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The Fontanar neighborhood: urban-architectural characterization with a systemic environmental approach

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Abstract: The Fontanar neighborhood is an exponent of the Cuban urban-architectural development of the 50s, which has been little studied up to now. This work had the objective of making an urban and architectural characterization of the neighborhood, through the integration of natural and built components, in its historical and social evolution. It starts from a systemic and integrated approach in the management of the natural and built environment, supported by the theories of Systems and Complexity, with emphasis on the integrated management of physical-environmental variables. Results: An analysis methodology is provided, and a documentary base of the neighborhood, useful for its future development, and for the knowledge of the urbanization processes of Havana. Conclusion: the Fontanar neighborhood stands out for its urban and architectural functionality, and its gradual socio-spatial integration, expressed in constructive and stylistic transformations that have not affected its original expression, giving it value as an urban sector.

Key words: Fontanar neighborhood; modern architectural urban heritage; systemic analysis; integration of natural and built components

1 Introduction

The central objective or message of this article is to contribute to providing organized and up-to-date information for understanding Havana's modern heritage, specifically regarding the characteristics of Fontanar, one of the outlying middle-class neighborhoods built comprehensively during the boom in such development programs in the 1950s. It presents a portion of the findings derived from the thesis submitted by the author toward the academic degree of Master of Land Use Planning and Urbanism in January 2017 [1], and incorporates methodological approaches from her current doctoral research.

No studies on this community, hereinafter referred to as the reparto, have been reported in the existing literature. Several of the solutions adopted, both in terms of urban planning and architecture, contribute—as in other case studies from that era [2,3,4]—positive elements from the standpoint of performance, that is, sustainability. These solutions deserve to be disseminated among the academic, professional, and housing construction and management communities in general, as a basis for achieving, in future projects, the high quality standards attained in these repartos, in this case, for current and future Cuban housing.

The study highlights the importance of the housing development in terms of the aspects examined, at a time when

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environmental sustainability is not sufficiently considered in the development of housing and its surroundings ─ a shortcoming observed throughout the country, where projects are highly repetitive and inadequately adapted to local climatic conditions, an issue the study aims to explore in greater depth. It is deemed sufficient to present the results regarding practices from seven decades ago, using the example of the Fontanar neighborhood, which was far more consistent than current practices in terms of sustainability.

2 Materials and methods

The primary source material available for this research was the housing development itself, given the scarcity of archival material.

The methods used in the study are divided into two parts. The first relates to the methodological structuring and approach to the information to be presented (Figure 1), and the second relates to the literature review, the extensive fieldwork, and the conduct of several follow-up interviews. Theoretical and empirical, quantitative and qualitative methods were combined, based on the authors' experiences.

Regarding the conceptual approach, the study began with a systemic structuring of the problem to be solved. The whole was considered from two perspectives: urban planning, whose internal components include the layout structure, architecture, and infrastructure; and, conversely, urban planning as a determining factor of the former during the initial stage of the joint creation of the urban environment—a process later transformed by interventions that were not always successful, due to many factors. This approach was derived from the works of Stafford Beer and Vester [5,6,7], upon whom the methodological framework of the author's doctoral dissertation is based and who have presented the systemic concepts applied in this study in a clear and accessible manner, although many other authors have offered their own interpretations on the subject; however, it should be clarified that it is not the objective of this study to delve deeper into that aspect.

A_ESTRUCTURACIÓN DEL MEDIO FÍSICO NATURAL Y CONSTRUIDO A ESCALA URBANA

A01_CLASIFICACIÓN DE COMPONENTES NATURALES

Aire / Sol / Lluvia / Topografía / Superficies de suelo y aguas / Vientos / Humedad / Temperatura / Luz / Ruido / Agua / Vegetación / Fauna / Suelos / Materias primas derivadas

A02_CLASIFICACIÓN DE COMPONENTES CONSTRUIDOS

A0201_Zonas funcionales al nivel urbano o rural

A020101	A020102	A020103	A020104	A020105
Escala territorial	**Circulaciones o movilidad**	**Uso de suelos**	**Tipo de función**	**Usos espaciales**
Región climática	Peatonales	Público	Principal	Alojamiento
País	para Ciclos	Comercial	Auxiliar	Salud
Provincia	Vehiculares internas	Productivo	Tecnológica	Educación
Ciudad	Vehiculares principales	Educacional	Circulaciones	Comercio
Comunidad	Mixtas	Comercial	Otras	Cultura y recreación
Barrio		Cultural		Circulaciones
Espacios públicos		Salud		Redes tecnológicas
Manzanas		Tecnológico		Producción
Lotes		Combinaciones		
Edificaciones				
Espacios interiores				

A0202_Clasificación y componentes de insfraestructura constructiva

A020201	A020202	A020203	A020204	A020205
Vías	**Conductos tecnológicos**	**Construcciones sobre terreno**	**Mobiliario urbano**	**Vegetación**
Peatonales	Soterrados	Paradas de omnibuses	Contenedores de basura	Arbolado
con Ciclos	Superficiales	Cuartos de bombeo	Bancos	Arbustos
Vehiculares internas	Aéreos	Otras	Kioscos	Sobre el terreno
Vehiculares principales			Murales	Sobre cubiertas y paredes
Mixtas			Bebederos	

A0203_ Clasificación y componentes de infraestructura tecnológica

A020301		A020302	A020303	A020304
Manejo del agua		**Redes de energía eléctrica**	**Sistemas de iluminación eléctrica**	**Otras**
A02030101	A02030103	Transmisión aérea	Ciudad	Manejo de la basura
Evacuación de pluviales	Evacuación de aguas servidas	Transmisión soterrada	Alimentación soterrada	Redes de abasto de gas
Recolección superficial	Evacuación superficial de aguas grises	Producción local convencional	Postes y puntos de luz	Centros de distribución de gas licuado
Recolección soterrada	Evacuación superficial de aguas negras	Producción fotovoltaica		Comunidad
Lagunas de recolección e infiltración	Registros	Producción eólica		Torres de telefonía móvil
A02030102	A02030104	Otras producciones renovables		
Abasto de agua	Tratamiento local de residuales			
Tanques de gravedad	Fosas individuales			
Cisternas acumuladoras	Tratamiento colectivo primario			
Sistemas de bombeo	Tratamiento primario y secundario			
Tubería soterrada o superficial	Lagunas de oxidación			
Acometidas	Campos de infiltración			

