

Incremental Housing as a method to the Sustainable Habitat

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ABSTRACT

The manuscript discusses the research relate to the study of Incremental Housing models as a contribution to achieve sustainability in developing societies.

The slums as products of unsustainability and uncontrolled urban growth generate social disparities on the quality of life. These areas characterized by an organic morphology produced without rules results in a precarious and no minimum of housing standards. This situation contributes negatively to social development and has consequences in public health.

The research focuses the housing model that can be applied to promote the slums transformation and its integration in the formal urban area. The intervention model also allows the rehabilitation and improves the housing safety by regenerating the local activities to change the dynamics of unregulated development of the informal areas.

The integration and involvement of residents during the process was developed using participatory processes. This social integration component in the planning, housing construction and neighbourhood development allows to achieve the most appropriate solution to the needs and also reinforces the sensation of inclusion in the neighbourhood contributing to sustainable development.

The research findings are supported on the case study: The Slum Barruncho, Odivelas. The conclusions show the advantages of integration and participation of the population and make clear some of the choices made by the population for the application of vernacular construction techniques which had influence on the transformation model of the fragile environment.

INTRODUCTION

In all world about a billion people live in informal settlements (known as slums, *barrios*, *favelas*, *shantytowns*, or spontaneous cities), number expected to double in the next 20 years. According to John Beardsley “Slums are now the dominant form of urban land use in much of the developing world”. Ahmedabad, Buenos Aires, Caracas, Delhi, Bangkok, Mumbai, Nairobi, Rio de Janeiro, Sao Paulo, Mexico City, Cape Town, Dhaka, Kampala, Dakar, Manila, they are all fast-growing cities full of informal settlements, (Beardsley, 2007).

Interventions in informal settlements are a subject of debate throughout the world seeking how to integrate these areas in the cities that surround them. The interventions arise from many types of possible approaches, identifying two distinct groups by their initial nature. One based on total demolition and

complete replacement of the area and the other in the transformation and requalification of these clusters through qualification strategies of the pre-existing. Following this last strategy emerges the Incremental Housing as a solution to a flexible intervention to the real needs of these areas.

Housing is a product of social, economic, political, and human realities. That thought gives us the perception that housing is much more than a consumer product, and may be understood as a process that helps building communities and be the roof for a fair and healthy society (Boonyabancha, 2011). Following this thought Turner defended the “Housing as a verb”, this is, housing as a basic need and necessary to enhance the aspirations to a better society (Turner, 1991). In a global scenario of shortages and fast developing is urgently design new ways of living that responds to the new paradigms of housing and his conception on the sustainability scenarios, valuing the inhabitant as the way of relation between the process, the product and the environment, (Canotilho, 2008).

Economically more viable, incremental housing has generated great interest throughout the world, especially when emerges united with social issues. This context allows the evolution and improvement of housing in medium-long term, giving better conditions of life for its residents without large upfront costs. The components are added or changed by inhabitants and/or builders as money, time, or materials become available. Are examples: the *Incremental Housing Strategy in India* (2008) the *Elemental in Chile* (2003); and the *Aranya Community Housing* in India (1989). The *Incremental Housing Strategy* (Smith, 2011:pp118-119) in India stands out for the community participation in the preparation of the Yerawada revitalization strategy, where the purpose solution was the increase of the number of housing units, according to the needs of each family, respecting the organization model of the existing neighbourhood regarding the pre-existing pathways, on the integration of new constructions on the mesh already built. The implementation of this project contributes to a better quality of community life at several levels (the project enabled the sanitary installation in every home) and also to the quality of urban space and territory. According to Filipe Balestra for this process be considering an effective sustainable project the improvement of existing housing has to be done based on a real community participation (Balestra, 2008).

Another example is the *Elementar* by Alejandro Aravena, where the project is based on performances over bounded communities, through the establishment of housing projects that intend to an appreciation over time taking into account housing not only as a habitat but as a mechanism for the family investment. The family begins with the base and wins motivation for their continuity through creative solutions for the community housing needs, according to a sustainable base and local economy. The *Elementar* defends that communities themselves promote their constructions and economy who have impact in the social improved stability and in the vision of a city equal for everyone. It was concluded that give the residents the possibility to adapt their “homes” to their true needs and lifestyle, allows safeguard the housing and adapt their functioning to the actual needs and at the same time allow them to create a strong sense of belonging and identity (Aravena, 2013).

