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LOW COST ADAPTIVE HOUSING MODEL

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ABSTRACT

The present paper refers to the development of a research about the housing problem in Sub-Saharan Africa region. The degradation of the urban environment, and consequent low quality of life, results from the lack of infrastructures and precarious housing due the absence of a planning and housing strategy model. This situation results mainly from inadequate housing strategies to territorial contexts, namely its environmental, social, economic and cultural features. The methodology points to the development of a new design process based on the understanding of the housing deficit and current housing strategies in Sub-Saharan Africa region in order to identify the main requirements related to social, economic, environmental and territorial aspects. Therefore, the research issue is: Is it possible to develop parameters that will perform a model, based on a global and integrated solution for housing? In future

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developments, the model will be applied through a case-study methodology and its evaluation and adequacy through two phases that considers the main stakeholders in housing processes: population, local entities, governments and specialists. Also, the research focuses in the creation of guidelines for low-cost housing programs and initiatives based on requirements and parameters recognized as fundamental for the housing solutions in developing countries.

Key words: Developing countries, Adaptive housing, Low-cost housing

Introduction

The present paper refers to a PhD research for the creation of a low cost adaptive housing model as a contribution and response for the housing deficit in developing countries.

The urban environment degradation is related with the lack of infrastructures and consequent informal and precarious housing. This situation results from the absence of adequate housing policies related to territorial contexts, namely climate and geographical features, and social and economic characteristics, leading to an increase in poverty and inequality. According to the Millennium Development Goals 2013, the Sub-Saharan African region show the most severe and urgent case where 62% of the populations live in slums [1].

According to the United Nations studies, in the next four decades it is expected that the populations from this region will have a rapid growth dues its fast economic development related to the exploitation of natural resources [1]. This fact, coupled with the political contexts, namely civil wars, lead to rural exodus i.e. internal migrations from the rural areas to urban centers where there is an economic cycle that provides employment. As the architect John Turn pointed out: "The urban poor have to solve a complex equation as they try to optimize housing cost, tenure security, quality of shelter, journey to work, and sometimes, personal safety. For some people, including many pavement-dwellers, a location near job (...) is even more important than a roof. For others, free or nearly free land is worth epic commutes from edge to the centre. And for everyone the worst situation is a bad, expensive location without municipal services or security of tenure."[2]. These rural populations are mostly from the poorest countryside areas and start to occupy available plots in the city or its outskirts, giving rise to overpopulated slums deprived from the minimum housing conditions.

These slums are formed by precarious housing, namely shacks, where sometimes live more than one family, with no access to the minimum infrastructures (potable water,

energy and sewer) and made with inadequate materials in terms of structural and safety stability as well as hygrothermal comfort for the occupants [3] [4] [2].
The housing policies promoted by governments and local entities are trying to solve this problematic through the implementation of imported models. These models, mainly Asian (as Kilamba City in Luanda for example) or western, are not suited for the population needs as well as its social and economic characteristics, showing also inadequacy in terms of territorial and environmental features. However, there are some experiences that show an intention of adaptability in specific contexts, according to the political priorities, namely the case of Indonesia, Chile, Mexico and Poland, this last as an example in a developed country.

This context shows an opportunity to research a low-cost adaptive housing model that responds to population needs in terms of housing conditions and quality but also considers the social, economic, environmental and territorial characteristics. The model also aims the identification of the main criteria for housing, according to different approaches, and the creation of parameters to provide guidelines for low-cost housing strategies.

Methodology

The research points to the development of a low-cost housing model for countries or regions that show a severe housing deficit. In order to achieve that it is necessary to understand the current models and methods considered in low-cost housing, namely through the study of national housing programs and housing initiatives/experiences perform by non-governmental entities as well as applicable legislation and regulation. Through this research it is possible to identify the main criteria and minimum requirements for housing supply in order to create the model parameters considering the social, economic, environmental and territorial context as well as its priority.

The adaptability concept as the Oxford Dictionary describes – "Able to adjust to new conditions" – has the premises to be implemented into the housing theme. Adaptive housing shows the potential to relate simultaneously social, economic, environmental and territorial conditions in order to present a viable option to solve housing deficit in developing countries.

