



Community housing with a focus on spatial progression in the Sergio Toral 1 Cooperative, Guayaquil

Salvador Minuche María Andrea ¹, Zambrano Murillo Christian Paúl ² and Saavedra Robles Lileana Carolina ³

¹ Prefecture of Guayas; [ORCID 0000-0002-9224-7195](https://orcid.org/0000-0002-9224-7195); maria.salvador@guayas.gob.ec

² JCL Construction Company; [ORCID 0000-0002-6743-0342](https://orcid.org/0000-0002-6743-0342); chris_pa88@hotmail.com

³ University of Guayaquil; [ORCID 0000-0003-2944-1451](https://orcid.org/0000-0003-2944-1451); lileana.saavedraro@ug.edu.ec

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Abstract— The access to decent and affordable housing in Guayaquil and at the national level is a latent need in terms of aspirations to improve the quality of life of families. Currently, 40% of the population cannot access decent housing, which is why family nuclei choose to settle irregularly in unplanned territories unsuitable for habitation. By this premise, a detailed diagnosis of the site will be prepared around perceived problems such as overcrowding, insecurity, and urban slums. The study's objective is to develop a housing plan scheme using two models of progressive community housing. First, an iterative analysis methodology with a qualitative-quantitative approach is used to analyze and parameterize the conditions of community housing focused on the progression of its spaces to obtain new schemes for housing plans that are accessible to low-income communities. Within the quantitative method, sequential and rational mathematical analysis is used to evaluate fundamental aspects of design. In conclusion, it is obtained that through the urban iterative process, planned spatial progressions can be obtained and that they improve the functional quality of the integral space and that the mathematical models generate acceptable spectra in the choice of the fundamental aspects.

Keywords: Community housing; spatial progression; productive housing; informal settlement; systemic approach.

I. INTRODUCTION

OVER the years, the so-called social housing in Ecuador and Latin America has had a succession of problems since its conception since it does not offer dignity to its users (occupants), resulting in effects such as the slums of neighborhoods, overcrowding in housing, and insecurity. As a structuring aspect of social housing, the accelerated urbanization experienced in the second half of the twentieth century constituted since its inception as a social structure marked by the inequality of economic income, low interest in social investment of the great elites, and general government entities has paralyzed this type of development. At the beginning of the twenty-first century, thanks to the expansion of the urban spot, the possibilities of obtaining a land (land) have been decreasing and with it the informal settlement has emerged that has generated nothing more than the disorganization of the territory and the misappropriation of natural resources and protected areas.

However, despite the structural aspects indicated, housing policies have been designed and implemented based on a reductionist reading focused on the quantitative housing deficit [1], but not focused on the qualitative or singular deficit of each settlement and its basic needs, so this type of projects have been unsustainable in the long term since they become emerging points of insecurity, overcrowding, and neighborhood slum [2].

A new thought of territorial planning has emerged since the late twentieth century, taking shape in the life of communities, which helps to reduce the consumption of resources and the use of common spaces, which translates into reduced use of territory and resources. This thought has constituted the so-called community housing as catalysts for populations and equitable development, which attribute a viable architectural proposal for sectors of scarce resources.

Within the conceptualization of community housing, the progression and sustained growth of housing emerge, giving way to the concept of progressive housing that entails performance of the house with projections of both horizontal and vertical growth to meet the needs of the family in phases of growth of its family nucleus, so they are retractable homes that contemplate long-term functional uses.

II. MATERIALS AND METHODS

The Sergio Toral 1 Cooperative is located northwest of the Guayaquil Canton and is called an irregular settlement that passed from informality since the 90's and has been developing as a peripheral urban environment that has acquired relevance of the analysis for being accelerated urban growth that welcomes the growing demand for housing in Guayaquil.

Theoretical Bases. - Architectural design is conceptualized in theoretical definitions of community housing and its structuring elements such as private, semi-private, and communal spaces [3], opening theories of spatial progression through the choice of mathematical models [4], after studying the various analogous models are analyzed.

Community housing is defined as equipment intended for living that has spatial conditions of moderate size whose functional principle is to promote social interaction and obtain a greater location of people within the house with common spaces. On the other hand, progressive architecture is a prospecting tool immersed in housing that generates planned and continuous uses [5] that improve the installed capacity of the house.

