the choice of CEB is based firstly on a logic of break with "all in concrete" and secondly on expectations in terms of alternative material (CEB) which has better thermal performances. The CEB provides better hygrothermal comfort than cement blocks.

3.2 Construction using compressed earth blocks: An adaptation of the architecture to the climatic context?

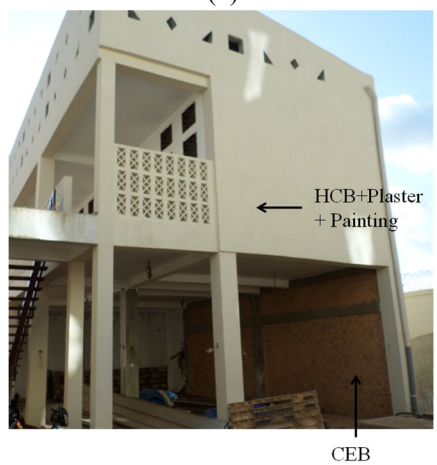
In Burkina Faso, the materials used in housing construction are mostly poorly adapted to the hot climate condition, thermally uncomfortable and energy-consuming. The results from the present study showed that whatever the categories concerned (nationals, mixed couples or expatriates), construction using CEB corresponds to a form of the adaptation of architecture to the climatic context. Thus, the choice of CEB, as an alternative material, during building design is perceived as taking into account the need for high thermal inertia of the building to deal with large fluctuations of temperature in the region. In fact, the choice of CEB for double-wall construction was guided by the quest for passive materials in the production of housing with improved thermal comfort. The city dwellers who have chosen CEB as a building material in the design and construction of their house are aware of the climatic challenges [13], [14]

In the tropical and Sahelian climatic zone like Burkina Faso, the CEB is used in different technics to reach better hygrothermal performances. The CEB is used either in single-layer or double-layer wall, leaving or not the air void between the two layers (Fig. 1(a) and (b)). The CEB acts as thermal capacitive layer and the air void as insulating layer to keep the heat from the outside to reach the inside of a building. Other times, the CEB is coupled with

cement-block, i.e. CEB as an inside layer and the cement-block as an outside layer (Fig. 1(c)). This is what motivated Xavier who was "*able to limit the heat in the rooms*" by using CEB (inside) in double-layer wall with cement block (outside), with an air gap of 4 cm. The application of cement-based materials in the outside layer also allows to protect the CEB against the hash environmental agent such as the erosion by rain and reach the durability of the structures over time.

(a)

(b)



(c)

Figure 1: Predominant wall constructions in Ouagadougou. (a) Single-layer wall of CEB; (b) Single-wall of CEB (bottom) and cement block (top); and (c) Double-layer wall of CEB (inside) and cement block (outside).

It emerges that the quest for materials with better properties in terms of thermal conductivity and diffusivity guide the choice of the CEB. To some extent, this allows to integrate the insulation into the construction. As highlighted by Roberts [15] and Coulibaly [16], the nature of materials, as well as the environmental and climatic considerations are necessary parameters in the design of housing. Different studies have shown that CEB has better thermal properties than other materials commonly used in construction. For example, the thermal conductivity of CEB is 0.6 W/m.K compared to 0.9 W/m.K for fired clay brick [17] and 1.3 W/m.K for concrete [18], for an apparent density of 2000 kg/m^3. This is consistent with the perspective of the users of CEB-based housing.

3.3 Choice of compressed earth blocks as a sign of social distinction

Given the western lifestyle of the most users of CEB-based housing in Burkina Faso, their choice justifies the quest for an alternative to distinguish them the common population who use cement-based housing. The empirical information collected from owners of CEB-based housing show their "tastes or preferences" about this form of construction, apart from the adaptation of architecture to the climatic context. According to Bourdieu [19], "*Taste is the principle of all that we have, people and things, and all that we are to others by whom we are classified* ". In the light of the field data, the choice of CEB as building masonry by most owners consists of logics of social distinction. Thus, if for some respondents, the choice of CEB is perceived as a banal gesture, the general view reveals that there are aspects of differentiation, social distinction and originality in the background. This is evidenced by François who considers the CEB-based construction to be of "*quality and aesthetics, integrates modernity and originality; stands out from the usual; and requires less intervention than cement block*".

This form of social distinction and differentiation is much more pronounced in mixed couples. In this regard, Monique considers that "*it is a certain social class that is increasingly building using CEB material; the majority are often Westerners or mixed couples; but there are also nationals who build using CEB*".

This study reveals that the mode of construction using CEB, of this fraction of the urban elites, remain the emanation of city dwellers that bear high cultural capital. This explains the romantic aspect of social distinction associated with this mode of building. As Bauhaun [20] pointed out, "*housing is a high place for the representation of social status, which will determine the hierarchy of both domestic life and architectural design*". So, what are other forms of reasoning than the social distinction of construction using CEB in Ouagadougou?

3.4 Construction using CEB as a form of ecological reasoning: what implication on the sustainable development in Burkina Faso?

