AN INTERNATIONAL RESEARCH NETWORK MODEL: ANALYSIS CASE OF SOCIAL SUSTAINABILITY IN SOCIAL HOUSING PROJECTS IN LATIN AMERICA

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ABSTRACT

In recent years, diverse Social Housing Projects (SHP) have been developed in Latin America, through housing programs that aim to decrease the current housing deficit in the region. In most cases, these projects are characterized by being carried out under requirements and minimum standards raised by their governments, which address the standardization of processes, without considering the local characteristics of their biogeographic environment, social and cultural conditions, and the proper identity of the communities served. The social, environmental, economic and institutional demands’ understanding by those responsible for the implementation of these projects, it is essential to ensure the sustainability of these developments, towards the environment and users. The aim of this paper is to present a collaborative research network model, created among the UNESCO Chair on Sustainability, the Research and Extension group in Management and Technology of Constructions at the Universidade Federal da Bahia (GETEC-UFBA) and the School of Habitat of the Faculty of Architecture at the Universidad Nacional de Colombia, located in Medellin (UNAL-MED). Additionally, in order to develop and implement a methodological proposal for post-occupancy analysis of these kind of projects in municipalities in Latin America, under different cultural and biogeographic characteristics, a case of comparative study between SHP carried out in municipalities of Bahia (Brazil) and Antioquia (Colombia) is shown. The network is initially designed to support comparative studies and comprehend in an international context, perception, satisfaction and adaptability of end users in SHP. Likewise, the network aims to identify the performance of technologies and materials used in the projects, in relation to biogeography and socio-cultural aspects of each region.

Keywords:
Social housing, Territorial diversity, Sustainability, Research Network

1. Introduction

The number of people living in precarious housing has increased progressively to exceed the figure of one billion people in the world at the beginning of the twenty-first century (A. G. Gilbert, 2014). In Latin America, the population living in slums is estimated at 134 million of people for 2005. In addition, cities increasingly face the advent of rural population in search of greater opportunities and new settlements. In the case of Latin America and the Caribbean, there was in 2000 approximately 75.5% of the population in urban areas and 84.6% is projected for 2030 (UN-Habitat, 2011).

In 1991, the Office of the United Nations High Commissioner for Human Rights established the right to adequate housing from a number of factors defining the concept of adequacy, which allowed proposing different guidelines in developing Social Housing Projects (SHP) in the States Parties (ONU, 1991).
Unfortunately, the progressive growth of the housing deficit in Latin America, especially in low-income families, has meant quick action plans by their governments to mitigate it. However, these strategic plans are carried out from a numerical approach instead of a systematic one.

Brazil's case with the "Minha Casa, Minha Vida" program, launched in 2009 stands out in the region. This program in the first half of 2015 had delivered 2.3 million housing units of 3.96 million units contracted (PAC, 2015). Similarly, the case of Colombia with the "100,000 free housing" program, approved in 2012, for families living in extreme poverty.

These programs are characterized by standardized and designed projects with focus on rationalizing the construction process. The major design and construction premise is to meet the high demand for homes built with the minimum time and cost.

In coordination with this context, it is common to find social housing projects that do not correspond with their own characteristics, biogeographic environment, culture and identity of their communities. These incongruities affect both welfare and living conditions of the inhabitants. Similarly, the lack of urban and territorial planning creates replication models that are slowly setting new urban areas of the municipalities expanding in a disorganized way, often repeating the same mistakes of large cities in the metropolitan area.

Addressing the issue of decent and adequate housing in Latin America is certainly complex because of multiple factors that interact in it. In the words of Alan Gilbert "As it takes place in most social debates, the first difficulty reaching any practical definition is to establish and agree an acceptable standard of housing" (A. Gilbert, 2000). However, housing is the result of the integration of a number of attributes that respond to a specific context that “[…] includes not only structural constraints, but also functional and symbolic features that respond to cultural, spatial, historical and temporal characteristics, determining the attributes that establish the quality housing and allow satisfying human needs” (González Escobar, 2010).