The social and economic conditions, related to development models, are directly linked to household dynamics, which have effect in its living habits. Also, the economic dynamic of these households, resulted from the number of people that contribute for the household income, has consequences in the housing form and dimension. In developing countries, for example Angola, the average household size was about 5 people in urban areas in 2009, according to Statistical National Institute. Without possibility to acquire a house, population between 20-39 years still living with the familiar core which means that in the some house might live more than one

family core [5]. In most cases, the households income is from informal economy or, in worst cases, people are not even employed [5]. An adaptive housing model is able to perform an improvement to quality of life due the capacity to expand and retract according to the household dynamic and its financial capacity [6], [7].

The adaptability to territory is related to geography but also to climate characteristics and its impact to housing. The territorial adaptability is supported by geographical parameters i.e. housing located in coastal areas should consider the rising level of the sea through the housing layout in order to reduce the impact of an eventual natural disaster. Adequacy to territorial aspects is also related to climate characteristics through two approaches: the hygrothermal comfort of the occupants in order to provide quality in indoors; the adequate protection to climatic extremes such as rains and storms, working efficiently as a shelter (the main core of housing) [7] [8].

The environmental adaptability is directly linked to territorial issues, namely the available resources and its importance for low-cost housing conception as well for local communities. The selection and appropriate application of local materials show advantages in terms of territorial aspects, namely the climate characteristics, which will naturally have implications in environment through passive solutions for cooling and ventilation, for example. Local materials have also advantages in terms of economic aspects i.e. the associated costs to build are reduced and local economy is enhanced, providing positive social and economic impacts to local population [8], [6].

The methodology considers the articulation of these four fields – society, economy, environment and territory – through the identification of the main criteria and the study of the priority levels of each. These criteria are based in housing experiences in developing countries but also in the housing strategies and current legislation that provide rules, norms and the minimum requirements as well as its clarification. Through the identification of these criteria it is possible to create parameters of each field in order to structure an integrated housing model able to be replicated in any context.

The present paper refers to Phase 1 composed by the State of Art and the potential to create an adaptive housing model for the housing deficit in developing countries, namely in the Sub-Saharan African region. Further research will points to the processing of knowledge into guidelines and reference criteria for housing model creation. Phase 2 corresponds to model application to a case study in Angola where there will be applied three approaches: data collection and processing about housing; surveys to population; and direct observation/fieldwork.

The model will be validated in Phase 3 in two different moments. The first moment refers to a first validation through a sample group (target-population) and the stakeholders involve in housing processes, namely public and private entities, which

will provide an adequacy to a real case scenario. After this first validation, the model will be subject to a second validation period through Delphi method.

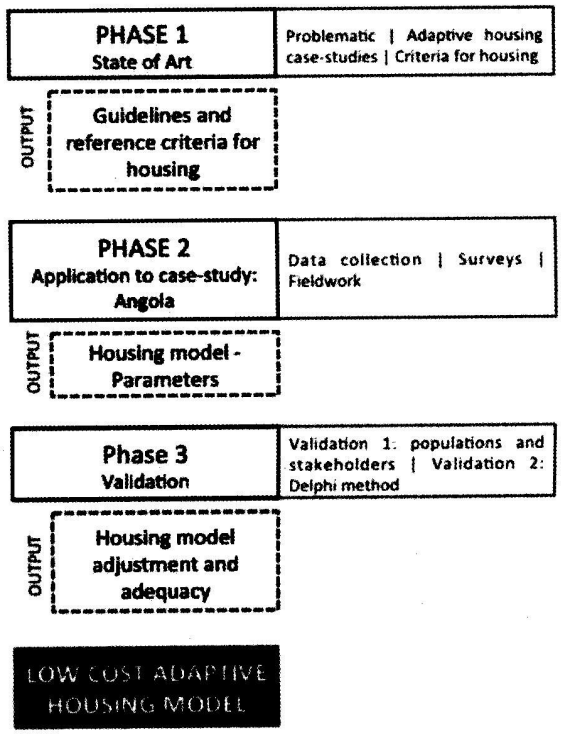

Figure 1 : Summary of Low-cost Adaptive Housing Model research methodology.