Figure 1. Structure of the natural and built physical environment at the urban scale. Source: author

The initial approach adopted considers the planet ─ represented by the natural elements primarily present on it (Nature) ─ and human beings in their spatiotemporal passage across that planet, producing a built environment from existing resources (Society), as an indissoluble unity. It is based on the premise that Society is permanently subordinate to Nature, protecting the latter's integrity for the future. This approach breaks with the widely accepted international conception of sustainability based on the three basic pillars ─ Nature, Economy, and Society ─ which prioritizes the still globally predominant focus on economic growth and makes the transition to a sustainable planetary society very difficult. The alternative adopted is widely represented in the international scientific literature. The aforementioned Stafford Beer, Vester, and others represent this trend in current scientific development regarding the management of sustainability in the development of modern societies. This constitutes a methodological approach which, despite its comprehensive nature, does not compromise the scope of the study. Its advantage lies in the fact that it incorporates aspects of comprehensive analysis that other studies have overlooked, prioritizing detail over the integrative approach to different aspects surrounding the subject of study adopted in this study.

Existing analytical methodologies with a systems approach begin with the characterization of the subject of study, and then identify the key variables to be considered through various means. This includes the work of Stafford Beer and Vester [5,6,7], as well as French Strategic Foresight [8] and others. In this case, a structure was applied based, on the one hand, on natural physical components and built components, primarily at the urban and architectural levels; and, on the other hand, on aspects related to the object itself and its adaptation to the environment, as illustrated in Figure 1. This structure is derived from the theory covered in the courses taught and from the author's previous work, addressing both the environment and the object of study itself.

The treatment of the components of the natural environment—which, as initial independent variables (A01), gave rise to the structural, urban, and architectural responses—has been fully incorporated as part of the characterization of the components of the built physical environment. The components of the urban environment (A02) have been structured into functional zones (A0201)—analyzed from different perspectives—constructive components (A0202), and finally technological infrastructure components (A0203). A brief description of technological systems is included, emphasizing the role of those whose performance aligns with a vision of sustainability. This inclusion has not been the norm in the previously analyzed articles and completes the comprehensive or systemic view of the subject of study. Based on the above, the Environment and System or Case Study variables to be considered were defined, as well as, to a large extent, the structure and sections of the report.

The second, practical part consists of literature reviews, interviews with founding residents of the neighborhood, and extensive fieldwork, in order to verify the anticipated aspects on the ground. Morphological analysis [9,10,11] was used to process a portion of the information.

3 Results

3.1 Location and relationship to the city

The neighborhood is located along Rancho Boyeros Avenue, between the road access to Cujae and the Pan American neighborhood. Built with automobile use in mind and located ten minutes from the Ciudad Deportiva, it enjoyed a favorable location relative to the city center. It is currently directly connected to a major vehicular transportation hub in the city. Around its main entrance, commuter traffic flows into the neighborhood and toward part of the city's southwest area: Boyeros, Santiago de Las Vegas, the neighborhoods of Abel Santamaría, Wajay, and El Chico, and the connections to El Morado, El Cano, and Arroyo Arenas, to name just the most important ones (Figure 2).

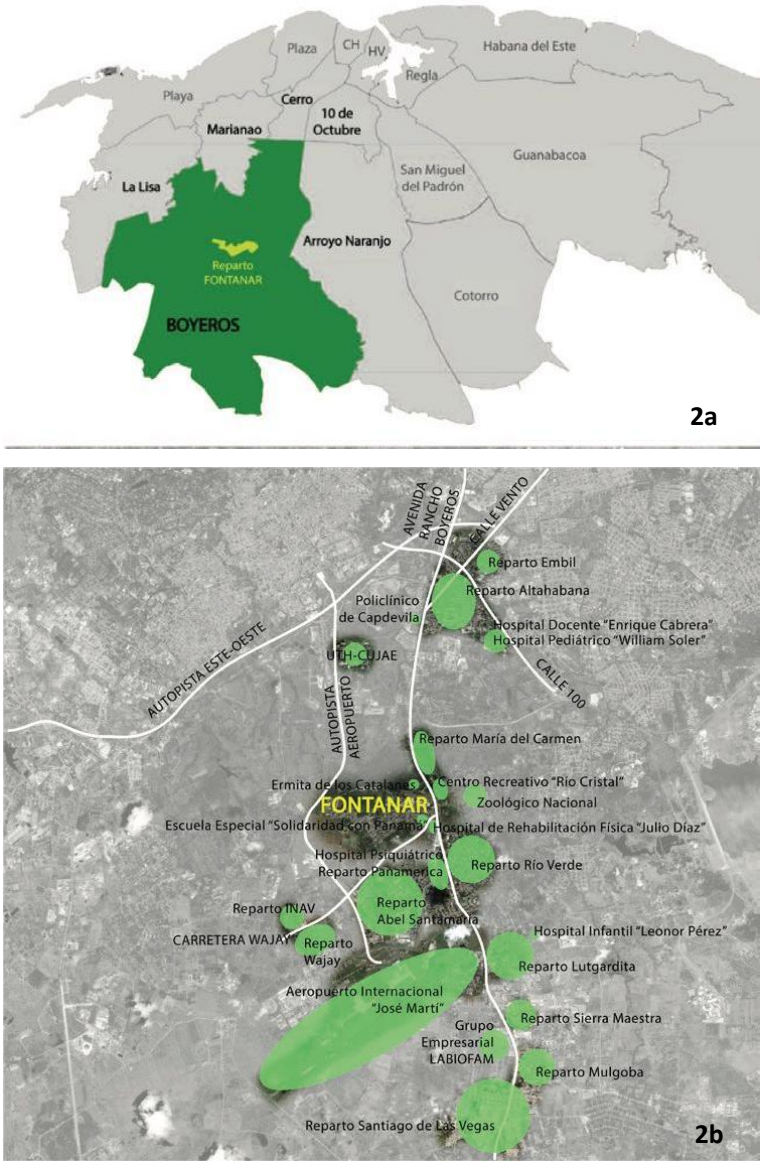


Figure 2. Location of the Fontanar neighborhood: a) within the city and b) in the immediate surroundings. Source: author, based on a satellite image from Google Maps

3.2 Brief historical overview

Construction of the Fontanar neighborhood began in the 1950s and was essentially completed in 1956. It was built on the grounds of the former Finca San José or Retiro de Vento, which at that time was located on the outskirts of the municipality of Marianao, now the municipality of Boyeros.