The *Aranya Community Housing* started in 1980 in the city of Indore, with the aim of creating incremental housing for critical areas of the city. To each family has been provided a small lot with different infrastructure according to its financing capacity. The plot could contain a complete housing or the minimum surface area to build one house. The project started with a strong analysis of the urban morphology and behaviours of the local population (the streets organization, the houses, the various types of aggregation) reflected on the participation of the residents. The project shows that after 30 years houses continue to evolve and grow, physically and aesthetically reflecting the user’s needs and the capability to generate solutions to its inhabitants. The neighbourhood became very busy, providing an attractive environment for its residents and visitors. *Aranya* is in many aspects the validation of the ideals of incremental housing applied on a critical area in urban expansion.

The concept of Incremental Housing is based on the capacity to adapt the house model to the evolution of the family (growth and decrease of the number of family members). However it is important to assure that it is available to adapt this evolution of the housing to the site and urban context (Neves, 2013).

Coelho and Cabrita discusses that the process of incremental housing is directly connected to the family evolution,“(…)embracing forms of gradual improvement and adaptability to the changes, more or less successive, of their inhabitants lifestyles, may so, ensuring the progressive realization of the “housing desires”, as they are being made and discussed by locals and chosen as real objectives to be attained at a certain time in these homes.”¹ (Coelho & Cabrita, 2009: p.11).

According to Portas and Silva Dias in the study “Incremental Housing”, the main quality of incremental housing is the capacity to build a system based on simple rules of design and execution, able to define the first phase of installation, promoting qualitative evolution of the home environment and others areas, essential to next inhabitant’s sociocultural evolution (Portas & Dias, 1972: pp.100-121). This concept ensures that the improvements of housing are according to the capacities and investment funds of each family.

Coelho and Cabrita also claim that some operating characteristics of the standard or inflexible housing make it impossible the continuous evolution and improvement of housing: spaces designed with only one function; inadequate fixed equipment; windows designed for rooms with specific function; proportions of compartments related to certain functions; narrow access and circulation; and the existence of only one access to the outside (Coelho & Cabrita, 2009: p.12). To avoid such difficulties it appears necessary the establishment of a minimum set of initial requirements, from which it will be possible to develop housing in a healthy manner.

The “incremental process” isn’t just a solution or an approach; it contains a large number of invariants through several volumetric increase forms and miscellaneous modalities of development, improvements and finishing of housing, being some more appropriate for single-family and others for multifamily housing. In a general way it’s possible to integrate the various models of evolution on three forms or principles: aggregation; expansion and division (which could act in an isolated or combined form, and appropriate to each individual case). These models should be studied in the project design phase in order to achieve stability during the different stages of development.

It is also important to ensure the integration of incremental housing at the urban level and have in all the urbanization physical structures adapted in order to integrate the housing development. Following this issue Portas and Silva Dias argue that urban integration of an incremental housing solution have at least two possible actions: one of functional nature relating the population economic and social behaviour; and the other of visual nature (spatial) linking the neighbourhood image and its morphological relationship with the city (Portas & Dias, 1972: pp. 100-121).

A solution that allows adapting the evolutions to the urban plan is its application in each phase, actions to ensuring the continuity whit the surrounding through a gradual improvement throughout the stages. Also the self construction integrated in the planning process with the population contributes allows create an application model that guarantees the essential of the self-governance by the population without going into ruptures between the inhabitant, the house and the public system (Neves, 2013).

Participatory process

The rehousing process involves significant change and requires a profound restructuring of daily life and its practices related not only the residential behaviour but also in transport, leisure and recreation, neighbourhood network and makes compulsory needs in the adaptation to the new living form of the residents (Portas, 1995). However, it is relevant to refer that the space appropriation whether it be of the territory or of the housing itself, is an important step towards the creation of an identity bond between the space and its inhabitants.

During the rehousing process, the housing living space appropriation and the public space are important aspect because we face a process that can break with previous modes of life, and required and rethinking of the space appropriation form and the established identity relations. It is necessary value the dimensions of appropriation, embeddedness and identity that happened through housing appropriation

¹ Translation by the author.

and consequently the neighbourhood since only in this way we can ensure a positive relocation and the safeguarding of existing housing and neighbourhood spirits.