Collective housing is conceived as a semi-private dwelling by grouping several houses that share public spaces between their vertical and horizontal circulations [6] and service spaces such as washing areas, cleaning, access or exit portals, parking, and waste deposit. A group of people uses this type of housing without any kind of family relationship, but if they share a social, cultural, or economic stratum, age, or specific function [7]. Cohousing is a type of intentional community housing in which people consciously choose to live together as a group. However, it is not the same as a commune, it is not the same as a commune, in which a group of families owns land collectively and shares all revenue and other resources. On the other hand, cohousing is more like a hybrid between individual and community life [8], where the private spaces of the house except the bedroom become for shared use; this concept of housing is used both to reduce costs, environmental impact, improve social interaction [9] and share tasks within the house. Therefore, they are usually more successful in people with small households of between 1 to 3 people.

Therefore, theoretically, it can be expressed that the creation of an architectural design of a progressive community housing building is characterized by the emerging horizontal or vertical expansion that generates a high social interaction and provides solutions at the community level that improve the quality of life of habitat spectra of several families [10], so theoretically this type of designs managed around the specific needs of the community would be a direct solution to the identified problems; neighborhood slums, overcrowding, and insecurity.

According to the current knowledge of sequential mathematical models, new flexible design approaches are structured [11] with the deployment of housing both in horizontal or vertical planes that will be planned and structured to the housing model, a planned process that will grant a high economic benefit and in turn access to decent housing for the benefit of the inhabitants of the Sergio Toral Cooperative 1. The Sergio Toral 1 Cooperative has the following social characterizations: made up of family nuclei of between 5 to 7 people, lower and lower middle stratum, descent in 60% of African Americans and 38% of mestizos and 2% Asians. It has had an urban and population growth from 1982 as an irregular settlement until becoming a Cooperative in 1997.

Methodology. - A methodology with a mixed approach was used, with an iterative process for the urban study of theoretical models and specific needs about the ways of living of the users. The qualitative approach to analyzing and conceptualizing theoretical models begins with its collection of scientific articles and field analysis through participant observation that expresses the needs of specific family nuclei. The types of research used for this paper will be descriptive and field, applying the deductive method through participatory research (observation). The quantitative approach applies sequential mathematical analysis in the first instance for the planned design process of spatial progressions that will be analyzed in optimal vertical or horizontal choice-making locations that respond to the projected capacity of the house. The rational analysis will be based on spatial optimization focused on the conceptualization of the design.

Iterative process. - The analysis was obtained through the process of process repetition (iteration) [12], comprising theoretical and design modeling steps configured from the following scheme (See Figure 1):

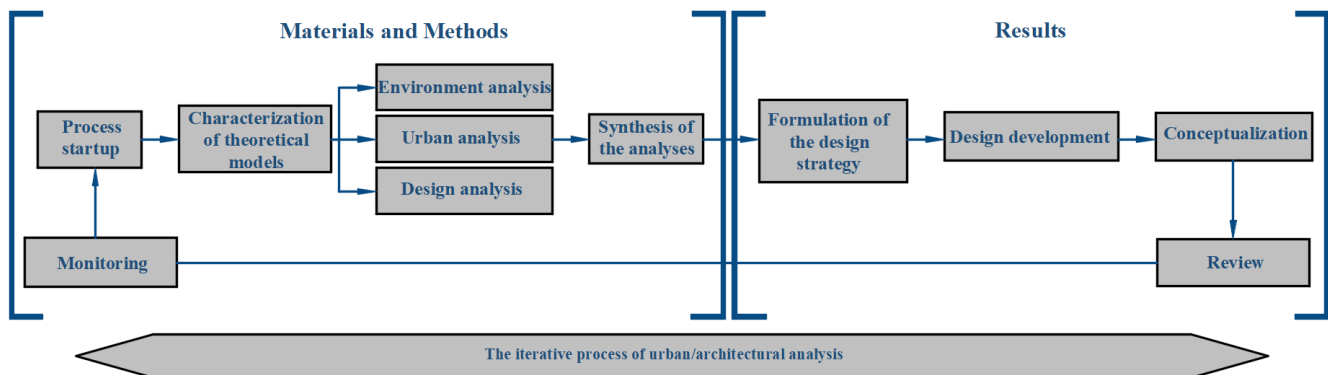


Fig. 1. Iterative urban/architectural analysis. Note: Prepared by the authors

In the start-up phase, the territory around its urban and territorial development will be characterized to configure the analysis of the environment and urban with the current prospection. As a peri-urban space, it has an irregular plot where the reticular shape predominates [13]. As an urban structure, it is made up of 5 blocks and is part of the planning areas of Guayaquil, comprised of 297 apple trees with 1122 established homes that currently serve a population of 32670 inhabitants.