The land was purchased by a construction company called Clamor S.A. Through the FHA (Federal Housing Administration) program, financing was offered for the construction of homes, which could be paid for in cash or in installments [12]. Various options were available for building the homes, including the purchase of one or more lots, the choice of whether or not to hire the company's construction crew, and the selection of either one of the models available for sale in the development or a custom design[1]. In addition, a wide range of sales information was provided through a map showing the subdivided master plan, along with general information on the advantages for those who decided to buy in the development—including structural strength due to the rocky soil, a cool, dry, and healthy climate resulting from the development's elevation above sea level, abundant water due to its proximity to both the Marianao aqueduct and the

presence of plentiful groundwater, proximity to the international airport, as well as modern urban, technological, and construction infrastructure (Figure 3). Another floor plan was provided with various details: general location, general prices and payment schedules based on the number of bedrooms, and floor plans of the housing models along with square footage, final home price, down payment, and monthly payments.

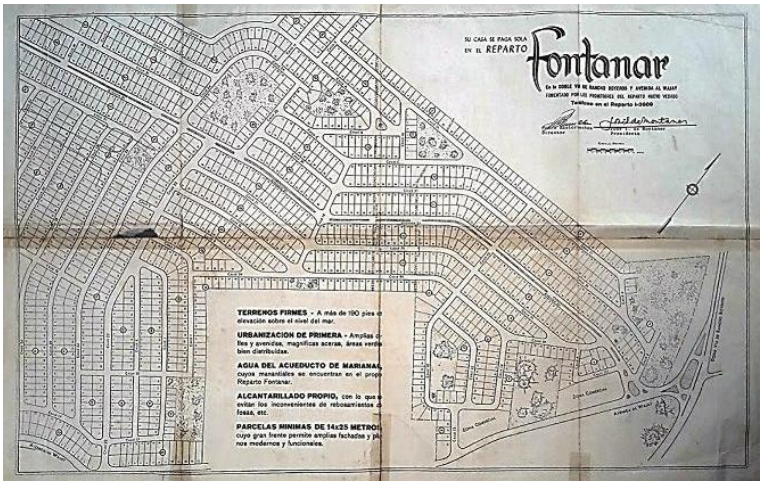


Figure 3. Original map showing the subdivided master plan. Source: property of architect Marcos Vidal

It soon became a favored place of residence for actors, intellectuals, and media personalities. A guardhouse manned by police officers was located at the entrance, providing security for the residents. According to information provided by residents at the time, there was a local newspaper called Fontanito [12], which covered topics of interest to the neighborhood as well as various promotions. Every year at Christmas, a pine tree from the spruce family (also known as Canadian Redwood), brought from Canada, was set up at the entrance and named "Siete Pisos." It was decorated with strings of lights and a glowing star at the top. It was considered the tallest Christmas tree in the world [13]. This tradition continued for three years, until 1960.

By late 1957, the neighborhood already had a modern shopping center operated by the Minimax chain. It was a commercial complex featuring a general store, a hardware store, a pharmacy, a barbershop, and a market. During that period, the members-only Recreational Club was also built, where members could enjoy sports, recreational activities, and dining. It also had a dental office and a post office. At the far end of the neighborhood was a grotto with an image of Our Lady of Lourdes, where, during the "Bloody Easter," the bodies of young fighters who had opposed Batista's tyranny were abandoned [12,14].

Peace and quiet were safeguarded by police checkpoints at the entrance to the neighborhood, which monitored all movement within it.

In the early years of the Revolution, the neighborhood was home to the founding families, as well as people who had worked on the homes and had been left to care for them when the owners emigrated to the United States. Those homes that were left uninhabited or neglected were declared "frozen"[2] by the State and assigned to the university, which distributed them among its staff in need. Starting in the 1970s, a process of transformation began for some of the homes, as they were divided and renovated to house—generally on a permanent basis—two families as owners[3] .

In 1971, a decision was made to construct a small residential complex consisting of two-story buildings using the Sandino system (Figure 4), with the aim of providing temporary housing for residents of the Cayo Hueso neighborhood while structural improvements were made to that neighborhood. Subsequently, between 1974 and 1975, new apartments of the same type were built in another area of the neighborhood, completing its first expansion and typological transformation

[12].

The neighborhood has continued to develop to this day, with the subsequent construction of two-story homes and multifamily buildings through residents' own efforts. Over the past two decades, a process of transformation of the original homes has begun, led by individuals with significant financial resources, involving reconstructions, renovations, the addition of stories, and changes to fences. These changes constitute a new addition to the neighborhood's growing formal and typological diversity and significantly undermine its original homogeneous character.

3.3 Characterization of the local natural environment

Methodologically, the natural environment serves as the starting point for the operational approach adopted. First, climatic aspects are characterized, followed by those specific to the site. Regarding the former, the city's climate prevails. It is cooled by winds from the east and northeast, originating from the undeveloped land in that area, where the National Botanical Garden, the National Zoo, and Lenin Park are currently located. Regarding the latter, it is noteworthy that the neighborhood was situated on open land with somewhat rugged topography and no nearby buildings. The area has abundant groundwater, and there are small lagoons, marshes, springs, and water sources. Hence the name of the neighborhood, which means "water source." It featured abundant and varied low- and medium-height vegetation—which remains today—as well as the fauna typical of that region of the country. The soil is primarily suitable for construction, although it contains areas of expansive clay and small limestone cavities that have caused structural problems in the homes. There were no significant sources of noise or disaster risks posed by existing facilities.