Herman Hertzberger defends the need for the participation of the population as a condition *sine quanon* for a perfect future space appropriation. For this author that should exist reciprocity between the shape and the use and the experience for different people and different times. This involvement and participation should follow the whole process of evaluation from the planning to the implementation (Hertzberger, 1999).

Christopher Alexander also states that “*the only way to build forms that are loved by its inhabitants is through their participation in the process. The mere fact of an individual participating in the planning or construction of his home or neighborhood establishes a connection between him and the realized object. (...) Most people don’t have the least concern for formal design virtues, they just want something that they can truly consider theirs.*”² (AAVV, 2006:p.28).

METHODOLOGY

This research involves a sequential methodology that requires the use of large transverse scales (focusing in the case study - Barruncho) for searching and proposes an intervention action into the surrounding urban grid.

It is important to the intervention in these informal settlement to have a complete understanding from the urban reality at the municipal level to the scale of the place (including the urban grid, infrastructural systems and accessibility, social and economic activities, conditions and ecological implications) to provide a complete systematic characterization of the site. This clear understanding of the territory in its different aspects turns as a starting point for defining the future approach and subsequent assessment of global impacts of continuing the isolation at the neighbourhood level; the planning development of the surrounding urban grid followed by the elaboration of the premises based on interventional leadings towards the development of the case study as a strategic option. The applied methodology promotes also an incremental module house built with sustainable materials and from an adaptive house design which the implementation in the territory results in the definition of a concept of balanced spatial and functional organization for local intervention. This process composed of variable and invariable parameters allows the construction of a final solution possible to application at any socio-economic and territorial context adapting it to the variable parameters for each context (Culture, family, climate, housing type – see figure 1).

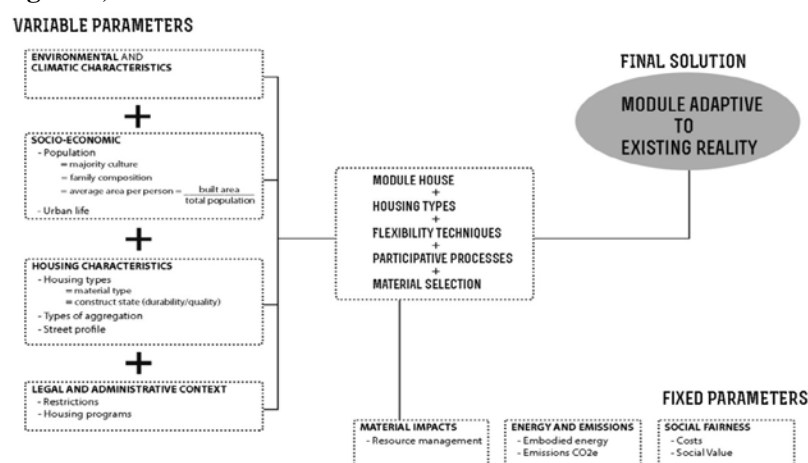


Figure 1 Design concept methodology diagram.

METHODOLOGY APPLICATION AT BARRUNCHO CASE STUDY.

The Barruncho neighbourhood is a primordial study subject because it is a critical area that

² Translation by the author.

highlights the greater number of typical slum houses in Odivelas city, Portugal. The need for an urgent intervention results not only as an urban issue to promote the urban consolidation, but also from the need to solve the social anthropological context. The crime settles and develops quickly in these settlements, who show that the greater the degradation of the same the lower results in promoting social and cultural integration of its inhabitants. The analysis shows to us the necessity of an imminent intervention and the clear understanding that the complete destruction of the settlements and scattered rehousing of its inhabitants is not always the most viable and effective solution.

Parameter 1: *Barruncho environmental and climatic characteristics*

The environmental and climatic analysis are important in the development of an efficient and sustainable housing module, and should be taking into account in the process since the location decision to the selection of construction materials. Barruncho's climate is a mild climate, Mediterranean, mild wet and moderately rainy, presenting maximum temperatures with average values in the order of 22.5 ° in July and August and an average relative humidity between 63% and 82%, revealing potential for agricultural activities. The mild climate and good sun exposure will determine the passive design conception and material selection, focusing the seeking for renewable energy sources and ensuring quality housing with thermal comfort. The orography (ratio between hydrography and topography), Barruncho arises as a natural amphitheatre that enclose the houses west side bounded by a water line marked and with orographic peculiarities which regulate the delimitation of streets and paths according to the verified slopes.