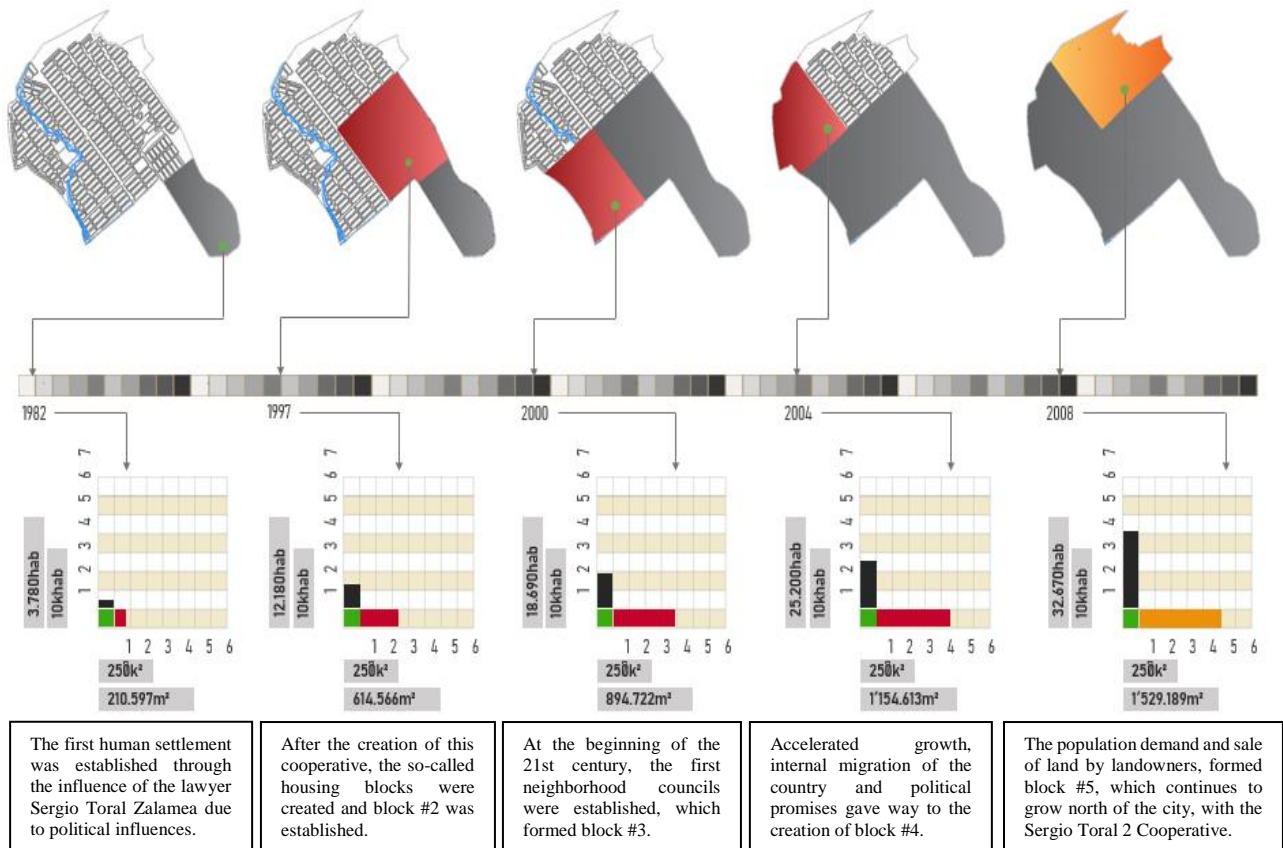


Fig. 2. Urban growth study Coop. Sergio Toral 1. Note: Prepared by the authors

The theoretical housing models used in the Sergio Toral 1 Cooperative for the analysis of the current design are characterized. The design of its houses is palafitic [14], mostly structured with cane, zinc, block and concrete, that is, of mixed construction, as the second preponderant design are the cane and zinc houses and those of reinforced concrete that comply with contemporary and traditional designs of the Ecuadorian coast with access spaces such as zaguanes, shared living and dining spaces, interior service spaces such as kitchen and exterior as laundry and private spaces such as bedrooms. Some of these homes only have a bedroom for families of up to 7 members.