Thus, the adaptive housing model includes these four fields – society, economy, environment and territory - through a structured and integrated model formed by parameters and guidelines for low-cost housing, applied to developing countries with several housing deficit.

Case-Studies: Experiences of Adaptive Housing to Specific Contexts

The adaptive housing has been research in different geographies as a solution for impoverishes populations living in precarious conditions. However, these solutions focus in one priority, according to current problems and needs of each country, disregarding a long-term strategy as well as an integrated solution that considers all the premises related to housing. The following case studies present three approaches to adaptability in housing and identify the main criteria used for the implemented solutions and strategies.

Adaptability to Natural Disaster: Banda Aceh, Indonesia

In 2004, Banda Aceh region was affected by a tsunami that destroyed almost all the coastal area, leaving about 500 000 people homeless. In this context, the NGO Uplink, supported by the Indonesian government, has held a housing initiative through a new approach based on a adaptive housing model to natural disasters related to rising level of the sea, the use of local materials and the community involvement [8].

Due the vulnerability of this area to natural disasters, the first premise was to develop a housing adequate to a potential disaster, namely floods and earthquakes. This operation was supported through the community involvement by understanding its expectations, ambitions and needs in order to achieve the most effective solution. The population participation into the process provided the housing layout, based on its social and economic activities (most of the people of this region are fisherman and farmers and the housing layout considered areas to stock these kinds of products) [8]. Thus, the house was able to complement the economic activities of the households.
The housing area, about 35m2, was set by government and supported by the rules for low-cost housing in Indonesia. By the articulation of safety, social, economic and cultural criteria, the final solution was a house built on stakes in order to achieve two objectives: in first place, by being built in stakes, the house was protected against floods and earthquakes; in second place, the ground level was able to store goods and products, complementing the economic activity of the household [8] [9]. By adopting this solution, the acceptance process was improved specially for creating a house adequate to population needs.

The other issue about this project was related to the building process. After the tsunami, the resource/materials demand become very high and materials once accessible like wood, bricks, concrete and steel become very expensive and scarce, leading to adoption of local materials and alternative construction methods [8]. This situation had also to consider the construction time which had to be quickly as possible due the 500 000 homeless living in temporary shelters. At this point, the emergency and low-cost criteria had been added to housing model and the final solution displayed these options.

As an alternative to common ceramic brick, that have a slow maturing process and consume a lot of energy in its production, Uplink decided to use compressed earth blocks (CEB), with a small percentage of cement, made through a manual press worked by local community. The maturing process for CEB was only fourteen days, which provide a fast response to building timings. Besides the material potential, these actions provided temporary jobs, namely for women, from a perspective of assisted self-building process. People were trained to build their own houses but also to monitoring the process in a long-term strategy through maintenance and good practices [8] [9].

This project was considered by UN-HABITAT one of the fastest and with the most satisfactory results in terms of rehousing by applying several adaptive principles to social, economic and territorial context, based on the local priorities and needs [9].

Adaptability to Social and Economic Features: Incremental Housing in Chile and Mexico

The second case study refers to incremental housing concept in Chile and Mexico where social and economic criteria were taken into account.

This concept results from the precarious slums in Latin American and the Caribbean. The social housing solutions promoted by the government were incapable to solve the access to housing, even low-cost i.e. people could not afford these kind of houses, maintaining the growth of informal settlements [10]. Informally, the incremental housing concept occurred in Chile in 1950 at local scale, namely neighbourhoods. The process was officially formalized later in 1993 in the national housing program through the allocation of a plot where the household was free to build the house, which helped to regulate the land title system [10], [7].

The main basis is to provide an infrastructure plot with a housing core to shelter. This main core could be expanded through an evolutive housing model with guidelines and premises for an effective expansion. The evolutive process was incremental, according to household financial capacity and its needs. "In the incremental construction process, the house is acquired with only the most basic features and is upgraded later, at a pace based on the financing capacities of the families through either savinas, micro loans or self-help, which implies waiting until the final stage to obtain a completely finished house" [7]. The incremental housing process is formed by three phases: assignment of an available plot; building of the main housing core; incremental expansion of the house.