The widespread ignorance among stakeholders in the development of SHP on issues related to the integrity of its components and inclusion of sustainability, hinders the implementation of these practices (Acevedo, Vásquez, & Ramírez, 2012). This situation increases the need for strategies and tools to facilitate this task and guide their implementation.

This article presents a model of collaborative research network focused on social housing in Latin America. This collaborative research network is created among the UNESCO Chair on Sustainability, the Group of Research and Extension in Management and Technology Constructions at the Universidade Federal da Bahia (GETEC-UFBA) and the School of Habitat of the Faculty of Architecture at the Universidad Nacional de Colombia, located in Medellín (UNAL-MED). Initially in this paper, the subject of methods of analysis of housing projects with some examples is exposed. Consecutively, the collaborative research network (background, partnership, participants, and brief description of the implemented methodology) is presented. Subsequently, the case study about six studied projects in the municipalities of Bahia (Brazil) and Antioquia (Colombia) is exposed. Finally, representative results of the comparative analysis of these projects and the conclusions are presented.

2. Methods of analysis of Housing Projects: Background

By discussing about housing is put into play very diverse complexity issues, it is not only a result of instrumental and economic nature, or the realization of a number of administrative policies; housing is more, comprises an ideal, a dream for many embodies emotion. It defines and interweaves family, it is where the home is based, everyday life, where the encounter, dialogue and silences occur, and inside the home is where the life of people who inhabit is set.

Accordingly, it is essential to address the human issue, since this component is ultimately who gives the meaning to housing as a habitat and space of multiple experiences and convergences, this person is who lives and dwells in various conditions in the building area. For this reason, it is not only necessary to have technical inputs that provide engineering, architecture or statistics, but our labor goes beyond, and in this line of thinking, we ask ourselves as Heidegger, “What is it to dwell?” and “How does building belong to dwelling?” (Heidegger, 1951). Considering this, it is intended to bring new meaning to that which is built, how and for what is constructed, matters pertaining even to a moral level since the final beneficiary of housing is a human being with all the invisible and intangible that includes this fact.

In addition, territorial and technological diversities make unique the project, singular and adaptable, and differentiate it. By studying these diversities, it is possible to comprehend dynamics that occur there in the integration of multiple variables.
According to S. M. Blas (2011), affordable housing became a research topic in the early twentieth century, with focused work on housing through the inclusion of minimum basic needs of families in poverty situation. In this regard, the International Congress of Modern Architecture ICMA, held in Frankfurt in 1929, entitled "Housing for minimum subsistence" was of vital importance in the analysis of social housing since commissions from the participating countries defined design codes and numerical calculations. Even though the program was only about housing plans and their collective association, the event and its results, with all subsequent criticism, marked the beginning of international exchange of experiences on the improvement of social housing.

The comparative analysis may allow highlighting elements or factors that contribute and stand out favorably in the construction of social housing or conversely, diminish or contradict statements for which they were conceived. Additionally, various studies have evaluated the house from different approaches or criteria, understood as part of a context and a larger territory where it interacts. Some studies are mentioned below.

The method of I+D+SH, performed by the group NuTac research at the Polytechnic University of Madrid, makes comparison of eight construction social housing projects in seven European cities that characterize, according to the authors, social, economic context and politician of its municipality and country concerned. The method is based on three fundamental concepts: economy (understood as a necessary compromise between resource use and satisfaction of needs and desires), diversity (comprehended as a mixture of uses, urban permeability, defining public spaces and combination of type and age of buildings) and density (which it refers to the relationship between proximity, and terrain-space consumption). Likewise, there are four scales determined frames per meter units, which are from highest to the lowest in following insets: 1000x1000 m, 250x250 m, 25x25 m and 1x1 m (Blas, 2011).

Abdul Karim, who analyzes the well-being and quality of life, also studies the theme of the scales in social housing in four different domains of housing environments, such as are the family domain, the social environment (neighbors and community), the community facilities environment and the neighborhood physical environment, which limits with cities. Correspondingly, five aspects are part of these domains; such aspects are Comfort, Convenience, Satisfaction, Safety and usage. The implementation is done in the city of Shah Alam in Malaysia (Abdul Karim, 2012).