Fig. 3. Typological study of housing and Coop environment. Sergio Toral 1. Note: Prepared by the authors

In summary, the Sergio Toral Cooperative has autochthonous housing models that meet mixed construction standards dedicated to users of medium and low economic stratum with a conformation of family nuclei of up to 7 people and grouping tendencies that share a relationship based on cultural traits of original social interaction of their ethnicities. As a design strategy, the grouping of houses is estimated both by family nuclei and by relationship groupings [15]. The development of the design focuses on the configuration of architectural spaces that reduce overcrowding and promote the appropriation of spaces in private, semi-private, and public spaces. It is conceptualized as shared housing with a minimum cost, which encourages the distribution of tasks and a moderate environmental and social impact that provides economic benefits through the productivity of communal spaces [16]. The process, according to the subsequent analyses, will be reviewed by rethinking and following up on the initial decision-making process for the modeling of the housing proposal.

As for the synthesis of results, it is obtained that the housing developments are palafitic and use local materials typical of vernacular architecture and simple plant configurations structured on one level and that currently, developments of up to 2 levels have obtained that supply a range of up to 7 people per dwelling.

III. RESULTS

Design Formulation – Sequential Analysis

Sequential analysis is conceptualized with the basic layout of spaces through sketches pigeonholed into grids that follow mathematical sequences to be able to contract and unfold, thus generating a flexible programmatic design of new spaces.

Sequential tables are used to establish patterns from modules to create new spaces. Three new spaces are structured that respond to the typical expansions within a house being: simple bedrooms and duplexes shared and individual bathrooms and service area (laundry).

Two deployment methods are used to create spaces, such as the Miura rigid map fold and the triangulated cube. The triangulation of the spaces is structured with the modulation of the rigid map with a base formulation:

$$L = \frac{\pi t}{6} (2^n + 4)(2^n - 1)$$

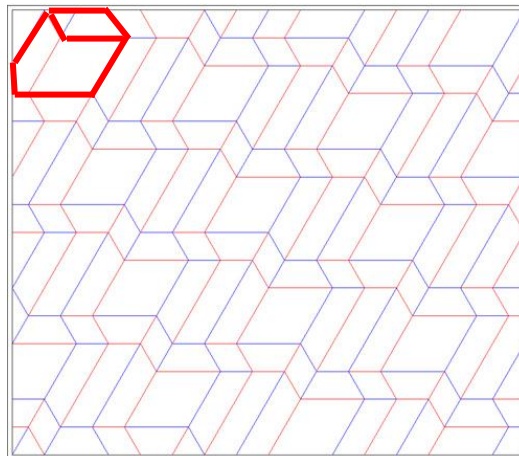


Fig. 4. Rigid map for design formulation. Note: Prepared by the authors

This means that the distribution of a quadrant is equivalent to 6 times its total dimension. This analysis involves two contained rotary sequential modeling, which at the time of its rotation can contain spatially in one square meter, 6 square meters deployable towards horizontal or vertical projections and generate a height of up to 3 meters.

Design Development – Rational Analysis

For the development of the progressive designs of the proposal, rational analysis based on the rationalism of architectural spaces was used, consisting of systemic modulations in proportion to the spaces with reference to rectangular geometry (cube) and its relationship with the human scale, forming a type modulation of 2.96 meters wide * 5.92 meters long with a height of 2.96 meters (modular – red series), for which a basic modular scheme is used and new distributions are projected that obey the open-plan concept promoted by rationalism. The scheme uses the theory of rotating deployment to generate this new space.