The first phase refers to the assignment of an available plot with access to the main infrastructures (potable water, energy and sewer) located in an area already improved, provided with equipment and commerce. This will propitiate an adequate urban environment for self-esteem where people are more willing to invest in their housing maintenance and improvement [7]. The second phase refers to the housing core that considers adaptability criteria to local climate in order to provide an adequate shelter. This operation is achieved through the implementation of local and adequate materials for this purpose. Usually, the preferred materials were cement blocks and ceramic bricks due its due price and durability. However, some experiences of incremental housing showed the effective application of traditional techniques as the quinchoa panels for walls, made with a sticks net covered with adobe and clay [11]. The third phase is supported by a technical team that provides several expansion models for people to choose, according to their needs. In this phase, depending on the model, the house is built through an assisted self-building process or made by a technical team.

The main criteria in these expansion models were the people needs and ambitions as well as the household dynamic and habits in order to provide an adequate response [6], [7].

In order to create viable solutions to people, the technical team have studied the Chilean household composition and behaviour. The Chilean household is mainly composed by a main familiar core, which is added the allegados (another family core related to the main one). The expansion models should consider this situation because each house would be densely populated and could easily become overpopulated. Thus, the expansion model considered not only the expansion of one housing core but also the aggregation of others housing cores, creating an integrated solution [6], [12].

Quinta Monroy built in Chile in 2004 was an example of the incremental process through a vertical housing expansion. The main conception parameters in order to provide adequacy to the household social and economic dynamics were the following: evolutive housing model up to 72m2; natural ventilation in kitchens and sanitary installations; an exterior structural shell; housing layout for cross ventilation; autonomous houses with independent entrances; modular rooms to replicate with 3mx3m [6], [10], [7].

This process was spread to surrounding countries, namely Mexico through national housing fund (Fondo Nacionale de Habitaciones Populares). One of the main examples refers to Chihuahua, near the American border. In this context, the proximity with a develop country was an important factor for the effectiveness of the program, namely through social and economic characteristics of the household related to border flows: "As the family grows, so does the need for more living space, and hence a new or bigger space is added to the existing construction. As the children get older and are able to work, greater improvements can be made to the homes. In the case of Chihuahua many families have at least one family member living in the U.S that send money back to his/her family" [10].

Figure 2 shows the incremental housing process through its articulation with household dynamics, namely income and social changes. The house expansion is related not only with the birth of a new member but mainly with the high income resulting from United States (the final layout was a house with seven rooms). This example in Cerro de la Cruz show another feature related to the house improvement: as the income increases, after 10 years, part of the house made in adobe was demolish in order to be built with better materials (cement bricks), performing the first improvement.

Other examples in Chihuahua show the importance of women empowerment. In Francisco Villa Settlement, the employability of family female members such as the mother and daughters resulted into an income increase and consequent housing expansion by the addition of a new floor with two bedrooms [13] [14].