Parameter 2: *Barruncho Socio-economic*

The Barruncho population is heterogeneous in cultural and ethnic terms, being composed mainly by Portuguese, Africans and gypsies. There is a great predominance of inhabitants born in Africa (PALOP – Cape Verde [41%]). Barruncho have about 540 people, distributed by approximately 115 households with an average size of 4,7 people. The reality reflects a large number of households consisting only of 2, 3 and 4 elements. In general, the population has low or no academic qualifications. The data reveals the poor education of the older generation and the high percentage of young people that are still at school age. The Barruncho is characterized by its strong neighbour relations and it is based on these relationships that most of the population develops its activities.

Parameter 3: *Barruncho Housing characteristic*

With only one floor level with lower ceiling height, the dwellings define precarious spaces with reduced interior areas. The dwelling starts with one compartment (where all house activities are done) and as it is possible and necessary evolves, increasing the number of compartments. Lack of space linked to the inhabitants needs requires flexibility of spaces functions in the interior of the housing. The interior of the housing is the place where are developed the main family activities. The construction materials are diversified and sometimes creatively solution as been applied. The most used materials in construction are zinc sheets, adobe brick, wood beams, MDF boards. As coverage material predominates the metal sheet, existing in smaller quantities fiber cement sheets, tile (associated with the pre-existing neighborhood buildings) and some mixed materials covers (plastics, tiles, plates). The current application of organic materials without a preliminary study with a long-term strategy (more durability and quality, less maintenance) is a very precarious solution.

Parameter 4: *Barruncho Legal and Administrative*

The legislation and regulations can be useful and applied to the study case as an important tool for the concept design since they establish the minimum standards required. However, to transform an informal settlement is important to consider more than the minimum legal standards. It is required the perception and adaptation of these measures according to the population real needs (culture) through good sense decisions.

In 2008 the Town Hall of Odivelas declared as *Critical Area for Recovery and Urban Reconversion* (ACRRU) the site of Barruncho, because the profound social and urban decay observed in this area. The methodology results in a construction model applied in Barruncho that is capable to solve the housing problems and create positive impacts at environmental, economic and social levels: “Cradle-to-Cradle posits that mankind can have a positive, restorative, beneficial impact on the environment.” (Cradle to Cradle Products Innovation Institute, 2013). The model is associated with a modular incremental housing concept that presents economic and environmental advantages. The standard incremental house concept allows an optimization in terms of costs, construction time, and resources management but also in a design strategy that suits the Barruncho social dynamic.

Module Composition - Based on the analyzes conducted both to population and the settlement itself, was calculated the average area per person (area required for this specific population) and the average number per family unit (there is a large percentage of households with 2 to 4 elements) which originates two adapted and evolutive base modules. One (module A) with an implantation area of 55.3 m² and one patio of 11.7 m² that allows the evolution by expansion and other (module B) with 60.3 m² implantation area plus a small patio with 17m². In this way, the designed strategy of incremental housing focuses on a modular logic, where the base module is not repeated by mere overlay, but occupies different positions in space, generating different types of aggregation based on major "existing" typologies currently at Barruncho. The application of these new modules in a phased process allows to create a more ruled settlement appearance, without jeopardizing its identity to avoid the “shock” associated to an abrupt change that is typical of common relocation situations and allows at the same time solves the problem of where to accommodate the population during the execution of the work. The incremental process is done according to the overall intervention plan (roads, streets, access, areas of public space and equipment), and taking into account the condition and construction quality of current housing, replacing first the most urgent housing. The phasing implies addition to replacing the “existing tents” by the new housing modules, the gradual improvement of public space through new reception areas and gardens, the creation of a central square which will host small commerce activities, as well as the development of housing. Phase I evolves into a phase II and simultaneously to a phase III until the whole settlement is rehabilitated. This sequential process ensures a component of evaluation and monitoring that allows plan adjustments to changes in initial premises.

Module A. This module was designed to develop by expansion. The base module (to a couple) is constituted by a social area, a private area and an outdoor area capable of evolution (an outdoor patio). The dimensions of the social area were carefully designed not to be too “big” at an early stage, which could result in a misappropriation or in an uncomfortable space; neither too “small” in a more advance stage, ensuring an adequate area to a larger number of inhabitants. In first phase of evolution, due to the household increasement or the need for more area, the base module evolves by expansion, through the construction of a second room in the zone previously designed for this evolution (patio). In a second phase a staircase is built in the second room, which will give access to an upper floor built in this phase where new rooms will be built as required. At this stage, the rooms offer flexibility strategies; being fixed only the exterior walls and the sanitary area. At last, when the household decreases or the children get married and need their own home, the lower floor access is closed and transformed into an independent access, turning the two floors house on two houses with independent accesses allowing through the evolution by division that the house always accompanys the household changes (see figure 2).