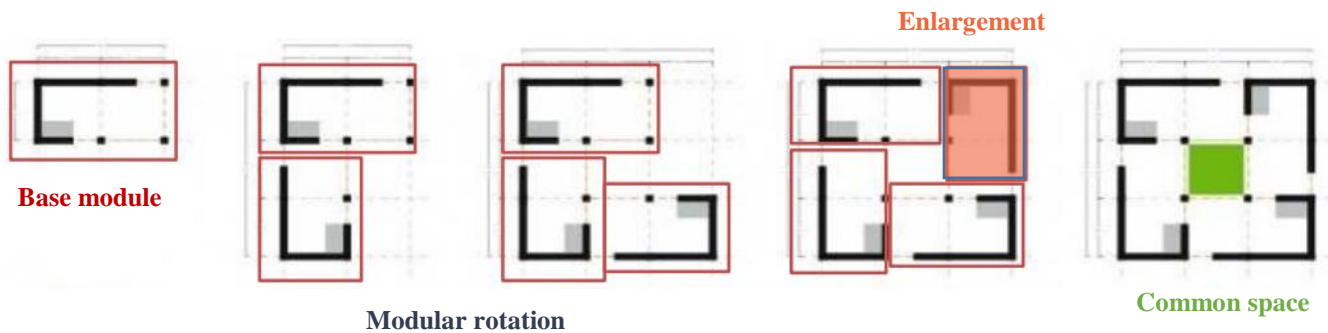


Fig. 5. Rational analysis for design development (modulation). Note: Prepared by the authors

Conceptualization – modular and flexible progression

The layout of the spaces will be structured from the selected module subtracting its central module to obtain a less central design and space-saving according to rational analysis. This common area will be introduced within the design as a future bi-progressive expansion, both horizontal and vertical, that is coupled with a rigid map to the main structure generating the spatial introspection that composes a flexible space with multiple uses, in which an expansion model configured from the sequential and rational analysis will be determined, obtaining an iterative development of architectural design analysis.

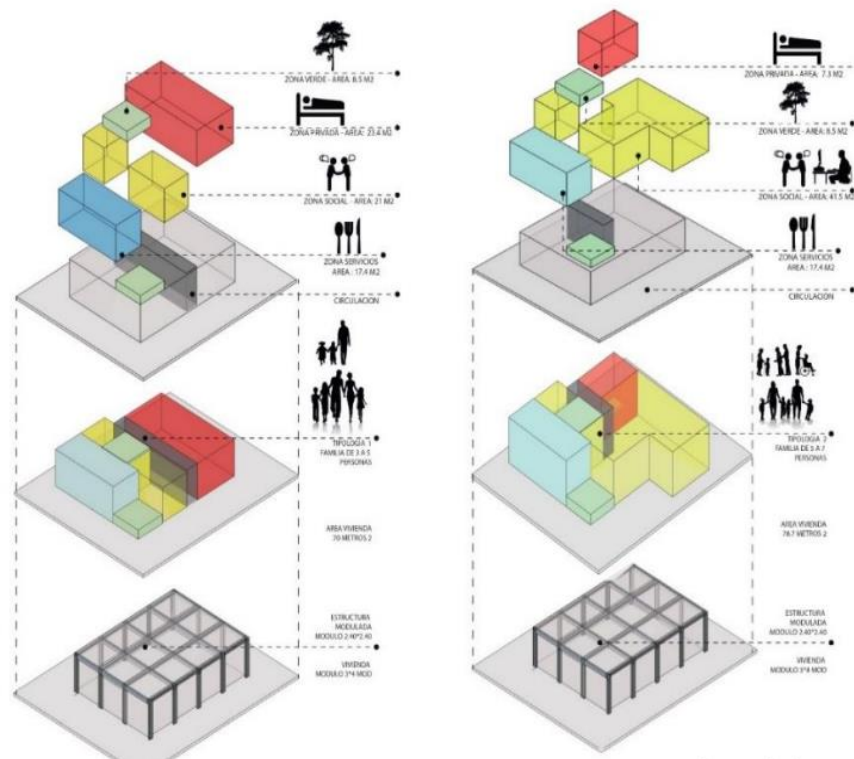


Fig. 6. Design conceptualization and flexible progression. Note: Prepared by the authors

A standard modulation was proposed based on the rationalist conceptualization 2.96*5.92 and submodular derivations (2.26x1.13). Three base modulations and an extension are handled, occupying a total area of 105.14 m² (11.84*8.88), with the base module of 2.96, you have the possibility to increase or decrease to thirds and a half, where four zones are created mainly defined by colors; red color for the private area, yellowish color or for the common/public area, blue color for service areas and green color for area connectors the first conceptualized as the void in height that connects the other houses and on the first floor is a garden that can be accessed, and the other is an area of own cultivation located near the kitchen. These areas will have the same

modular base and can be modified in different typologies with a hierarchical space which is the patio that connects height. The module takes functional, spatial, and technical adaptability as design determinants. In the red area, the extension will be introduced, which generates new private spaces such as a new bedroom and a bathroom, which in the lower part can serve to generate an extension in the social room or new rest area. It is expected with this design conceptualization to improve the capacity of the house to 8 inhabitants each.