3.4 Urban characterization

According to Figure 1, the analysis begins with a description of the urban structure, comprising the pedestrian and vehicular mobility network (A0201), land use according to function on the one hand (A0202), and its classification—whether primary, auxiliary, or technological—on the other (A0203). This determines how the available area has been used and is based on a site suitability analysis that considers terrain and climate conditions. In this case, there were no pre-existing structures either on the site or in its surroundings.

3.4.1 The vehicular mobility network

The layout was designed with automobile use in mind, both in terms of internal circulation and its relationship to the city. The vehicular network was designed to largely respect the topography of the land and existing river channels, giving it a distinctive character compared to similar subdivisions of the era.

There are two types of vehicular thoroughfares: the central dual-lane distributor road with a median strip, called the Avenida, which connects the neighborhood to Rancho Boyeros Avenue; and the remaining secondary roads, all with cross-sections suitable for two-way traffic (Figure 5). A side access road off what was then the Carretera al Wajay, next to the gas station—built with similar characteristics to those of the Avenida but only one block long—facilitated access to fuel and automotive services. In the 1960s, another access point to the Carretera al Wajay was opened via an existing two-lane road to facilitate the passage of the bus route serving the neighborhood to that town (Figure 6).

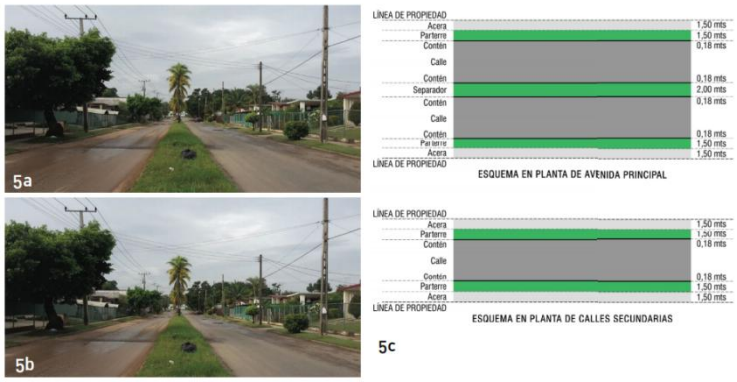


Figure 5. Types of roads: a) main avenue, b) side street, and c) structure of both road profiles. Source: author



Figure 6. Vehicle traffic in the neighborhood. Source: author, based on a Google Maps satellite image

The street network, lined with houses on both sides and arranged in a meandering pattern based on the multi-directional layout of the main road segments, serves elongated rectangular blocks with two deep lots. Of this road grid, only the first part of the development, located near its entrance, was completed exactly as in the original proposal (Figure 7). The streets were oriented longitudinally along three main axes: E-W and within the range from NE-SW to ENE-WSW. The street grid follows the slopes of the terrain, which creates changing views along its route.

The pedestrian network was designed with sidewalks on both sides of all streets, featuring a green median with trees and grass along the curbs. No elements were included in the urban design to facilitate pedestrian accessibility, so pedestrian mobility was limited to the relatively narrow sidewalks. Originally, on-street parking was provided along the roads, with a single public parking area located at the entrance to the neighborhood, near the shopping center.

In general, the road and pedestrian network was well constructed and has been maintained in good condition. The damage visible today is found on the road surfaces, as they were not designed for public or semi-heavy-duty transportation, and due to the destruction of the pavement for repairs to the water systems—which were almost never restored to their original condition. In both cases, this is due to inadequate and insufficient maintenance.

3.4.2 Zoning of the neighborhood

In terms of land use, the most significant feature remains the predominance of blocks dedicated to residential use (Figure 8). There are a few other land uses interspersed throughout, such as peri-urban agriculture, educational services, health services, and commercial services—the latter including both public and private entities.

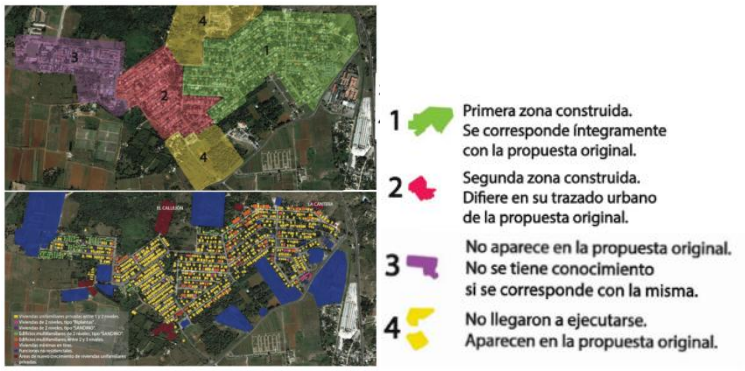


Figure 7. Comparison between original plans and the completed development. Source: author, based on a Google Maps satellite image



Figure 8. Existing land uses. Source: author, based on a Google Maps satellite image

Single-family homes with one or two stories predominate, accounting for 74.8% of all existing buildings. The remaining building types consist of multifamily buildings with two to three stories and two-story single-family homes, which account for 18.7%. The remaining 6.5% consists of various nonresidential uses.

The city blocks are elongated and narrow, with orthogonal shapes and dimensions. Their aspect ratios range from 1:4.5 to 1:8, always maintaining a total cross-sectional width of 50 meters to accommodate two rows of houses, which is highly efficient in terms of urban land use. The urban morphology is semi-compact, with a perimeter corridor, and the lots were designed for single-family homes with an open frontage and a mandatory building line 5.00 meters from the sidewalk, along with side corridors at least 1.25 meters wide, with the narrowest side facing the street. In a typical block, the lots were characterized primarily by two criteria. On the one hand, they were organized according to their dimensions and proportions, defining two types: Type 1, measuring 14 x 25 meters (with a land area of 350 m^2 of land area) for the intermediate lots, and Type 2, measuring 21 x 25 meters (with 525 m^2 of land area) for the corner lots, regardless of their orientation (Figure 9a). Both types were further divided into other groups based on their orientation, resulting in six groups in total: Type 1 lots were subdivided into two groups, one for each orientation based on their position, and Type 2 lots into four groups, based on their corner positions (Figure 9b). Additionally, other lot types with varied shapes were created to take advantage of the terrain's topography.