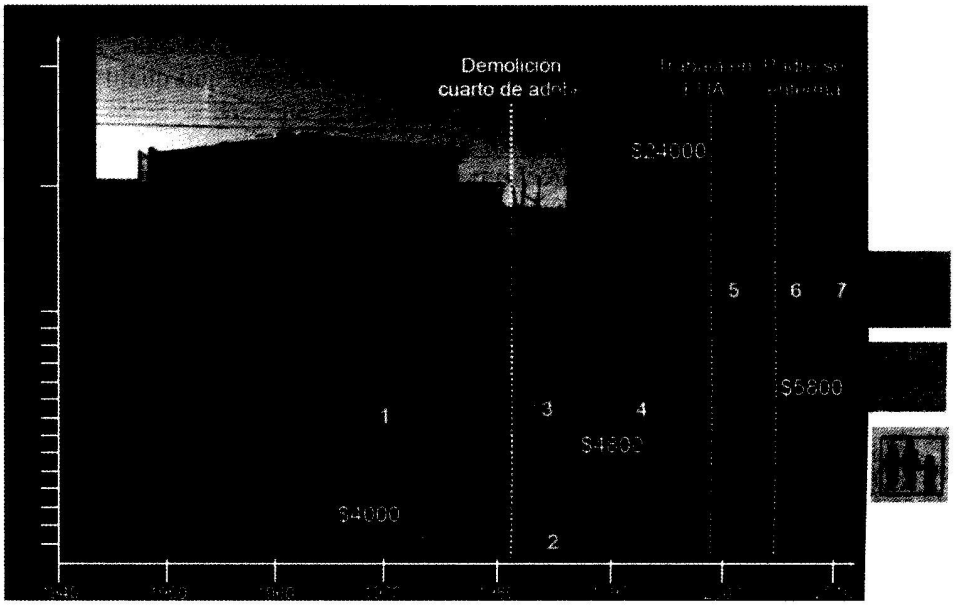

Figure 2 : Incremental Housing process in Cerro da la Cruz, Chihuahua, Mexico. [14]

These two examples had mainly considered an adaptation at social and economic level but also cultural, especially in the Chilean example of Quinta Monroy where the family aggregation was an important factor for housing model.

3.3. Adaptability to post-war context: Incremental housing in Poland

The last case study refers to an approach in developed countries in a post-war context. After World War II, Poland had a severe problem related to housing due the destruction of the main polish cities, namely Warsaw. Therefore, most of the homeless population start to occupy the outskirts of the cities with precarious shelters as shacks and shanties made with the available resources and materials [10] [15].

In this context, the national housing program has decided to implement a housing strategy based on an incremental and self-building process using the waste from destroyed buildings in order to provide houses but also clean the cities.

The first incremental housing experiences in Poland started shortly after the armistice in 1945 and named "Grass-Root Houses". These houses, made by the owners with the available materials, were very precarious but providing a minimum housing core for living and were able to be improved throughout time i.e. the main criteria was the create an effective housing core to rehouse the homeless population as soon as possible [15].

In 1959, local entities started to provide sets of evolutive housing models that people could choose according to their needs. These models were formed by guidelines and plans that people could easily follow in order to achieve an adequate expansion, avoiding subsequent healthiness problems related to ventilation and quality of indoor air [15].

In 1988, before Soviet Union break-up, the government had formally created incremental housing through the "Grow Houses". These houses considered not only the household dynamics but also the aggregation of other families i.e. the evolutive model was formed by a core with a bathroom, a bedroom and a stairs for further vertical expansion while the aggregation model was composed by a unit with a kitchen and a living room [10], [15]k.

In order to become affordable to low-income population, this houses were primarily built as a shelter (a structural shell) which could be improved throughout time, according to people capacity: "(...) completed exterior shells houses with low-quality interior finishes that allow for initial occupation and low up-front costs, but require continual upgrading by homeowners to ensure durability." [10]

The polish example of incremental housing showed an effective solution for an urgent problem of housing deficit. Besides the precarious characteristics of the first experiences with the "Grass-Root Houses", these housing models were able to solute the housing deficit in a short period of time. Therefore, with the creation of "Grow Houses", people were able to improve their houses throughout time, according to their needs and financial capacity. This strategy consider two phases: first one, as a priority, the rehousing of the homeless population based on providing a shelter; second one, the increase of living conditions through housing improvement, considering the economic and social criteria of the affected population.

Conclusions

The population growth in developing countries, namely those in the Sub-Saharan African region, calls for an alternative housing solution able to respond effectively to social, economic, environmental and territorial premises in a long-term context. The current models for low-cost houses provided by governments lack mostly in terms of adaptation terms due the import of western or Asian models suited for their specific contexts.

The presents paper refers to a PhD research for the formulation of a low cost adaptive housing model for developing countries, namely in the Sub-Saharan African region that presents the most severe situation. In this paper are shown several adaptive approaches and priorities to specific contexts in order to identify the main criteria considered for low-cost housing conception. These case studies present an adaptive

housing model to natural disaster, through Banda Aceh example, but also the experiences of incremental housing in Chile, Mexico and Poland, focused on cultural, social and economic criteria.

Further research will create guidelines and summarize the main social, economic, environmental and territorial requirements for housing in order to develop the model parameters to implement in a real case scenario in Angola.

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