According to the United Nations Environment Programme [21], the building sector contributes nearly 30% of annual global greenhouse gas emissions, and consumes up to 40% of total energy, mainly related the operation of buildings (air conditioning, ventilation, heating). In Burkina Faso, as in sub-Saharan Africa, the environmental impacts are linked to the growing need for air cooling in buildings. Moreover, most of the commonly used building materials are imported, on the one hand and on the other hand, the majority of buildings are not designed according to the principles and standards of bioclimatic architecture. This results in de facto high energy demands and carbon footprint.

Throughout the present study, the field survey revealed that there is an ecological reasoning behind the housing construction using CEB. On the one hand, the minority of urban

dwellers who build using CEB in the city of Ouagadougou have construction practices that are interconnected with the global objectives of sustainable development. The field investigations revealed that both mixed couples and nationals who have built using CEB have a logical quest for "sustainable house". On the other hand, the owners of CEB housing are aware and attempt to mitigate environmental impact through their lifestyles and modes of construction, by breaking with the "all in concrete". Concrete is a high embodied energy and polluting material. According to Boussichas and Nossek [22], sustainable development goals seek for access to adequate, resilient and sustainable housing in cities. Similarly, the sustainability concepts integrate the low energy demand in buildings, choice of less energy-consuming materials and adaptation of architecture to the climatic environment [23].

Therefore, the ecological reasoning emerges among the owners of CEB-based housing, beyond the forms of social distinctions associated with this form construction. Relating the ecological reasoning and quest for energy-efficient materials, Sophie stated the quest for "*(thermal) comfort in the house, a material that is more ecological than concrete and that is more insulating*". Similarly, Serge echoed that CEB "*can really counteract the climate: little green touch in relation to the climate and a certain advantage in terms of comfort: a fairly warm climate [inside the house]*".

Although, the quest for materials with better thermal performances in terms of insulation and diffusivity are at the heart of the respondents, the ecological, sustainability and financial reasoning in terms of energy consumption are also noticed to be taken into account. In this regard, Boukaré expressed the "*problem of the cost of electricity which is high in Burkina Faso; [CEB] would also allow to save the electricity [on air-conditioning]*".

Nikyema and Blouin [24] pointed out that the adoption of green practices of constructions is a standard in developed countries. According to the authors, local and global barriers justify the low adoption of green materials in Africa or in developing countries in general. The authors showed that the return to local construction materials such as CEB already integrates sustainable logics in the construction of housing in Ouagadougou.

Moussa et al. [25] showed the advantages of using local materials (CEB) on the hygrothermal conform and energy saving of building in the context of Burkina Faso. The authors carried out simulation study of a building using CEB stabilized with calcium carbide residual (CCR) for wall masonry (CEB building) and compared to buildings constructed using hollow cement block (HCB building). Without air conditioning systems, CEB building reduces the hygrothermal discomfort by 400 hours in the year compared HCB building. In addition, if air conditioner is operated to keep the indoor ambiance in both buildings at 28°C throughout the year, the CEB building allows to save about 310 000 Franc CFA (535 USD) on electricity consumption compared to the HCB building. Moreover, the stabilization of CEB using CCR, an industrial by-product, adds more value toward the sustainability in terms of wastes management and natural resources saving.

Thus, the energy concerns and environmental thinking are intertwined. Therefore, lifestyles and building styles, using CEB, are part of a sustainable logic. The break with "all in concrete" is in line with the emergence of a form of sustainable construction in the city of Ouagadougou. The triple reasoning: break with "all in concrete", reduction of the electricity bill, and search for thermal comfort, illustrates the orientation towards CEB construction. As previously noted, bioclimatic designs, integrating adapted materials (less energy-consuming) and architectural techniques that promote indoor climate regulation, are interconnected with the objectives of sustainable development [26], [27]. Thus, this particular way of building, using CEB, by the fraction of the population integrates nowadays the logics of sustainability in the construction in Ouagadougou.

4 CONCLUSION

This study revealed that the use of local building materials such as CEB in the construction of housing is concerned with urban elite in the city of Ouagadougou. The choice of CEB as the masonry for housing construction contains a certain hierarchy of interconnected values. For this fraction of the urban elite, the quest for a break with "all in concrete", adaptation of architecture to climatic conditions, expectations of social distinctions, and logics and reasoning in terms of sustainability are intertwined in the social practices of the users. Moreover, the quest for materials with good thermal performance is also linked to this form of construction. Although, the propensity to use CEB in architecture remains the emanation of a few urban elites, their construction styles and lifestyles reflect the awareness of the global issues of sustainable development.

Furthermore, if the logics of sustainability in relation to sustainable housing are not sufficiently implemented in developing countries such as Burkina Faso, this study allows to explore new ways of disseminating the potentials of CEB. Based on the experience of the minority users interviewed in the present study, their perceptions can be combined with the scientifically proven engineering performances and economic benefits of using CEB to encourage more population to use this material in the future. Moreover, this can also be done by taking into account other barriers such as cost, accessibility, financial, social and technological constraints in order to raise public awareness. These parameters can be explored in a new form of awareness raising and dissemination by including ecological issues or sustainable urbanization in the agendas of new public policies on housing.

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