On the other hand, the method presented in "Tools for inhabiting the present: Housing in the 21\textsuperscript{st} century" theme of contemporary home is considering four basic concepts, such as are society, city, technology and resources. It also includes other four "complementary" concepts as management, rehabilitation, typology and perception. The method analysis is based on the definition and descriptive presentation of elements that compose six examples of houses, considered representative by the authors of best practices and good architectures, located in (3) Spain, (2) Austria and (1) Japan (Montaner, Muxi, & Falagán, 2011).

In Latin America, the Faculty of Architecture and Urbanism at the University of Chile carried out the assessment of housing welfare in residential housing projects from six factors, such as are physical space, psychosocial, thermal, acoustic, lighting, and safety-maintenance. Additionally, this study provides design recommendations according to the qualities of space, which is divided into three scales like residential environment, immediate environment and housing. The main objective of study is to provide design guidance, standards and evaluation criteria in residential housing (Jirón et al., 2004).

3. Collaborative Research Network Model

3.1. Background

UNESCO Chair on Sustainability is an educational, research and extension institution, supported by UNESCO, at the Universitat Politècnica de Catalunya, Spain. As one of its objectives is the development of strategic projects related to construction and sustainable urban development through the development, improvement and consolidation of academic and institutional relations of the UNESCO Chair in an international context, especially with Colombia, Brazil, Mexico, Argentina and Peru.

This collaborative network, meanwhile, aims to conduct comparative studies to determine, in an international context, perception, satisfaction and adaptability of end users in SHP, and likewise, the response of technologies and the materials used in social housing with respect to the biogeography and sociocultural aspects studied.
For this purpose, it promotes common and parallel activities framed in the development of a methodology for promoting sustainability in SHP in Latin America; initially, advanced in the PhD on Sustainability at the Universitat Politècnica de Catalunya.

The collaborative network is currently comprised of the following institutions:

- UNESCO Chair on Sustainability, Universitat Politècnica de Catalunya (UPC), Spain
- School of Habitat (CEHAP), Faculty of Architecture, Universidad Nacional de Colombia at Medellin, Colombia
- GETEC, Universidade Federal da Bahia (UFBA), Brazil

Consequently, it seeks to generate and develop strategies that lead to research results that can be reported and allow academic exchanges and discussions of the results on the issue of social housing in different regions under study. Likewise, it aims to establish and strengthen scientific and academic relations among the signatory parties in favor of continuing activities and future common projects.

3.2. Brief description of the methodology implemented

The methodology for the project analysis is based on both housing and project studied as in comparative case analysis. This analysis is based on a technical and qualitative evaluation of different variables grouped into six factors (Physical Structure and Spatial (PSE), Material and Technology (MT), Thermal-Acoustic-Luminous (TAL), Physical Environment (FE), Socio-Cultural and Economic (SCE), Institutional and Participatory (IP)). These variables are evaluated in three different scales or areas of study, such as Housing (H), Immediate Environment (IE) and Territory (T).

![Figure 1: Factors and scales used in the methodology](image)

Initially, the methodology starts from the recognition of social, technological and biogeographic diversities, type of housing, the project and the population, as applicable. Based on the above, the projects under study are analyzed, based on the application of indicators that may be either quantitative or descriptive, depending on the variable studied. It allows to create reference patterns at the moment to analyze and compare differences and particularities of each project.

This methodology allows a larger picture of the housing and the project relative to its population and territory in different scales. In this manner, it allows a detailed diagnosis where multiple variables interact, with which are intended to comprehend the perception, satisfaction and adaptability of end users and the response of the technologies and materials used in social housing with respect to biogeography and own socio-cultural aspects.
Finally, based on statistical analysis, studies of urban and rural territory, and the sociocultural aspects of the population, collaborative network participants contribute on analysis of information according to their expertise. It is expected to develop a methodology for post-occupancy evaluation with international coverage. The objectives are both to allow in the future creating improvement plans in the most vulnerable aspects that affect the development of social housing, and in the same way, to discuss issues including relevant aspects considered for new housing developments and generate proposals in terms of materials and appropriate technologies to the context analyzed.