The open area ranges from 50–73%, and the maximum building coverage ranges from 27–50%. The resulting profile was low-rise, with buildings mostly consisting of one or two stories. This allows for abundant sunlight and the passage of breezes. Given the orientation of the urban grid, the main wind flow occurs throughout the entire neighborhood, both along the streets parallel to the main avenue and through the courtyards located within the blocks, with wind channels forming

between the perimeter corridors. The profiles of the facades do not vary substantially.

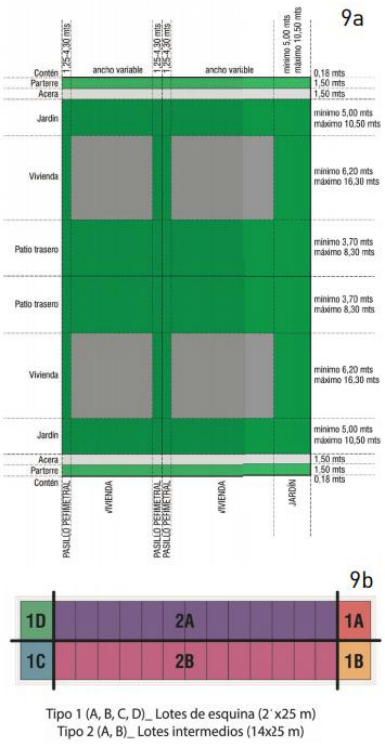


Figure 9. Lot types: a) by dimensions and b) by orientation. Sources: author

3.4.3 Vegetation

From the very beginning, the vegetation along the streets has been abundant and varied. Originally, the flower beds were planted with ocuje trees, whose numbers have gradually declined—either due to damage caused by storms and hurricanes or because residents cut them down due to the nuisance caused by their leaves falling on their front yards and gardens.

Currently, there is a trend among the municipal services company—which maintains the neighborhood's outdoor areas—toward planting various species of areca palms, other palms, coconut palms, and shrubs.

In the gardens, one can observe many varieties of ornamental plants and flowers, some growing naturally and others planted in pots as decorations (Figure 10). The surfaces were water-permeable: along the front yards, they consisted of lawns and ornamental plants in gardens, as well as climbing shrubs on garages, exterior staircases, and other areas—not only for ornamental purposes but also as a means of shading. The courtyards feature a variety of fruit trees: guava, mango, plum, various varieties of plantains, avocado, mamey, soursop, cherimoya, and coconut.

Since the late 1990s, there has been an inappropriate increase in the paving of garden areas, flower beds, and, to some extent, backyards. This not only detracts from the urban landscape and violates urban planning regulations but also increases both the heat island effect—due to excessive paving of streets and the use of low-albedo materials—and radiant heat and glare in the area.



Figure 10. Existing vegetation in gardens. Source: author

3.4.4 Fences

Front fences were partially present; they were low in height and generally consisted of imported chain-link wire mesh—commonly referred to as "Peerles" after the supplier's brand name (Figure 10)—although they were also sometimes made from strips of shrubs. The side and rear fences were similar or consisted of low masonry walls. Many homes did not have a front fence, which provided a high degree of transparency in the view of the lots and buildings.

Over time, many residents raised the height of their fences, using the same original material or combining metal parts or synthetic tarps with masonry walls. In some cases, metal sheets were added to block views into private properties, and in others, a dense, tall strip of vegetation was incorporated for the same purpose. The solutions that contrast most sharply with the original urban landscape—and violate zoning regulations—have been those involving the construction of tall, opaque walls along nearly their entire length, featuring diverse designs and materials in mismatched combinations, completely isolating the dwelling from its urban surroundings and reducing airflow. These solutions emerged in response to existing security concerns—primarily theft—although by blocking views into the homes, they also prevent the detection of unusual activity inside and leave the homes completely isolated.

3.4.5 Noise

High noise levels are concentrated on the main avenue and at the intersections with the neighborhood's exits, reaching very high levels when small vehicles with two-stroke engines, as well as buses and trucks, pass by. However, noise levels decrease on the side streets (Figure 11). Additionally, pedestrian noise is noticeable at school entrances in the mornings, as well as during dismissal times at noon and in the afternoon. The most intense vehicular noise occurs during the morning commute when workers and students leave for work and school, and during the afternoon commute when they return home. In this regard, there are five major points of localized noise emission associated with commercial and educational areas.



Figure 11. Noise map. Point sources of noise: 1) middle school, 2) service complex and surrounding areas, 3) service center, 4) traffic junction, 5) elementary school. Source: author, based on a satellite image from Google Maps

3.4.6 Water management

Respect for the topography largely determined the flow of storm water, which was channeled over the surface and through the road network, adapted to rainfall patterns.

The terrain's natural slope—which descends from the end of the neighborhood toward its entrance and toward a series of valleys located to the northwest—was utilized, creating specific low points toward which this surface water flowed. Finally, the water accumulated in retention ponds, which were not always filled with water (Figure 12). Channeling along the streets was achieved in a very cost-effective manner—both in construction and operation—using curbs.

As for water supply, drinking water comes from local springs in the Vento watershed, which provide water of very high quality. Initially, a central elevated tank system was planned for the water supply, but this was ultimately replaced with a direct pumping system due to structural defects in the constructed tank. Given the limitations of the supply, the water supply system has been supplemented with cisterns and private elevated tanks.

The water distribution network runs through the central median on the main road and a side median on the remaining streets. This has created various problems regarding the maintenance and repair of leaks or the replacement of defective sections of the network, as service connections must cross the streets to serve homes located on the opposite side and all those located on the main avenue.