IV. DISCUSSION

Through iterative analysis, feedback on the results can be obtained that improves the conceptualization of the design by applying multi-disciplinary analysis methods. It is demonstrated that there can be an unlimited number of modelings from origami as the design basis and the standard formulation to determine the desired type of growth. The study of materials is an element of debate since it must comply with the configuration of a flexible architecture that entails a posterior rigidity to preserve the safety of the inhabitants and stability of the interior elements.

A previous conceptualization of rational analysis shows that scalar modulations generate greater use of space and direct integration of immersed common spaces by generating open-plan conceptualizations leading to the relationship of the expansion of housing oriented to private areas, which are shared by the main family nucleus that happens to obtain an internal extension for future family growth.

V. CONCLUSION

The approach of iterative urban/architectural analysis as an applied method for the analysis of elements of both environment and architectural layout resulted in an approach to design considerations as part of their integration into the studied environment so that conceptualizations welcome the greatest use of the territory.

The cubic form is taken as a starting point to establish the rigid formulation map, obtaining in a square meter a deployment of up to 6 square meters that would generate new spaces, which going to the deployment plane demonstrates a greater variety of spaces with polyhedral shapes.

It is concluded that the rational analysis manifests conceptualizations of open plan and spatial purity that lead to better integration of the module that starts from the sequence of generation of spaces that are based on the rotation of modulations and generation of spaces immersed in a base module of 2.96 x 2.96 that originates general modules of 3x4 bodies established in an area of 105.14 m². The extensions are due to generate private spaces in vertical progression and common/public areas in horizontal progression.

As a future line of research, the element of material study could lead to improving the design of progressions and obtain a greater variety of shapes that can be expanded up to 12 times their content, so that material designs with a greater degree of elasticity and rigidity must be structured in constructive elements such as slabs, covers and walls.

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First A. Author – María Andrea Salvador Minuche born in Machala, Ecuador, architect graduated from the Catholic University of Santiago de Guayaquil, with a Master's Degree in Architecture and Territorial Planning, for 12 years she has provided service to the community through public institutions, she was deputy director of building and urbanization control in the Municipality of Guayaquil, currently works in the prefecture of Guayas as an expert in the direction of public works and as a teacher in the Faculty of Architecture and Urbanism at the University of Guayaquil. Her work stands out for generating strategic alternatives that aim at collective wellbeing with a sustainable and resilient approach. She has built and designed renowned restaurants and housing in the city of Guayaquil.



Second B. Author – Christian Paul Zambrano Murillo born in the city of Guayaquil, province of Guayas, Ecuador. Architect and builder by profession with a master's degree in territorial planning and urbanism, graduated from the University of Guayaquil. In the professional field with twelve years of experience in the real estate sector, from the development of real estate projects, planning and execution of building and urban projects. In the academic field he has published in high impact scientific journals indexed in Scopus and participated in international conferences on Human Factors in Architecture, Sustainable Urban Planning and Infrastructure. He currently teaches in technical areas of building and theoretical areas within sustainable urban development, as well as being part of the center of excellence of the Faculty of Architecture and Urbanism at the University of Guayaquil. His research is focused on the planning and optimization of decision making for

buildings, application of bioclimatic criteria, renewable energy generation, building technologies and land planning, under sustainability criteria.



Third C. Author – Saavedra Robles Lileana Carolina born in Guayaquil, Ecuador. Architect with a master's degree in Territorial Planning and Environmental Management graduated from the University of Guayaquil. She have worked as general manager of a company carrying out construction activities. She have been a contractor for several works in the city of Naranjal, Ecuador.

She has made a scientific publication in springer magazine that is indexed in Scopus about Application of Fuzzy Cognitive Maps in Critical Success Factors. Case Study: Resettlement of the Population of the Tres Cerritos Enclosure, Ecuador.

Currently works as a teacher at the University of Guayaquil in the Faculty of Architecture and Urbanism. Her research interests are sustainable territorial planning, public space and building technologies.