4. Case Study: Social Housing in Antioquia (Colombia) & Bahia (Brazil)

4.1. Brief description

In this study, the proposal methodology was used to analyze sustainability in six social housing projects, whose applicability was directed to different municipalities outside the metropolitan areas of two regions of Latin America.

As for data and information, these were collected between the months of September 2015 and February 2016. The location and climate zone of the projects analyzed both in the department of Antioquia in Colombia and in the state of Bahia in Brazil are presented below.

Table 1: Location and climate zone of the projects studied

<table>
<thead>
<tr>
<th>Project</th>
<th>Country</th>
<th>State/Department</th>
<th>Region</th>
<th>Municipality</th>
<th>Climate zones*</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA-SH1</td>
<td>Brazil</td>
<td>Bahia</td>
<td>Médio São Francisco</td>
<td>Bom Jesus da lapa</td>
<td>Tropical semi-arid</td>
</tr>
<tr>
<td>BA-SH2</td>
<td>Brazil</td>
<td>Bahia</td>
<td>Extremo Oeste</td>
<td>Luis Eduardo Magalhaes</td>
<td>Tropical sub-humid</td>
</tr>
<tr>
<td>BA-SH3</td>
<td>Brazil</td>
<td>Bahia</td>
<td>Metropolitana de Salvador</td>
<td>Dias D’avila</td>
<td>Tropical sub-humid</td>
</tr>
<tr>
<td>AN-SH1</td>
<td>Colombia</td>
<td>Antioquia</td>
<td>Suroeste</td>
<td>Fredonia</td>
<td>Temperate per humid</td>
</tr>
<tr>
<td>AN-SH2</td>
<td>Colombia</td>
<td>Antioquia</td>
<td>Occidente</td>
<td>Uramita</td>
<td>Tropical sub-humid</td>
</tr>
<tr>
<td>AN-SH3</td>
<td>Colombia</td>
<td>Antioquia</td>
<td>Bajo Cauca</td>
<td>El Bagre</td>
<td>Tropical per-humid</td>
</tr>
</tbody>
</table>

*The climates zones are based on Holdridge life zones system.

4.2. Participants

In addition to the institutions that are part of the collaborative network, the state company that provided the information of the projects in Antioquia and the families, who participated in the survey in the six different projects, are also part of participants, which are listed below:
The survey applied to users of the projects was personally filled out through questionnaires divided into the same factors and scales presented in the methodology. The total number of respondents and housing units as well as delivery time of housing projects are presented in Table 2.

Housing projects of Bahia were built by the same construction company, while in Antioquia, the three projects analyzed were built by different construction companies, but within the same housing supply of VIVA.

### Table 2: Description of the project studies

<table>
<thead>
<tr>
<th>Project</th>
<th>Usage time of project at the moment of the survey (months)</th>
<th>Total housing units (units)</th>
<th>Surveyed housing units (units)</th>
<th>Surveyed housing units (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA-SH1</td>
<td>24</td>
<td>330</td>
<td>51</td>
<td>15.5</td>
</tr>
<tr>
<td>BA-SH2</td>
<td>11</td>
<td>900</td>
<td>90</td>
<td>10.0</td>
</tr>
<tr>
<td>BA-SH3</td>
<td>2</td>
<td>121</td>
<td>35</td>
<td>28.9</td>
</tr>
<tr>
<td>AN-SH1</td>
<td>4</td>
<td>86</td>
<td>45</td>
<td>52.3</td>
</tr>
<tr>
<td>AN-SH2</td>
<td>3</td>
<td>36</td>
<td>20</td>
<td>55.6</td>
</tr>
<tr>
<td>AN-SH3</td>
<td>22</td>
<td>126</td>
<td>53</td>
<td>42.1</td>
</tr>
</tbody>
</table>

5. Results

Figures and tables presented below are part of the overall results found in the analysis of social housing projects in the municipalities under this study. Initially, building typology used, the built-up areas, and total costs per m² unit in the different housing units are described (table 3). Subsequently, the shape and distribution of housing units are exposed (fig. 3) and finally, it is presented the satisfaction level and the quality perception of the users in the housing units (fig. 4 & 5).