Sewage disposal is conventional. It is carried out via an underground pipe that flows by gravity through medians separate from those used for drinking water. The sewage is directed toward low-lying areas, and in some cases must be pumped to the oxidation pond located in the northwest part of the neighborhood.

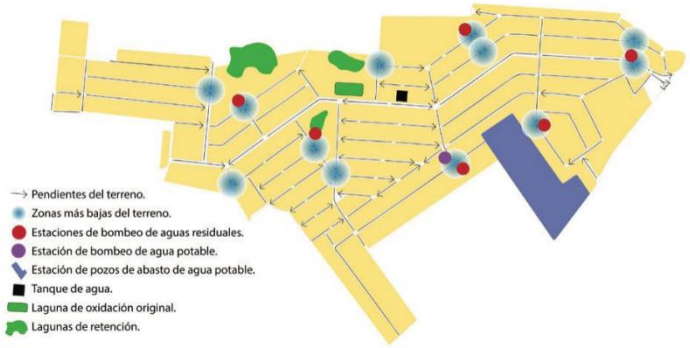


Figure 12. Surface hydrology. Source: author

3.4.7 Electrical and lighting networks

The electrical and telephone networks are overhead, creating significant conflicts with the trees located in the medians where they intersect. The staggered street lighting uses the same poles as the power lines and landline telephone lines, and systematically contributes to the functional conflict with the trees.

3.4.8 Urban furniture

Initially, given its nature, the neighborhood did not have bus stops as part of its urban infrastructure. Later, very lightweight versions with roofs and benches were gradually added. Most were located in extensions made to the concrete pavement used on the sidewalks, while others were installed after negotiating with the affected property owners.

Public trash collection was not planned, so no urban furniture was provided for this purpose, and it is currently a source of health and aesthetic problems.

However, in the zoning plans for Sandino-style multifamily buildings, common spaces designed with urban furniture were incorporated for several buildings. These spaces are still in use today and serve as the quintessential setting for children's play, community gatherings, and casual social interactions.

3.5 Architectural characterization

3.5.1 Basic general aspects

The homes, like those built in similar housing developments of the era, were formally part of the Modern Movement of the 1950s. They were designed with low-rise structures, pure geometric forms, and no ornamentation, featuring accents of natural materials on some facade surfaces. In this case, most had slightly sloped roofs with 42-cm perimeter eaves (Figure 13).



Figure 13. Original housing models: a) two-bedroom, b) three-bedroom, and c) four-bedroom. Sources: author.

The positioning of the homes on the lots was based on bio-climatic criteria, prioritizing natural ventilation in the bedrooms. Ten different orientations were defined, all aligned with the existing urban grid (Figure 14). Priority was given to the private area (consisting of the bedrooms and the main bathroom) toward the northeast, which was the predominant direction of the breezes for most of the year at that time (Figure 15) (Figure 16). The service area (kitchen, servants' quarters, and auxiliary bathroom) was oriented to ensure sunlight, while the social area depended on the location of the former.

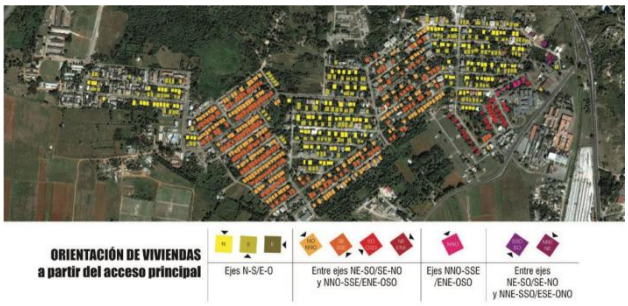


Figure 14. Orientation of embedded housing units. Source: author

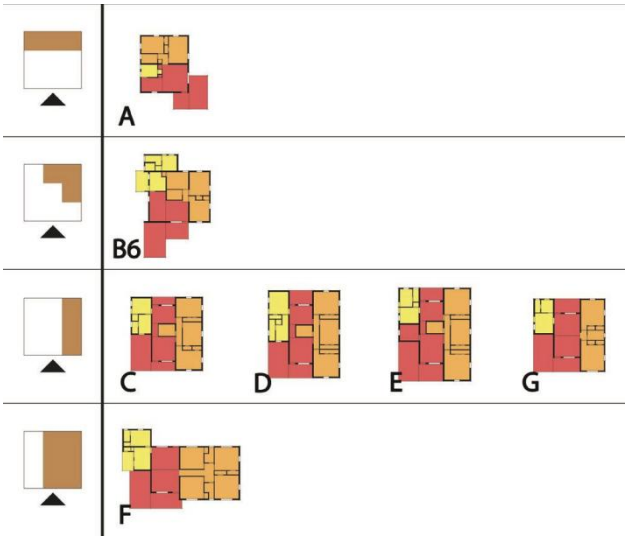


Figure 15. Typological classification of housing models based on the layout of the bedrooms on the floor plan. Source: author

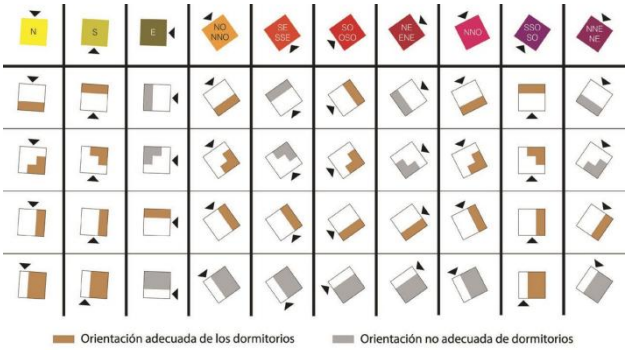


Figure 16. Feasibility of housing types, based on wind frequency, according to the orientation of the bedrooms on the floor plan. Source: author

There were six basic housing models (Figure 17), consisting of a living room, dining room, kitchen, main bathroom, entrance way, carport[5], rear terrace, and between two and four bedrooms. Some models included a small room for service staff and a basic associated bathroom.