Figure 2 Module A evolution scheme.

Module B. This typology more rigid in terms of the module’s physical limits (doesn’t evolve by expansion) but the interior is more free and flexible and can be changed and adapted to new needs, allowing to develop by division (transformation into two independent modules). The concept goes through keeping fix the “wet areas” and allowing that the rest constituting the free plan, able to host some of the space flexibility desired, through walls-cabinets (cabinets that stretch from floor to ceiling turning into divisions); fake-walls; folding walls. Thus the spaces are open to changes at function level, punctually in area and sometimes through the day (egg. at daytime one division is a living room with sofa; at night the sofa becomes a bed), (see **figure 3**).



Figure 3 Module B evolution scheme.

Material Selection

The adaptability to the family needs is the objective of Incremental Housing. It is important that its constructive system be accessible. Thus, the modules were designed allowing its construction by two people, due to its simple geometry and easy materials application. The materials choice also consisted in the identification of materials according to the principles of Cradle-to-Cradle: natural and local materials with low environmental impact (low emission of CO₂ e/m² and embodied energy); economically viable; recycling potential and compatible with local population culture and know-how. According to the territorial analysis, the most common and environmentally effective material in Barruncho housing is the adobe brick. However, due to the advantages and the easy access to land as raw material, it is proposed the use of Compressed Earth Bricks (BTC). The manufacturing process is fast and doesn’t need an oven. This allows a production with natural resources and almost with no transport efforts, reflected in cost reduction. The earth construction is an easily adaptable and teachable technology that allows unqualified people to learn a skill, increasing social values and creating and opportunity for local business. Based on Cradle-to-Cradle model, the embodied energy and emissions calculation is an important tool for material sustainability and efficient evaluation about the harmful gases emissions and energy consumption. According to the evaluation by *Auroville Earth Institute*³, the BTC are about four times less pollution and spend about four times less energy than normal bricks (see **table1**).

Table 1. Sustainability and Environmental Friendliness of BTC

Initial Embodied Energy per m3 of wall	Pollution Emission (Kg of CO2) per m3 of wall
BTC wall = 631MJ/m3	BTC wall = 56.79 Kg/m3
Kiln Fired Brick (KFB) = 2,356 MJ/m3	Kiln Fired Brick (KFB) = 230.06 Kg/m3
Country Fired Brick (CFB) = 6,35 8MJ/m3	Country Fired Brick (CFB) = 547.30 Kg/m3

Note: Kiln fired bricks are often called wire cut bricks. (Unesco Chair Earthen Architecture- AVEI)

CONCLUSION

Housing is perhaps the biggest problem of actual societies since it is a basic human need. But, the

³ <http://www.earth-auroville.com/> (May 2014)

society not always has secured the access to this fundamental human right.

For long time we have seen several cases of social housing where the only purpose is to accommodate the greater number of people in the most economical and easy way, opting for a standardizer construction aggregated in height or disposed at a ruled mesh without being thought to the experiences of the people (neighbourhood networks, sociability and culture).

The fact that urban projects are created as dorms and not as qualified urban spaces which assume the existence of a complex sociability network makes it important to provide different spaces that dynamize the neighbourhoods experiences done by an incremental social housing with support on participatory processes as a positive result. It's necessary to rethink how it can be promoted the population involvement along all the rehousing process. In result the potential of Incremental Housing as a possible solution to housing access, inserted in a participative planning process with the population knowledge and involvement are a successful solution.

From the reality of Barruncho project, it is possible to understand the importance of the population and its territory, on a situation of in-situ rehousing; creating an intervention appropriated to the existing reality without rupturing with the population memory neither with the way of life. Involving the population in the house construction and change of the neighborhood morphology enables the adaptation to the population real needs and develops the strong sense of belonging and affection which is fundamental to the well-being of the residents. The use of onsite materials is an affordable and environmentally sustainable solution; reducing transport, fuel and construction costs and providing work opportunities and local economy. The reduction of embodied energy is a goal to be observed in every step process

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