In all cases, it is perceived some patterns of housing project such as two bedrooms, an average of 43 m² per dwelling area, and a variation in total cost between 280 and 400 USD per m² built.

### Table 3: Physical description and cost of housing projects studied

<table>
<thead>
<tr>
<th>Project</th>
<th>Building typology</th>
<th>N° bedrooms</th>
<th>Area (m²)</th>
<th>Total cost (USD)</th>
<th>Cost (USD/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA-SH1</td>
<td>Structural Masonry with clay brick</td>
<td>2</td>
<td>40.8</td>
<td>13,189</td>
<td>323</td>
</tr>
<tr>
<td>BA-SH2</td>
<td>Cast in place concrete walls</td>
<td>2</td>
<td>43.3</td>
<td>12,080</td>
<td>279</td>
</tr>
<tr>
<td>BA-SH3</td>
<td>Cast in place concrete walls</td>
<td>2</td>
<td>40.8</td>
<td>16,115</td>
<td>395</td>
</tr>
<tr>
<td>AN-SH1</td>
<td>Structural Masonry with clay brick</td>
<td>2</td>
<td>44.9</td>
<td>17,942</td>
<td>400</td>
</tr>
<tr>
<td>AN-SH2</td>
<td>Structural masonry with concrete block</td>
<td>2</td>
<td>44.5</td>
<td>17,898</td>
<td>402</td>
</tr>
<tr>
<td>AN-SH3</td>
<td>Structural masonry with concrete block &amp; clay brick</td>
<td>2</td>
<td>43.8</td>
<td>13,503</td>
<td>308</td>
</tr>
</tbody>
</table>

**Note:** Costs are given in US Dollars at the date of January 2015
The structural masonry has been adopted as most common typology among projects studied. This type is usually used in SHP, since it enables quickness, rationality and economy in the construction stage. The variations observed are related to the type of material used. In all projects in Antioquia, it has been used structural masonry either baked clay brick or concrete block. In Bahia, BA-SH1 is equally in baked clay brick; however, the other projects are in cast in place concrete walls.

By analyzing the typical architectural floor plans of housing projects studied, it is verified patterns of shape and distribution of housing units. It is observed that BA-SH1 and BA-SH3 have practically the same distribution, while BA-SH2 basically presents one modification related to bathroom location. The similarity of architectural plans is a reflection of the fact that the three projects done in Bahia have been built by the same builder.

![Architectural plans of the projects analyzed](image)

Housing projects constructed in Antioquia, meanwhile, have a wider range of distribution of space. Nonetheless, AN-SH1 is very similar to the distribution of projects in Bahia. The project AN-SH2 has a kitchen integrated to the living room, and laundry area integrated to the bathroom. Already in the AN-SH 3, a major concern is observed to ensure a yard space into the house.

Figure 4 shows the results of level of user satisfaction for 19 different variables. This measurement was composed by five answer choices, with the qualification intervals from (1) "very dissatisfied" to (5) "very satisfied". The radar graphic is used to analyze in a more integrated way the study variables in this section.
It is noted that the projects in Bahia have similar levels of user satisfaction regarding aspects of the area and distribution of housing, number of bedrooms, natural lighting, location within the housing project, privacy, structural safety, appearance, costs associated with housing, and social support. On the other hand, some user perception variations have been observed in aspects related to thermal and acoustic perception, natural ventilation, location, view to outside, noise intensity, coexistence, road connectivity and transport system.