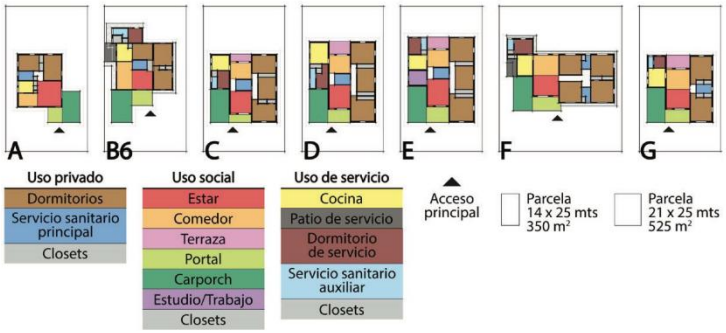
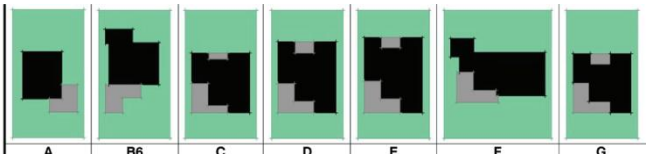


Figure 17. Basic housing models. Source: author

All had a garden, side hallways, and a backyard, while those occupying more than one lot had side yards. The main facade is always parallel to the street or faces the public thoroughfare, aligned with neighboring buildings. In general, the houses have double-sloped roofs extending to the sides, with a maximum clear height of 2.70 m, decreasing to 2.40 m at the lowest point. The floor areas of the existing models range from 64.36 m² to 94.09 m², depending on the types of lots on which they were built (Figure 18).



	A	B6	C	D	E	F	G
Parcela	350 m²	350 m²	350 m²	350 m²	350 m²	525 m²	350 m²
Total de piso	75,79 m²	97,51 m²	117,68 m²	140,39 m²	148,88 m²	151,09 m²	116,86 m²
Edificada	93,35 m²	122,8 m²	133,38 m²	158,46 m²	175,1 m²	169,79 m²	130,63 m²
Libre	256,7 m²	227,3 m²	216,62 m²	191,54 m²	174,9 m²	355,21 m²	219,37 m²
Descubierta	121,81 m²	155,16 m²	154,98 m²	190,26 m²	200,34 m²	214,83 m²	159,5 m²
Intramuros	64,36 m²	86,18 m²	95,94 m²	113,1 m²	119,2 m²	127,51 m²	94,09 m²
Elementos verticales	17,56 m²	25,24 m²	15,70 m²	18,07 m²	26,2 m²	18,7 m²	13,67 m²
Perímetro	33,82 m²	42,6 m²	48,6 m²	55 m²	56,2 m²	59,4 m²	45,72 m²
COS	0,27	0,35	0,38	0,45	0,50	0,32	0,48
Ocupación máxima	27 %	35 %	38 %	45 %	50 %	32 %	37 %
Área descubierta mínima	73 %	65 %	62 %	55 %	50 %	68 %	63 %

Figure 18. Occupancy and floor area indicators for the basic models. Source: author

In the housing units that were collectively allocated during the 1970s, in addition to the garden, the perimeter hallways, and the courtyard, some interior spaces, such as the living room, dining room, and kitchen, became shared by more than one family. When dividing their homes, the owners made architectural modifications to incorporate the previously shared spaces into each individual unit. In other cases, modifications were made due to an increase in household size or the need to incorporate offices, studios, or other types of spaces. The original kitchens were also combined with the service quarters to make the former more spacious.

Elements such as perimeter hallways, the spacing between buildings, eaves, and abundant vegetation provided shade for the buildings. The element with the greatest impact on solar radiation is the roof, as it constitutes a large built surface area exposed to the sun practically all day long. Miami-style shutters—made of wood with slats or glass—used in all models helped regulate the flow of breezes, sunlight, and light (Figure 19). All windows were equipped with mosquito screens.

Most models had built-in parking spaces in the form of carports—spaces integrated into the physical floor plan, partially enclosed along their front or side perimeters (Figure 13). Over time, many residents enclosed them with various wrought-iron designs, maintaining transparency, while others did so to gain functional space for their homes. In some cases,

they were located in the outdoor area and remained open, with a lightweight overhead enclosure made of corrugated metal or asbestos-cement sheets. Others were enclosed—some in their original location and others in the outdoor area; in the latter case, the works fail to comply with urban planning regulations.

It is worth noting the existence of homes that do not conform to the original models featured in the development's promotional catalog, given the option provided by the FHA Plan to purchase only the lot and build according to one's own design. In these cases, the homes range from one to two stories in height, occupy between one and three lots, and feature a larger built area, yet are equally representative of the Modern Movement (Figure 20).



Figure 19. Types of permeable enclosures, Miami-style window: a) wooden with a transom window and b) glass version. Sources: author



Figure 20. Homes built using different designs: a) and b) single-story, c) and d) two-story. Sources: author

3.5.2 Construction aspects

Regarding the structure, the foundations were generally cyclopean strip foundations. Their performance proved deficient due to unforeseen settlement problems caused by the clay present in the soil, which led to cracking in the walls, both horizontal and diagonal.

The walls were built with blocks of mortar made of sand, gravel, and cement, which were commonly used at the time of construction. These were laid with third-part mortar, similar to that used in the plasterwork. This material has performed adequately over the years.

The 20-cm-wide load-bearing walls, like the other exterior walls, were enclosed by a monolithic reinforced concrete perimeter wall integrated with the roofs—made of the same material—which bore the load in a single direction onto the transverse walls at the front of the dwellings. Efflorescence frequently appears on the first two courses of the walls due to inadequate insulation between the walls and the foundations. Sea sand was frequently used in the mortars for these elements, particularly in the reinforced concrete of the slabs, which led to significant deterioration problems. This manifested as porosity and water ingress despite the slope, rapid corrosion of the steel, cracking of the concrete, and the resulting spalling of the lower protective layer, leading in some cases to the collapse of the slabs in various areas of the dwellings. Some roofs had coatings of gravel surfacing and bituminous sealing.

As for the interior finishes, the floors were mostly made of integral terrazzo, with high-quality workmanship. The vertical surfaces were finished with a fine plaster coat and vinyl paint. The interior finishes of the slabs were made of gypsum putty and lasted as long as the substrate allowed. The doors were smooth, made of plywood, and in some cases of iron and glass with fine ornamentation. The adjustable shutters were Miami-style, made of wood with latticework or glass (Figure 19).

During the first two decades of its existence, the neighborhood remained in its original state: the homes were well-maintained, the gardens were tended, the outdoor green spaces were manicured and tidy, the streets were clean, and there were no instances of urban or social disorder. A large number of the original homes remain today without any changes to their volume or floor plans, although they suffer from serious maintenance issues on their exterior walls.

4 Discussion

The Fontanar housing development, along with others built in the 1950s, such as Víbora Park, Altahabana, Casino Deportivo, Capri, Santa Catalina, Náutico, Flores, Alturas de Embil, and Parque Residencial Bahía, represented one of the most significant urban interventions of the period [2,3,4].

In terms of its morphology, it reflects the urban developments carried out in the United States during the second half of the 20th century, beginning with the emergence of New Urbanism, whose principles have been taken into account in the gradual shift toward sustainable urbanism [15,16]. Its urban-architectural design incorporated some of the criteria proposed decades later by Andrés Duany and Elizabeth Plater-Zyberk in the Traditional Neighborhood Development methodology, developed for the Seaside development in California, the first example of the New Urbanism movement [15,16].

Noteworthy in the development is the use of existing climatic and topographic conditions in its design:

- The adaptive design of the road network to the topography, integrating corridors for the placement of stormwater collection, water supply, sewerage, electrical network, and tree planting infrastructure, resulting in savings in urban land, infrastructure costs, and, to some extent, maintenance costs.
- The use of sloped building roofs to facilitate the drainage of stormwater to the ground, as well as its infiltration into the lots and subsequent surface runoff at the urban level into the drainage channels.
- The use of breezes and solar shading to define the floor plans and the location of the dwellings, with a diverse range

of housing types, thereby making effective use of breezes in their operation and providing distinctive visual elements.

- The incorporation of urban greenery as a distinctive functional element.
- The absence or minimal use of perimeter fences during the neighborhood's early years, with those that were used being primarily low in height to ensure transparency between public spaces and individual lots.

All of this contributed to the creation of an indisputable and enduring genius loci in the development. However, although the development is one of the best-preserved examples of an important period in the history of Cuban urban planning, the guiding documents of the National and Provincial Directorates of Physical Planning do not designate it as significant within the Area of High Historical and Cultural Value in the municipality of Boyeros [17,18].

4.1 The new social and spatial integration of the neighborhood

This is a neighborhood that met the aspirations of the middle class for whom it was originally created. Its structure was based on mobility via automobile use, with delivery services for basic necessities, private security (uncommon at the time), and a market-defined socioeconomic and cultural homogeneity. Its initial owners were professionals, intellectuals, artists, merchants, etc., all members of the middle class.

The changes made contributed to the gradual transformation of the neighborhood's urban image and social structure, bringing it more in line with the country's inclusive popular conception and helping to erase the spatial class segregations that existed prior to 1959.

The vast majority of the original buildings retain the architectural elements that defined them from the outset. The modifications that took place were initiated by private owners and focused primarily on expanding interior spaces and enclosing terraces and carports.

As for green spaces, there is potential for them to contribute to improving the neighborhood's functional structure. If properly interconnected, they could significantly increase their efficiency for urban uses (recreation, sports, social interaction), as there are few public spaces designed for this purpose. The neighborhood has only one park, which is currently in a state of serious disrepair due to lack of maintenance.

5 Conclusion

This assessment concludes that the neighborhood represents a valuable example of the development of Cuban urban planning and architecture in the 1950s, preserved very close to its original form and the conceptual essence of the urbanization model. It constitutes an interesting architectural heritage, due to the functionality of its urban design and the beauty of its architecture, and a cultural heritage, due to the sense of belonging among its oldest residents and the ways of life that converge there. Although many homes have undergone formal alterations, most retain a perceptible trace of their original character, which confers heritage value on the neighborhood as an urban area. Notable is the gradual socio-spatial integration, manifested in the constructive and stylistic transformations of the neighborhood, achieved over seven decades, stemming from the social integration promoted by the social policy of the Revolution.

It is classified as a non-critical zone within the city's urban challenges and, therefore, does not constitute a site for intervention in the investment projections for the 2014–2030 period, although it is geographically located within the intervention area of certain major investments related to transportation and its infrastructure, as well as public spaces and green areas.

For the reasons explained, consideration should be given to treating it, at the very least, as an area requiring attention and study, since it forms part of the landscape committed to the development of the actions described and represents a unique icon in the territory's urban design by incorporating diverse aspects that are rarely considered in national urban

practice. Given its scale and its urban and spatial characteristics, it could even form part of pilot programs for new models of urban management.

Its study is valuable in the quest to recover the best of the urban and architectural output from earlier stages of the country's development, as well as the urbanistic and stylistic outcomes of the social integration promoted by the Revolution.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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Note

[1] Information provided by Lic. Lourdes Rodríguez, former resident of the neighborhood.

[2] Term used in Cuba to designate those dwellings placed under the exclusive disposal of the State, pending definition of their subsequent use.

[3] Information provided by Prof. Arch. Rubén Andrés Bancrofft Hernández, who was allocated a dwelling in 1972 as a young professor of the Faculty of Architecture and non-resident of Havana.

[4] At present, according to data provided by the Institute of Meteorology of Cuba, the prevailing direction of the breezes has been shifting toward the east, although this change does not constitute a substantial alteration in the thermal performance of the dwellings.

[5] In Cuba, this term is used to identify garages with a partially open perimeter.