Meanwhile, housing projects in Antioquia have great similarities in the level of user satisfaction for AN-SH1 and AN-SH2 projects with satisfactory answers in most of the variables studied except the noise intensity from both the housing and the immediate environment, the costs associated with housing and privacy in the family environment. However, there are large differences in comparison to the AN-SH3 project where dissatisfaction levels are very high in most of the variables analyzed. The grading of dissatisfied and very dissatisfied were in social support, housing delivered appearance, structural safety perception, lack of privacy, the number of bedrooms, acoustic comfort at home. Meantime, they gave good evaluations in view to outside, housing and location of the project, natural lighting. Lastly, the housing distribution, thermal comfort, the transport system, coexistence and associated costs had an intermediate satisfaction.

As the level of user satisfaction, it is presented quality perception that users have in different aspects studied, with the qualification intervals from (1) "very low" to (5) "very high". These graphs allow to know the trend, strong and weak points regarding the perception of users to their homes and projects in a specific urban environment.
There is a great variation in responses from users regarding the perception of the quality of homes delivered. In Bahia, has been observed a lower quality perception in BA-SH1 with respect to the users located at BA-SH2 and BA-SH3. Notably, the BA-SH1 project is the one with longer delivery time, what has probably given more opportunities to families accustomed or adapted to housing with its strong and weak points. The same situation applies to projects done in Antioquia. The projects AN-SH1 and AN-SH2 have a few months of delivery, and best levels of quality perception than the AN-SH3 project, which already has nearly two years of use. In the latter, the responses pointing out a low perception of the quality of the user, which is directly reflected to the answers presented in the level of satisfaction (Fig. 4).

6. Conclusions

The right to decent and adequate housing is one of the major challenges faced by Latin American governments in order to dignify all those individuals and communities with higher socio-economic difficulties. Therefore, it is necessary to include comprehensive approaches by public and private companies, developers of SHP in the region.

The study of the SH in Latin America requires methodologies that integrate site characteristics as well as technological and material project response to users and the environment. In this order, the methodology used by the collaborative network includes the biogeographical, technological and social context of the place under the use of sustainability criteria.

The comparative analysis between projects and correlation of their variables contributes to the understanding of the factors involved into diverse regional contexts. It allows to visualize aspects both negatives and positives for either the inclusion of improvement plans or to take these aspects into account in new Social Housing Projects.

The proposed methodology is the central tool of collaborative network. This allows a broad view of the housing and successively, a detailed analysis of different variables without leaving the set. This integration of factors and scales mentioned above, allow a study for social housing from a more holistic perspective.

From the results of the comparative study of SHP in Antioquia and Bahia, it has been possible to note that:

- The proposal implemented of post-occupancy evaluation has as a partial database a very variable aspect referred to the user perception measure. This perception may change over family dwelling time in housing; depend on the unique relationship that this family has with the neighborhood, with the location of its home in a specific environment.

- It is essential that the research team responsible for data collection is well familiar with the concepts addressed in the post-occupancy evaluation proposal implemented. Misunderstanding of the questions of the survey may be subtle, and at the same time, produce incorrect answers.
• Although it confirmed an important similarity between the projects built in Bahia, especially by the fact that the three projects have been made by the same company, AN-SH1 resembles to distribution of Brazilian projects. It is observed a standardized trend of architectural solutions used for these types of projects, in an international context.

• As larger the dwelling time is, lower has been its quality perception that it has noticed in its housing and residential project. The difficulty of maintenance of public security conditions and infrastructure have been the main evidenced points.

• Contrasting to quality perception, on the level of user satisfaction has not been observed the same relation. In this context, it is noted that regional and cultural aspects are predominant in the response of the respondent, and should be considered at the time of project development.

Formed collaborative model can be replicated in similar studies in other regions of Latin America, and at the same time, promote the expansion of the subjects addressed at the international level, related to sustainable urban development. Therefore, it is proposed to promote a greater technical and scientific knowledge on the subject to support the construction of the internationalization of actions committed to the sustainability of the products being developed. Additionally, it is also intended growth of collaborative network and thus a greater participation of new institutions/organizations from different regions.

7. Bibliography


